CATS ARE NOT PEAS

A CALICO HISTORY OF GENETICS

LAURA GOULD

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The chance acquisition of George, a very rare male calico kitten, sent Laura Gould on an unexpected and lengthy odyssey into the history of genetics. She thought she remembered that all calico cats were female. But why was that? And how did the rare exceptions like George occur?

Gould's curiosity about her new cat's existence caused her to learn some basic genetics, to examine its history, and to explore cat folklore. The result is a thoroughly enjoyable and not too technical book narrated with inimitable grace and wit.

In this story of an unrecognized chapter in the history of science, Gould takes us from ancient theories about inheritance and sex determination, through Mendel's famous experiments with his round and wrinkled peas, to speculations by Darwin and others about the rare male calicos. The struggles of early twentieth-century scientists to find and study rare male calicos in the hope of answering fundamental questions in the newly emerging field of genetics are explored in amusing detail.

Beautifully told, with a keen eye for both human and feline behavior, this book brings both science and cats to charming and engaging life.

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A Calico History of Genetics

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For George, of course
(and Max, too)

and in memory of my mother,
Emma Trotskaya Lehmer,
who died peacefully in her Berkeley home exactly halfway
through her one hundred and first year, just as the final
revisions to this book were being made. She didn't like cats at all,
but she did like Cats Are Not Peas, and was pleased to know
that this very personal book would live on.

Also in memory of my father,
Derrick Henry Lehmer,
whose provocative question
"How does the Thermos bottle know whether to make things
hotter or colder?"
sent his children down the path of lifelong learning.

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Preface to the Second Edition

Cats Are Not Peas was a labor of love: love of its protagonists, love of the pursuit of knowledge, love of the unexpected, the arcane, and the bizarre. It began in 1986 with the joint arrival of George and Max, who filled my life with joy and struggle. Then suddenly—in 1991, when the cats turned five—all of my historical questions about George and his weird genetics appeared to have been answered and I realized that the book was done.

A remarkable amount of progress has been made in the field of genetics since 1991, so some sort of update is clearly needed. Making changes to the original text, however, feels wrong: It documents a personal odyssey, long completed, and almost all of its scientific content remains accurate because so much of it deals with theories, problems, personalities, and publications relating to the now long-resolved mystery of the rarity of male calico cats. Thus, the first edition is reprinted here virtually unchanged, but with this minor warning: When you read descriptions of tasks not yet completed or facts not yet known, please keep in mind that some of these issues may since have been resolved.

A lengthy Addendum has been provided, however, which can be found following the Afterword to the first edition. It explores two major new areas of genetics in which cats have had significant roles to play: the sequencing of genomes and the production of clones. Information from this Addendum has been added to the Informal Glossary, Dateline, References, and Question Index sections, also to be found at the back of the book.

Writing about leading-edge science is very different from writing about science long past, and that difference is reflected in the

style and structure of this new material. It's personal only in the sense that I'm the one who has chosen what to write about from within the immense wealth of information that's now available to all of us via the World Wide Web. Some reflections on the use of this new medium are also included.

The Addendum is described as a smorgasbord, and my hope is that it will give you the impetus and confidence to follow your noses, as I have, to explore the nooks and crannies of genetics (or any other field that sparks your interest) in some way that is personal, informative, and compelling. But as you read it, please remember that some of what's documented is so current that if there were to be a third edition, it might have to be updated or re-written. With this caveat, I wish you bon voyage and bon appétit!

Preface to the First Edition

I like to read Prefaces (and Forewords and Prologues), those lonely, neglected texts, often thumbed past hastily on the way to the core of the tome. I read them carefully for what they can tell me about the origins of objects and ideas, and I am often rewarded, as I was in this 1949 example written by Lady Christabel Aberconway:

> Many people may wonder how I came to make this Dictionary of Cat Lovers. Briefly, this is the answer. In the early days of the war I travelled twice a week between London and North Wales, at the best a seven-hour journey. After dark, one read by the light of a torch or a bicycle lamp, precariously perched on a knee or a shoulder.
>
> One evening, while an Alert was sounding, a fellow passenger remarked: "That noise is like the screaming of demon cats in agony."
>
> I found the speaker liked cats. The man sitting opposite then declared he loathed them. The woman beside me said, for her part, she liked them. The little man opposite her said he loved them. I have always loved them. . . .
>
> It occurred to me, sitting in that darkened train, that if I could read about people who had liked cats, and if I could read what they had written about their own cats, perhaps I might discover why those exquisite, fastidious, and sympathetic animals are either warmly loved—or loathed. . . .

> The idea, conceived in a half-dream, has been carried out, and this Dictionary is the result. I confess to feeling almost certain that if at the beginning I had foreseen the years of study and research on which I was embarking, and the depressing times when unknown Memoirs or Letters, arid and unrewarding, seemed to be my only reading, my courage would have failed. Yet now, looking back, my most vivid memories are of intoxicating moments when I discovered, sometimes through a written reference, sometimes through the kindness of a friend, new and lovely works unknown to me until then, even perhaps by name.

How charming and amusing it is: the image of the Baroness on the darkened wartime train; the truly random event that sent her off on a journey that was to last not seven hours but years and years; her excitement and dismay over various discoveries; her persistence and passion for the task; her gratitude for paths to unexpected treasures. I have been there too. I recognize it all.

My journey began not in a darkened train but in a brightly lighted garage where evidence of country mice was all too visible. Cats, we thought, we must get some cats—working cats who would patrol the property and keep the vermin at bay. A small and simple thought, reasonable and straightforward, easily implemented. Who could have foreseen its consequences?

In happy ignorance, we visited the local animal shelter and selected two kittens, George and Max, and the choice of George (based largely on his ability to get along with Max) turned out to be the random event responsible for this lengthy odyssey. For George was a calico cat—a male calico cat—and calicos are invariably female. He was a genetic anomaly, a manifestation of something that isn't supposed to happen, a creature so rare that even most vets have never seen one.

George was also an instigator of infinite questions. My curiosity about his existence has caused me to learn some basic genetics, to examine its history, to explore the calico folklore, and to think about evolutionary change. Thus George has sent me to a multitude of libraries and kept me in my studio on beautiful

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afternoons, with my nose deep in a book or my eyes squinting wearily before a computer screen; he has caused me to become a bore at dinner parties and a pest on the telephone; he is responsible for all that follows.

In surveying a diverse literature I've been happily surprised by the unexpected humor that has bubbled forth, often unintentionally, from the pages of scientific books and journals that one might expect to be much less effervescent. Consider, for example, the Preface to an 1881 book with the incredibly comprehensive title *The Cat. An Introduction to the Study of Backboned Animals, Especially Mammals*. This sizeable work was written by St. George Mivart, a leading biologist of the time, who felt that change in his field was so rapid that "the Natural History of Animals and Plants needs to be rewritten—the field of Nature being surveyed from a new stand-point." He eschews Man as his "stand-point" because,

> The human body is so large that its dissection is very laborious, and it is a task generally at first unpleasing to those who have no special reason for undertaking it.
>
> The problem then has been to select as a type for examination and comparison, an animal easily obtained and of convenient size; one belonging to man's class and one not so different from him in structure but that comparisons between it and him (as to limbs and other larger portions of its frame) may readily suggest themselves to the student. Such an animal is the common Cat.

Scientists, of course, are human, and their paths are filled with pitfalls, like those of all the rest of us. Some of their tales are truly remarkable and bizarre. In reading papers from long ago, one is reminded that, given the rapid explosion of knowledge, the next generation of readers may find current efforts just as amusing. We're still stumbling about in semi-darkness as we attempt to make sense of our confusing universe.

Perhaps no one has stumbled more than I, as in my overwhelming ignorance I've attempted both to comprehend a foreign discipline and to describe it in ways that may make it acces-

sible to others. The vocabulary of genetics is both formidable and horrendous. Even its routine parlance is filled with words like autosomal, blastocyst, epistasis, homozygous, and so on, ad nauseum; its more exotic offerings, like acatalasemia, are to be found only in specialized dictionaries of biology or genetics. Although these densely packed terms are efficient vehicles for conveying information to the cognoscenti, they're tough on us newcomers who are having a hard enough time trying to grapple with new concepts. Having been forced to cope with them as a reader, I've tried to avoid them as a writer and have chosen to use "common" rather than "technical" language wherever possible; I've even had the hubris to invent some new and simpler terminology.

Much has been written, of course, about such giants in the field as Darwin and Mendel, Morgan and Sturtevant, Watson and Crick. Here, with the exception of the irresistible Mendel, they're given short shrift, not to minimize their importance but to avoid the duplication of easily accessible material. Except to provide the necessary background, they don't really belong here in any event, for this tale revolves not around peas or fruit flies or DNA, but around calico cats and the people who were curious, as I was, about their origins. The contributions of the cat people (and the cats) to the development of genetics seem to have been largely ignored—a great pity, for their history is both charming and valiant.

Given the conflicting information in what I've read, I've tried, wherever reasonable, to write from primary sources, some quite old and moldy. As one follows the reference trail through the literature, eventually coming full circle and recognizing as old friends documents that once were strange and mysterious, one can see how misinformation is propagated: It's happily copied from place to place, or sometimes miscopied—a mutation of a mutation arising to join the ranks of "facts" to be dealt with.

Among other things, this work represents for me a celebration of innocence. Rather than reading a beginning textbook diligently from cover to cover to acquire the necessary vocabulary and concepts, I made a deliberate effort to learn in a non-standard fashion: to follow my nose and my instincts, to leap into the

middle, to learn to swim by almost drowning. This seemingly haphazard approach comes not from laziness but from fear; it represents a need, if you will, to preserve my virginity. Only someone as ignorant as I was in the beginning could have asked the kinds of questions that I did. I was afraid that following the carefully laid out, well-trodden paths of the texts would blunt my curiosity and lull me into believing that I understood things I really didn't.

Having deliberately read in this rather chaotic fashion, I've chosen to write that way as well. Thus rather than peering down from the exalted height of my newly acquired knowledge and mapping out the most efficient route to the pinnacle, I've chosen to let the reader follow in my wondering and wandering footsteps; these have led into more corridors and cul-de-sacs than one would have thought possible. The meandering structure that resulted attests to three beliefs: that a path may be as interesting as its destination, that country lanes have more charm than superhighways, and that there is more than one way to skin a cat.

Over the years my intellectual life, like that of the Baroness, has been most disorderly. It's been characterized by unexpected and lengthy detours caused by random and seemingly innocuous events: an insult in a bookstore which led to years of struggle with ancient Akkadian texts; a chance meeting in a parking lot which propelled me onto the path of machine translation and other computer-based endeavors. So it isn't surprising that George has had such a powerful effect—he's a much more interesting (and more lovable) catalyst than any that has come before.

I've wondered from time to time whether George or I might die before this book was done. (Every answer spawned yet more questions, so that seemed a definite possibility.) George's death, I thought, might be as fatal a blow to this project as would my own. Because George hunts at night while I hunt during the day, our working schedules might seem to be disjoint. Yet he helps me just by curling up on the sofa in a companionable fashion, with his paws tightly covering his eyes. There he sleeps most peacefully in my studio while I struggle and squirm and scratch my head, attempting to fit the pieces together. I seem to need the

consolation and encouragement of his daily, albeit unconscious, presence to proceed. Without George I might lose interest, abandon the tangle, and learn to play golf or bridge.

Somehow we've both survived, and I, at least, am considerably wiser for the effort. While George is occupied with "seeing no evil," I see much that is fascinating and am filled with wonder at both the course of scientific discovery and the complexity of even the tiniest creature. I hope that George and I have been able to transmit this wonder, fascination, and humor in the pages that follow.

Acknowledgments

I don't like to read Acknowledgments, those tedious, obligatory recitations of accumulated debt. I avoid reading them because they don't usually tell me anything I want to know. They are filled with the names of people I've never heard of and have no need to pursue: the valiant typist (rapidly being phased out by the author's own encounters with a word processor), the patient and devoted spouse, the neglected children, sometimes even the family dog.

Here my debt is so large that I've decided to declare literary bankruptcy by defaulting on my obligation to mention by name the incredible numbers of diverse participants, without whose bemused assistance I would still be back at square one. Thus the scholars of ancient languages, the many librarians (mad and otherwise), the scientists, the veterinarians, the cat lovers, the folklorists, the various people of Japanese descent, and the huge contingent of helpful friends—all will remain anonymous (no doubt to the relief of many). But I do thank them all, most fervently.

Still, major credit must be given to Serendipity, that lovely lady who continues to rule my life, and to Severo, my remarkable husband, who does his best to rule it when She's not around. He also rules, as best he can, our physical world, which makes it possible for me to retreat so deeply into my mental one. He builds Pooneries, splits wood, struggles with generators, plants gardens and orchards, edits drafts, hugs me tenderly, and plays the piano most beautifully.

In deference to George and Max, we have no dog.

"Treasure your exceptions!"
–William Bateson

In the Beginning, There Was George...

... and Max too

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George came to us from the Humane Society. At six weeks he was tiny and scrawny, embodying the description on his cage, which explained that his "family" had given him up for adoption because they couldn't afford to feed him. He was awkward as well and appeared to be walking on thin white stilts—stilts that were slightly taller in back than in front. He had a long skinny tail, striped like a raccoon's, and a plain white belly. But his back was beautifully colored in patches of orange and black, making me wonder suddenly whether he could really be a male, as his identification card declared. I thought I remembered that all calico cats were female.

However, I wasn't going to ask any questions. The week before, we'd spent several hours falling in love with a charming pair of kittens, only to be told at the adoption counter that we wouldn't be allowed to take them both home because they were of different sexes and might mate before they were old enough for their mandatory neutering. This time we'd decided in advance to select two males. I picked out an elegant, long-haired black tom with a white tuxedo front, whose name seemed obviously to be Max, and at first my husband selected a particularly frisky, feisty coal-black kitten who was great fun to watch in his cage. But when we put them together in a playroom they immediately spat and attacked and tried to scratch each other's eyes out. This was not the sort of relationship we'd had in mind.

We replaced the feisty fighter with the short-haired, long-legged, clumsy calico, who had an amusing kind of charm and a seemingly intelligent face. Now we were treated to a very different kind of encounter: The kittens manifested instant rapport, played happily, and gave each other a bath. So we filled out the adoption forms, stating, despite my suspicions, that the calico's name was George (my husband calls all cats George). We were not to be foiled again.

George and Max spent their first week in the garage, where George kept falling over things and Max almost immediately caught a small frog. (The mice, who had sent us on our journey to the Humane Society, simply packed up and moved out without waiting to see what kind of hunters these cats might turn out to be.) As we spent the first week just watching their antics, I was reminded of an elderly mathematician who had told me years before of his vision of paradise. Imagine, he said, a long corridor, drawn in perspective, stretching back toward a narrow point at infinity. Then imagine that each side of the corridor is lined with straight-backed cane-bottomed chairs. Then imagine that on the seat of every chair there is a kitten.

As George and Max explored the world beyond the garage in the days that followed, some of their antics were reminiscent of old Tom and Jerry cartoons. It had never occurred to me that cartoonists actually draw from life, because their portrayals of action are so extreme. Yet George and Max both went straight up into the air, tails high, feet splayed apart in the prescribed fashion, when they unexpectedly encountered one another coming around a blind corner. And when George leapt clumsily from the level railing of the deck onto the slanting handrail of the stairs below, he had just that expression of horror, and that backward-leaning posture of trying futilely to apply the brakes, that cartoonists portray so vividly. (Fortunately, my husband happened to be standing at the foot of this long flight of stairs and simply scooped him up as he came flying off the end of the rail.)

There were serious things to notice as well. One quiet, sunny afternoon we were playing with George on the lawn when suddenly he streaked away to hide under the front steps. I hadn't

heard or seen anything, but George had noticed the shadow of a hawk and had instinctively run for cover. This reminded us that our kittens were low in the predator chain and would need some protection, at least for a while. It also made us wonder how information about hawk shadows is transmitted and stored.

The vets turn pale

At the end of this blissful week we took them to the vet for their first examination. I watched the vet's lip curl into a knowing smile as we announced that the calico's name was George, and I wondered whether he was going to suggest Georgette or Georgina instead. But as he took a closer look, the blood drained from his face and he said, with considerable excitement, "I've been a vet for twenty-eight years and I've heard that male calicos exist, but I've never seen one. Would you mind if I take him into the back room so the rest of the staff can see him?"

When the vet returned, still looking awed and pale, I expected that he would be able to explain why virtually all calicos are female and how the rare exceptions like George occur. To my surprise, he couldn't. He wasn't even able to suggest where I might look for the answers to these questions. His ignorance, coupled with his pallor, piqued my curiosity—there was certainly a story to be unearthed about George, who must be a very rare cat indeed.

As they grew older, we noted that Max was wonderfully graceful and moved with swift, sure instinct, whereas George continued to be clumsy but gave the appearance of thinking: He seemed to employ logical processes; he plotted and planned. He knew that when the sprinklers shut off, a little bubbling fountain would remain just long enough for him to drink from, so when they started their three-minute cycle he would sit and wait. He could discover how to get down from the high storage area of the garage, but Max would remain trapped up there until carefully coaxed and coached. George was definitely smarter. Was this because calicos, lacking males, could not become inbred?

As we shopped around for a vet we really liked, George and Max visited two more clinics during the next few months, completing their initial sets of shots. And the scene was replayed twice more: The vets turned pale but could provide no useful information. The last one murmured in wonder, "There's a penis in there all right" and then mumbled something about XXY, leaving me to make what I could of this cryptic offering. And so the search for George's genetics began.

Why are all calico cats female? (except George and his ilk)

Although many of the scientific news stories of 1986 (the year the vets turned pale) were about recombinant DNA, genetic engineering, and the finding of markers for various hereditary diseases, I had somehow maintained a profound level of ignorance about these matters. I had vague memories about the nineteenth-century monk Gregor Mendel and his simple but elegant experiments with round and wrinkled peas. I knew that genes, chromosomes, and the double helixes of DNA were their twentieth-century fruition, but I needed a dictionary to discover what these terms meant and how they were related to one another.

Having ascertained that genes were indeed smaller than chromosomes, I went on to larger issues. *Human Genetics*, a freshman text from the local college bookstore, helped to paint some general pictures in my mind, but a more specific understanding of George's genetics came from *The Book of the Cat*, a comprehensive compendium of information lent by an enthusiastic friend. From these joint sources, the following overly simplified picture emerged:

> Chromosomes are thread-like structures found in the nucleus of almost every cell; they are made in part of DNA. They come in matching pairs, one member of the pair providing genetic information from the mother, the other from the father. Cats have 19 pairs of chromosomes; people have 23.

Genes are just little pieces of these chromosomes: tiny segments of DNA. Each segment acts as a code and specifies the production of a particular protein. These proteins do a variety of jobs, but most are concerned with keeping things in good running order.

Each gene has a fixed location on its chromosome and helps to specify a certain trait, like blue eyes or orange hair. (Most genes don't have such visible effects, however, because they're largely occupied with housekeeping.)

Each location may provide a choice of different genes that can occur there (one that says yes, give this person Huntington's disease, or one that says no, don't). The choice is often binary, but some locations have a set of three or more related genes associated with them. (For example, you may be of blood group A, B, or O. As an extreme example, cattle have over 600 different genes for blood type, all competing for the use of a single location!)

There's no fixed limit to the number of alternative genes that might occupy a given location, but any specific organism should have only two members of the set to deal with at a time—one on the chromosome from the mother, the other on the matching chromosome from the father.

When the gene from the mother disagrees with the gene from the father, some mechanism must be used for deciding the nature of the offspring. Often a simple choice is made, depending on which gene is dominant and which recessive. (In a disagreement about blue eyes vs. brown, the dominant brown gene always wins out over the recessive blue, at least in humans.) Sometimes the method of conflict resolution is more complicated.

Calico cats arise when the genes controlling orange coat color disagree: The gene from one parent says yes, the

hair should be orange; the gene from the other says no, it shouldn't. In this case, for reasons to be explained later, the result is a mosaic—some hairs orange, some black.

The chromosome pairs come in a variety of sizes and shapes, but except for the so-called sex chromosomes, the two members of a pair are always the same size and shape as each other.

Sex chromosomes come in two flavors: X and Y. Mammals with two X chromosomes are female (XX); those with one X and one Y are male (XY).

The two kinds of sex chromosomes differ greatly in size and shape. The X is long, and the Y is very short. Hence there isn't room on the Y for all the genes that fit on the X.

In cats, the gene for orange hair color happens to lie on the X. There's no space for a matching gene on the Y. Therefore, it's not possible for an XY cat (a male) to have one gene saying yes orange and a matching gene saying no orange. So if you see a calico cat, even at great distance, you can be sure that it's a female. Usually.

Questions, questions, everywhere

At first I felt a flush of triumphant understanding. I could already explain, as the vets couldn't (or wouldn't), why virtually all calicos are female. But then how do you get a George? How could I account for him? The mumbled "XXY" of the third vet gave a clue. Perhaps George had three sex chromosomes where he should have had only two? If so, one of his Xs could say yes orange, the other could say no orange, and the Y could say male. This seemed plausible, but how did it happen? As I reviewed my tiny treasure trove of facts, numerous other questions instantly arose in all directions.

What did Nature have in mind when she left so little space on the Y-chromosome? Why are the sex chromosomes the only pair to be different in size and shape from one another? Isn't this bizarre? What other genes besides those specifying orange hair color do male cats lack because of this real estate problem?

And what about people? What genes do we have on our X-chromosome that aren't represented on the Y? Does this mean that females, with two Xs, have twice as much genetic information about certain traits as males? If so, isn't this an unfair advantage? Does it in some way account for things like baldness, color blindness, muscular dystrophy, and hemophilia, which usually afflict males only?

If there are XXY cats, are there XXY people? Would you know it if you saw one on the street? What about other combinations of X and Y? What determines sex anyway? How did the sex chromosomes get such boring names?

Are XXs females and XYs males in all creatures? What about the birds, where the brilliant colors are characteristic of the males instead of the females? Is it reversed for them? Do the males have extra color genes?

If people have 23 chromosome pairs and cats 19, what about dogs? And mice? And Mendel's peas? Do people have the most? Does it matter?

When did people first notice that almost all calicos are female? How did they explain this strange phenomenon? Did they believe these cats had special properties for good or evil? And what about the rare males? Were they idolized and valued? When did the first calicos—or for that matter, the first cats—appear?

What about current folklore? Do most people know that male calicos are virtually nonexistent? Could they remember how they learned this curious fact?

Do people who own calico cats, especially male ones, understand why this color scheme is usually found in females only? Do they communicate with one another through some society? Is George valuable? Is he an important genetic anomaly? Could he serve some useful scientific purpose? Is he likely to be fertile?

The destruction of data

This last question was of particular significance and urgency because George and Max were now six months old. They had developed a particularly loving relationship and spent hours curled up in an old clothes basket in the laundry room simultaneously washing each other's necks. They slept front to front with their limbs entwined in a variety of endearing poses, or front to back like two spoons, as Kurt Vonnegut likes to say. Max was bigger and heavier and appeared even more so because of his very long hair. He had developed a protective air toward George, making me wonder whether he perceived him as female; they continued to impersonate the perfect couple.

Besides developing this ideal relationship, they had both developed neat round balls. Max's were a silky black duo, but George's were exotic: one black and one orange, with a neat line between the two. This was troublesome. We had signed a paper at the Humane Society, promising (and paying in advance) to have them castrated before they were seven months old. But if we neutered George, were we destroying a national treasure?

I called a school of veterinary medicine to learn what I could about the prognosis for George's fertility. It wasn't good. I was assured that there was less than one chance in a million that George would have viable sperm. The veterinarian on the phone didn't seem particularly interested in his existence, indicating that everything important about the Georges of this world had already been discovered. She said we should just neuter him, enjoy him for himself, and stop fretting about his uniqueness. I meant to take a picture of George's beautiful bi-colored balls but failed to have film in the camera at the crucial moment—and then it was too late. The dastardly deeds were done and George and Max resumed their idyllic existence, lazing in their basket or collaboratively hunting rats or snakes (one tracking the head while the other tracked the tail).

Terrors of the night

Since being adopted when six weeks old, George and Max had seen other members of their species only during their three visits to the vets and their rather frightening return visit to the Humane Society where they had been caged next to some fierce feral cats, also awaiting castration. Back home they pretended to hunt one another, stalking and pouncing, sharpening their skills as well as their claws for the wide variety of prey and predators that our isolated country environment provided. George was still long-legged, awkward, and clumsy, but he had proved he could negotiate trees at a rapid rate when necessary. So with some trepidation we now let them loose at night to be their nocturnal selves, hoping that they would be agile enough to escape the jaws of the foxes, coyotes, bobcats, and mountain lions we knew to inhabit our forests and meadows.

Our feline friends were usually to be found in the morning waiting to greet us when we arose. George would be curled in a tight ball on the doormat of the covered porch, paws over his eyes. Max was more likely to assume a sentry position on the railing with his long tail hanging down like that of a Colobus monkey, but black instead of white. Occasionally Max would worry us by not making an appearance, but then around lunchtime he would come nonchalantly strolling in across the meadow. His thick coat would be filled with burrs, and he would seem very pleased with himself; sometimes he would have a large rabbit swinging by the nape of its neck, so heavy that it was dragging on the ground.

Despite his neutering, Max still wandered widely. Arriving home late one night, we had picked him up as if he were an errant teenager when we found him near our neighbor's gate, half a mile from home. George, by contrast, always stayed close at hand, hunting behind the woodshed and leaving us little tokens of affection: usually intestines of various sizes and shapes, but occasionally an entire velvety mole, the whiskered snout of a gopher, the paw of a squirrel, or the foot-long tail of a woodrat.

We had allowed the cats full reign over their wild dominion for several months and had just come to believe in their survival skills when we were awakened at four in the morning by horrible screams. Rushing out onto the deck, shouting and clapping our hands to simulate gun shots, turning on all the outdoor lighting, we hoped to frighten off whatever predator had invaded our peaceful surroundings. Waving a powerful flashlight, we soon found Max arched in classic fashion on the high peak of the garage. He was still very frightened and could not be coaxed down—and George was nowhere to be seen.

With heavy hearts we descended into the dark woods, flashlight in hand, valiantly calling his name. But where should we look in this endless forest? The task seemed hopeless. We were virtually certain that George had been eaten and would never be seen again. Weary and downhearted, we struggled back up the hill wondering what life without George would be like, both for us and for Max. It was inconceivable.

As we were trying to adjust to these grim new images, we heard a faint and plaintive meow—it was George, high in a tree apparently unable to get down. Our weariness vanished, ladders were fetched, and both cats were retrieved and incarcerated in the garage. Our world was safe again from we knew not what. We could sleep, at least for the moment.

George victorious

Then one morning in the spring it was George, not Max, who failed to give the morning greeting. Max looked lonely and disconsolate. He lay around and complained; as the afternoon wore on, he demanded ever more attention. It became dark and George still failed to appear. We slept badly and hoped to find him on the doormat in the morning.

But he didn't come and didn't come, and once again we were sure he had been eaten. We took Max for long walks through various favorite haunts, hoping George would smell him and return. We shouted for George, we suffered, we waited and

hoped. We saw a pair of teen-age bobcats crossing the meadow and shivered with fear instead of viewing them with our usual excitement and admiration. And Max became morbid as well, plaintive and lethargic and needing so much attention that we experienced all phases of a lunar eclipse as we catered to his piteous cries. Finally, after four nights of lonely misery, we gave up hope and decided that this time George was gone for good. In a stunned and still disbelieving mood, we located a calico kitten (female, of course) to console us all in our bereavement.

But just as Max and I were setting off in the car to interview this calico surrogate, the great shout "GEORGE IS HOME!" rang out across the countryside. And there he was, ambling in, looking neither tired nor hurt nor hungry nor particularly glad to see any of us—back from some private adventure whose details we were not to know. Within a few hours he accepted Max's solicitous attentions, and once again our lives resumed their former course. George was victorious; he had made our level of dependence abundantly clear. Thereafter he was to remind us in this way several times a year.

Is George valuable?

George and his anomalous genetics had cast a spell over some of our friends as well. They came bearing gifts of information, some popular, some technical, some general—all welcome additions to our small supply. The first batch came in the form of two clippings from a popular cat lover's magazine and immediately answered the question about value with a resounding "No." Although his value to us had been proved boundless, his value to the world was apparently nil. The magazine agreed with the vet school that George wasn't a national treasure. He was just one of those rare accidents that occasionally occurs.

The article went on to say, however, that male calicos used to be of slight financial value and had been sought, some twenty years or so ago, by researchers, perhaps at the University of Washington, who had been trying to prove that the orange gene