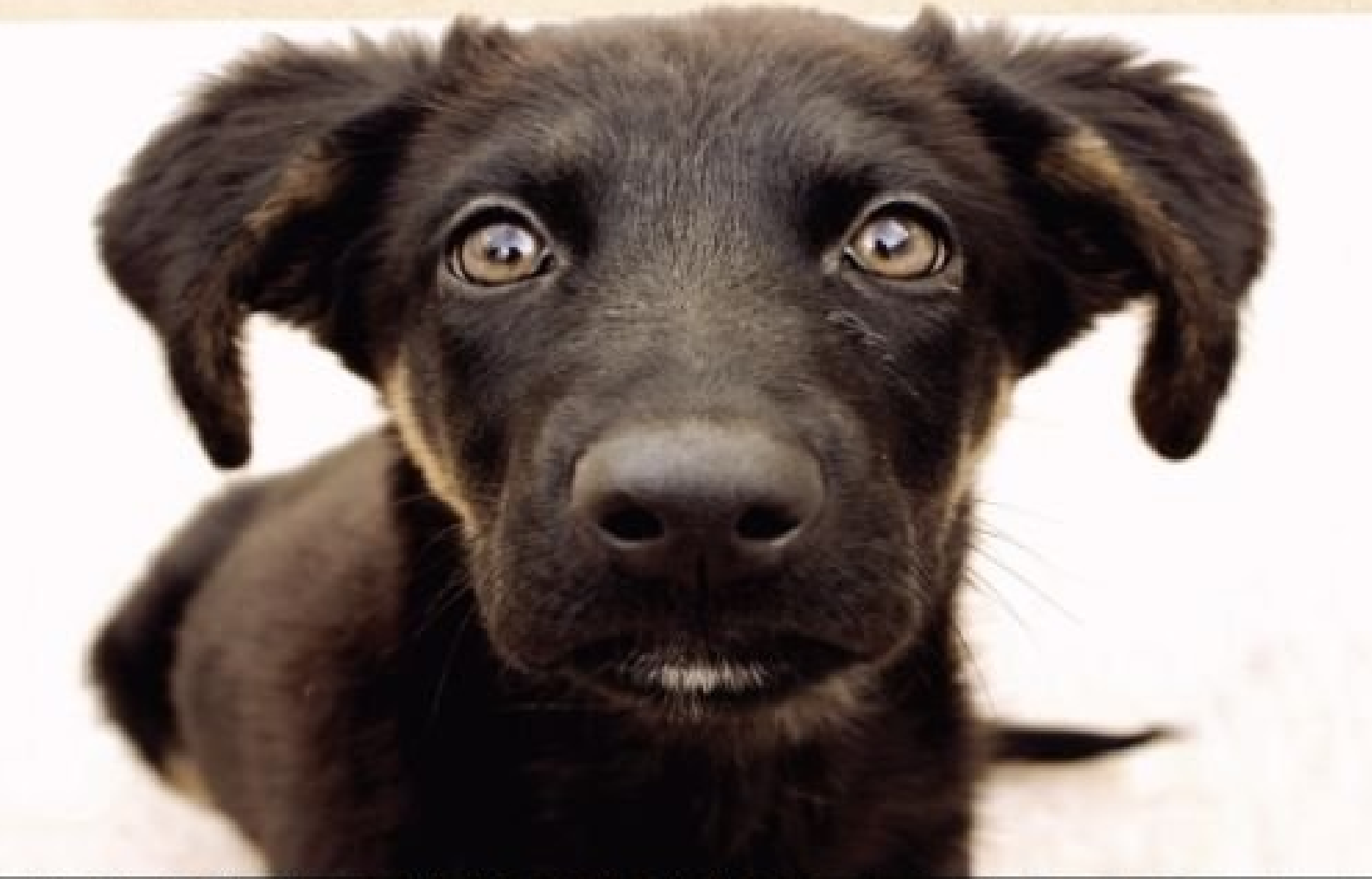
Dog Sense

HOW THE NEW SCIENCE OF DOG BEHAVIOR CAN MAKE YOU A BETTER FRIEND TO YOUR PET



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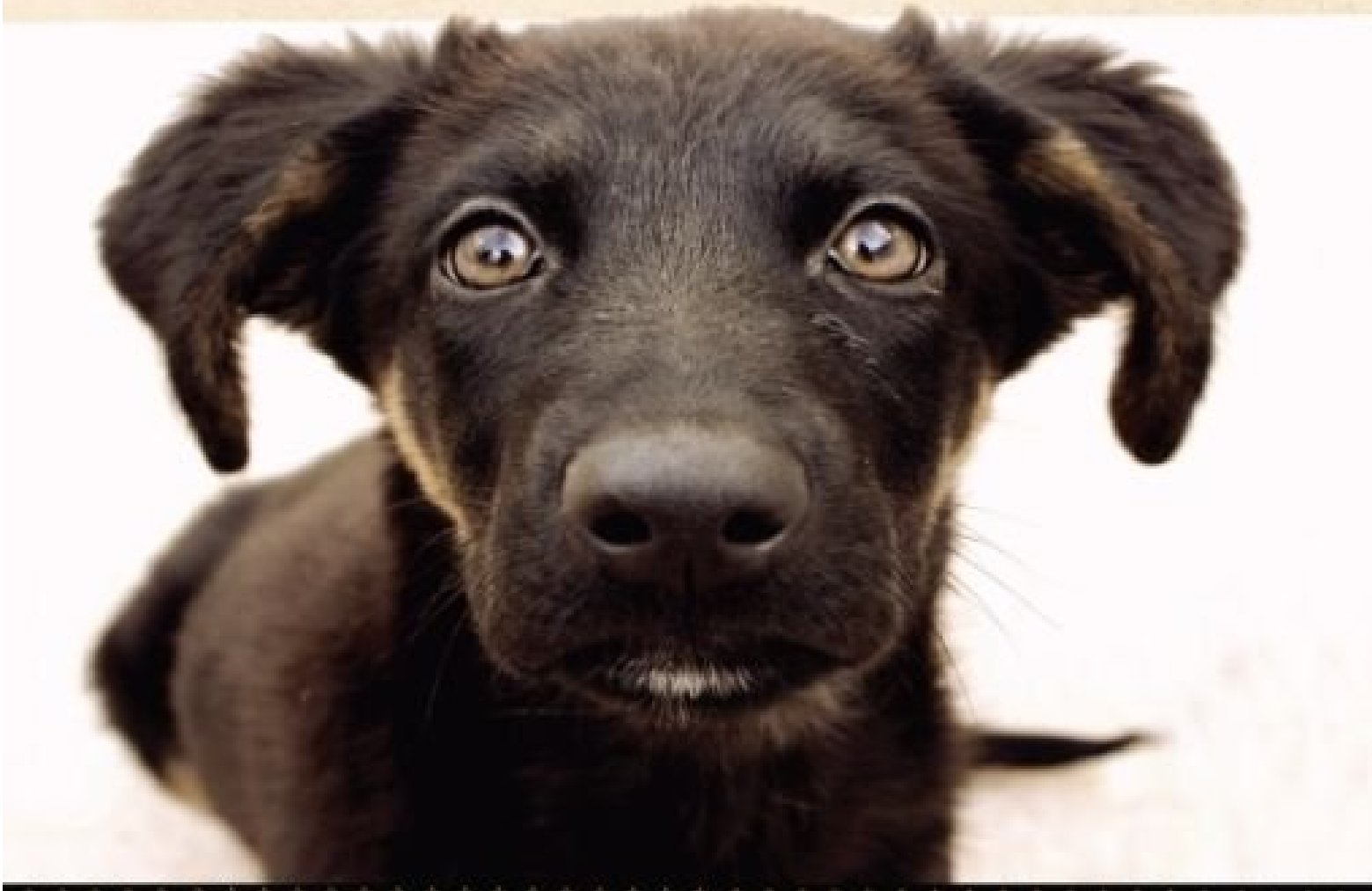

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BETTER FRIEND TO YOUR PET

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To Alexis
(1970–1984), a Real Dog

Ginger

Preface

The first dog I became attached to was one I never met. He was my grandfather's Cairn terrier, Ginger—typical long-legged Cairn of the early twentieth century, only a few generations removed from his worki forebears. Ginger had died long before I was born, and I grew up in a pet-free household; stories abo Ginger were, for a while, the nearest I came to having a dog of my own.

My grandfather, an architect, liked to walk. He walked to and from his office in the industrial city Bradford and to and from the churches and mill buildings he specialized in; but especially he walked f recreation, whether in the Yorkshire moors or in the Lake District or in Snowdonia. Whenever he coul

he took Ginger with him. The family maintained that Ginger, who was taller than he should have been f
his breed, had acquired his longer-than-average legs through all this exercise. Actually, in the photograp
I have of him he looks quite typical of his breed, and not unlike the Cairn chosen to play Toto in the 193
movie *The Wizard of Oz*. It was not until much later on, when I became professionally interested
pedigree dogs, that I was struck by how much the breed had changed over the intervening decade
including becoming significantly shorter in the leg. I doubt many modern Cairns would enjoy the amoun
of exercise that my grandfather evidently relished, although Cairns today are less prone to inherite
diseases than many other breeds are.

Ginger was a genuine Yorkshire "character," and the family had a fund of stories about him, but wh
amazed me the most was the freedom he had been given, even though he lived within sight of the ci
center. Every lunchtime, when my grandfather was at work, Ginger was allowed to take himself for
walk around the neighborhood. Apparently he had a routine. First he would cross the road into List
Park, where he would sniff lampposts, interact with other dogs, and, in summer, try to persuade t
occupants of the park benches to part with one of their sandwiches. Then he would cross the tram trac
on Manningham Lane and amble to the rear of the fish and chip shop, where a scratch at the back do
would usually elicit a handful of scraps of batter and some misshapen chips. Then he usually heade
straight for home, which involved crossing a busy junction. Here, according to family legend, there w
usually a policeman, directing the lunchtime traffic, *who would solemnly stop the cars to allow Ging
safe passage across*.

I've not been to Bradford for many years, but if other cities are anything to go by, Lister Park
probably now ringed with poop-bins, most of the dogs walked there are at the end of a leash, and t
Bradford dogwardens are called out to catch any dog that routinely roams the park, let alone the nearb
streets. The trams are long gone, of course, and traffic lights have replaced policemen on point duty, bu
doubt that one of today's body-armored community support officers would dare to stop a car to allow
small brown terrier to cross the road, even if he or she wanted to.

Seventy-odd years have passed since Ginger was allowed to roam the streets and charm his way in
the affections of everyone he met, including the local law enforcement officers. During that same perio
almost unnoticed, there have been enormous changes in society's attitudes toward man's best friend.

Such attitudes were still quite relaxed when I was growing up in 1970s' Britain. My first dog,
Labrador/Jack Russell cross named Alexis, was also a roamer, although he was more interested in t
opposite sex than in lunchtime snacks. Despite our best efforts to keep him in sight he would manage
get away once in a while, and so, unlike Ginger, he did end up in police kennels a few times (in tho
days the police in the UK still had responsibility for stray dogs). But no one seemed to mind muc
Nowadays such tolerance of dogs and their ways is hard to find, especially in cities, and dog ownersh
is showing signs of retreating to its roots in the countryside. After many millennia in which the dog h
been man's closest animal companion, cats are taking over as the most popular pet in many countrie
including the United States. Why is this happening?

First of all, dogs are expected to be much better controlled than they used to be. There has never been
shortage of experts telling owners how to take charge of their dogs. When I took on my second dog,
Labrador/Airedale terrier cross named Ivan, I was determined that he would be better behaved tha
Alexis. I decided I ought to find out something about training but was then shocked to discover t
approach adopted by the trainers of the day, such as Barbara Woodhouse, who seemed to see the dog
something that needed to be dominated at all times. This simply didn't make sense to me—the whole poi
of having dogs as pets was for them to become friends, not slaves. As I researched, I found that th
approach to training had stemmed from the ideas of Colonel Konrad Most, a police officer and a pione

in dog training who, more than one hundred years ago, had decided that a man could control a dog only the dog was convinced that the man was physically superior. He derived this idea from contempora biologists' accounts of wild wolf packs, which at that time were considered to be controlled by o individual who ruled the others through fear. Biology, by then my profession, seemed to be at odds wi my gut feeling as to how my relationship with my dogs ought to work.

To my relief, this dilemma has resolved itself over the past decade. The wolf pack, always t touchstone for the interpretation of dog behavior, is now known to be a harmonious family group exce when human intervention renders it dysfunctional. As a consequence, the most enlightened modern traine have largely abandoned the use of punishment, relying on reward-based methods that have their roots comparative psychology. Yet for some reason, old-school trainers continue to dominate the media- largely, I suspect, because their confrontational methods make for a more exciting spectacle.

While a more sympathetic understanding of dogs' minds is being applied to training, albeit patchi their physical health has been progressively undermined. As more and more demands have been plac on the family dog in terms of hygiene, control, and behavior, the breeding of dogs who might be suited f this ever more demanding niche has been left in the hands of enthusiasts whose primary goal is to produ dogs that look good. Ginger, although he came from pedigree stock, was only ten or so generations aw from Scottish and Irish rat-catchers of no particular breeding and, as a result, led a long and healthy lif Now, the Cairn terrier is in danger of becoming the victim of inbreeding for the show-ring, plagued b over a dozen hereditary complaints such as the exotically named but apparently excruciatingly painf Legg-Calvé-Perthes disease.

Biologists now know far more about what really makes dogs tick than they did even a decade ago, b this new understanding has been slow to percolate through to owners and, indeed, has not yet mad enough of a difference to the lives of the dogs themselves. Having studied the behavior of dogs for ov twenty years, as well as enjoying their company, I felt it was time that someone stood up for dogdom: n the caricature of the wolf in a dog suit, ready to dominate his unsuspecting owner at the first sign weakness, not the trophy animal who collects rosettes and kudos for her breeder, but the real dog, the p who just wants to be a member of the family and enjoy life.

Acknowledgments

I've spent the best part of thirty years studying dog behavior, first at the Waltham Centre for Pet Nutritio then at the University of Southampton, and finally at the University of Bristol's Anthrozoology Institut Some of what I've learned about dogs has come from direct observation, especially in the early days, b much has been informed by collaborations and discussions with many, many colleagues and gradua students. The original research described in this book owes much to them, though of course I take fu responsibility for the interpretations presented here. In roughly chronological order, they are: Christoph Thorne, David Macdonald, Stephan Natynczuk, Benjamin Hart, Sarah Brown, Ian Robinson, Helen No Stephen Wickens, Amanda Lea, Sarah Whitehead, Gwen Bailey, James Serpell, Rory Putman, Ani Nightingale, Claire Hoskin, Robert Hubrecht, Claire Guest, Deborah Wells, Elizabeth Kershaw, An McBride, Sarah Heath, Justine McPherson, David Appleby, Barbara Schöning, Emily Blackwell, Jolan Pluijmakers, Theresa Barlow, Helen Almey, Elly Hiby, Sara Jackson, Elizabeth Paul, Nicky Robertso Claire Cooke, Samantha Gaines, Anne Pullen, and Carri Westgarth—and many more too numerous to lis Two deserve a special mention: Nicola Rooney, who, in addition to producing consistently world-cla research on dog behavior and welfare for the past dozen years, has been the social life and soul of m research group; and Rachel Casey—arguably the UK's leading veterinary behaviorist and unarguably a indefatigable champion of evidence-based dog training and behavioral therapy. My thanks also to t University of Bristol's School of Veterinary Medicine, and especially professors Christine Nicol a Mike Mendl, and Dr. David Main, for nurturing the Anthrozoology Institute and its research.

Our research has relied on the cooperation of literally thousands of volunteer dog owners and the dogs, to whom I express my gratitude. Also, much of our research would have been impossible witho the facilities and cooperation offered by the UK's leading animal rehoming charities: Dogs Trust, the Blu Cross, and the RSPCA.

There are many other academics and dog experts I've met only briefly, but whose published work h been an enormous inspiration. Many I have been able to mention specifically in the endnotes. Like a branch of science, the systematic study of dog behavior embraces many approaches and opinions, a sometimes these can be expressed quite forcefully. Yet there is a crucial difference between cani science and canine folklore—scientists are ready to evaluate evidence gathered by others, and to chan their opinions if these evaluations indicate that they should. Canine scientists are not in the business peddling opinion as if it were fact; they contribute to a body of knowledge that, while never complet continually gains strength from ongoing discussion among numerous experts. I am grateful to them a even those whose views are now largely discredited or unfashionable. Science advances through t replacement of one hypothesis by another that better fits the data; without the first to act as a stimulus creative thought, the second might never have been conceived.

Condensing all of this science into a book of reasonable length has not been easy, but my agent Patri Walsh, and Lara Heimert, my editor at Basic Books, have taught me a great deal about how to aim for wider audience than the academic community that I have mainly written for in the past.

I've been amazed and delighted by how my old friend Alan Peters' drawings have brought m descriptions of dogs and canids to life. He's not only a wonderful artist but also a skillful gundog train (and falconer) and so was able to bring to the task a lifetime's experience of how dogs move and interac

Finally, to my family. My wife, Nicky, has been an unwavering source of support throughout all t years of my academic career, and especially during the year or so it's taken me to write this book–

cannot thank her enough. Thanks also to my brother Jeremy for giving me the encouragement to start th
book in the first place. Netty, Emma, and Pete, thank you for refreshing my brain with music; Tom and J
likewise but with microbrews, Rioja, and cricket.

Introduction

The dog has been our faithful companion for tens of thousands of years. Today, dogs live alongsi humans all across the globe, often as an integral part of our families. To many people, a world witho dogs is unthinkable.

And yet dogs today unwittingly find themselves on the verge of a crisis, struggling to keep up with t ever-increasing pace of change in human society. Until just over a hundred years ago, most dogs work for their living. Each of the breeds or types had become well suited, over thousands of years and corresponding number of generations, to the task for which they were bred. First and foremost, dogs we tools. Their agility, quick thinking, keen senses, and unparalleled ability to communicate with huma suited them to an extraordinary diversity of tasks—hunting, herding, guarding, and many others, each important component of the economy. In short, dogs had to earn their keep; apart from the few lapdo who were the playthings of the very rich, the company that dogs provided would have been incidenta rewarding, but not their raison d'être. Then, a few dozen generations ago, everything began to change and these changes are still gathering pace today.

Indeed, an ever-increasing proportion of dogs are never expected to work at all; their sole function to be family pets. Although many working types have successfully adapted, others were and still a poorly suited to this new role, so it is perhaps surprising that none of the breeds that are most popular family pets have been specifically and exclusively designed as such. Thus far, dogs have done their be to adjust to the many changes and restrictions we have imposed upon them—in particular, our expectati that they will be companionable when we need them to be and unobtrusive when we don't. However, t cracks inherent in this compromise are beginning to widen. As human society continues to change and t planet becomes ever more crowded, there are signs that the popularity of dogs as pets has peaked and th their adaptation to yet another lifestyle may be a struggle—especially in urban environments. After a dogs, as living beings, cannot be reengineered every decade or so as if they were computers or cars. the past, when dogs' functions were mostly rural, it was accepted that they were intrinsically messy a needed to be managed on their own terms. Today, by contrast, many pet dogs live in circumscribed, urba environments and are expected to be simultaneously better behaved than the average human child and self-reliant as adults. As if these new obligations were not enough, many dogs still manifest t adaptations that suited them for their original functions—traits that we now demand they cast away as they had never existed. The collie who herds sheep is the shepherd's best friend; the pet collie who tri to herd children and chases bicycles is an owner's nightmare. The new, unrealistic standards to whi many humans hold their dogs have arisen from one of several fundamental misconceptions about wh dogs are and what they have been designed to do. We must come to better understand their needs and the nature if their niche in human society is not to diminish.

Our rapidly changing expectations are not the only challenge that dogs face today. The ways in whi we now control their reproduction also represent a major challenge to their well-being. For much human history, dogs were bred to suit the roles that humankind assigned to them—but whether their ta was herding, retrieving, guarding, or hauling, dogs' stability and functionality were considered far mo important than their type or appearance. In the late nineteenth century, however, dogs were grouped in self-contained breeds, reproductively isolated from one another, and each assigned a single ide appearance, or "standard," by breed societies. For many dogs this rigid categorization has not worked o well; rather, it has worked against their need to adapt into their new primary role as companions. Ea

breeder strives not to breed the perfect pet but to produce the perfect-looking dog who will succeed in t
show-ring. These winning dogs are considered prized stock and make a hugely disproportionate genet
contribution to the next generation—resulting in "pure" breeds whose idealized appearance belies the
deteriorated health. In the 1950s, most breeds still had a healthy range of genetic variation; by 2000, on
some twenty to twenty-five generations later, many had been inbred to the point where hundreds
genetically based deformities, diseases, and disadvantages had emerged, potentially compromising t
welfare of every purebred dog. In the UK, the growing rift between dog breeders and those concerne
with dogs' welfare finally became public in 2008, resulting in the withdrawal of the humane charities-
and subsequently that of BBC Television, the event's broadcaster—from Crufts, the country's national do
show. While such protests are a start, the dogs themselves will not feel any benefit until the problem
brought about by excessive inbreeding have been reversed and dogs are bred with their health and role
society, not their looks, in mind.

Ultimately, people will have to change their attitudes if the dog's lot is to improve. So far, howeve
neither the experts nor the average owner have had their preconceived notions challenged by the wealth
new science that is emerging about dogs. Much of the public debate thus far, whether about the merits
outbreeding versus inbreeding or the effectiveness of training methods, has amounted to little more tha
the statement and restatement of entrenched opinions. This is where scientific understanding becom
essential, for it can tell us what dogs are *really* like and what their needs *really* amount to.

Science is an essential tool for understanding dogs, but the contributions of canine science to do
welfare have, unfortunately, been somewhat mixed. Canine science, which originated in the 1950s, se
out to provide a rational perspective on what it's like to be a dog—a perspective ostensibly mo
objective than the traditional human-centered or anthropomorphic view of their natures. Despite th
attempt at detachment, however, canine scientists have occasionally misunderstood—and even give
others the license to cause injury to—the very animals whose nature they have endeavored to reveal.

Science has, unwittingly, done the most damage to dogs by applying the comparative zoology approac
to studies of dog behavior. Comparative zoology is a well-established and generally valuable way
understanding the behavior and adaptations of one species through comparisons with those of anothe
Species that are closely related but have different lifestyles can often be better understood throug
comparative zoology, because differences in the way they look and behave mirror those changes
lifestyle; so, too, can those species that have come to have similar lives but are genetically unrelated. Th
method has been highly successful in helping to disentangle the mechanisms of evolution in genera
especially now that similarities and differences in behavior can be compared with differences betwe
each species' DNA, so as to pinpoint the genetic basis of behavior.

Yet although the applications of comparative zoology are usually benign, it has done considerable har
to dogs, as one expert after another has interpreted their behavior as if they were, under the surface, litt
altered from that of their ancestor, the wolf. Wolves, which have generally been portrayed as vicio
animals, constantly striving for dominance over every other member of their own kind, have been held u
as the only credible model for understanding the behavior of dogs.[1] This supposition leads inevitably
the misconception that every dog is constantly trying to control its owner—unless its owner is relentle
in keeping it in check. The conflation of dog and wolf behavior is still widely promoted in books and o
television programs, but recent research on both dogs and wolves has shown not only that it is simp
unfounded but also that dogs who do come into conflict with their owners are usually motivated b
anxiety, not a surfeit of ambition. Since this fundamental misunderstanding has crept into almost eve
theory of dog behavior, it will be the first to be addressed in this book.

Despite the misapplication of comparative zoology, more recent scientific discoveries could, if applie

properly, benefit dogs considerably. Although canine science went into eclipse in the 1970s and '80s, t
1990s saw the field's resurgence, which has continued to the present day. After nearly fifty years
almost total neglect, this extraordinary uplift in scientific interest in the domestic dog has been drive
partly by the increasing role that dogs play in detecting substances such as explosives, drugs, and oth
illicit substances (which they still sniff out more effectively than any machine) and the attenda
realization that humans need to better understand how dogs perform these tasks. It has also been due to t
shift in attention from the chimpanzee to the domestic dog on the part of a few primatologists who hav
attempted to gain fresh insights into the way that animal and human minds work. A further contribution h
come from veterinarians and other clinicians who wish to improve the therapies available for treati
dogs with behavioral disorders. Finally, it should not be forgotten that many biologists are dog lovers to
Once the professional stigma of working on so-called artificial animals has been overcome, su
scientists are often keen to apply their skills to improving dogs' lives.

By further pulling back the curtain on dogs' inner lives, the new school of canine science has t
potential to provide everyday dog owners with new ways of thinking about—and relating to—their pe
Thanks to the efforts of this new community of scientists, we now have a vastly improved understandi
of how dogs' minds work—specifically, how dogs gather and interpret information about the wor
around them, and how they react emotionally to varying situations. Some of this research has reveale
startling differences between dogs and people, suggesting that it is both desirable and possible for d
owners to "think dog" rather than simply assuming that whatever they themselves are sensing and feelin
their dog must be sensing and feeling too.

Although the new science about dog behavior has the potential to put the dog's role in human socie
back on track, little of the research has been made available outside of obscure academic texts until no
In this book, I attempt to translate for the general readers—and dog lovers—the exciting ne
developments in canine science. Doing so requires me to overturn a great deal of conventional wisdo
about dogs and how we should interact with them. In the first half of the book, I show that the most up-t
date account of the dog's origins, while confirming that the wolf is indeed the dog's only ancestor, revea
a very different image of dog's nature than seemed to be the case only two decades ago. Dogs may
constructed from wolf DNA, but this does not mean that they are compelled to behave or think li
wolves; indeed, domestication has changed dogs' minds and behaviors to the point where su
comparisons can be a hindrance, rather than an aid, to any genuine understanding of our pets.

The new science of dog behavior has dramatic implications for humans—and for our choice of the be
and most humane ways to train our dogs. A word of caution here, though: This book is not a traini
manual. Rather, its purpose is to show where modern ideas about dog training have come from, so th
owners themselves can effectively evaluate whether the training manuals or trainers they have chos
really know what they are talking about.

After revising the story of the dog's origins, I will explore what might loosely be referred to as dog
"brainpower." Scientists have recently turned their attention to the kinds of beliefs that owners have abo
their dogs' emotional and intellectual capabilities, and their findings are demonstrating how accurate-
but also how mistaken—these beliefs can be. It's an integral aspect of human nature to attribute feelin
not just to animals but also to inanimate objects—to speak, for example, of "an angry sky" or "the cru
sea"—and yet, until a few decades ago, it was anybody's guess as to what emotions different anima
might have. Many scientists, moreover, used to regard emotions as simply too subjective to be accessib
to serious study. While animal intelligence has been studied for more than a hundred years, hardly anyo
considered dogs worthy of study until perhaps the end of the twentieth century. Since then, research h
significantly changed the ways in which we think about dogs' minds. The new canine science reveals th

dogs are both smarter and dumber than we think they are. For example, they have an almost uncan ability to guess what humans are about to do, because of their extreme sensitivity to our body languag but they are also trapped in the moment, incapable of projecting the consequences of their actio backward or forward in time. If owners were able to appreciate their dogs' intelligence and emotion life for what it actually is, rather than for what they imagine it to be, then dogs would not just be bett understood—they'd be better treated as well.

Just as canine science can inform human attitudes about dogs' minds, it can also tell us how do experience and interpret the world around them. Physically speaking, a dog and his or her owner live the same house, visit the same park together for exercise, travel in the same car, meet the same friends a acquaintances. However, the types of information arriving at the dog's brain and the owner's brain in ea of those situations are profoundly different. We are visual creatures; dogs primarily rely on their sense smell. We refer to high-pitched noises that we can't hear (e.g., the squeaking of bats) as "ultrasound dogs would, if they could, scoff at our inability to hear such sounds, which they pick up perfectly. To ful appreciate our dogs' world, we need science to tell us what they can and can't detect, what they fi pleasant and what they would object to if they could. For example, I don't suppose your dog has ev been bothered by the colors you've picked out to decorate your house, but his or her delicate nose w very likely insulted by the odor of the drying paint.

Although our lack of understanding of dogs' nature often compromises their well-being, it pales in insignificance beside the problems we have generated for pedigree dogs through excessive inbreedin Rigid breed standards encourage breeders to eliminate all traits that don't fit the "perfect" type. In theo this should allow breeders to select for traits that would create healthy and well-adjusted, if rath uniform, animals—but in practice it has led to the appearance of an extensive range of inherited defec that compromise the welfare of large numbers of dogs in many, many breeds. Science, thankfully, can he to get dog breeding back on track. While it is beyond the scope of this book to provide a detailed manu of canine genetics, the penultimate chapter addresses the underlying principles that breeders should f following, emphasizing what it is about pedigree breeding that directly affects dogs' well-being.

In the final chapters of the book, I look at how science can help dogs to adjust to twenty-first-centu life. Currently, most of the attention given to dogs' breeding has focused on endowing them wi superficial, rather than practical, traits. Many pet dogs are essentially breeders' rejects, deemed unlike to reach the perfection demanded by the breed standard; puppies who look as though they're never goi to become champions in the show-ring are the ones who become pets. Surely the needs of the pet do deserve more attention than that? As dog owners and dog lovers, we need to think constructively abo how to breed dogs whose primary purpose is not to herd sheep, retrieve game, or win prizes at dog show but, rather, to be rewarding, obedient, healthy, happy family pets.

In writing this book, I have tried to promote a greater understanding and appreciation of the speci place that dogs hold in human society. If these aims can be achieved, they should go a long way towa sustaining and reinforcing our relationship with our beloved companions as the next decades unfold.

CHAPTER 1

Where Dogs Came From

"**T**he wolf in your living room"—a powerful image that reminds dog owners that their trusted companio is, under the skin, an animal, not a person. Dogs are indeed wolves, at least as far as their DNA concerned; the two animals share 99.96 percent of their genes. Following the same logic, you might ju as well say that wolves are dogs—but, surprisingly, no one does. Wolves are generally portrayed as wil ancestral, and primeval, whereas dogs tend to be cast in the role of the wolf's artificial, controlle subservient derivatives. Yet dogs, in terms of sheer numbers, are far more successful in the modern wor than wolves are. So, what do we gain from knowing that wolves and dogs share a common ancesto Many books, articles, and TV programs about dog behavior have claimed that understanding the wolf the key to understanding the domestic dog. I disagree. My view is that the key to understanding t domestic dog is, first and foremost, to understand the domestic dog, and it's a view I share with increasing number of scientists worldwide. By analyzing the dog as its own animal rather than as a less version of the wolf, we have the opportunity to understand it—and refine our dealings with it—as nev before.

To be sure, it's undeniable that dogs share many of their basic characteristics with other members of t Dog family (the Canidae) of which the wolf is a part. Dogs evolved from canids, and they owe su qualities as their basic anatomy, their refined sense of smell, their ability to retrieve, and their capacity form lasting social bonds to this evolution. To some extent, then, comparing dogs to their wild ancesto can be illuminating—but when the wolf is taken as the only available point of reference, o understanding of dogs suffers.

At the most fundamental level, dogs are distinguished by the fact that, unlike wolves or other canid they have adapted to live alongside human beings, the result of the process of domestication. As do have been altered by domestication, many of the subtleties and sophistications of wolf behavior appear have been stripped away, leaving an animal that is still recognizably a canid but no longer a wo Domestication has altered the dog considerably, more than any other species. It's self-evident that do come in a wide range of shapes and sizes; indeed, there's more size variation among domestic dogs tha in the whole of the rest of the Dog family put together. Yet this is by no means the only profound effect domestication. Perhaps the most important one, for both us and our dogs, is their ability to bond with and understand us, to an extent that no other animal can match. Understanding what has happened duri domestication is therefore a key element in understanding the dog.

To understand the domestic dog fully, we need to look beyond the process of domestication—beyo even the wolf—to examine the dog's entire history. We need to know where the dog came from and wh all its ancestors were like—not just its closest living relative, the wolf. Of course, it is ultimate impossible for us to know precisely how the domestic dog's ancestors behaved, whether we a examining its immediate forebears (wolves that lived more than ten thousand years ago) or its mo distant ancestors (social canids, the precursors of the wolf, in the Pliocene era several million years ago They are all extinct. We can, however, get some idea of how they might have behaved by examining t range of behavior that is characteristic of today's social canids. Indeed, a detailed examination of t behavior of those species would not only shed light onto the dog's earliest ancestors but also help

work out why it was that, apart from the wolf, none of the canids were successfully and permanent domesticated.

DNA analysis leaves no doubt that the dog is descended only (or at least almost entirely) from the gr wolf, *Canis lupus*. The first comprehensive sequencing of the maternal DNA of dogs, wolves, coyote and jackals, published in 1997, produced no evidence that dogs had ancestors in any species other th the grey wolf.[1] None of the dozens of investigations performed since then have contradicted thi however, there is still a relative lack of data on paternal DNA, which is more difficult to analyze, so it still possible that a few types of dog could claim descent from other canids through their paternal line.

Genetically, dogs and wolves have a great deal in common—but the mere fact that two species hav considerable overlap in their DNA doesn't mean that their behavior will be the same. Indeed, ma animals with similar DNA are drastically different from one another, especially in terms of behavior. W know this thanks to the DNA "revolution," which has led to the sequencing of the genomes of human canines, felines, and an increasing number of other species. Many of these sequences exhibit a remarkab degree of similarity. For example, your DNA and your dog's are identical for about 25 percent of the length, which is perhaps not surprising given that you are both mammals; roughly the same 25 percent also found in mice. The other 75 percent accounts for why dogs, mice, and people look—and behave very differently from one another.

Species that are much more closely related to one another than we are to dogs can share almost the entire DNA sequences, and it's tempting to assume that they must therefore be restricted to the same rang of behavior. But DNA doesn't control behavior directly; rather, it specifies the structure of proteins an other constituents of cells, such that a tiny change in DNA can lead to a huge change in behavior. F example, there is no "blueprint" for the brain; each nerve cell in the brain emerges out of interactio between thousands of DNA sequences. A change in one "letter" in those sequences could have a enormous effect on the way the brain functions, or none at all—we simply don't know enough yet abo how DNA and behavior interact. Take two closely related apes: the chimpanzee and the bonobo. Comm chimps share 99.6 percent of their DNA with bonobos, and yet the social behavior of these two kinds great ape couldn't be more different. Common chimps are omnivorous, often hunting other kinds monkey, and their social groups are based on coalitions between males, who are highly aggressive towa outsiders and may even murder them if they get the chance. Bonobos, on the other hand, are vegetaria live in societies centered on groups of related females, rarely show aggression, and have never been se to murder in the wild. Genetically almost identical, the two species are vastly different in behavior.

Like bonobos and chimpanzees, dogs and grey wolves share most of their DNA—but there seems litt reason to presume that, based on this fact, they must inevitably share the same social systems as well. fact, domestication appears to have dissolved away much of the detail of wolfspecific behavior in dog leaving them with a behavioral repertoire that has much in common with that of slightly more distant related species, such as the coyote *Canis latrans*, and even some more distant relatives in the san family, such as the golden jackal *Canis aureus*.

Even to early biologists, the differences between dogs' behavior and that of wolves were obviou Many of these differences are manifested socially: Dogs, for instance, are clearly not pack anima (although they do occasionally form groups), and they are much more adept than wolves at formi relationships with people. Over the years, many eminent biologists, including Nobel Prize winner Konra Lorenz and even Charles Darwin himself, have been struck by the flexibility of the dog's behavior as we

as by the enormous size difference between the smallest and largest breeds. Both suggested that domest dogs must be some kind of hybrid between two or even several of the canids. Lorenz, in his charmi book *Man Meets Dog*, was convinced that wolves were far too independent in nature to explain t indiscriminate friendliness shown by many dogs, and proposed that most of the breeds that had originate in Europe were predominantly jackal in origin. He later retracted this idea, having realized that there w no evidence for spontaneous crossbreeding between dogs and jackals (as readily happens between do and wolves) and that the details of jackal behavior didn't fit that of the dogs (the jackal's howl, f example, is nothing like any dog's).

Despite these scientists' best efforts to determine why dogs are so different from wolves in the behavior, the puzzle was not resolved and remains largely unanswered to this day. Yet perhaps some clu can be gathered if we look further back in evolutionary time, thinking of our domestic dog as a product n of one species, the grey wolf, but of a whole family, the Canidae (also referred to as the Dog family, noted above, but hereafter referred to as canids to avoid confusion with the domestic dog). Many of t canid species have sophisticated social lives, which—when they overlap with those of dogs—ca potentially shed light on the origins of dog behavior; coyotes, for instance, are much more promiscuo than wolves, a characteristic shared with dogs. Although the behavioral traits of other canids are not well understood or well publicized as those of the grey wolf, they nevertheless have a great deal to tell about when—and how—dog behavior may have originated.

Tracing the canids back to their origins reveals that their social intelligence was likely one of the ear traits that set dogs' ancient ancestors apart. Canids probably first evolved some 6 million years ago North America, where they eventually replaced another type of dog-like mammal, the borophagine. Th was a large, hyena-like animal that specialized in scavenging and had massive bone-crushing jaws match. The original canids, which probably looked more like foxes than dogs, must have been litt Davids to the cumbersome borophagine Goliaths, outcompeting them in speed, cunning, and intelligen and ultimately helping to drive them to extinction. If we then fast-forward a mere 1.5 million years, w find that the surviving canids had spread all over the world and split into several types, one of which wa the ancestor of today's dogs, wolves, and jackals—collectively referred to as *Canis*.[2] Subsequentl further diversification produced three strands of evolution, any one of which could potentially hav culminated in a domestic animal, for there is nothing in the behavior of any of the canid lineages suggest that they could not have produced an animal that was suitable for domestication. Indeed, it likely that at least two of the three did produce domestic animals and entirely possible that the wolf wa not the only species in its lineage to be domesticated.

The first evolutionary break within the *Canis* genus occurred in North America, and eventually (about million years ago) gave rise to today's coyote, still confined to that continent. Another group emerged South America, where they live to this day, and are classified as *Dusicyon* rather than *Canis*. Rath misleadingly, they are collectively known as South American foxes, though they are only distantly relate to the much better known red fox of hunting fame. The other six species of *Canis* all evolved in the O World, most likely in Eurasia, although some possibly in Africa. Four of these are jackals, although one these, the Simien jackal, is sometimes confusingly referred to as the Ethiopian wolf; they include t golden jackal that Lorenz thought might have been the origin of some breeds of dog. The other is the gr wolf *Canis lupus*, the ancestor of our domestic dogs. Of the Eurasian canids, only the grey wolf reache North America, migrating across the Baring land bridge a hundred thousand years ago during one of t

periods when Alaska was joined to Asia.

Many of these species superficially seem to be potential candidates for domestication, thanks to number of social tools that they share with the domestic dog. All can, when conditions are favorable, liv in family groups or "packs." All seem able to adapt their lifestyle—specifically, whether they live alo or in small or large groups—to the circumstances they find themselves in.[3] (Nowadays, the mo important such "circumstance" for all wild canids is often our own species' activities, whether dire persecution or incidental provision of food at garbage dumps.) The current consensus is that the can genome is rather like a Swiss Army knife,[4] a social toolkit that has remained resistant to evolutiona change and can be used to cope with a wide variety of circumstances, ranging from solitary living wh times are hard to complex societies when food is plentiful and persecution is at a minimum. The succe of the domestic dog in adapting so well to life with humans can therefore be seen not as a specific set changes that began only with the grey wolf but, rather, as a new use for this ancient canid social toolkit- one that allowed the dog to socialize not just with other members of the same species but also wi members of ours.

While we are now certain that the grey wolf is the domestic dog's one and only direct ancestor, the d shares its earlier ancestors with many other still-living relatives, each of whom may offer us a ne perspective on these ancient forebears. The dog's lineage, after all, goes back much further than that of t grey wolf—specifically, to canids that are now extinct but were themselves the ancestors of all of today living canids. Each of the latter has something to tell us about the ways that canids can adapt to different circumstances—that is, construct their social groups—and therefore each provides a different s of clues as to what the canid "toolkit" may have looked like as it emerged some 5 million years ago. A all of these canids carry the same "toolkit," the fact that none apart from the wolf has been successful domesticated will also need to be accounted for.