Seeing What Others Don't

The Remarkable Ways We Gain Insights

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"No one has taught me more about the complexities and mysteries of human decision-making than Gary Klein."
—MALCOLM GLADWELL

GARY KLEIN

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THE REMARKABLE WAYS WE GAIN INSIGHTS

GARY KLEIN

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ENTERING THROUGH THE GATES OF INSIGHT

How Do Insights Get Triggered?

CHAPTER ONE

Hunting for Insights

THIS WASN'T SUPPOSED TO BE A MYSTERY STORY. It started out innocently as a collection of clippings from newspapers and magazines. I would come across an article describing how someone made an unusual discovery, and I'd add it to a stack on my desk. The stack included notes describing stories I'd heard during interviews or in conversations. Like other enthusiasms, the stack sometimes got covered up in the competition for space. But unlike the rest, this stack survived. Whenever it got completely buried, it recovered each time I found another article and searched for a place to put it. This pile of clippings endured the occasional bursts of house cleaning that sent many of its neighbors into the purgatory of my file cabinets, if not the trash basket. I'm not sure why it survived. I didn't have any grand plans for it. I just liked adding new material to it. And I liked sifting through it every few months, savoring the stories.

Here's an example of the type of incident that made its way into my stack. Two cops were stuck in traffic, but they didn't feel impatient. They were on a routine patrol, and not much was going on that morning. The older cop was driving. He's the one who told me the story, proud of his partner. As they waited

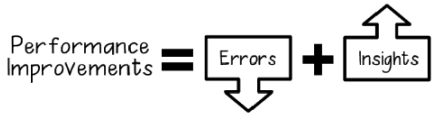
for the light to change, the younger cop glanced at the fancy new BMW in front of them. The driver took a long drag on his cigarette, took it out of his mouth, and flicked the ashes onto the upholstery.

"Did you see that? He just ashed his car," the younger cop exclaimed. He couldn't believe it. "That's a new car and he just ashed his cigarette in that car." That was his insight. Who would ash his cigarette in a brand new car? Not the owner of the car. Not a friend who borrowed the car. Possibly a guy who had just stolen the car. As the older cop described it, "We lit him up. Wham! We're in pursuit, stolen car. Beautiful observation. Genius. I wanted to hug him it was so smart."

I like this kind of story that shows people being clever, noticing things that aren't obvious to others. They're a refreshing antidote to all the depressing tales in the popular press about how irrational and biased we can be. It feels good to document times when people like the young police officer make astute observations.

What changed the fate of this stack of discoveries was that I couldn't answer an important question. I am a cognitive psychologist and have spent my career observing the way people make decisions. Different types of groups invite me to give talks about my work. In 2005, I learned about a movement called "positive psychology," which was started by Martin Seligman, a psychotherapist who concluded that his profession was out of balance. Therapists tried to make disturbed and tormented people less miserable. However, eliminating their misery just left them at zero. What about the positive side of their experience? Seligman was looking for ways to add meaning and pleasure to the lives of his clients.

I felt that the concept of positive psychology applied to decision making as well. Decision researchers were trying to reduce errors, which is important, but we also needed to help people gain expertise and make insightful decisions. Starting in 2005, I added a slide to my presentations showing two arrows to illustrate what I meant. Here is an updated version of that slide:



To improve performance, we need to do two things. The down arrow is what we have to reduce, errors. The up arrow is what we have to increase, insights. Performance improvement depends on doing both of these things.

We tend to look for ways to eliminate errors. That's the down arrow. But if we eliminate all errors we haven't created any insights. Eliminating errors won't help us catch a car thief who chooses the wrong moment to flick his ashes.

Ideally, reducing mistakes would at least help us gain insights but I don't believe that's how it works. I suspect the relation between the arrows runs the other way. When we put too much energy into eliminating mistakes, we're less likely to gain insights. Having insights is a different matter from preventing mistakes.

When I showed this slide in my seminars, I got a lot of head nods. The participants agreed that their organizations were all about the down arrow. They felt frustrated by organizations that stifled their attempts to do a good job. Their organizations hammered home the message of reducing mistakes, perhaps because it is easier for managers to cut down on mistakes than to encourage insights. Mistakes are visible, costly, and embarrassing.

However, I also started getting a question: "How can we boost the up arrow?" The audiences wanted to know how they could increase insights. And that was the question I couldn't answer. How to boost insights? I had to admit that I didn't know anything about insights. This admission usually drew a sympathetic laugh. It also drew requests to come back if I ever learned anything useful about insights.

After one such seminar in Singapore, I had a long flight back to the United States to reflect on the up arrow. I wished I could help all the people who wanted to restore a balance between the two arrows in the equation. And then I remembered my stack of clippings that was waiting for me back home.

So in September 2009, I started my own investigation of insight. I began collecting more examples. I was just poking around, nothing serious.

I wanted to explore how people come up with unexpected insights in their daily work. Most studies on insight take place in laboratory settings using college undergraduates trying to solve artificial puzzles. I wondered if I could learn anything useful by studying the way people form insights in natural settings.

I didn't anticipate that this project was going to dominate my attention for the next few years. I didn't foresee that I was going to get drawn into a mystery.

Actually, I got drawn into two mysteries. The first was, What sparks an insight? What happens that lets us make sense of a jumble of unconnected and sometimes contradictory facts, events, and impressions?

Once I got going on that one, a second mystery arose (covered in Part II): What prevents us from grasping an insight? Even when it sits dangling in front of our eyes, ripe for the plucking? Even when others brighten at what they have unexpectedly uncovered?

As I tried to sort that mystery out, I began wrestling with a third issue, more of a challenge than a mystery: Are there any practical ways to increase the flow of insights? That's what my audiences wanted to know, and we'll come to it in Part III. But I'm jumping ahead. At the start, I just wanted to get a better sense of what happens when people have insights. Here are a few of the stories from my collection.

LIGHTING UP LIFE

Martin Chalfie is a soft-spoken man with a relaxed way of describing complicated topics. He is a professor in the Biological Sciences Department at Columbia University, conducting research on the nervous system of worms. One day, almost twenty-five years ago, he walked into a casual lunchtime seminar in his department at Columbia to hear a lecture outside his field of research. An hour later he walked out with what turned out to be a million-dollar idea for a natural flashlight that would let him look inside living organisms to watch their biological processes in action. Chalfie's insight was akin to the invention of the microscope, enabling re-

searchers to see what had previously been invisible. In 2008, he received a Nobel Prize in Chemistry for his work.

You can tell that he's still a bit surprised at the way things worked out for him. He majored in biochemistry at Harvard, but after a disastrous summer laboratory experience at the end of his junior year, he soured on the notion of becoming a researcher. He finished the requirements for his major in his senior year but mostly took courses in law, theater, and Russian literature. He didn't know what he was going to do after college. After graduating in 1969, he worked selling dresses in his parents' dress manufacturing business and also taught at a day school in Connecticut. But when one of his old laboratory projects turned into a publication, he gained the confidence to apply to graduate school at Harvard, and he completed his PhD in 1977.

When the Nobel Prize Committee called him in October 2008, he was sleeping and never heard the phone ring. Later, when he finally woke up, he knew that the prize was to be awarded that day, and in the absence of any notification, he assumed someone else had won. He said to himself, "Okay, who's the schnook that got the Prize this time?" He opened his laptop, went to the Nobel Prize site, and discovered that he was the schnook.

Something happened to him during the hour he spent at the seminar that started his path to the Nobel Prize. Chalfie was studying the nervous system of worms. The type of worms he investigated just happened to have translucent skin, an incidental feature that had played no part in his project up to that point. To study the neurons of worms, Chalfie's assistants had to kill the worms in order to examine their tissues. Chalfie hadn't given the methodology for running these experiments much thought because it was the standard way for researchers like him to do their work.

The speaker at the April 25, 1989, lunchtime talk, one of the regular Tuesday seminars arranged by his department, covered a range of issues that didn't particularly interest Chalfie. Then, in the middle of the talk, the speaker described how jellyfish can produce visible light and are capable of bioluminescence. In 1962, a Japanese scientist discovered the protein

that fluoresces to produce a green light in the jellyfish. When ultraviolet light is shined on the protein, it reacts by emitting green light.

That was Chalfie's eureka moment. Suddenly, he understood that if he inserted the green fluorescent protein (GFP) into his transparent worms, he could shine ultraviolet light on it and see where the protein was spreading. He could track the cells into which he placed the GFP. He thought, "I work on this transparent animal, this is going to be terrific! I'll be able to see the cells within the living animal."

Chalfie doesn't remember much about the rest of the lecture because he was so busy making notes about how he could use this GFP as a biological flashlight.

Today, these biological flashlights are a workhorse of molecular biology and a multimillion-dollar industry. Other researchers cloned the GFP so that technicians don't have to chop up lots of jellyfish to extract it. The GFP now comes in additional colors, such as blue, cyan, and red. The GFP is easily inserted into a variety of organisms, not just jellyfish and worms, and it has been put to all kinds of uses. When scientists add the GFP to a virus that is injected into mice, they can watch the virus spread and interact with the immune system. Cancer researchers have inserted the GFP into viruses that grow inside prostate cancer cells, making the physiology of these cells visible. The GFP can be added to a molecule that binds to nerve cells so that surgeons can illuminate nerve fibers that they might otherwise have cut by mistake.

The protein has other important uses. One is detecting pollution. When inserted into a bacterium, the GFP glows brighter as pollution levels increase. Another use is for agriculture. Farmers no longer have to spray an entire field. Instead, they can track which plants the insects are attacking and spray only that part of the field. Some technologists have wondered if it is practical to grow bioluminescent trees that could replace streetlights, thereby reducing shadows and cutting energy costs. There was a puppy named Ruppy (short for Ruby Puppy). She was a cloned beagle, the world's first transgenic dog, and she glowed ruby-red when the protein was activated.

Chalfie's insight about luminescence shows some classical features of the way ideas fit together to form insights. His discovery came without warning. It was emotional, a sudden jolt of excitement. It emerged from a combination of ideas—the transparent worms and the protein that emitted green light. His insight transformed his direction. Before Chalfie walked into the seminar, his investigation of the worm neurons was central to his work and the methods were the background. When he walked out of the seminar, his ideas for a new method took center stage.

No one else in the lunchtime audience had this insight because only Chalfie was studying a transparent animal. And the insight was an act of creation that resulted in something new—Chalfie could use the green fluorescent protein to watch the workings of neurons in a living organism.

If we had an insight Geiger counter, these cues would set it off: a sudden discovery, a jolt of excitement, a combination of ideas that fit tightly together, a feeling of confidence in the new direction. And no one else has the insight, despite receiving the same information. These cues tell us that an insight has just appeared. They are like the green light that Chalfie used to trace living processes.

SPOTTING A MASTER SWINDLER

Bernie Madoff ran the largest Ponzi scheme in history before being arrested in 2008. But a side story described an obscure financial analyst, Harry Markopolos, who way back in 1999 became convinced that Madoff was dishonest. For the next decade, Markopolos set off on Madoff's trail like Inspector Javert in *Les Misérables* trying to bring Jean Valjean to justice, except in this case, Madoff was guilty of more than stealing a 40-sou coin from a young chimney sweep. Like Javert, Markopolos was dogged in his pursuit of Madoff, offended by the thought that a lawbreaker should walk free.

Markopolos notified the Securities and Exchange Commission (SEC) about Madoff in 2000, and his warnings continued until 2008 when Madoff turned himself in. Markopolos got the brush-off each time. The SEC

kept treating him as a crank because Madoff was highly respected, a former NASDAQ chairman and well-connected philanthropist. Madoff had sat on the Board of Directors of the Securities Industry Association. No one had heard of Markopolos, who was rumpled where Madoff was smooth, excitable where Madoff was calm. Markopolos himself admits that he is a bit eccentric—for example, naming his twin sons Harry Louie and Louie Harry. More seriously, you have to be a bit nuts to embark on a prolonged investigation the way Markopolos did.

Markopolos's credibility wasn't helped by the fact that he was a competitor of Madoff's in the financial services industry. In addition, he hinted to the SEC about getting a reward. The Securities and Exchange Commission had reasons to be suspicious of Markopolos's accusations.

Markopolos has his own explanations for the brush-off. The SEC bureaucracy isn't well designed to catch frauds of this magnitude, and the SEC staff members don't have the skills to pursue a complicated fraud. Markopolos also believes that government agencies such as the SEC are more interested in protecting Wall Street than in investigating it.

In Part II, we'll explore the reasons that organizations such as the SEC stifle insights. My initial interest in Markopolos was that he recognized from the start that Madoff was dishonest. How did he do it?

In 1999, Markopolos was working at Rampart Investment Management Company in Boston. Frank Casey, one of Markopolos's colleagues, challenged him to match the outstanding results of Bernie Madoff's investment firm. Markopolos was skeptical that anyone could achieve such consistent rates of return, but he agreed to study Madoff's success. And there is another detail to this example: Markopolos was also a certified fraud examiner.

Initially, Markopolos was just curious about how Madoff was operating. "We weren't looking for a crime; we simply wanted to see how he made his numbers dance." He got hold of the publicly available data on Madoff's hedge fund and within minutes knew something was wrong. The numbers just didn't add up. Madoff was said to be using a conservative strategy that wasn't designed to yield consistent profits. Yet Madoff was claiming that his investments were profitable month after month. In

fact, Madoff reported losing money in only three months over a period of seven years.

In his book *No One Would Listen,* Markopolos describes his reaction when he first saw a sheet of Madoff's results:

> I glanced at the numbers . . . and I knew immediately that the numbers made no sense. I just knew it. I began shaking my head. I knew what a split-strike strategy was capable of producing,* but this particular one was so poorly designed and contained so many glaring errors that I didn't see how it could be functional, much less profitable. At the bottom of the page, a chart of Madoff's return stream rose steadily at a 45-degree angle, which simply doesn't exist in finance. Within minutes I told Frank, "There's no way this is real. This is bogus."

The odds were astronomical against Madoff reliably sustaining the rate of return he had claimed for so many years.

Markopolos didn't know how Madoff was cheating, although he suspected that Madoff was illegally misdating the times that he placed orders. The other explanation, that Madoff could be running a Ponzi scheme, seemed too far-fetched.

The Markopolos insight that Madoff had to be cheating was sudden, just like those of Chalfie and the young cop. Markopolos used his experience as a fraud investigator to spot telltale implications that others didn't pick up on. Implications that were striking to Markopolos, Chalfie, and the cop were invisible to people without their background and training.

Markopolos, Chalfie, and the young cop all transformed their thinking. After arriving at the insights, they held a different set of beliefs than the ones they had started with. In Markopolos's case, the insights contradicted

* A split-strike conversion strategy involves buying a basket of stocks as well as option contracts on them. For each stock the investor buys a "put" option to protect against the price falling too low and at the same time sells a "call" option to let someone else buy it if it rises above a given "strike" price. If the price rises, the investor makes a profit but only up to the strike price—the gain is capped. If the price falls far enough that it hits the put level, the investor has limited the loss.

his original beliefs. Before he looked at the numbers, Markopolos couldn't imagine that a man with such renown and celebrity as Madoff could engage in a crude swindle. After he looked at the numbers, Markopolos wondered how Madoff was pulling off his fraud.

Yet the stories of these three men differ in important ways. Chalfie noticed how different ideas fit together. Markopolos and the young cop each noticed that some data points did *not* fit together. Chalfie's insight was about how he could build on a combination of ideas. Markopolos and the cop had insights that certain beliefs were unlikely, if not impossible.

Right away, as I studied the incidents in my stack, I could see lots of differences among them and I doubted that I'd find a common script for how all of these insights worked. Here is a fourth incident.

STUMBLING ONTO A PLAGUE

Michael Gottlieb, MD, published the first announcement of the acquired immune deficiency syndrome (AIDS) epidemic. After receiving his medical degree, he did a fellowship at Stanford University on the immune system. In 1980, Gottlieb started out as an assistant professor at UCLA studying the effect of radiation on the immune system of mice. He didn't find this type of research very captivating and was on the lookout for patients with interesting conditions. In January 1981, a young resident told Gottlieb about an unusual case—a thirty-one-year-old man with a yeast infection in his throat. The severe infection made it difficult for the man to breathe. Gottlieb knew that this condition typically affected people who had defective immune systems, and accepted the patient.

Gottlieb tested a sample of the patient's blood. The results didn't make sense. Our immune systems contain different kinds of white blood cells. *Helper* cells activate the immune reaction by triggering disease-fighting cells and guiding the body to produce antibodies that destroy microbial invaders. *Suppressor* cells keep the immune system in check. We have more helper cells than suppressor cells, particularly when we get sick. But this patient was just the reverse. He had more suppressor cells than helper cells. In fact, the patient had hardly any helper cells. Whatever

was wrong with him, it was destroying only one type of white blood cell, his helper cells. Gottlieb couldn't find any way to explain these results.

When the patient developed a fever and pneumonia several days later, Gottlieb made arrangements to assay his lung tissue. The patient had *Pneumocystis* pneumonia, a disease caused by a fungus that attacks the fibrous lining of the lungs and interferes with the transport of oxygen into the blood. This yeastlike fungus is sometimes found in the lungs of healthy people. However, it rarely gets out of control unless something goes wrong with a person's immune system. *Pneumocystis* pneumonia affects cancer patients, people receiving organ or bone marrow transplants that require drugs to suppress their immune systems, premature infants, and the elderly. Healthy young adults don't get it. So Gottlieb had another piece of evidence that this patient had something wrong with his immune system.

Gottlieb remembered other things about his patient. The attractive young man was a model who'd even had cheekbone implants. Gottlieb's patient had moved to Los Angeles to live a gay lifestyle. Gottlieb overheard a telephone call in which the patient confided in a friend, "These doctors tell me that I am one sick queen." Such candor, while common today, was unsettling thirty years ago. Like most people, Gottlieb wasn't used to it.

A few months later, Gottlieb examined two others in the Los Angeles area with some of the same symptoms. Both also came down with *Pneumocystis* pneumonia. Gottlieb saw the similarity to his earlier patient and noticed a coincidence: these two men were also gay.

By April, Gottlieb had his fourth and fifth *Pneumocystis* pneumonia patients, with all the typical symptoms: swollen lymph nodes, fever, weight loss, and a nasty case of yeastlike fungal infection. Like the others, these men were gay.

To get the word out quickly, Gottlieb and his colleagues published their findings in the *Morbidity and Mortality Weekly Report,* issued by the Centers for Disease Control. That paper was the first public announcement of the beginning of an epidemic that came to be called "AIDS." Gottlieb's paper, "*Pneumocystis* Pneumonia—Los Angeles," appeared on June 5, 1981.

Gottlieb's insight centered on a frightening pattern. He didn't know what caused this coincidence—his insight didn't extend that far. He just knew that the cluster of cases seemed ominous. In December, Gottlieb had no inkling of the onrushing AIDS epidemic. By May, he was sounding the alarm. His belief system had been profoundly transformed. So had his medical practice; he began specializing in working with AIDS patients. Years later Gottlieb was Rock Hudson's physician when the actor was first diagnosed with AIDS. Hudson, a six-foot, five-inch romantic actor, had often been voted the favorite leading man by film magazines. He was the first major celebrity to die from AIDS, giving the disease a face that the public could recognize.

Gottlieb built his career around his discovery of AIDS. He published more than fifty papers on AIDS in the mid-1980s and was an investigator on the early clinical trials of the HIV-suppression drug AZT. He was one of the founding chairs of the American Foundation of AIDS Research, a charity established through a $250,000 gift from Rock Hudson's estate. Later, Gottlieb's celebrity status was tarnished when the Medical Board of California reprimanded him and two other physicians for overprescribing painkillers for Elizabeth Taylor, another founder of the charity.

Unlike the first three examples, Gottlieb's insight transformation wasn't sudden. It grew from case to case. What began as a curiosity in January turned into a suspicion in February when Gottlieb saw the second and third AIDS patients, then transformed into a pattern with the fourth and fifth patients. Gottlieb's insight was to see the pattern, as opposed to Chalfie, who spotted an opportunity to combine seemingly unrelated ideas, and Markopolos and the young cop, who both homed in on an inconsistency.

GETTING MY CAR FIXED

Insights aren't reserved for people who win Nobel Prizes, sound the alarm about master criminals, or unravel the mystery of new epidemics. People have insights all the time. Sometimes we notice them, as in the story about the young cop who spotted a car thief. Usually, they're so trivial we don't

pay much attention to them unless we're collecting them as a hobby. For example, I was once scheduled to drop off my car for service on a Monday, but that afternoon my mechanic, Don Friessen, telephoned that he was backed up and wouldn't be able to work on it until Wednesday. Unfortunately, it was the Wednesday before Thanksgiving and my wife Helen and I were driving her car out of town that morning. I didn't want to leave my car at Don's repair shop all weekend because then my house might look deserted with no cars in the driveway, possibly attracting the wrong kind of attention.

I told Don that when he finished working on my car, I'd like him to bring it back to my home, a five-minute drive from his shop. I have been going to him for several decades, so he readily agreed even though it would mean more work for him—arranging for someone to drive down separately and pick him up once he dropped off my car.

Then a few hours later, while Helen and I were at a restaurant, I realized there was a better solution. I could just drop off a spare key with Don. When he was ready to work on my car, he'd drive his truck to my house, swap the truck for my car, and then reverse the process when he finished. That way we would have a truck or car in the driveway at all times and Don wouldn't have to make any special arrangements.

Unlike the Chalfie, Markopolos, and cop examples, my little insight came after a period of incubation. During dinner it just popped into my head without any new information. My routine with Don until that day was to bring my car to him. Helen would pick me up after I dropped off the car. Then when it was ready, Don would bring it to me and I'd run him back to his shop. I had never thought about the transaction any other way. I had never considered the advantage of turning a car drop-off into a key drop-off.

There was no great creativity involved in coming up with this solution. It's simply an illustration that everyday insights are much more common than we might think.

We all have a natural tendency to gain insights. We're on the lookout for patterns, as Gottlieb was, and see connections and associations that might be important, just as Chalfie did. We notice inconsistencies, like

the young cop and like Markopolos, getting suspicious when we spot irregularities that might be important. We get excited when we find better ways to do things, as I did with my car keys, or when we find new opportunities, like Chalfie. Many people spend time in activities like puzzles that call for insights because the act of struggling and then gaining understanding is so satisfying. We are built to seek insights.

But where do our insights come from? As I started collecting stories about insights, I didn't find any common strategy. I began my little project to survey some examples of insight in order to see what they had in common and to try to find some advice for pursuing the up arrow in the equation. However, as I compared the different stories, I got caught up in the mystery of what causes people to arrive at an insight in the first place. Each incident seemed different from the others. The stories of insights seemed to contain many clues, but I couldn't see how to make sense of them.

CHAPTER TWO

The Flash of Illumination

ALMOST A CENTURY AGO, GRAHAM WALLAS, a cofounder of the London School of Economics, published the first modern account of insight. His 1926 book, *The Art of Thought*, contains a model that is still the most common explanation of how insight works. If you do any exploration into the field of insight, you can't go far without bumping into Wallas, who is the epitome of a British freethinking intellectual.

In contrast to my struggles to make sense of the incidents in my collection, Wallas succeeded in finding clear themes in the collection of insight stories he compiled. Perhaps I could learn from his example. His insight model might even answer questions about how the up arrow works and how to boost insights. It was time for me to get a history lesson.

Wallas was born in 1858 in Monkwearmouth, Sunderland, in the northeast corner of England. His father, a minister, gave his son a standard religious upbringing, but Wallas abandoned his Christian faith as a student at Oxford University from 1877 to 1881. He replaced it with a new faith, socialism. He joined the Fabian Society in 1884, shortly after it was founded by Sidney and Beatrice Webb. Fabians wanted to transform society by gradual, rather than revolutionary, means. Members included Bertrand Russell, Leonard and Virginia Woolf, H. G. Wells, and other luminaries. The society was named after the Roman general

Fabius Maximus, nicknamed The Delayer, who avoided open battle with the Carthaginian leader Hannibal, relying instead on continual pressure.

The Fabian Society was an advocate for causes such as minimum wage, slum clearance, a universal health care system, and a national education system. Several members of the Fabian Society helped form the British Labour Party in 1900.

Wallas quickly moved into the inner circle of the Fabian Society and formed a close connection with the Webbs. When Sidney and Beatrice Webb established the London School of Economics in 1895, they asked Wallas to be its first director. He turned down the offer but agreed to teach at the college. In her diary, Beatrice Webb remembered Wallas as a tall but slouching man, with pleasant features, driven by moral fervor rather than ambition. Although Wallas seemed a bit preachy to Beatrice Webb, he had a genius for teaching and inspired his disciples.

Among his various identities, Wallas was a psychologist. He believed that psychology could be used to improve society, especially to reduce some of the stresses created by the Industrial Revolution. He disagreed with the theory that people behave rationally and base their behavior on calculating the costs and benefits of each possible course of action. Wallas argued that politicians who want to get people to behave sensibly will need to study psychology.

In *The Art of Thought,* Wallas tried to apply concepts of psychology to show people how to think more effectively. Some contemporaries of Wallas—William James and Henri Bergson—had also speculated about the nature of insight, but neither provided an account as comprehensive and compelling as the one Wallas produced. He drew on his forty years of experience as a teacher and administrator; accounts that poets, scientists, philosophers, and others had published on their thought processes; and examples from students and friends.

The most lasting contribution of *The Art of Thought* is contained in a chapter called "Stages of Control," in which Wallas presents a four-stage model of insight: preparation, incubation, illumination, and verification.

During the *preparation* stage we investigate a problem, applying ourselves to an analysis that is hard, conscious, systematic, but fruitless.

Then we shift to the *incubation* stage, in which we stop consciously thinking about the problem and let our unconscious mind take over. Wallas quoted the German physicist Hermann von Helmholtz, who in 1891 at the end of his career offered some reflections on how this incubation stage feels. After working hard on a project, Helmholtz explained that "happy ideas come unexpectedly without effort, like an inspiration. So far as I am concerned, they have never come to me when my mind was fatigued, or when I was at my working table. They came particularly readily during the slow ascent of wooded hills on a sunny day."

Wallas advised his readers to take this incubation stage seriously. We should seek out mental relaxation and stop thinking about the problem. We should avoid anything that might interfere with the free working of the unconscious mind, such as reading serious materials. Wallas quoted the poet John Drinkwater about the way insights come about:

Haunting the lucidities of life
That are my daily beauty, move a theme
Beating along my undiscovered mind.

Next comes the *illumination* stage, when insight bursts forth with conciseness, suddenness, and immediate certainty. Wallas believed that the insight, the "happy idea," was the culmination of a train of unconscious associations. These associations had to mature outside of conscious scrutiny until they were ready to surface.

Wallas claimed that people could sometimes sense that an insight was brewing in their minds. The insight starts to make its appearance in fringe consciousness, giving people an intimation that the flash of illumination is nearby. At this point the insight might drift away and not evolve into consciousness. Or it might get interrupted by an intrusion that causes it to miscarry. That's why if people feel this intimation arising while reading, they often stop and gaze out into space, waiting for the insight to appear.

Wallas warned of the danger of trying to put the insight into words too quickly, before it was fully formed.

Finally, during the *verification* stage we test whether the idea is valid. If the insight is about a topic such as mathematics, we may need to consciously work out the details during this final stage.

Wallas's four-stage model of insight is still the way most people explain how insight works. It's a very satisfying explanation that has a ring of plausibility—until we examine it more closely.

Wallas claimed that a preparation stage is necessary for insights to occur, but none of the five people discussed in Chapter One—the young cop, Martin Chalfie, Harry Markopolos, Michael Gottlieb, or I—spent any time preparing for an insight. Each insight came unexpectedly. Each was a surprise.

Now, in all five cases the protagonists drew on their background and expertise, but that isn't the same thing as deliberate preparation. The police officer had nothing to prepare as he sat in traffic. Chalfie would have had no reason to prepare for a biological marker. He wasn't looking to improve his methods. Likewise, Markopolos wasn't preparing to nail Bernie Madoff. He had to be goaded into examining Madoff's financial results. Gottlieb wasn't preparing to sound the alarm on the AIDS epidemic. No one knew about AIDS or anticipated how virulent it would be. And I wasn't preparing to reengineer my arrangement with my mechanic. The advice to begin by preparing wouldn't have helped any of us. We wouldn't have known what to prepare.

It is easy to confuse preparation with expertise. After we know what the insight is, we can see how the person gaining it acquired special kinds of knowledge. These previous interests and experiences prepared the person's mind to register the insight in ways that others missed. We can call this a *generally* prepared mind, a characteristic of Chalfie, Markopolos, and Gottlieb. None of the three would have gained his insight without years of special experience. A generally prepared mind is the same thing as having expertise. The young cop didn't have much experience, but he did have a mind-set to be alert for criminals. (And I didn't have any experience worth considering.)

Wallas, however, recommended that we have a *specifically* prepared mind by making deliberate preparations to solve a thorny problem. According to Wallas, when we're stuck and need to find an insight that will get us past an impasse, we should start with deliberate preparation. A few decades later this preparation activity was illustrated in one of the greatest achievements in science. James Watson and Francis Crick worked very hard to identify the structure of DNA (deoxyribonucleic acid) and eventually discovered that it was a double helix. If they hadn't gone through so much deliberate and specific preparation, they wouldn't have achieved their finding.

While the idea of deliberate preparation appeals to our work ethic—and is, of course, crucial for many types of work—it was not a factor in the insights attained by the cop, Chalfie, Markopolos, Gottlieb, or me. So I don't think deliberate preparation is necessary or even practical for many insights.

One flaw in Wallas's method is that his sample of cases was skewed. He only studied success stories. He didn't consider all the cases in which people prepared very hard but got nowhere. In the DNA example, researchers who were more respected at the time than Watson and Crick, such as Rosalind Franklin and Linus Pauling, were also working hard to discover the structure of DNA but didn't succeed. Deliberate and specific preparation doesn't guarantee success. Therefore, I didn't see how I could advise people to start with a preparation stage when so many insights are accidental and when specific preparation doesn't reliably lead to breakthroughs.

The incubation stage also doesn't fit most of the Chapter One examples. Gottlieb had time for his impressions to incubate between the different AIDS patients he examined. I had a few hours before having dinner with my wife and coming up with my car key scheme. None of the others had any time to incubate. The cop saw the driver ash his car and right away knew something was wrong. Chalfie heard about the green fluorescent protein and immediately saw the implications. Markopolos looked at the financial data and immediately sensed something was fishy.

Whereas preparation appeals to our work ethic, incubation appeals to our play ethic. It feels like a welcome time-out. Lots of people can recall insights that suddenly came to them while they were taking showers, but

I doubt that organizations could increase the rate of insights in their workers by having them double the number of showers they take. The incubation stage doesn't seem necessary and often would be impossible.

Then there's the third stage of Wallas's model, the flash of illumination. Yes, we all had it, although Gottlieb arrived at it more slowly as he spotted the similarities among his patients. How does this flash of illumination work? Wallas describes it as the result of a train of unconscious associations.

That explanation seems too magical to be satisfying. This was the process I wanted to examine further, the mystery I started pursuing. What happens during this third stage? If I were going to tell people more about the up arrow, I'd need a better account of the flash of illumination.

What was I trying to explain, the illumination or the flash? Perhaps the "aha" experience, when everything finally snaps into place, marks the culmination of the insight process. Perhaps it isn't the insight itself.

We can use an analogy here: "aha" is to insight as orgasms are to conception. In both cases the experience is more noticeable than the achievement, but the experience doesn't guarantee the achievement, and the achievement can happen without the experience.

So what mystery was I trying to solve? At times, I felt like a bull charging forward at a swirling cape, hoping to make contact with a shadowy matador.

Wallas's four-stage model of insight isn't a good fit with any of the five people in Chapter One. That doesn't mean the model is wrong. Some aspects of it may be useful, but which ones?

Most cognitive scientists talk about insight as moving from an impasse state to a solution state. We hit an impasse, struggle for a while, and then find a way to overcome our mental block. This view is pretty much the same as Wallas's first three stages. But I don't see impasses with the cop, Chalfie, or any of the other cases in Chapter One. No one was stuck while trying to solve a problem.

If I wanted to describe how the up arrow works, I'd need at least a vague definition, some criteria, for what counts as an insight. I'd need something better than getting past an impasse.

AN UNEXPECTED SHIFT TO A BETTER STORY

The five people in Chapter One were shifting to a better story about how things work. These weren't entertainment stories. They were stories about what causes things to happen. The stories described the causes for past and present events (the young cop, Markopolos, Gottlieb) or ways to cause future outcomes (Chalfie as well as my car keys). These shifts weren't about making minor adjustments or adding more details. The shifts changed some of the core beliefs the five people initially held. During this transition some initial beliefs were abandoned or replaced. The shifts were *discontinuous discoveries*—unexpected transitions from a mediocre story to a better one.

Sometimes the shift landed immediately on the better story, as in the cop, Chalfie, and car keys examples. Other times the shift was toward the better story, but took a while to get there. Harry Markopolos's insight put him on the road to finding a better story about how Bernie Madoff was cheating. Similarly, Michael Gottlieb's detection of an ominous pattern of symptoms put him and the medical community on the road to identifying a new disease, AIDS, and the virus that caused it. Insights shift us toward a new story, a new set of beliefs that are more accurate, more comprehensive, and more useful.

Our insights transform us in several ways. They change how we understand, act, see, feel, and desire. *They change how we understand.* They transform our thinking; our new story gives us a different viewpoint. *They change how we act.* In some cases insights transform our abilities as well as our understanding; the Chalfie and car keys examples show how insights change our notions of what we can do. These shifts went beyond a richer story about how the world works. The new story was about how to make it work better, by using the green fluorescent protein in Chalfie's case and by giving keys to a car mechanic in my own example. *Insights transform how we see;* we look for different things in keeping with our new story. Gottlieb examined his new patients differently once he picked up the AIDS pattern. *Insights transform how we feel*—what

excites us or makes us nervous. The two police officers got amped up when they suspected they'd found a car thief. Markopolos began with dread that Madoff was more skillful in financial investments than he was, then shifted to skepticism, and then to outrage that fueled his campaign to uncover Madoff's scam. Finally, *insights change our desires;* the new stories shift our goals, leading us to give up some ambitions and pursue others. Chalfie needed to find techniques for implanting the green fluorescent protein into the nerve cells of his worms. Markopolos needed to nail Bernie Madoff. Gottlieb needed to get to the bottom of a mysterious disease.

As a friend summarized all these transformations, "Insight is when it happens, everything that happens afterward is different." Hilary Mantel made the same observation in *Wolf Hall:* "Insight cannot be taken back. You cannot return to the moment you were in before."

So I had a working definition of insight—an unexpected shift to a better story—along with the ways insights transform us. I also had some ideas about what makes insights unique. Compared with routine problem solving, insights aren't conscious or deliberate. They come without warning. Our minds do their heavy lifting without our awareness. Watson and Crick labored to build a model of DNA, but the eventual insight—that it was a double helix—came as a surprise even to them.

Insights are unique in some other ways. When they do appear, they are coherent and unambiguous. They don't come as part of a set of possible answers. When we have the insight, we think, "Oh yes, that's it." We feel a sense of closure. This sense of closure produces a feeling of confidence in the insight. Wallas claimed that the flash of illumination results in a feeling of certainty. We aren't picking an idea that seems better than others. Instead, we're struck that this is the answer, the happy idea. We may even have an aesthetic reaction to the beauty of the insight. Watson and Crick felt that their double helix model was too beautiful not to be true. Chalfie may have had this experience when his new research agenda fell into place. Markopolos felt it when his puzzlement shifted into certainty that he had uncovered a clear case of fraud. Gottlieb

had a grim sense of satisfaction when the new cases conformed to the pattern he had identified. The older police officer wanted to hug his partner.

Now I was ready to pursue the mystery of what produces the flash of illumination. Yet the more I learned, the more complexity and confusion I experienced. I wasn't sure if I would come up with anything useful. I didn't have a sense that I was getting warmer.

A NATURALISTIC INVESTIGATION

When I started my investigation into the flash of illumination, I experienced all the usual doubts I have at the beginning of a project, plus some new ones. I hadn't done any previous research on insight or even played around with the traditional insight tasks that cognitive scientists have used for almost a century. These puzzle tasks don't seem to have any possible solution until you find a way out of the impasse.

But perhaps that could be an advantage. I wanted to explore how insights work in more natural settings. I could then examine the flash of illumination without getting trapped by all the constraints surrounding laboratory-based experiments. The puzzle tasks used in the laboratory held little interest for me.

Twenty-five years earlier I had the same feelings when I set out to examine the way people made decisions. I'd never done a decision making experiment or even taken a course in decision making. I was trying to solve a different mystery at that time: how people can make life-and-death decisions under extreme time pressure and uncertainty. Instead of working in a laboratory, I chose to study how people actually make these kinds of decisions. You can't study that in a laboratory.

I studied firefighters because they have to make good decisions in stressful situations. I didn't give the firefighters any standard decision tasks. Instead, my fellow researchers and I interviewed the firefighters about their toughest challenges. We collected their best stories, and we probed those stories to learn more about the firefighters' strategies.

What we found surprised us. Our results didn't fit any of the existing models of decision making. The firefighters weren't trying to compare options to select the best. They didn't have time. Instead, they relied on their experience, the patterns they had acquired over decades, to quickly size up situations and recognize the option most likely to work.

The firefighters made rapid decisions by recognizing how the situations they encountered fit the patterns they had learned. The pattern-matching part of their decisions was fast and automatic. It was how they used their intuition to quickly identify an option that was likely to succeed. Then they evaluated their intuitions, not by comparing the option they recognized with others, but by consciously and deliberately imagining how it would fare if they carried it out. The firefighters relied on this strategy to make more than 80 percent of their tough decisions.

Other researchers have replicated our findings and showed that different specialists, such as military commanders and oil-rig managers, also rely on what we called the recognition-primed decision strategy for about 90 percent of their challenging decisions. These efforts helped to start the field of naturalistic decision making, which studies the way people think in natural settings, rather than how they are forced to think in laboratory experiments using artificial tasks.

Studying how people think in natural settings unnerves many research psychologists. They question whether naturalistic studies are real science. For them, science depends on testing ideas under tightly controlled conditions. Naturalistic decision making researchers like me concentrate on the early stages of the scientific method to provide the ideas that can later get tested. We try to observe and understand phenomena such as how people make tough decisions and how they form insights.

Traditional decision researchers hadn't come up with the recognitional strategy because their laboratory work on decision making typically studied novices trying to perform unfamiliar tasks. Their theories of decision making didn't take expertise into account. Recognitional decisions depend on decades of experience to build up hundreds and thousands of patterns.

And now, déjà vu. Almost all the studies of insight were taking place in laboratories and using artificial tasks. These studies were aimed at formulating and testing hypotheses. I saw a parallel between the field of insight and the field of decision making twenty-five years earlier, giving me some hope that a naturalistic study of insight might succeed. I didn't have any idea of how insight works, so I wasn't ready to test hypotheses. And that was the point. I could perform a naturalistic study of insight—explore the way people actually form insights—and if I were lucky, I might find some useful ideas in my stack of stories.

The work with firefighters might suggest that insights are the same as intuitions, but they're actually very different. Firefighters build up patterns that they apply in making rapid decisions in emergencies. *Intuition* is the use of patterns they've already learned, whereas *insight* is the discovery of new patterns.

Although insight differs from intuition, the firefighter study influenced my thinking about insights twenty-five years later. Firefighters often changed their beliefs about a complex fire as they learned more details, usually adding those specific details into their story. The most dramatic scenarios, however, contained surprises that forced the firefighters to rethink what was going on and replace erroneous beliefs. The firefighters shifted the story they told themselves about what was happening inside the burning structures.

Stories are a way we frame and organize the details of a situation. There are other types of frames besides stories, such as maps and even organizational wiring diagrams that show where people stand in a hierarchy. My work centers on stories because they are common ways we frame the events in the situations we encounter. These kinds of stories organize all kinds of details about a situation and depend on a few core beliefs we can call "anchors," because they are fairly stable and anchor the way we interpret the other details. In some later research I found that most of these stories build on only three or four anchors.

The cop's anchors were the expensive car and the driver's indifference to its upkeep. Chalfie's anchors were the transparency of the worms, the

fact that the green fluorescent protein could be made to glow, and the belief that proteins like this could be implanted in neurons inside his worms. Markopolos's anchors were that investment funds that never lost money in the stock market were usually fraudulent, and that the method Madoff claimed to be using was too conservative to generate large profits. Gottlieb's anchors for the story he was forming were that he had encountered a disease that targeted gay men, that it devastated part of their immune systems, and that it left the victims vulnerable to all kinds of infections.

Anchors can change as a person gets more information. Chalfie's story got richer as he learned how to manufacture the green fluorescent protein and how to insert it into a variety of cells. Markopolos's story evolved as he learned more about the kinds of fraud Madoff was committing. Gottlieb came to learn that AIDS did not afflict only gay men.

Actually, I wasn't thinking of any of these ideas when I began investigating the flash of illumination. I wasn't thinking of firefighters or anchors or the ways we frame and organize events. It is only now, with hindsight, that I appreciate how my earlier studies enabled me to form a richer explanation of how insights work. At the time what the earlier projects with firefighters and others gave me was hope that I might be able to make a discovery here, even though I hadn't done any experiments with insight puzzle problems, or perhaps *because* I had not done any of these kinds of studies. I was ready to examine cases of actual insights, starting with the clippings in my stack.

ARCHAEOLOGICAL TRENCHES

When field archaeologists want to explore the structures inside an unnatural hill, they don't excavate the entire hill. That level of effort would be too costly and take too long. Instead, they dig a trench that gives them a snapshot of what's inside the hill. It helps them assess whether the site has walls or housing materials or any other significant structures. The archaeologists may judge that the hill is not worth further investigation, or they may decide that the site has enough potential for a fuller excavation.

My research plan was like an archaeological trench. I didn't conduct the kind of laboratory experiment that would constitute a traditional study of insights. Instead, I searched for insights of people who made an unexpected shift in their beliefs. I collected a set of incidents—120 examples, including the small number in my original stack. Once I had assembled them, I could review them to see if I could find any themes. With luck, somewhere in those stories I would run across some clues to what was behind the flash of illumination.

It took me more than half a year to compile my sample of 120 cases in my spare time. I didn't do much interviewing because I found so many examples in the media. I relied heavily on books, especially those describing innovations and discoveries. I also used newspaper and magazine articles. I drew on interviews I'd conducted over the previous thirty years and selected those in which people unexpectedly made radical shifts in their stories and beliefs about how things work.

The books on innovation yielded a harvest of examples from science, inventions, business, and management. I searched through transcripts of interviews I had conducted with military decision makers. Books and articles about financial investment in the wake of the 2007–2008 financial collapse yielded many more examples, as did stories about medical discoveries. I trolled for examples in my discussions with professional colleagues and even with family members. The 120 stories were the only data I had. I didn't anticipate where these stories would lead or how they might fuse to create their own story. That came later as I was finishing the project. Perhaps as you read the insight stories in these early chapters, you will form a better picture than I had.

My collection came together in a somewhat haphazard way. When I felt I could learn from an incident, I studied it further. Researchers in the future may come up with more systematic ways to assemble incidents, but at this point, doing an initial naturalistic study of insight, I just needed to gather observations. I needed to start digging.

Most of the 120 stories are about successes, the same criticism I made of Graham Wallas. An investigator can pull together a bunch of success

stories and conclude that a certain strategy, such as careful preparation, invariably results in insights. We won't see the failures, the cases in which preparation didn't pay off. To counter this weakness, late in my project I selected a small set of cases that each had a built-in control. These cases described not only the person who had the insight, but also another person who had access to the same data yet didn't achieve the insight. That's one of the criteria for insights: that others with the same information somehow miss the discovery. This control sample highlighted the strategies and traits that make a difference between success and failure. I'll describe this comparison later in the book in Part II.

As I assembled the 120 examples of insights, I summarized each one in a short account, three pages or less, sometimes only a half page. I divided each account into three sections: background on the incident, the critical events that led to the insight, and the nature of the insight.

Next, I coded the incidents to try to uncover patterns. I defined a set of coding categories. The list started small, but I added new features that I wanted to learn more about, and the set eventually grew to fourteen categories as the project went on. This was a trench, not a controlled experiment. Its purpose was to explore insights.

The categories were issues like whether the person struggled with an impasse (yes or no), whether the person had time to incubate (yes or no), whether the insight was sudden or gradual, and so forth. Once I had defined the categories, my research assistant, Andrea Jarosz, and I independently coded each incident using each of the fourteen categories. Our ratings had a 78 percent rate of agreement, which wasn't a bad start. Then we discussed the cases on which we disagreed and adjusted our criteria to reduce confusion. I also added more details to some of the stories. By the end our interrater agreement was 98 percent.

Eventually I was able to sort these 120 cases into five different strategies for gaining insights: connections, coincidences, curiosities, contradictions, and creative desperation. Did the incident rely on a person making a connection? Did the person notice a coincidence as a trigger for the insight? Was the insight triggered by some curiosity—an odd fact

or event? Did it depend on seeing a contradiction? Or was the person stuck, desperately seeking some way out of an impasse?

All the 120 cases fit one of these strategies. Most relied on more than one of the five strategies. But which of the five was the best strategy, the "real" one that explained insights? Or should all five be combined into one general strategy? Neither of these approaches seemed promising to me as I struggled to find a pattern in the data, but you can judge that for yourself. The next four chapters will describe the five candidate strategies. We'll start with the prime suspect.