

Chapter 1

Reaching Minds

People and Their Animals

I'm standing at the edge of a dusty road in a little town in South America. A barefoot, grimy boy walks past, a very little boy, maybe between three and four years old. He's eating a bun. Behind him trails a skinny puppy, itself very young.

The boy turns around, sees the dog, and raises a threatening fist. The dog cowers dramatically, cringing to the ground. The boy looks up with a huge, triumphant grin: "I scared the heck out of him, didn't I!" He walks on down the road. The puppy gets up and slinks after him -- and guess what: the boy has forgotten about the bun. He lets it fall, and the puppy grabs it and runs away.

That's how we've dealt with domestic animals ever since we and they evolved together. We treat them like subordinate, stupid human beings. We dominate them. We punish them. We make them do what we want. And they figure out how to get us to do what they want, anyway. Both sides get some benefit out of the system: in this case, food for the skinny puppy, and a rare moment of superiority for a small boy.

Traditionally the person who actually *trains* animals, beyond these ordinary practices of threatening them one minute and feeding them the next, has always been a special individual. Often it's someone with a "way with animals," a "natural gift." Usually that gift consists of two things: a personal interest in some particular kind of animals (dog trainers train dogs; horse trainers train horses) and a better understanding than the rest of us of the subtle uses of fear and force.

Traditional animal training, the way it's been practiced for millennia, relies largely on force, intimidation, and pain. While traditional trainers may also use praise and rewards, dominating the animal and obtaining control over its behavior are the main goals, and the main tools are fear and pain.

Traditional trainers are abundant among us. Nowadays of course they justify their practices with pseudoscientific explanations about pack leadership and the importance of dominance and of being the alpha animal; but the basic method, in spite of the overlay, is punishment; and people generally accept that approach. Most horse owners still keep whips and spurs in the barn. The walls in pet stores are plastered with choke chains and the aisles lined with shock collars, and people buy them. Maybe you use them yourself. I won't argue with you. Force and intimidation have been working for people since the first dogs hung around the first campfires (or, more likely, around the first garbage dumps).

But that's all obsolete now. Now we have a new way of dealing with animals. Out of real science we've developed a training technology. Like any good technology it's a system that anyone can use. The basics are easy to learn. It works with *all* animals (and that includes people). It's fast. What used to take months, the traditional way, can now happen in minutes. It's completely benign; punishment and force are never part of the learning system. And it produces real communication between two species.

D'Artagnan the Wolf

Erich Klinghammer, a professor at Purdue University, is a well-known ethologist. He is the founder of a research facility in Indiana called Wolf Park. Dr. Klinghammer came across my book *Lads Before the Wind*, which describes the years in which I worked as head dolphin trainer at a pioneering oceanarium, Sea Life Park, in Hawaii. Klinghammer saw that the technology we used for training dolphins would be useful for managing wolves. He invited me to Wolf Park to show him how to do it.

We modern trainers love the chance to work with a new species. Not just one more dog or horse or dolphin, but something we have never trained before. We begin, always, with curiosity: "Who are you? What can you do? Show me." I had never worked with wolves, so of course I said yes.

A few weeks later I fly to Indiana. At Wolf Park, Erich Klinghammer is eager to have me go into the pens and meet some wolves personally, to "experience their boisterousness." This I am not willing to do. Klinghammer is six feet four with a big Germanic bass voice. He walks through the gate into the main pack's enclosure and booms, "Good morning, wolves!" The wolves gather around him, waving their tails and jumping up to greet him: "Good morning, Dr. Klinghammer!" For me, I think it would be "Good morning, breakfast."

Besides, I don't need to be close to a wolf to work the training magic; in fact, both of us are safer and will feel better with a fence between us. This wonderful technology does not depend on my being able to impress or dominate the wolf. Nor does it depend on making friends first, or on having a "good relationship." That's often a happy outcome, but it's not a requirement: the laws of reinforcement will get the job done.

Klinghammer has selected a large male, D'Artagnan, as my learner. That's a typical wolf name; no one calls wolves Pete or Blackie or Pal. D'Artagnan was raised by humans, so he does not know how to get along with other wolves and has to live alone in a pen on the far side of the park. Klinghammer and I jump into a truck with a couple of students and a large can of dry dog food and drive to D'Artagnan's pen. I get out my dolphin trainer's whistle, pick up the can of kibble, and go over to the chain-link fence. Wolves look a lot like dogs in paintings and even in photographs, but in real life they're quite different. For one thing they don't have pointed ears like a German shepherd, but small, round ears, like a bear; for another, they don't smell like dogs, they smell like fur rugs.

D'Artagnan meets me with a spectacular threat display, snarling, snapping, and lunging at the chain-link fence between us. He is about the size of a St. Bernard but with much wider jaws and bigger teeth, especially the bone-crunching carnassials in back, at which I am getting a really good look.

I'm sure this show of aggression is learned behavior. His hackles are not up, his eye whites are not showing; he's not really that upset. However, he has probably discovered he can sometimes make people flinch, or even run away, by being scary; and that must be fun to do.

The first step toward change is to explain to the wolf that when he hears the whistle, food will arrive. I blow the whistle and throw in some kibble. D'Artagnan just goes on snarling and leaping and snapping at my face. The chain-link fence between us suddenly seems flimsy. I don't want to reinforce his behavior by moving away, but it is indeed difficult to just stand there.

A Jeep full of volunteers and students pulls up. The wolf is quiet for an instant, studying the Jeep. I whistle and toss more kibble through the fence right under his nose. "Oh," he says, and vacuums up the food. I whistle and toss kibble again. Again he eats the kibble. Then he looks at me. I do nothing. He turns away. Good! It's a relief to see the back of that wolf.

So far, I've just paired the whistle with the food, to make it a "conditioned reinforcer," a sound that means "food is coming." I'm now going to start using the whistle to identify for the wolf what action he's getting paid for. This will turn the sound into an event marker (usually just called a marker). So I whistle as he moves away, and toss in more treats. He returns and eats again.

Now that the wolf is listening to the whistle, coming back for more food when he hears it, and has been reinforced for moving away, I can begin "shaping" his behavior. *Shaping* is the technical term for shifting a behavior by reinforcing any moves that happen to occur in the direction you have in mind and ignoring everything else.

In the middle of D'Artagnan's big enclosure, about thirty feet off, stands a small evergreen tree. I tell the watchers, "I'm going to train him to go out and around that tree and come back." Bravado, of course. I'm going to try would be a wiser promise; but even if it only works for part of the way, it's a useful demonstration. Using a marker signal to shape the behavior of going away from the food, in order to earn the food, helps to shut up the skeptics.

I mark each time the wolf turns away from me, timing my whistle to the stepping of his right front paw. Every time he hears the whistle, I toss in a lump or two of kibble. He snatches them up and then, with increasing confidence, turns and starts moving directly away from me again.

I wait for three strides before I give the whistle, then five, then ten. Now D'Artagnan is so confident he grabs up the kibble and actually trots off, still chewing. Each time, I wait to blow the whistle until he's gone farther than before. Now he's going more than halfway to the little tree.

Then, on the next try, he stops before I blow the whistle. Uh-oh. He is new to the game and hasn't had enough experience to know that a missed marker doesn't mean the game is over, but simply means that you should try again. If I give him a whistle while he is standing still, he might develop the behavior of going out just that far and stopping. And if I don't give him a whistle at all, he might quit altogether. I watch him, praying he'll take another step forward so I can reinforce moving, not just standing.

Instead, he turns around and makes eye contact with me. His yellow eyes look into mine with a focus so intense that it feels as if he were seeing right into my brain -- which, in a way, he is. That penetrating stare is literally breathtaking: I hold my breath and look steadily back.

Deciding, I think, that the game is still on, D'Artagnan turns away from me and heads straight off toward the tree again, breaking into a canter for the first time. I blast the whistle to mark that bold decision. His loping stride brings him abreast of the little evergreen. The wolf wheels around the tree and comes back down the other side at a gallop, screeching to a halt right in front of me, making my brag come true. Quit while you're ahead! I push a double handful of kibble through the chain link and leave him to enjoy that jackpot. Thanks, wolf! You saved my neck.

One experience was all D'Artagnan needed. Now, when Klinghammer takes visitors around Wolf Park, he can drive up to D'Artagnan's pen and blow the horn to call him. The wolf comes to the fence, sizes up the situation (Klinghammer, Jeep, whistle, kibble, got it), then turns away, gallops out and around the little evergreen, hears a blast of the whistle, and comes back for his treats. This new skill also ends his aggression display. Training people to give you kibble is much, much more satisfying than the old game of Get the Guest.

That single demonstration with D'Artagnan was also all Klinghammer needed to convert Wolf Park to the new technology. The staff and volunteers began using treats and acoustic markers, either whistles or clickers, to handle and move wolves and to give medical care. Staff ethologist Pat Goodman mitigated her border collie's irritating habit of staring at her incessantly by teaching him to turn his head when she whistled "Dixie" ("Look away, look away..."). Klinghammer, meanwhile, had fun using the same principles to coach a Purdue girls' volleyball team.

That demonstration paid off for me, too. I learned that wolves, or at least this wolf, enjoy a bit of fun: his game of scaring people was on the rough side, but it *was* a game. Then, that memorably powerful look into my eyes told me something more: compared to dogs, wolves are grown-ups. He was not asking for help, head down, forehead wrinkled, as a dog might: "Is this right? What do you want?" Instead, head high, gaze level, he was

assessing me, like a poker player: "Are you in or out?" Judging that I was in, he made his move; and we both won.

Two Scientists, Two Sciences

Two tremendously innovative scientists have influenced the development of this kind of training: Konrad Lorenz and B. F. Skinner. Both started out in the 1930s and achieved their greatest prominence in the 1960s. Lorenz identified innate, evolutionary patterns of behavior in whole species of animals, work for which he and two other ethologists ultimately won a Nobel Prize. Skinner discovered basic laws of nature governing the way individuals, regardless of species, learn or acquire new behavior. Both of them gave us new understanding of the mechanisms underlying behavior.

Both of them also gave rise to new schools of behavioral science. The study of innate behavior, Lorenz's field, is called ethology, or just animal behavior. On any university campus you'll find these folks in the biology buildings. The study of learned behavior, Skinner's field, is called behaviorism, or behavior analysis. On most campuses you'll find these people over in psychology.

Often the people in those buildings tend to specialize in their own view of behavior and trivialize or dismiss the other. They typically don't talk to each other, don't read each other's papers, and don't go to the same meetings. This is annoying for those who are using this new technology. What we do involves both processes: what Mother Nature gives the animal, and what the individual discovers for itself. Yet if we have a question for a scientist, whichever kind of behaviorist we quiz can probably give us only half the answer.

The New Technology

We tend to think of "technology" as involving a lot of machines. How can this training be a technology when no machinery is involved beyond an event marker such as a whistle or a toy clicker? Hey, lots of technologies don't involve complicated equipment. The alphabet, when it first surfaced, was a new technology, too, and all you needed to use it was a stick and some clay.

A technology provides *repeatable* solutions to a problem. It is a replicable, transferable, and reliable system by which lots and lots of people can do something that has previously been difficult and chancy, requiring vast individual skills.

A technology does not limit you to one use: to dogs but not horses; to gymnasts but not pilots. A technology can have as many applications as there are people to think them up. Once you know how to build bridges, you can get across lots of different rivers.

As with any good technology, with this training the advantages are obvious the minute you see it in use. "Wow, how'd you do that? Let me try." Like any good technology, it is

easy to get started. You can get results in the first few minutes. You can learn and use just as much as you want; total mastery of the whole system is not required. Also, like using a cell phone or any other new electronic gadget, you can pick it up from friends or even get started (sometimes) from written instructions.

A Contagious Idea

In my 1984 book, *Don't Shoot the Dog!*, I describe the mechanics of training with reinforcement instead of punishment. It was mostly about people, not animals; but the title (chosen by the publisher over my violent objections) gradually attracted the attention of dog trainers. Though the book said next to nothing about dogs specifically, it did explain how this new kind of training worked in general. Many dog owners, offended by traditional systems using choke chains and domination, were drawn in by the title and then intrigued by the possibility of training a dog without the traditional use of force.

Skinner himself had suggested that a cricket or toy clicker would make a good marker for dogs. In the early nineties sturdy, cheap clickers came on the market. I started distributing them by the hundreds, first at scientific meetings, then at seminars for dog trainers. On Internet lists and groups the technology spread in the dog world. Horse trainers also began to read my book and to convert traditional horse training to positive reinforcement.

Zookeepers turned their attention to these new ways to handle their animals. Medical care for large zoo animals used to be difficult. If you needed to sew up a cut or pull an infected tooth or give a vaccination to a tiger or a polar bear or a gorilla, you had to immobilize the animal with physical restraints or shoot it with a tranquilizing dart. Both procedures are scary and dangerous for the animals and the people, too. You did that only in emergencies.

Thanks to positive reinforcement training, keepers today can train their animals to come when called, to go in and out of doors when asked, and to accept medical treatment voluntarily, even daily. Lives are saved, animals are much less stressed overall, and the training is interesting and fun for both the keepers and the kept.

It's Okay for Animals, but We're Not Animals!

Both Skinner and Lorenz were roundly attacked and vilified during their lifetimes and since. Skinner, in particular, remains the personification of evil in many people's minds. In my opinion what mainly causes the hostility is resistance to the concept that what these scientists discovered doesn't just apply to animals: it applies to people, too. It's unnerving to some people, even to some scientists, to think that we, too, might be subject to the instinctive, automatic behavior patterns studied by ethologists. It's even more ruffling to think that we, like laboratory rats, might be controlled by mysterious systems of rewards and punishments, against our will and without our knowledge, as behaviorism seems to imply.

I think it's largely a religious issue, even if the person doing the huffing and puffing would not consider himself religious. In any case it's ridiculous. We no longer object to the fact that we share with the animals products of evolution such as digestive systems, skeletons, eyes, circulating blood, and so on. Why not give the same respectful understanding to things behavioral?

We all express our emotions through behavior, much of it innate (blushing, for example). The laws of learning also apply to all of us. Of course we humans differ from the rest in our ability to think and talk, to make things, and to accumulate learning through cultural means. We are a notch up, no doubt about that; but the anxiety we seem to feel about *any* possibility that we are also "animals" is, I think, misplaced.

Animals are more various in their behavior than it was fashionable to assume in the past, and we humans are more programmed than we used to think. So what? Every species has some behaviors dictated by its genes and some not. Every species can discover and enjoy new ways to make the universe pay off. The new technology, blending two behavioral sciences, is a highly enjoyable way to explore the possibilities.

What I Do

As a scientist, a writer, and an entrepreneur, I've been busy developing this technology and explaining it to others for about forty years. However, plenty of people in my life who know me as a writer, or as a businesswoman, would be astonished to hear me calling myself a scientist.

I certainly don't fit the normal picture of a scientist. I'm not a professor. I don't work in a laboratory. I'm not easily identified as one or another kind of specialist. I also don't have what has become the defining asset of a scientist: a Ph.D. I have, in fact, a good scientific education, but I acquired it bit by bit and unnoticed by the people around me, including family and friends.

Both my scientific education and my scientific career have occurred more or less underground. As a freshman at Cornell I realized that majoring in biology, my natural bent, would force me to take many premedical courses that I knew would be useless to me and a huge waste of strength and time. So I majored in English and took the science courses I actually wanted -- a year of ornithology, a year of entomology, a nice little dip into botany, and so on -- as electives.

In the years I was raising my children, I sandwiched in some graduate work whenever time and money permitted. The education was crucial; the degrees themselves were not. I could not afford to waste a single hour on those department requirements, such as organic chemistry or German, that were not germane to my interests or to the research I was already doing and publishing. And I definitely did not want to be a professor, so I didn't need degrees to get a job. Over the years, my peculiar specialties have brought me a steady stream of consulting contracts in areas ranging from commercial fishing to autism; and my clients never seem to care whether I am Dr. Pryor or just plain Karen.

What Is *She* Doing Here?

My low-profile scientific career has produced occasional honors, too, sometimes to the bewilderment of onlookers. For example, I sit on the board of the B. F. Skinner Foundation, which serves as an archive of his work and a resource for researchers. I have met more than one distinguished professor whose pained expression made it clear that he thought he would be a much more suitable member of that board than some woman who doesn't even have a degree in psychology.

In the 1980s I was appointed by the White House to a term on the Marine Mammal Commission. The commission oversees the wellbeing of all the marine mammals in U.S. territory and waters. It has been a powerful agency for good in marine conservation in general. I'm sure some marine mammal scientists assumed this dolphin trainer was picked largely because the White House needed to find female appointees (I thought it likely myself).

However, in addition to my scientific work, I had gained considerable business experience helping to develop Sea Life Park and some other commercial projects. I had then built a successful information technology business of my own. The combination of scientific training, marine mammal expertise, and a business background allowed me to bring some common sense to many of the commission's activities, from drafting legislation to evaluating research proposals and funding. Meanwhile, if people ask me what I did on the commission, I tell them what the writer part of me accomplished: during my tenure, outgoing Marine Mammal Commission documents and correspondence were no longer riddled with split infinitives.

Animals without Big Brains

Explaining what I *do* depends on who's asking. Nowadays, since everyone seems to have heard of clicker training for dogs, many people think of me as a dog trainer. I never contradict them. But there's a lot more going on here than that. One of the wonderful aspects of reinforcement training is that it can open a connection with any animal, not just big, smart ones like wolves.

When I was still living in Hawaii, someone gave my kids a big hermit crab for a pet. It was the size of my hand. It lived in a turban shell as big as a baseball, in a saltwater aquarium in the living room. One afternoon, dropping some food in the water for the hermit crab, I wondered, what can *you* learn? Skinner's associate Richard Herrnstein once told me that he had trained a scallop to clap its shell for a food reward. I won't say I doubted him, but I did wonder how on earth you deliver food to a scallop, and what does it eat, anyway?

Well, I'm thinking to myself, here is another invertebrate, with a vigorous appetite for (what else?) crab meat. Maybe it can do something on purpose. Maybe it can ring a bell. I find a little brass bell in the kitchen drawer, glue a string to it, and hang it from a stick

laid across the tank. I rig up a counterweight consisting of a thimble filled with candle wax. A pull on one end of the string tilts the bell over so the clapper hits the side, and the weighted thimble, stuck to the other end of the string, pulls the bell over the other way. Ding-dong.

Contriving the apparatus is the hard part. Teaching the crab is easy. In the kitchen drawer I also find a pair of ten-inch-long dissecting forceps left over from my graduate-student days. With this I can pop a bit of food directly into the crab's weird little waving mouthparts. The crab is receptive to being fed this way and eats fast, too.

I hang the string into the tank, hold the forceps in the water about three inches from the crab, and keep the forceps absolutely still until a waving claw accidentally touches the string. Then I pop the food in. The crab can see and probably sense through water pressure the quick movement of the forceps. I'm hoping and expecting that the movement of the forceps will serve as an event marker, communicating to the crab that its own action, touching the string, makes the food arrive.

I guess it's working, because in about five tries the waving claw arm is hitting the string repeatedly. Now the crab is full and doesn't seem to want any more food; so we stop.

The next day, I begin shaping for stronger behavior by marking behavior selectively, moving the forceps only when the claw is swinging strongly at the string, and letting smaller movements go unrewarded. Sometimes the string happens to fall inside the open claw, then the claw closes; that's probably almost a reflex, an automatic event. I start marking only the actual closing of the claw on the string. In another session or two, the crab is downright reliable at reaching for and grabbing the string on purpose. While the forceps moving is the marker, telling the crab it's doing the right thing, the string itself is the cue, telling the crab "Grab here" and "Grab now!" I am careful to put the string in the water only when I have the forceps in position, ready to mark the behavior and deliver the food. I don't want it to respond correctly to the string and not get results!

Pulling stuff toward its mouth with a claw is a natural movement for the crab, so by the fourth day I up the ante and reinforce only downward pulls. Again, it takes just a few reinforcements to get the goal behavior: a pull that is strong enough to ring the bell. Ding-dong. Yes, this crab can learn, and learn fast. Learning in this fashion is not a product of IQ but of the whole nervous system's alertness to the environment, and the hermit crab has plenty of that.

In building behavior step by step like this, I am discovering what the animal can do. The animal, meanwhile, is discovering new and better ways to make *me* deliver food. "The animal's training *you*," people say with an uneasy laugh. Sure. That's the point. But I don't think that's how the animal sees it. The animal is not bossing me around (although, like D'Artagnan, it might initially try that). The animal has discovered, in me, a new resource, like a new water hole or berry patch. Thus it takes a new and intense interest in what I do. That opens up huge opportunities for understanding.

I take particular pleasure in the people who have tried this kind of training with their dogs, not just the serious competitors and fanciers, but regular pet owners, with typical pets, who have perhaps found a good clicker class in the local park or pet store. Their first reaction, as the dog begins to offer them behavior, is a thrill of personal success: wow, finally, look, he did what I wanted! And the second reaction is from the heart: I had no idea I had such a smart dog. I used to think he was such a nuisance. *I love this great dog!*

What's the Potential?

Positive reinforcement training, using the marker signal and the rest of this modern technology, certainly benefits a lot of animals. But the big potential for this technology is with people.

Used correctly, a marker simplifies the learning of any physical skill. The good tennis coach or golf pro knows exactly what five or ten different things you are doing wrong. Make him or her narrow the focus down to fixing one mistake at a time, hand over a clicker for instant feedback to your nervous system when you do the move right, and your game will actually start to improve.

The first public application of clicks to human muscle moves was in children's sports, particularly gymnastics and track. Human applications are now being developed in industrial settings, in physical therapy and rehabilitation, and in speech and language training. Nonverbal marker-based techniques are also proving useful in work with children or adults with language deficits and other developmental disabilities.

A Shift in Perception

More profound than any specific application is the change the technology brings about in the people who are using it. When you stop relying on aversive controls such as threats, intimidation, and punishment, and when you know how to use reinforcement to get not just the same but better results, your perception of the world undergoes a shift.

You don't have to become a wimp. You don't have to give up being in charge. You lose nothing of yourself. You just see things you didn't see before. One man said to me, "I stopped jerking my dogs around; and then I noticed what I was still doing with my kids." It's not a moral question. He was trying to be a good parent before. He is still trying to be a good parent. It's just that now he sees an alternative way.

The shift reminds me of those puzzles that came in comic books when I was a child. There's a line drawing of a landscape, say, showing a river and a leafy tree. Then, when you look for a while, you see it's also a woman's face. The two birds are her eyes, the leaves are her hair, the clump of flowers is her smile, and the river is the wrap around her shoulders. You can still see the landscape, but now you can also see the portrait; and once

you've seen it, you can't unsee it. You might still be doing what you did before, but now you know it; and you can envision doing things another way.

I have heard professors of behavioral science, who should revere positive reinforcement, boasting about how tough they make life for their graduate students. As if that would help them learn better. Oh, come on, folks! I have watched the highest officials in my government bickering about different forms and degrees of torture, still relying on the primitive tools of fear, dominance, and injury without any recognition of what any dolphin trainer knows: that aversives stop behavior, they don't start it; and that fear and pain produce completely unpredictable and usually highly undesirable side effects, including being both exciting and reinforcing to the punisher. I have a faint but undying hope that the new technology that is the topic of this book might help to bring us all just a *little* bit past the behavioral Stone Age we are still in.

It seems to me that people are still jumpy about being compared to animals (in spite of acting in these primitive ways themselves). One way to tiptoe around the issue has been to focus only on really, really smart animals, individuals that might be assumed to be interesting special cases. Over and over one reads the same old stories about the same species and even the same individuals: Alex the parrot, Koko the gorilla, Washoe the chimpanzee, a collie that knows a hundred words, and so on.

These are indeed remarkable individuals, and the mentors who elicit their abilities have done remarkable work. To me, though, this emphasis on animals that seem to share our cognitive skills misses an important point. The mind has, at least, two parts: the cognitive part that thinks, consciously, in ideas and words, sometimes referred to as the left brain; and the part that senses, feels, and acts without that deliberative process, the right brain. That nonverbal part of the brain controls and learns movements, learns and recognizes scents and sights and sounds, is engaged when we dance or laugh or make music, and runs our emotions. We dismiss it unfairly by focusing on the cognitive side. That other part of the mind is far from stupid. It's aware and good at learning. It's that part of the brain that's engaged when we learn through reinforcement.

That's the kind of brain function that animals have, too. My goal is to show you the depth of awareness in many animals, not a special few; to identify the processes that can let you experience real communication with whatever animal is sitting in front of you; and, finally, to show you how you can use reinforcement-based technology to reach and communicate with the nonverbal side of the human mind.

I am going to avoid regurgitating both the work and the opinions of others. I intend, instead, to share with you mostly events I participated in personally, with many different organisms, revealing a huge range of preferences, intentions, and capabilities.

I don't want you to think that these kinds of events are unique to me. Everyone who uses this technology has had similar moments of astonishment, communication, recognition, and joy. In describing my own observations and what I think they mean, I speak for all of us.

Once, years ago, I glimpsed Jonas Salk on television. He was tall, thin, and balding. He stood quite motionless. His eyes didn't move. He seemed, I thought, as cold and still as a lizard: a formidable personality.

The interviewer asked him to sum up his illustrious career in science. Salk said nothing for a beat, then gave a gentle, even humble answer: "My job is to tell people what I see; and if they find it useful, good."

Hey, I thought. That's what I do, too.

So here's what I see. Come and have a look. If you find it useful, good. I'm pretty sure you will find it fun.

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