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Lasting Contribution

How to Think, Plan, and Act to Accomplish Meaningful Work

Tad Waddington

Does Your Work Matter?

Lasting Contribution is for everyone interested in finding out how your work can truly make a difference.

This profound little book demonstrates how to create meaning in your life, take sophisticated action, manage your career, and make a lasting contribution to the world.

Tad Waddington synthesizes the thought of Aristotle, Sun Tzu, Gödel, Frankl, Confucius, and many others. He draws insights from information theory, sociology, Zen, psychology, the history of art, management theory, the philosophy of science, and a dozen other fields.

Using the *Titanic*, avatars, Santa Claus, skate-boarding, muses, cocktail parties, Oprah's shoes, and an array of other vivid examples to make its points clear, *Lasting Contribution* is both enjoyable and deeply thought-provoking.

Lasting Contribution

HOW TO THINK, PLAN, AND ACT TO ACCOMPLISH MEANINGFUL WORK

Tad Waddington

A B2 Book

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I

Getting Started

THINKING CAUSALLY

The greatest use of life is to spend it for something that will outlast it.

—WILLIAM JAMES

Sooner or later every thinking person asks the immortal question: have I made a difference in the world? If you ask this question later in life, your next step is an exercise in ethical accounting: you once spilled tea on your friend's new shirt, but made up for it by saving his life after he was in a car wreck. If, however, you ask this question sooner, then your next question is: how do I make a difference? Actually that shouldn't be your next question, because it is easy to make a *difference.* A single match can burn down a forest and what a difference that makes. A better question is: how can I contribute to the world?

There are many answers to this question. You can run errands for your elderly neighbor, pick up litter in the park, or leave a generous tip for your footsore waiter. But while these activities are important, they point to the limits of the question. Imagine that cars always speed near a certain playground, and it's only a matter of time before a child is killed. You could make

the world a better place if you were to stand by the road and wave a flag at the speeding cars to encourage them to slow down, but your contribution would stop the moment you stopped waving the flag. Or you could post a sign that says, "Slow." For this to be a contribution, however, drivers would have to read and heed the sign. The sign is ineffective, because the speeders might be driving too fast to see it. So you decide to change the nature of the equation. You get a speed bump installed. The speeders slow down, and the kids are safer.

So the question isn't just: how do you contribute? The question is: how do you make a contribution that lasts? Unfortunately the solutions to most of the world's problems aren't as easy as installing the occasional speed bump, so the question becomes: given that the world is big and complex, how do you make a lasting contribution? In other words, how do you accomplish something that matters? How do people like you and me achieve not the ephemeral, but the enduring; not the trivial, but the significant? The answer is that just like everything else in the world—from tea stains to speed bumps—lasting contributions *are caused.* Simply put, you *cause* a lasting contribution to happen. The problem is that the way people usually think about causality does not serve them well when it comes to thinking about taking action.

People tend to think of causality as one billiard ball striking another that ricochets into another and another. On a wintry mountain a squirrel drops an acorn. It falls and dislodges some snow. The snow slides, knocking free yet more snow, causing an avalanche. The distant roar of the avalanche startles you as you pour tea. It

spills on your friend's new shirt. You apologize to your friend, but in a sense, it was the squirrel that caused the tea stain.

But even if the world does work this way, this may not be the best way to *think about* taking meaningful action. Suppose you want to help people by healing them. You plan to use your existing skills and knowledge to attend medical school to become a doctor. This thought raises some problems with our notion of billiard-ball causality: healing people, which started the whole chain of events, hasn't happened yet. Does this mean the future causes the past? Probably not. Maybe it is your *desire* to help people that starts the chain of events. But is your desire caused or is it free will? Aren't your existing skills and knowledge, your passion to contribute to the world, and your plan of going to medical school all part of the *cause* of your becoming a doctor?

When it comes to human action, skills, passions, and plans are part of causality. Some 2,300 years ago, Aristotle argued that it is useful to think in terms of four causes:

1. *Of what* a thing is made, also called the **material cause**. Clay is the material cause of a brick. Steel, rubber, and plastic are part of the material cause of a car.
2. *How* something is made, also called the **efficient cause**. The efficient cause is billiard-ball causality, the action that brings something into being. It is the gathering and firing of clay to make a brick. The workers on an assembly line are the efficient cause of a car.
3. *What* a thing is, also called the **formal cause**. The formal cause is the essence, idea, or plan of a thing.

The essence of a brick is that it is an expression of an idea of the right size, shape, and strength of an object needed for building. The engineer's design is the formal cause of a car.

4. *Why* a thing is, the sake for which a thing is done, also called the **final cause**. The final cause of a brick is to make a wall. The final cause of a car is that it helps you get from here to there.

What is the cause of climbing a mountain? The material cause is your climbing gear—oxygen, ice axes, and tents. The efficient cause is putting one foot in front of the other. The formal cause is the route you plan to take. The final cause, explained British mountaineer George Mallory, who died on Everest, is "because it is there."

Bricks, cars, and mountains, however, are simple. How do the four causes work in a complex, dynamic, and messy world such as the one in which we live? The intent of this book is to help you make a lasting contribution to the world, because when doers think before acting and when thinkers take action, remarkable results follow. When doers don't think before acting and when thinkers don't act, good people's efforts fail to achieve their full impact. It is not that that doers are stupid or that thinkers are lazy; they merely lack a theory to guide and facilitate their actions. Using Aristotle's four causes to guide and facilitate your actions can help you to think more clearly and act more effectively, which will help you to achieve lasting results—results that are worth achieving.

At this point, you may be concerned that you are not

talented enough to make a lasting contribution. In the course of this book, I will show that this concern is chimerical, but for now, here is an example of the sort of lasting contribution that is within your reach. It comes from Peter F. Drucker's book, *The Effective Executive*:

> A new hospital administrator, holding his first staff meeting, thought that a rather difficult matter had been settled to everyone's satisfaction, when one of the participants suddenly asked: "Would this have satisfied Nurse Bryan?" At once the argument started all over and did not subside until a new and much more ambitious solution to the problem had been hammered out.
>
> Nurse Bryan, the administrator learned, had been a long-serving nurse at the hospital. She was not particularly distinguished, had not in fact ever been a supervisor. But whenever a decision on patient care came up on her floor, Nurse Bryan would ask, "Are we doing the best we can do to help this patient?" Patients on Nurse Bryan's floor did better and recovered faster. Gradually over the years, the whole hospital had learned to adopt what came to be known as "Nurse Bryan's Rule"; had learned, in other words, to ask: "Are we really making the best contribution to the purpose of this hospital?"
>
> Though Nurse Bryan herself had retired almost ten years earlier, the standards she had set still made demands on people who in terms of training and position were her superiors.

Every person is capable of accomplishing as much as Nurse Bryan.

Finally, a word of warning. You will be disappointed if you believe that contribution is a nail, and this book a hammer. The world and what you must do in it to make a lasting contribution are far too complex for such a simple perspective to be effective. This book was written to help you not in the way a hammer helps you to build a house, but in the way a blueprint does. It prepares you for action.

II

Dealing With Complexity

EFFICIENT CAUSE

For every complex problem there is a solution that is simple, straightforward, and wrong.

—H. L. MENCKEN

Efficient causation is about taking action. Sometimes you can "just do it," knock down the first domino—which topples the next in a long line of dominoes—and achieve the result you want. More often, however, the world is not domino-simple. The poet Percy Bysshe Shelley nailed the nature of the problem: "Nothing in the world is single, All things...In one another's being mingle...." Business strategist Peter Senge has expressed the same idea less poetically but more precisely: "human endeavors are...systems. They...are bound by invisible fabrics of interrelated actions, which often take years to fully play out their effects on each other." Senge said this is a problem of *dynamic complexity,* which he defined as "situations where cause and effect are subtle, and where the effects over time of interventions are not obvious."

At the simplest level, dynamic complexity is the problem of the hotel shower with a delay between the faucet and water temperature, resulting in water that lunges

between freezing and scalding. At more complex levels, it is the problem of the well-intentioned action that has disastrous unintended consequences, such as early settlers importing rabbits to make Australia look more like England—rabbits that ultimately caused widespread habitat destruction.

The world is not only a dynamic system; it is an *open* dynamic system. This means that it is not only complex, but also that new things can enter the picture to change the nature of the equation. For example, complex though it was, the ocean ecosystem off the shores of Peru was functioning harmoniously until an outside force intervened. In the 1950s, enterprising fishermen decided to make some easy money by harvesting 14 million tons of anchovies to sell as food for cattle and pets. Unfortunately, the guanay (a seabird) eats anchovies, and the guanays' droppings make an excellent fertilizer, particularly for plankton. Plankton feed not only the anchovies but also tuna and sea bass. After the giant Peruvian anchovy harvest, the guanay population dropped by 98.5 percent. As a result, the populations of plankton and the fish that fed on them also crashed. Now, fifty years later, the fish populations in the area have yet to recover. With one ill-conceived action, the fishermen destroyed generations of livelihood for future fishing families.

Senge suggested that the best way to deal with complex systems is with systems thinking: "Systems thinking is a discipline for seeing wholes. It is a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static 'snapshots.'" He went on to say, "Seeing only individual actions and

missing the structure underlying the actions...lies at the root of our powerlessness in complex situations."

Ah, but *how* do you deal with such complexities? Every situation is different so you need to engage in *considered action,* features of which include:

Acting complexly

In *The Logic of Failure,* German psychologist Dietrich Dörner summarized experiments on how people deal with complex systems. Dörner created a computer model of an imaginary country in West Africa that he called Tanaland. The people of this imaginary land depend on growing crops, gathering fruit, and herding sheep and cattle. Participants in Dörner's experiment were given the opportunity to control certain variables of the Tanaland computer model, such as whether to use irrigation and fertilizer. Most participants quickly wiped out Tanaland's population, but a few were able to preserve a healthy rate of growth. The differences between the experiment's two groups, Dörner wrote, were striking: "The good participants acted *more complexly.* Their decisions took different aspects of the entire system into account, not just one aspect. This is clearly the more appropriate behavior in dealing with complicated systems," he added, because complexity means there are "many interdependent variables in a given system," which makes "it impossible to undertake only one action."

Dörner continued, "To the ignorant, the world looks simple. If we pretty much dispense with gathering information, it is easy for us to form a clear picture of reality and to come to clear decisions based on that picture." Further, "The bad participants displayed...a reluctance

to gather information and an eagerness to act. By contrast, the good participants were initially cautious about acting and tried to secure a solid base of information.... The less information gathered, the greater the readiness to act."

Moving your focus

Complex action requires an ever-moving focus, which involves:

- Solving the problem that needs to be solved, which means resisting the temptation to do only what you enjoy doing or only what you are good at doing.
- To the degree you can, tackling problems while they are still small. I'm thinking of the children's book *The Little Prince,* in which the prince is looking for a sheep to help him with his baobab-tree problem. When told that the trees are enormous, he points out that they start small.
- Shifting your focus from the big picture to the details and back again without fixating at just one level of the problem.
- Balancing the need to gather more information with the need to get something done.

To return to the example of your becoming a doctor, suppose you are an emergency room physician. One day your tea-stained friend, who has been in a car wreck, is wheeled in. First you'd make sure his airway is clear and that his breathing and circulation are fine (details and action), but all the while you would keep an eye on his vital signs (big picture and information). At the same time that all of this is going on, you would attend to his emotional needs and try to moderate your emotional

reaction at seeing your friend in such a state. Definitely very difficult to do, but you have to do it all at once to achieve the best outcome.

Gathering feedback

Gathering feedback is important because it allows you to test your understanding of the problem you are trying to solve. Even more important, it helps you to make sure you are solving the right problem. Drucker says that quality isn't what you put into a thing: it is what somebody else gets out of it. He is right, right in the irritating way that natural selection is right. If nature allows the saber-toothed tiger to go extinct while the roach flourishes, which is more fit? If nobody buys an obviously better product, then is it truly better? If you tell a joke and nobody laughs, then is it funny? The question to consider is: Who defines the outcome? I don't get to say whether I am a good husband, a good father, a good teacher, a good consultant; only feedback from my wife, son, students, and clients counts as an answer.

It is, of course, not enough simply to *collect* feedback. You must allow the most recent information to inform—that is, to change—your actions. You must allow for the possibility that the next thing you learn can change everything. Suppose that you went to medical school so you could become a doctor, because you wanted to help people. Unfortunately, while in medical school you discovered that you have an atrocious diagnostic sense, but a real gift for virology. You'd be a fool to ignore this feedback. You could continue to pursue the goal of helping people, but change it to help people by fighting the viruses that ail them.

Employing redundancy

Efficiency entails using the minimum resources to maximum effect; redundancy involves over-determining the outcome. The problem with efficiency is that if any link in the efficient chain breaks, the chain fails and the goal falls to its doom. Redundancy is the opposite of efficiency. It entails intentionally using more than the minimum resources necessary to achieve an effect, which helps to guarantee that you will achieve the desired outcome.

A break in a link may cost you one chain, but if you have multiple chains, it doesn't matter. In fact you shouldn't have just chains, but ropes, cables, and straps, because the type of problem that can break one chain could break all chains. It is, however, less likely to break things of different natures. Call this *heterogeneous redundancy,* which is to generate different kinds of causes that will all lead to the same results. If you're a general, you should be able to supply your troops by land, sea, and air so that if the land route is cut, you can still feed them, which, as the Prussian general von Clausewitz recommended in *On War,* should happen "almost every day."

Engaging in *K*-selection

Think of a mosquito. It uses an evolutionary reproductive strategy called *r*-selection. With *r*-selection an animal creates as many offspring as it can, invests little in each, and plays the odds. Some, at least, are going to make it. The opposite of *r*-selection is *K*-selection, in

which an animal has few offspring and invests a lot in each. Picture an orangutan.

Legendary stock investor and billionaire Warren Buffett follows a *K*-selection strategy. Buffett has said that investing well isn't a matter of how big your circle of competence is, but of how clear you are on the boundary of that circle. Buy a stock when you are sure it will increase in value. Otherwise, be patient. It's not about smarts, but discipline. You could become rich if you were allowed to make only twenty stock purchases in your entire life, according to Buffett, because such a constraint would force you to choose carefully, an approach that Buffett has labeled *strategic inaction.*

Ted Williams, the last baseball player to bat over .400, was also a *K*-strategist. He calculated that there were seventy-two different paths along which a ball could pass through his strike zone. He reckoned that he could hit five of them—and he swung at *only* those five. Deciding what *not* to do is crucial. Drucker recommended that you should not only set your priorities, you should also set your posteriorities, or that which you will *not* do. Management consultant Tom Peters has called this having not just a to-do list, but also a to-don't list.

The strategy of *K*-selection is akin to that of the Prussian king Frederick the Great's observation that "Those generals who have but little experience attempt to protect every point, while those who are better acquainted with their profession, having only the capital object in view, guard against a decisive blow, and acquiesce in smaller misfortunes to avoid greater." You allow many opportunities to slip past, but you seize the few

that matter. The trick is to err well within your circle of competence. This forces clarity of purpose on your actions and helps to guarantee that you do not waste resources.

Acquiring foreknowledge

One way to increase your efficacy is to know the outcome before you attempt a task. But how do you obtain such foreknowledge? One way is to choose which side you will err on. Suppose it usually takes you half an hour to get to work, but one day you have an important meeting scheduled early in the day. So you leave for work an hour and a half early. By guaranteeing that you arrive too early, you have foreknowledge that you'll be at the meeting on time.

Another avenue to foreknowledge is to choose *before* a situation arises how you will handle it. You can see this with a thought experiment: no matter what happens at work today, make certain you leave by five o'clock. By committing to do this, you have accurately predicted the future. The more general point is that as you increase your ability to choose your reactions to various situations or stimuli, you gain knowledge of the future. By deciding beforehand what is on both your to-do list and your to-don't list, you know something about the future—namely that you won't be swinging at the sixty-seven pitches that even Ted Williams couldn't hit.

Foreknowledge is an effective tactic because it changes the nature of the task. It decreases the demands on you in the particular moment. Having already decided what to do, you no longer have to think about it and thus can put your attention elsewhere, such as on executing the

task, rather than dividing your attention between deciding and executing. The key to martial arts sparring is to realize that when you attack, your opponent will freeze, attack, or retreat. If he freezes, you punch. If he attacks, you block and jab. If he retreats, you lunge and jab. Then practice each of these moves a thousand times, so that when you face an opponent, you don't have to think about what to do. Then do the same with kicks, elbow strikes, and all other attacks. Eventually, you will map the entire space of everything that could happen, and you will have practiced every inch of it—that is, you will have developed foreknowledge—so that no matter what your opponent does, you can respond at the speed of thought.

The power of foreknowledge is why it is the central focus of *The Art of War* and why Sun Tzu emphasized that "The victorious first win and then engage the battle. Losers engage the battle and then seek to win."

Calculating comparative advantage

Opportunity cost is the next best alternative you could have had with your time or money. It is that which you give up by choosing what you chose. The opportunity cost of going to school is the money you could have made while you were in school (a sum usually surpassed within a few years of completing school). *Absolute advantage* comes from being better at doing something than someone else. If you were a virologist, then you might be faster at setting up lab equipment than your research assistant. *Comparative advantage* combines opportunity cost and absolute advantage. Even though you are faster at setting up lab equipment, you should

still have your research assistant set it up, because if you set it up, then you are not spending the same time performing the analysis, which only you can perform and which adds more value.

Trading problems

Bridge the gap between your circle of competence and the demands of the world by trading problems with people who have the skills to solve the problems you can't. It would be easy to underestimate how useful this approach is, but Robert Kelly's research in *How to Be a Star at Work* found it to be the single most decisive factor in separating the best from the rest. You help others with their problems and they help you with yours. Suppose you did become a virologist. Using this tactic, you would go out of your way to help colleagues with their work, such as researching the virological causes of cancer. Then, when you became stuck on a problem—for example, trying to assess if viruses progress differently in children than in adults—you could ask for help from the people you'd helped. Because you'd helped them, they'd be more likely to help you.

Applying what you know

Make your circle of competence speak to the problem. This is akin to how people use myths. Historian of religions Jonathan Z. Smith drew on anthropologist Victor Turner's work in divination to explain how myths are similar to wine. People can make wine from nearly any fruit but typically make wine only from grapes. Yet from that initial reduction in choices (from any fruit to just grapes), there then follows a great expansion in

that there are thousands of different kinds of wines, all made from grapes. From "an almost limitless horizon of possibilities that are at hand," said Smith, the field of possible cultural meanings is reduced to the fixed set of meanings that are contained in the myth. In other words, myths are often a small number of stories that people tell again and again.

"Then," Smith elaborated, "the most intense ingenuity is exercised to overcome the reduction" when people apply these cultural meanings to deal with a problem. That is, even though there are a small number of stories in the myth, people make these stories speak to an ever-increasing number of different circumstances. People apply ancient sutras to decisions on biotechnology; they ask the Bible to speak to issues of nuclear proliferation. In other words, your circle of competence may be quite small, but by exercising it creatively, you can apply it to many problems.

Summary

The efficient cause is concerned with taking action to get results, particularly in a complex and dynamic world such as ours. Think again of Nurse Bryan. Patients on her floor did better and recovered faster than patients on other floors; that is, she got results. Nurse Bryan mastered the efficient cause of patient care. Effective action in a complex world requires considered action—knowing when and how to take action and when not to. But on what do you base your actions? The material cause addresses the issue of your most important resources.

III

Your Resources

MATERIAL CAUSE

The exercise of the virtues is itself a crucial component of the good life.

—ALASDAIR MACINTYRE

Material cause involves what you have to work with—your resources. Perhaps you command legions or can throw millions of dollars at a problem. Perhaps not. Whatever other resources you may have (or may lack), you unquestionably have a mind. Indeed, if you have read this far, then you have the capacity to acquire enough material cause to make a lasting contribution, so I'll focus on you and what you can do with your mind. In their book, *Why We Want You to be Rich,* Donald Trump and Robert Kiyosaki hold a similar view of mind-as-resource. They noted, "Putting...ideas into action will require resources. So we're back to your...intelligence, also known as your...skills."

In the previous chapter I wrote that to make a lasting contribution is difficult, because the world is an open dynamic system. You can overcome this difficulty because your mind is also an open dynamic system. You can interact with the world and become more sophisticated in your thoughts and actions. In this sense, your

most valuable resource is captured with the Greek word *aretê* [ar-uh-tay] (αρετή), from Greek, meaning *virtue* or *excellence.* The more *aretê* you have to work with, the more you can achieve. There are three aspects of *aretê* that are particularly helpful in striving to make a lasting contribution—perception, expertise, and mastery.

Perception

People do not perceive primarily with their senses, but with their minds. Psychologist Egon Brunswik and others have shown that people often don't see a thing unless they have some idea of what they are looking for. The reason for this may be biological. In *On Intelligence,* Jeff Hawkins and Sandra Blakeslee wrote that "for every fiber feeding information forward into the neocortex, there are ten fibers feeding information back toward the senses." Where most people see an undifferentiated mass of green leaves, a bird watcher spots a toucan, three species of parrots, and a hummingbird. Since I've been trained in statistics, I see the familiar bell-shaped curve when I look at skid marks on runways, smudges on doors, and wear patterns in carpets.

The need to cultivate your perception is even more important when it comes to seeing abstract ideas. I think this may have been what the *New York Sun* had in mind in 1897 when the paper's editors responded to young Virginia's question as to whether there really is a Santa Claus:

> The most real things in the world are those that neither children nor men can see.... Nobody can con-

ceive or imagine all the wonders there are unseen and unseeable in the world.

You tear apart the baby's rattle and see what makes the noise inside, but there is a veil covering the unseen world which not the strongest men, nor even the united strength of all the strongest men that ever lived could tear apart. Only faith, poetry, love, romance can push aside that curtain and view and picture the supernal beauty and glory beyond. Is it all real?.... [I]n all this world there is nothing else real and abiding.

This makes me wonder what I don't see because I lack the words, such as the following example of a concept from Christopher Moore's book *In Other Words*:

From Hungarian: *egyszer volt budán ktyavásár* [egd-zair volt bood-an koocha-vah-sha] (idiom) An enigmatic Hungarian idiom that literally translates as 'there was a dog-market in Buda only once.' The meaning in English is close to 'a favorable opportunity that only happens once.' It is something to be grasped with two hands, otherwise you will find yourself regretting it at a later date.

Nor must you leave English to find concepts that, once learned, help you to see through the glass less darkly. Anthropologist Alexander Goldenweiser gives an example with the word *involution.* Involution happens when a system has developed to a point when it should move to the next stage, but fails to and so grows inward, becoming ever more complex. Late Gothic art,

with its ornateness, is one example. Or, compare Bach's complexity with Beethoven's expansiveness. I think of involution when I see the wild tricks city kids do on skateboards and bicycles—Misty Flips, nose pokes, tail whips, and X-Ups. Would they perform such tricks if they had broad open spaces in which to skate and ride?

You can cultivate your ability to perceive through practice. Ray Bradbury contended:

> I believe that eventually quantity will make for quality.
>
> How so?
>
> Michelangelo's, da Vinci's, Tintoretto's billion sketches, the quantitative, prepared them for the qualitative, single sketches further down the line, single portraits, single landscapes of incredible control and beauty.
>
> A great surgeon dissects and re-dissects a thousand, ten thousand bodies, tissues, organs, preparing thus by quantity the time when quality will count—with a living creature under his knife.
>
> An athlete may run ten thousand miles in order to prepare for one hundred yards.
>
> Quantity gives experience. From experience alone can quality come.

Because conception leads perception, you have to cultivate your inner eye. In this sense, beauty is not the only intangible that is in the eye of the beholder. You must look with your eyes, but see with your mind. Listen with your ears, but hear with your heart. When you do, you will see into the world more deeply:

- Before you've ever thrown a punch, an expert martial artist can tell by your stance whether you have been trained.
- An owl's nest, if read properly, speaks to the health of a forest.
- That cloud means rain.
- Comparing their sales to their profits, I'd say that their stock is about to crash.

Your powers of perception will allow you to see and seize opportunities that others miss. Hotel magnate Kemmons Wilson capitalized on the knowledge that "Opportunity comes often. It knocks as often as you have an ear trained to hear it, an eye trained to see it, a hand trained to grasp it, and a head trained to use it."

Expertise

When scientists began to study expertise, they first assumed that experts must be smarter or more talented than novices, but they quickly learned that the key difference between experts and novices is not mental power, but knowledge. Cognitive psychologists Michelene Chi, Marshall Farr, and Robert Glaser have defined an expert as somebody who has a great deal of highly organized domain-specific knowledge, where a domain is a network of knowledge, such as chess, mathematics, or music. For experts, knowledge has morphed from many pieces into a unified whole. An expert can start with any piece of knowledge and explain how it fits with every other piece. I always picture the way Sherlock Holmes could start with a soil stain and, through a chain of reasoning, solve the case.

Understanding other people's expertise can help you

develop your own. Surprisingly, experts make mistakes, but experts catch and correct their mistakes faster than do novices. Experts take a long time to make sure they understand a problem. If you give an expert and a novice the same problem, the novice will immediately begin to try to solve it. The expert will reflect on the nature of the problem. From the outside, it will appear as if the expert is doing nothing and the novice is making progress. Once the expert understands the problem, she can solve it better and faster than can the novice.

Understanding expertise also helps you see where intuition comes in: it comes last. Experts do use intuition to solve problems, but it is a cultivated intuition resulting from at least 20,000 hours of on-task study. Intuition works as a guide only after experts have saturated themselves with their field's knowledge. Herbert Simon described expertise as follows:

> Counts have been made of the number of "friends" that chess masters have: the numbers of different configurations of pieces on a chessboard that are old familiar acquaintances to them. The estimates come out, as an order of magnitude, around fifty thousand, roughly comparable to vocabulary estimates for native speakers. Intuition is the ability to recognize a friend and to retrieve from memory all the things you've learned about the friend in the years you've known him. And of course if you know a lot about the friend, you'll be able to make good judgments about him. Should you lend him money or not? Will you get it back if you do? If you know the friend well, you can say "yes" or "no" intuitively.

Nobel laureate Luis "Luie" Alvarez provides an example of how to learn the language of a domain. Alvarez and his son, Walter, were the first scientists to suggest that an asteroid killed the dinosaurs. The clue was a dusting of iridium, an isotope that is rare on earth but common in asteroids. As soon as Alvarez saw it, he knew it was significant; but *how* did he know? Alvarez's biographer Richard Rhodes wrote that for years, Alvarez ran the only cyclotron in the world: "On a wall in the laboratory the young physicists put up a big board laid out with the periodic table, with hooks projecting from the boxes designating elements, and each time someone identified a new isotope, Luie labeled a wooden tag with the isotope's characteristics and hung the tag from the appropriate hook. That's how he got to know isotopes so well. The knowledge he derived from those hard early years of work stayed with him like a vocabulary for the rest of his life." In short, you are an expert in your field when you know its vocabulary and grammar as well as you know that of your native language.

Mastery

I think of mastery in the way Japanese think of *sasuga* [sa-sü-ga] (流石), the idea that if you are a master of one thing, then you are a master of all things. This idea has ancient roots, beginning in China in the sixth century with the *Chan** practice of seeking enlightenment by pondering *koans* [ko-an] (公案). A *koan* is the Japanese word for the Chinese *gong-an* [gäng-an], or *case,* as in *a legal case* or *precedent.* Buddhist scholar D. T. Suzuki's

*The word *Chan* (禪) comes from the Sanskrit *dhyana,* but is better known in the West by the Japanese word *Zen.*

famous example of a *koan* is, "What is the sound of one hand clapping?" To understand it, Suzuki wrote, you should "Devote yourself to it day and night, whether sitting or lying, whether walking or standing; devote yourselves to its solution during the entire course of the [day]. Even when dressing or taking meals, or attending to your natural wants, you have your every thought fixed on the *koan*. Make resolute efforts to keep it always before your mind."

The value of such an intense focus is that it allows you to master something, even if what you master is infinitesimal. The understanding of mastery can then act as a guide to tackling new tasks. For example, any child can finger paint. To paint well, however, you must learn the rules of the craft, and eventually get those rules down to a science. Japanese students of painting did not begin by trying to paint something as complex as a bamboo shoot. Instead, they began by mastering a very small technique, such as painting a straight line. Zen scholars Omori Sogen and Terayama Katsujo wrote, "The basis of Oriental calligraphy and painting is the line. Traditionally, students of both disciplines were instructed to spend a minimum of three years concentrating on the brushing of straight lines."

Of course, just learning the rules won't make you a true master. Painting by numbers can only take you so far. To paint a beautiful line, you have to know how to break the rules; you have to learn how to get the rules down to an art. Still, even the artful breaking of a few rules, however, does not a true master make. You can only paint an exquisite line when you achieve *muga*