From Outliers

by Malcolm Gladwell

CHAPTER ONE

The Matthew Effect

"FOR UNTO EVERYONE THAT HATH SHALL BE GIVEN, AND HE SHALL HAVE ABUNDANCE. BUT FROM HIM THAT HATH NOT SHALL BE TAKEN AWAY EVEN THAT WHICH HE HATH."
— MATTHEW 25:29

1.

One warm, spring day in May of 2007, the Medicine Hat Tigers and the Vancouver Giants met for the Memorial Cup hockey championships in Vancouver, British Columbia. The Tigers and the Giants were the two finest teams in the Canadian Hockey League, which in turn is the finest junior hockey league in the world. These were the future stars of the sport—seventeen-, eighteen-, and nineteen-year-olds who had been skating and shooting pucks since they were barely more than toddlers.

The game was broadcast on Canadian national television. Up and down the streets of downtown Vancouver, Memorial Cup banners hung from the lampposts. The arena was packed. A long red carpet was rolled out on the ice, and the announcer introduced the game's dignitaries. First came the premier of British Columbia, Gordon Campbell. Then, amid tumultuous applause, out walked

Gordie Howe, one of the legends of the game. "Ladies and gentlemen," the announcer boomed. "Mr. Hockey!"

For the next sixty minutes, the two teams played spirited, aggressive hockey. Vancouver scored first, early in the second period, on a rebound by Mario Bliznak. Late in the second period, it was Medicine Hat's turn, as the team's scoring leader, Darren Helm, fired a quick shot past Vancouver's goalie, Tyson Sexsmith. Vancouver answered in the third period, scoring the game's deciding goal, and then, when Medicine Hat pulled its goalie in desperation, Vancouver scored a third time.

In the aftermath of the game, the players and their families and sports reporters from across the country crammed into the winning team's locker room. The air was filled with cigar smoke and the smell of champagne and sweat-soaked hockey gear. On the wall was a hand-painted banner: "Embrace the Struggle." In the center of the room the Giants' coach, Don Hay, stood misty-eyed. "I'm just so proud of these guys," he said. "Just look around the locker room. There isn't one guy who didn't buy in wholeheartedly."

Canadian hockey is a meritocracy. Thousands of Canadian boys begin to play the sport at the "novice" level, before they are even in kindergarten. From that point on, there are leagues for every age class, and at each of those levels, the players are sifted and sorted and evaluated, with the most talented separated out and groomed for the next level. By the time players reach their midteens, the very best of the best have been channeled into an elite league known as Major Junior A, which is the top of the pyramid. And if your Major Junior A team plays for the

Memorial Cup, that means you are at the very top of the top pyramid.

The way most sports pick their future stars. It's the [illegible]er is organized in Europe and South America, and it's [illegible]ay Olympic athletes are chosen. For that matter, it is not all that different from the way the world of classical music picks its future virtuosos, or the way the world of ballet picks its future ballerinas, or the way our elite educational system picks its future scientists and intellectuals.

You can't buy your way into Major Junior A hockey. It doesn't matter who your father or mother is, or who your grandfather was, or what business your family is in. Nor does it matter if you live in the most remote corner of the most northerly province in Canada. If you have ability, the vast network of hockey scouts and talent spotters will find you, and if you are willing to work to develop that ability, the system will reward you. Success in hockey is based on *individual merit*—and both of those words are important. Players are judged on their own performance, not on anyone else's, and on the basis of their ability, not on some other arbitrary fact.

Or are they?

2.

This is a book about outliers, about men and women who do things that are out of the ordinary. Over the course of the chapters ahead, I'm going to introduce you to one kind of outlier after another: to geniuses, business tycoons, rock stars, and software programmers. We're going to uncover

the secrets of a remarkable lawyer, look at what separates the very best pilots from pilots who have crashed planes, and try to figure out why Asians are so good at math. And in examining the lives of the remarkable among us—the skilled, the talented, and the driven—I will argue that there is something profoundly wrong with the way we make sense of success.

What is the question we always ask about the successful? We want to know what they're *like*—what kind of personalities they have, or how intelligent they are, or what kind of lifestyles they have, or what special talents they might have been born with. And we assume that it is those personal qualities that explain how that individual reached the top.

In the autobiographies published every year by the billionaire/entrepreneur/rock star/celebrity, the story line is always the same: our hero is born in modest circumstances and by virtue of his own grit and talent fights his way to greatness. In the Bible, Joseph is cast out by his brothers and sold into slavery and then rises to become the pharaoh's right-hand man on the strength of his own brilliance and insight. In the famous nineteenth-century novels of Horatio Alger, young boys born into poverty rise to riches through a combination of pluck and initiative. "I think overall it's a disadvantage," Jeb Bush once said of what it meant for his business career that he was the son of an American president and the brother of an American president and the grandson of a wealthy Wall Street banker and US senator. When he ran for governor of Florida, he repeatedly referred to himself as a "self-made man," and it is a measure of how deeply we associate success with the efforts of the individual that few batted an eye at that description.

"Lift up your heads," Robert Winthrop told the crowd many years ago at the unveiling of a statue of that great hero of American independence Benjamin Franklin, "and look at the image of a man who rose from nothing, who owed nothing to parentage or patronage, who enjoyed no advantages of early education which are not open—a hundredfold open—to yourselves, who performed the most menial services in the businesses in which his early life was employed, but who lived to stand before Kings, and died to leave a name which the world will never forget."

In *Outliers*, I want to convince you that these kinds of personal explanations of success don't work. People don't rise from nothing. We do owe something to parentage and patronage. The people who stand before kings may look like they did it all by themselves. But in fact they are invariably the beneficiaries of hidden advantages and extraordinary opportunities and cultural legacies that allow them to learn and work hard and make sense of the world in ways others cannot. It makes a difference where and when we grew up. The culture we belong to and the legacies passed down by our forebears shape the patterns of our achievement in ways we cannot begin to imagine. It's not enough to ask what successful people are like, in other words. It is only by asking where they are *from* that we can unravel the logic behind who succeeds and who doesn't.

Biologists often talk about the "ecology" of an organism: the tallest oak in the forest is the tallest not just because it grew from the hardiest acorn; it is the tallest also because no other trees blocked its sunlight, the soil around it was deep and rich, no rabbit chewed through its bark as a sapling, and no lumberjack cut it down before it

matured. We all know that successful people come from hardy seeds. But do we know enough about the sunlight that warmed them, the soil in which they put down the roots, and the rabbits and lumberjacks they were lucky enough to avoid? This is not a book about tall trees. It's a book about forests—and hockey is a good place to start because the explanation for who gets to the top of the hockey world is a lot more interesting and complicated than it looks. In fact, it's downright peculiar.

3.

Here is the player roster of the 2007 Medicine Hat Tigers. Take a close look and see if you can spot anything strange about it.

No.	Name	Pos.	L/R	Height	Weight	Birth Date	Hometown
9	Brennan Bosch	C	R	5'8"	173	Feb. 14, 1988	Martensville, SK
11	Scott Wasden	C	R	6'1"	188	Jan. 4, 1988	Westbank, BC
12	Colton Grant	LW	L	5'9"	177	Mar. 20, 1989	Standard, AB
14	Darren Helm	LW	L	6'	182	Jan. 21, 1987	St. Andrews, MB
15	Derek Dorsett	RW	L	5'11"	178	Dec. 20, 1986	Kindersley, SK
16	Daine Todd	C	R	5'10"	173	Jan. 10, 1987	Red Deer, AB
17	Tyler Swystun	RW	R	5'11"	185	Jan. 15, 1988	Cochrane, AB
19	Matt Lowry	C	R	6'	186	Mar. 2, 1988	Neepawa, MB
20	Kevin Undershute	LW	L	6'	178	Apr. 12, 1987	Medicine Hat, AB
21	Jerrid Sauer	RW	R	5'10"	196	Sep. 12, 1987	Medicine Hat, AB

No.	Name	Pos.	L/R	Height	Weight	Birth Date	Hometown
22	Tyler Ennis	C	L	5'9"	160	Oct. 6, 1989	Edmonton, AB
23	Jordan Hickmott	C	R	6'	183	Apr. 11, 1990	Mission, BC
25	Jakub Rumpel	RW	R	5'8"	166	Jan. 27, 1987	Hrnciarovce, SLO
28	Bretton Cameron	C	R	5'11"	168	Jan. 26, 1989	Didsbury, AB
36	Chris Stevens	LW	L	5'10"	197	Aug. 20, 1986	Dawson Creek, BC
3	Gord Baldwin	D	L	6'5"	205	Mar. 1, 1987	Winnipeg, MB
4	David Schlemko	D	L	6'1"	195	May 7, 1987	Edmonton, AB
5	Trever Glass	D	L	6'	190	Jan. 22, 1988	Cochrane, AB
10	Kris Russell	D	L	5'10"	177	May 2, 1987	Caroline, AB
18	Michael Sauer	D	R	6'3"	205	Aug. 7, 1987	Sartell, MN
24	Mark Isherwood	D	R	6'	183	Jan. 31, 1989	Abbotsford, BC
27	Shayne Brown	D	L	6'1"	198	Feb. 20, 1989	Stony Plain, AB
29	Jordan Bendfeld	D	R	6'3"	230	Feb. 9, 1988	Leduc, AB
31	Ryan Holfeld	G	L	5'11"	166	Jun. 29, 1989	LeRoy, SK
33	Matt Keetley	G	R	6'2"	189	Apr. 27, 1986	Medicine Hat, AB

Do you see it? Don't feel bad if you don't, because for many years in the hockey world no one did. It wasn't until the mid-1980s, in fact, that a Canadian psychologist named Roger Barnsley first drew attention to the phenomenon of relative age.

Barnsley was at a Lethbridge Broncos hockey game in

southern Alberta, a team that played in the same Major Junior A league as the Vancouver Giants and the Medicine Hat Tigers. He was there with his wife, Paula, and their two boys, and his wife was reading the program, when she ran across a roster list just like the one above that you just looked at.

"Roger," she said, "do you know when these young men were born?"

Barnsley said yes. "They're all between sixteen and twenty, so they'd be born in the late sixties."

"No, no," Paula went on. "What *month*."

"I thought she was crazy," Barnsley remembers. "But I looked through it, and what she was saying just jumped out at me. For some reason, there were an incredible number of January, February, and March birth dates."

Barnsley went home that night and looked up the birth dates of as many professional hockey players as he could find. He saw the same pattern. Barnsley, his wife, and a colleague, A. H. Thompson, then gathered statistics on every player in the Ontario Junior Hockey League. The story was the same. More players were born in January than in any other month, and by an overwhelming margin. The second most frequent birth month? February. The third? March. Barnsley found that there were nearly five and a half times as many Ontario Junior Hockey League players born in January as were born in November. He looked at the all-star teams of eleven-year-olds and thirteen-year-olds—the young players selected for elite traveling squads. Same story. He looked at the composition of the National Hockey League. Same story. The more he looked, the more Barnsley came to believe that what he was seeing was not a chance occurrence but an iron law of Canadian hockey:

in *any* elite group of hockey players—the very best of the best—40 percent of the players will have been born between January and March, 30 percent between April and June, 20 percent between July and September, and 10 percent between October and December.

"In all my years in psychology, I have never run into an effect this large," Barnsley says. "You don't even need to do any statistical analysis. You just look at it."

Look back at the Medicine Hat roster. Do you see it now? Seventeen out of the twenty-five players on the team were born in January, February, March, or April.

Here is the play-by-play for the first two goals in the Memorial Cup final, only this time I've substituted the players' birthdays for their names. It no longer sounds like the championship of Canadian junior hockey. It now sounds like a strange sporting ritual for teenage boys born under the astrological signs Capricorn, Aquarius, and Pisces.

March 11 starts around one side of the Tigers' net, leaving the puck for his teammate January 4, who passes it to January 22, who flips it back to March 12, who shoots point-blank at the Tigers' goalie, April 27. April 27 blocks the shot, but it's rebounded by Vancouver's March 6. He shoots! Medicine Hat defensemen February 9 and February 14 dive to block the puck while January 10 looks on helplessly. March 6 scores!

Let's go to the second period now.

Medicine Hat's turn. The Tigers' scoring leader, January 21, charges down the right side of the ice. He stops and

circles, eluding the Vancouver defenseman February 15. January 21 then deftly passes the puck to his teammate December 20—wow! what's he *doing out there?!—who shrugs off the onrushing defender May 17 and slides a cross-crease pass back to January 21. He shoots! Vancouver defenseman March 12 dives, trying to block the shot. Vancouver's goalie, March 19, lunges helplessly. January 21 scores! He raises his hands in triumph. His teammate May 2 jumps on his back with joy.*

4.

The explanation for this is quite simple. It has nothing to do with astrology, nor is there anything magical about the first three months of the year. It's simply that in Canada the eligibility cutoff for age-class hockey is January 1. A boy who turns ten on January 2, then, could be playing alongside someone who doesn't turn ten until the end of the year—and at that age, in preadolescence, a twelve-month gap in age represents an enormous difference in physical maturity.

This being Canada, the most hockey-crazed country on earth, coaches start to select players for the traveling "rep" squad—the all-star teams—at the age of nine or ten, and of course they are more likely to view as talented the bigger and more coordinated players, who have had the benefit of critical extra months of maturity.

And what happens when a player gets chosen for a rep squad? He gets better coaching, and his teammates are better, and he plays fifty or seventy-five games a season instead of twenty games a season like those left

behind in the "house" league, and he practices twice as much as, or even three times more than, he would have otherwise. In the beginning, his advantage isn't so much that he is inherently better but only that he is a little older. But by the age of thirteen or fourteen, with the benefit of better coaching and all that extra practice under his belt, he really *is* better, so he's the one more likely to make it to the Major Junior A league, and from there into the big leagues.*

Barnsley argues that these kinds of skewed age distributions exist whenever three things happen: selection, streaming, and differentiated experience. If you make a decision about who is good and who is not good at an early age; if you separate the "talented" from the "untalented"; and if you provide the "talented" with a superior experience, then you're going to end up giving a huge advantage to that small group of people born closest to the cutoff date.

In the United States, football and basketball don't select, stream, and differentiate quite as dramatically. As

* The way Canadians select hockey players is a beautiful example of what the sociologist Robert Merton famously called a "self-fulfilling prophecy"—a situation where "a false definition, in the beginning...evokes a new behavior which makes the original false conception come true." Canadians start with a false definition of who the best nine- and ten-year-old hockey players are. They're just picking the oldest every year. But the way they treat those "all-stars" ends up making their original false judgment look correct. As Merton puts it: "This specious validity of the self-fulfilling prophecy perpetuates a reign of error. For the prophet will cite the actual course of events as proof that he was right from the very beginning."

a result, a child can be a bit behind physically in those sports and still play as much as his or her more mature peers.* But baseball does. The cutoff date for almost all nonschool baseball leagues in the United States is July 31, with the result that more major league players are born in August than in any other month. (The numbers are striking: in 2005, among Americans playing major league baseball 505 were born in August versus 313 born in July.)

European soccer, similarly, is organized like hockey and baseball—and the birth-date distributions in that sport are heavily skewed as well. In England, the eligibility date is September 1, and in the football association's premier league at one point in the 1990s, there were 288 players born between September and November and only 136 players born between June and August. In international soccer, the cutoff date used to be August 1, and in one recent junior world championship tournament, 135 players were born in the three months after August 1, and just 22 were born in May, June, and July. Today the cutoff date for international junior soccer is January 1. Take a look at the roster of the 2007 Czechoslovakian National Junior soccer team, which made the Junior World Cup finals.

Here we go again:

* A physically immature basketball player in an American city can probably play as many hours of basketball in a given year as a relatively older child because there are so many basketball courts and so many people willing to play. It's not like ice hockey, where you need a rink. Basketball is saved by its accessibility and ubiquity.

No.	Player	Birth Date	Position
1	Marcel Gecov	Jan. 1, 1988	MF
2	Ludek Frydrych	Jan. 3, 1987	GK
3	Petr Janda	Jan. 5, 1987	MF
4	Jakub Dohnalek	Jan. 12, 1988	DF
5	Jakub Mares	Jan. 26, 1987	MF
6	Michal Held	Jan. 27, 1987	DF
7	Marek Strestik	Feb. 1, 1987	FW
8	Jiri Valenta	Feb. 14, 1988	MF
9	Jan Simunek	Feb. 20, 1987	DF
10	Tomas Oklestek	Feb. 21, 1987	MF
11	Lubos Kalouda	Feb. 21, 1987	MF
12	Radek Petr	Feb. 24, 1987	GK
13	Ondrej Mazuch	Mar. 15, 1989	DF
14	Ondrej Kudela	Mar. 26, 1987	MF
15	Marek Suchy	Mar. 29, 1988	DF
16	Martin Fenin	Apr. 16, 1987	FW
17	Tomas Pekhart	May 26, 1989	FW
18	Lukas Kuban	Jun. 22, 1987	DF
19	Tomas Cihlar	Jun. 24, 1987	DF
20	Tomas Frystak	Aug. 18, 1987	GK
21	Tomas Micola	Sep. 26, 1988	MF

At the national team tryouts, the Czech soccer coaches might as well have told everyone born after midsummer that they should pack their bags and go home.

Hockey and soccer are just games, of course, involving a select few. But these exact same biases also show up in

areas of much more consequence, like education. Parents with a child born at the end of the calendar year often think about holding their child back before the start of kindergarten: it's hard for a five-year-old to keep up with a child born many months earlier. But most parents, one suspects, think that whatever disadvantage a younger child faces in kindergarten eventually goes away. *But it doesn't.* It's just like hockey. The small initial advantage that the child born in the early part of the year has over the child born at the end of the year persists. It locks children into patterns of achievement and underachievement, encouragement and discouragement, that stretch on and on for years.

Recently, two economists—Kelly Bedard and Elizabeth Dhuey—looked at the relationship between scores on what is called the Trends in International Mathematics and Science Study, or TIMSS (math and science tests given every four years to children in many countries around the world), and month of birth. They found that among fourth graders, the oldest children scored somewhere between four and twelve percentile points better than the youngest children. That, as Dhuey explains, is a "huge effect." It means that if you take two intellectually equivalent fourth graders with birthdays at opposite ends of the cutoff date, the older student could score in the eightieth percentile, while the younger one could score in the sixty-eighth percentile. That's the difference between qualifying for a gifted program and not.

"It's just like sports," Dhuey said. "We do ability grouping early on in childhood. We have advanced reading groups and advanced math groups. So, early on, if we look at

young kids, in kindergarten and first grade, the teachers are confusing maturity with ability. And they put the older kids in the advanced stream, where they learn better skills; and the next year, because they are in the higher groups, they do even better; and the next year, the same things happens, and they do even better again. The only country we don't see this going on is Denmark. They have a national policy where they have no ability grouping until the age of ten." Denmark waits to make selection decisions until maturity differences by age have evened out.

Dhuey and Bedard subsequently did the same analysis, only this time looking at college. What did they find? At four-year colleges in the United States—the highest stream of postsecondary education—students belonging to the relatively youngest group in their class are underrepresented by about 11.6 percent. That initial difference in maturity doesn't go away with time. It persists. And for thousands of students, that initial disadvantage is the difference between going to college—and having a real shot at the middle class—and not.*

"I mean, it's ridiculous," Dhuey says. "It's outlandish that our arbitrary choice of cutoff dates is causing

* Even more social phenomena can be linked to relative age. Barnsley and two colleagues, for instance, once found that students who attempt suicide are also more likely to be born in the second half of the school year. Their explanation is that poorer school performance can lead to depression. The connection between relative age and suicide, however, isn't nearly as pronounced as the correlation between birth date and athletic success.

these long-lasting effects, and no one seems to care about them."

5.

Think for a moment about what the story of hockey and early birthdays says about success.

It tells us that our notion that it is the best and the brightest who effortlessly rise to the top is much too simplistic. Yes, the hockey players who make it to the professional level are more talented than you or me. But they also got a big head start, an opportunity that they neither deserved nor earned. And that opportunity played a critical role in their success.

The sociologist Robert Merton famously called this phenomenon the "Matthew Effect" after the New Testament verse in the Gospel of Matthew: "For unto everyone that hath shall be given, and he shall have abundance. But from him that hath not shall be taken away even that which he hath." It is those who are successful, in other words, who are most likely to be given the kinds of special opportunities that lead to further success. It's the rich who get the biggest tax breaks. It's the best students who get the best teaching and most attention. And it's the biggest nine- and ten-year-olds who get the most coaching and practice. Success is the result of what sociologists like to call "accumulative advantage." The professional hockey player starts out a little bit better than his peers. And that little difference leads to an opportunity that makes that difference a bit bigger, and that edge in turn leads

to another opportunity, which makes the initially small difference bigger still—and on and on until the hockey player is a genuine outlier. But he didn't start out an outlier. He started out just a little bit better.

The second implication of the hockey example is that the systems we set up to determine who gets ahead aren't particularly efficient. We think that starting all-star leagues and gifted programs as early as possible is the best way of ensuring that no talent slips through the cracks. But take a look again at that roster for the Czech Republic soccer team. There are no players born in July, October, November, or December, and only one each in August and September. Those born in the last half of the year have all been discouraged, or overlooked, or pushed out of the sport. *The talent of essentially half of the Czech athletic population has been squandered.*

So what do you do if you're an athletic young Czech with the misfortune to have been born in the last part of the year? You *can't* play soccer. The deck is stacked against you. So maybe you could play the other sport that Czechs are obsessed with—hockey. But wait. (I think you know what's coming.) Here's the roster of the 2007 Czech junior hockey team that finished fifth at the world championships.

No.	Player	Birth Date	Position
1	David Kveton	Jan. 3, 1988	Forward
2	Jiri Suchy	Jan. 3, 1988	Defense
3	Michael Kolarz	Jan. 12, 1987	Defense
4	Jakub Vojta	Feb. 8, 1987	Defense

No.	Player	Birth Date	Position
5	Jakub Kindl	Feb. 10, 1987	Defense
6	Michael Frolik	Feb. 17, 1989	Forward
7	Martin Hanzal	Feb. 20, 1987	Forward
8	Tomas Svoboda	Feb. 24, 1987	Forward
9	Jakub Cerny	Mar. 5, 1987	Forward
10	Tomas Kudelka	Mar. 10, 1987	Defense
11	Jaroslav Barton	Mar. 26, 1987	Defense
12	H. O. Pozivil	Apr. 22, 1987	Defense
13	Daniel Rakos	May 25, 1987	Forward
14	David Kuchejda	Jun. 12, 1987	Forward
15	Vladimir Sobotka	Jul. 2, 1987	Forward
16	Jakub Kovar	Jul. 19, 1988	Goalie
17	Lukas Vantuch	Jul. 20, 1987	Forward
18	Jakub Voracek	Aug. 15, 1989	Forward
19	Tomas Pospisil	Aug. 25, 1987	Forward
20	Ondrej Pavelec	Aug. 31, 1987	Goalie
21	Tomas Kana	Nov. 29, 1987	Forward
22	Michal Repik	Dec. 31, 1988	Forward

Those born in the last quarter of the year might as well give up on hockey too.

Do you see the consequences of the way we have chosen to think about success? Because we so profoundly personalize success, we miss opportunities to lift others onto the top rung. We make rules that frustrate achievement. We prematurely write off people as failures. We are too much in awe of those who succeed and far too

dismissive of those who fail. And, most of all, we become much too passive. We overlook just how large a role we all play—and by "we" I mean society—in determining who makes it and who doesn't.

If we chose to, we could acknowledge that cutoff dates matter. We could set up two or even three hockey leagues, divided up by month of birth. Let the players develop on separate tracks and then pick all-star teams. If all the Czech and Canadian athletes born at the end of the year had a fair chance, then the Czech and the Canadian national teams suddenly would have twice as many athletes to choose from.

Schools could do the same thing. Elementary and middle schools could put the January through April–born students in one class, the May through August in another class, and those born in September through December in the third class. They could let students learn with and compete against other students of the same maturity level. It would be a little bit more complicated administratively. But it wouldn't necessarily cost that much more money, and it would level the playing field for those who—through no fault of their own—have been dealt a big disadvantage by the educational system. We could easily take control of the machinery of achievement, in other words—not just in sports but, as we will see, in other more consequential areas as well. But we don't. And why? Because we cling to the idea that success is a simple function of individual merit and that the world in which we all grow up and the rules we choose to write as a society don't matter at all.

6.

Before the Memorial Cup final, Gord Wasden—the father of one of the Medicine Hat Tigers—stood by the side of the ice, talking about his son Scott. He was wearing a Medicine Hat baseball cap and a black Medicine Hat T-shirt. "When he was four and five years old," Wasden remembered, "his little brother was in a walker, and he would shove a hockey stick in his hand and they would play hockey on the floor in the kitchen, morning till night. Scott *always* had a passion for it. He played rep hockey throughout his minor-league hockey career. He always made the Triple A teams. As a first-year peewee or a first-year bantam, he always played on the [top] rep team." Wasden was clearly nervous: his son was about to play in the biggest game of his life. "He's had to work very hard for whatever he's got. I'm very proud of him."

Those were the ingredients of success at the highest level: passion, talent, and hard work. But there was another element. When did Wasden first get the sense that his son was something special? "You know, he was always a bigger kid for his age. He was strong, and he had a knack for scoring goals at an early age. And he was always kind of a standout for his age, a captain of his team...."

Bigger kid for his age? Of course he was. Scott Wasden was born on January 4, within three days of the absolute perfect birthday for an elite hockey player. He was one of the lucky ones. If the eligibility date for Canadian hockey were later in the year, he might have been watching the Memorial Cup championship from the stands instead of playing on the ice.

CHAPTER TWO

The 10,000-Hour Rule

"IN HAMBURG, WE HAD TO PLAY FOR EIGHT HOURS."

1.

The University of Michigan opened its new Computer Center in 1971, in a brand-new building on Beal Avenue in Ann Arbor, with beige-brick exterior walls and a dark-glass front. The university's enormous mainframe computers stood in the middle of a vast white room, looking, as one faculty member remembers, "like one of the last scenes in the movie *2001: A Space Odyssey.*" Off to the side were dozens of keypunch machines—what passed in those days for computer terminals. In 1971, this was state of the art. The University of Michigan had one of the most advanced computer science programs in the world, and over the course of the Computer Center's life, thousands of students passed through that white room, the most famous of whom was a gawky teenager named Bill Joy.

Joy came to the University of Michigan the year the

Computer Center opened. He was sixteen. He was tall and very thin, with a mop of unruly hair. He had been voted "Most Studious Student" by his graduating class at North Farmington High School, outside Detroit, which, as he puts it, meant that he was a "no-date nerd." He had thought he might end up as biologist or a mathematician. But late in his freshman year, he stumbled across the Computer Center—and he was hooked.

From that point on, the Computer Center was his life. He programmed whenever he could. Joy got a job with a computer science professor so he could program over the summer. In 1975, he enrolled in graduate school at the University of California at Berkeley. There, he buried himself even deeper in the world of computer software. During the oral exams for his PhD, he made up a particularly complicated algorithm on the fly that, as one of his many admirers has written, "so stunned his examiners [that] one of them later compared the experience to 'Jesus confounding his elders.'"

Working in collaboration with a small group of programmers, Joy took on the task of rewriting UNIX, which was a software system developed by AT&T for mainframe computers. Joy's version was very good. It was so good, in fact, that it became—and remains—the operating system on which literally millions of computers around the world run. "If you put your Mac in that funny mode where you can see the code," Joy says, "I see things that I remember typing in twenty-five years ago." And do you know who wrote much of the software that allows you to access the Internet? Bill Joy.

After graduating from Berkeley, Joy cofounded the

Silicon Valley firm Sun Microsystems, which was one of the most critical players in the computer revolution. There he rewrote another computer language—Java—and his legend grew still further. Among Silicon Valley insiders, Joy is spoken of with as much awe as someone like Bill Gates of Microsoft. He is sometimes called the Edison of the Internet. As the Yale computer scientist David Gelernter says, "Bill Joy is one of the most influential people in the modern history of computing."

The story of Bill Joy's genius has been told many times, and the lesson is always the same. Here was a world that was the purest of meritocracies. Computer programming didn't operate as an old-boy network, where you got ahead because of money or connections. It was a wide-open field in which all participants were judged solely on their talent and their accomplishments. It was a world where the best men won, and Joy was clearly one of those best men.

It would be easier to accept that version of events, however, if we hadn't just looked at hockey and soccer players. Theirs was supposed to be a pure meritocracy as well. Only it wasn't. It was a story of how the outliers in a particular field reached their lofty status through a combination of ability, opportunity, and utterly arbitrary advantage.

Is it possible the same pattern of special opportunities operate in the real world as well? Let's go back over the story of Bill Joy and find out.

2.

For almost a generation, psychologists around the world have been engaged in a spirited debate over a question that

most of us would consider to have been settled years ago. The question is this: is there such a thing as innate talent? The obvious answer is yes. Not every hockey player born in January ends up playing at the professional level. Only some do—the innately talented ones. Achievement is talent plus preparation. The problem with this view is that the closer psychologists look at the careers of the gifted, the smaller the role innate talent seems to play and the bigger the role preparation seems to play.

Exhibit A in the talent argument is a study done in the early 1990s by the psychologist K. Anders Ericsson and two colleagues at Berlin's elite Academy of Music. With the help of the Academy's professors, they divided the school's violinists into three groups. In the first group were the stars, the students with the potential to become world-class soloists. In the second were those judged to be merely "good." In the third were students who were unlikely to ever play professionally and who intended to be music teachers in the public school system. All of the violinists were then asked the same question: over the course of your entire career, ever since you first picked up the violin, how many hours have you practiced?

Everyone from all three groups started playing at roughly the same age, around five years old. In those first few years, everyone practiced roughly the same amount, about two or three hours a week. But when the students were around the age of eight, real differences started to emerge. The students who would end up the best in their class began to practice more than everyone else: six hours a week by age nine, eight hours a week by age twelve, sixteen hours a week by age fourteen, and up and up, until by

the age of twenty they were practicing—that is, purposefully and single-mindedly playing their instruments with the intent to get better—well over thirty hours a week. In fact, by the age of twenty, the elite performers had each totaled ten thousand hours of practice. By contrast, the merely good students had totaled eight thousand hours, and the future music teachers had totaled just over four thousand hours.

Ericsson and his colleagues then compared amateur pianists with professional pianists. The same pattern emerged. The amateurs never practiced more than about three hours a week over the course of their childhood, and by the age of twenty they had totaled two thousand hours of practice. The professionals, on the other hand, steadily increased their practice time every year, until by the age of twenty they, like the violinists, had reached ten thousand hours.

The striking thing about Ericsson's study is that he and his colleagues couldn't find any "naturals," musicians who floated effortlessly to the top while practicing a fraction of the time their peers did. Nor could they find any "grinds," people who worked harder than everyone else, yet just didn't have what it takes to break the top ranks. Their research suggestes that once a musician has enough ability to get into a top music school, the thing that distinguishes one performer from another is how hard he or she works. That's it. And what's more, the people at the very top don't work just harder or even much harder than everyone else. They work much, *much* harder.

The idea that excellence at performing a complex task requires a critical minimum level of practice surfaces again

and again in studies of expertise. In fact, researchers have settled on what they believe is the magic number for true expertise: ten thousand hours.

"The emerging picture from such studies is that ten thousand hours of practice is required to achieve the level of mastery associated with being a world-class expert—in anything," writes the neurologist Daniel Levitin. "In study after study, of composers, basketball players, fiction writers, ice skaters, concert pianists, chess players, master criminals, and what have you, this number comes up again and again. Of course, this doesn't address why some people get more out of their practice sessions than others do. But no one has yet found a case in which true world-class expertise was accomplished in less time. It seems that it takes the brain this long to assimilate all that it needs to know to achieve true mastery."

This is true even of people we think of as prodigies. Mozart, for example, famously started writing music at six. But, writes the psychologist Michael Howe in his book *Genius Explained*,

> by the standards of mature composers, Mozart's early works are not outstanding. The earliest pieces were all probably written down by his father, and perhaps improved in the process. Many of Wolfgang's childhood compositions, such as the first seven of his concertos for piano and orchestra, are largely arrangements of works by other composers. Of those concertos that only contain music original to Mozart, the earliest that is now regarded as a masterwork (No. 9, K. 271) was not composed until he was twenty-one: by that time Mozart had already been composing concertos for ten years.

The music critic Harold Schonberg goes further: Mozart, he argues, actually "developed late," since he didn't produce his greatest work until he had been composing for more than twenty years.

To become a chess grandmaster also seems to take about ten years. (Only the legendary Bobby Fischer got to that elite level in less than that amount of time: it took him nine years.) And what's ten years? Well, it's roughly how long it takes to put in ten thousand hours of hard practice. Ten thousand hours is the magic number of greatness.

Here is the explanation for what was so puzzling about the rosters of the Czech and Canadian national sports teams. There was practically no one on those teams born after September 1, which doesn't seem to make any sense. You'd think that there should be a fair number of Czech hockey or soccer prodigies born late in the year who are *so* talented that they eventually make their way into the top tier as young adults, despite their birth dates.

But to Ericsson and those who argue against the primacy of talent, that isn't surprising at all. That late-born prodigy doesn't get chosen for the all-star team as an eight-year-old because he's too small. So he doesn't get the extra practice. And without that extra practice, he has no chance at hitting ten thousand hours by the time the professional hockey teams start looking for players. And without ten thousand hours under his belt, there is no way he can ever master the skills necessary to play at

the top level. Even Mozart—the greatest musical prodigy of all time—couldn't hit his stride until he had his ten thousand hours in. Practice isn't the thing you do once you're good. It's the thing you do that makes you good.

The other interesting thing about that ten thousand hours, of course, is that ten thousand hours is an *enormous* amount of time. It's all but impossible to reach that number all by yourself by the time you're a young adult. You have to have parents who encourage and support you. You can't be poor, because if you have to hold down a part-time job on the side to help make ends meet, there won't be time left in the day to practice enough. In fact, most people can reach that number only if they get into some kind of special program—like a hockey all-star squad—or if they get some kind of extraordinary opportunity that gives them a chance to put in those hours.

3.

So, back to Bill Joy. It's 1971. He's tall and gawky and sixteen years old. He's the math whiz, the kind of student that schools like MIT and Caltech and the University of Waterloo attract by the hundreds. "When Bill was a little kid, he wanted to know everything about everything way before he should've even known he wanted to know," his father, William, says. "We answered him when we could. And when we couldn't, we would just give him a book." When it came time to apply to college, Joy got a perfect score on the math portion of the Scholastic Aptitude Test. "It wasn't particularly hard," he says matter-of-factly. "There was plenty of time to check it twice."

He has talent by the truckload. But that's not the only consideration. It never is. The key to his development is that he stumbled across that nondescript building on Beal Avenue.

In the early 1970s, when Joy was learning about programming, computers were the size of rooms. A single machine (which might have less power and memory than your microwave now has) could cost upwards of a million dollars—and that's in 1970s dollars. Computers were rare. If you found one, if was hard to get access to it; if you managed to get access, renting time on it cost a fortune.

What's more, programming itself was extraordinarily tedious. This was the era when computer programs were created using cardboard punch cards. Each line of code was imprinted on the card using a keypunch machine. A complex program might include hundreds, if not thousands, of these cards in tall stacks. Once a program was ready, you walked over to whatever mainframe computer you had access to and gave the stack of cards to an operator. Since computers could handle only one task at a time, the operator made an appointment for your program, and depending on how many people were ahead of you in line, you might not get your cards back for a few hours or even a day. And if you made even a single error—even a typographical error—in your program, you had to take the cards back, track down the error, and begin the whole process again.

Under those circumstances, it was exceedingly difficult for anyone to become a programming expert. Certainly becoming an expert by your early twenties was all but impossible. When you can "program" for only a few

minutes out of every hour you spend in the computer room, how can you ever get in ten thousand hours of practice? "Programming with cards," one computer scientist from that era remembers, "did not teach you programming. It taught you patience and proofreading."

It wasn't until the mid-1960s that a solution to the programming problem emerged. Computers were finally powerful enough that they could handle more than one "appointment" at once. If the computer's operating system was rewritten, computer scientists realized, the machine's time could be shared; the computer could be trained to handle hundreds of tasks at the same time. That, in turn, meant that programmers didn't have to physically hand their stacks of computer cards to the operator anymore. Dozens of terminals could be built, all linked to the mainframe by a telephone line, and everyone could be working—online—all at once.

Here is how one history of the period describes the advent of time-sharing:

> This was not just a revolution. It was a revelation. Forget the operator, the card decks, the wait. With time-sharing, you could sit at your Teletype, bang in a couple of commands, and get an answer then and there. Time-sharing was interactive: A program could ask for a response, wait for you to type it in, act on it while you waited, and show you the result, all in "real time."

This is where Michigan came in, because Michigan was one of the first universities in the world to switch over to time-sharing. By 1967, a prototype of the system

was up and running. By the early 1970s, Michigan had enough computing power that a hundred people could be programming simultaneously in the Computer Center. "In the late sixties, early seventies, I don't think there was anyplace else that was exactly like Michigan," Mike Alexander, one of the pioneers of Michigan's computing system, said. "Maybe MIT. Maybe Carnegie Mellon. Maybe Dartmouth. I don't think there were any others."

This was the opportunity that greeted Bill Joy when he arrived on the Ann Arbor campus in the fall of 1971. He hadn't chosen Michigan because of its computers. He had never done anything with computers in high school. He was interested in math and engineering. But when the programming bug hit him in his freshman year, he found himself—by the happiest of accidents—in one of the few places in the world where a seventeen-year-old could program all he wanted.

"Do you know what the difference is between the computing cards and time-sharing?" Joy says. "It's the difference between playing chess by mail and speed chess." Programming wasn't an exercise in frustration anymore. It was *fun*.

"I lived in the north campus, and the Computer Center was in the north campus," Joy went on. "How much time did I spend there? Oh, a phenomenal amount of time. It was open twenty-four hours. I would stay there all night, and just walk home in the morning. In an average week in those years, I was spending more time in the Computer Center than on my classes. All of us down there had this recurring nightmare of forgetting to show up for class at all, of not even realizing we were enrolled.

"The challenge was that they gave all the students

an account with a fixed amount of money, so your time would run out. When you signed on, you would put in how long you wanted to spend on the computer. They gave you, like, an hour of time. That's all you'd get. But someone figured out that if you put in 'time equals' and then a letter, like *t* equals *k*, they wouldn't charge you," he said, laughing at the memory. "It was a bug in the software. You could put in *t* equals *k* and sit there forever."

Just look at the stream of opportunities that came Bill Joy's way. Because he happened to go to a farsighted school like the University of Michigan, he was able to practice on a time-sharing system instead of with punch cards; because the Michigan system happened to have a bug in it, he could program all he wanted; because the university was willing to spend the money to keep the Computer Center open twenty-four hours, he could stay up all night; and because he was able to put in so many hours, by the time he happened to be presented with the opportunity to rewrite UNIX, he was up to the task. Bill Joy was brilliant. He wanted to learn. That was a big part of it. But before he could become an expert, someone had to give him the opportunity to learn *how* to be an expert.

"At Michigan, I was probably programming eight or ten hours a day," he went on. "By the time I was at Berkeley I was doing it day and night. I had a terminal at home. I'd stay up until two or three o'clock in the morning, watching old movies and programming. Sometimes I'd fall asleep at the keyboard"—he mimed his head falling on the keyboard—"and you know how the key repeats until the end, and it starts to go beep, beep, beep? After

that happens three times, you have to go to bed. I was still relatively incompetent even when I got to Berkeley. I was proficient by my second year there. That's when I wrote programs that are still in use today, thirty years later." He paused for a moment to do the math in his head—which for someone like Bill Joy doesn't take very long. Michigan in 1971. Programming in earnest by sophomore year. Add in the summers, then the days and nights in his first year at Berkeley. "So, so maybe... ten thousand hours?" he said, finally. "That's about right."

4.

Is the ten-thousand-hour rule a general rule of success? If we scratch below the surface of every great achiever, do we always find the equivalent of the Michigan Computer Center or the hockey all-star team—some sort of special opportunity for practice?

Let's test the idea with two examples, and for the sake of simplicity, let's make them as familiar as possible: the Beatles, one of the most famous rock bands ever; and Bill Gates, one of the world's richest men.

The Beatles—John Lennon, Paul McCartney, George Harrison, and Ringo Starr—came to the United States in February of 1964, starting the so-called British Invasion of the American music scene and putting out a string of hit records that transformed the face of popular music.

The first interesting thing about the Beatles for our purposes is how long they had already been together by the time they reached the United States. Lennon and

McCartney first started playing together in 1957, seven years prior to landing in America. (Incidentally, the time that elapsed between their founding and their arguably greatest artistic achievements—*Sgt. Pepper's Lonely Hearts Club Band* and *The Beatles* [White Album]—is ten years.) And if you look even more closely at those long years of preparation, you'll find an experience that, in the context of hockey players and Bill Joy and world-class violinists, sounds awfully familiar. In 1960, while they were still just a struggling high school rock band, they were invited to play in Hamburg, Germany.

"Hamburg in those days did not have rock-and-roll music clubs. It had strip clubs," says Philip Norman, who wrote the Beatles biography *Shout!* "There was one particular club owner called Bruno, who was originally a fairground showman. He had the idea of bringing in rock groups to play in various clubs. They had this formula. It was a huge nonstop show, hour after hour, with a lot of people lurching in and the other lot lurching out. And the bands would play all the time to catch the passing traffic. In an American red-light district, they would call it nonstop striptease.

"Many of the bands that played in Hamburg were from Liverpool," Norman went on. "It was an accident. Bruno went to London to look for bands. But he happened to meet an entrepreneur from Liverpool in Soho who was down in London by pure chance. And he arranged to send some bands over. That's how the connection was established. And eventually the Beatles made a connection not just with Bruno but with other club owners as well. They kept going back because they got a lot of alcohol and a lot of sex."

And what was so special about Hamburg? It wasn't that it paid well. It didn't. Or that the acoustics were fantastic. They weren't. Or that the audiences were savvy and appreciative. They were anything but. It was the sheer amount of time the band was forced to play.

Here is John Lennon, in an interview after the Beatles disbanded, talking about the band's performances at a Hamburg strip club called the Indra:

> We got better and got more confidence. We couldn't help it with all the experience playing all night long. It was handy them being foreign. We had to try even harder, put our heart and soul into it, to get ourselves over.
>
> In Liverpool, we'd only ever done one-hour sessions, and we just used to do our best numbers, the same ones, at every one. In Hamburg, we had to play for eight hours, so we really had to find a new way of playing.

Eight hours?

Here is Pete Best, the Beatles' drummer at the time: "Once the news got out about that we were making a show, the club started packing them in. We played seven nights a week. At first we played almost nonstop till twelve-thirty, when it closed, but as we got better the crowds stayed till two most mornings."

Seven days a week?

The Beatles ended up traveling to Hamburg five times between 1960 and the end of 1962. On the first trip, they played 106 nights, five or more hours a night. On their second trip, they played 92 times. On their third trip, they

played 48 times, for a total of 172 hours on stage. The last two Hamburg gigs, in November and December of 1962, involved another 90 hours of performing. All told, they performed for 270 nights in just over a year and a half. By the time they had their first burst of success in 1964, in fact, they had performed live an estimated twelve hundred times. Do you know how extraordinary that is? Most bands today don't perform twelve hundred times in their entire careers. The Hamburg crucible is one of the things that set the Beatles apart.

"They were no good onstage when they went there and they were very good when they came back," Norman went on. "They learned not only stamina. They had to learn an enormous amount of numbers—cover versions of everything you can think of, not just rock and roll, a bit of jazz too. They weren't disciplined onstage at all before that. But when they came back, they sounded like no one else. It was the making of them."

5.

Let's now turn to the history of Bill Gates. His story is almost as well known as the Beatles'. Brilliant, young math whiz discovers computer programming. Drops out of Harvard. Starts a little computer company called Microsoft with his friends. Through sheer brilliance and ambition and guts builds it into the giant of the software world. That's the broad outline. Let's dig a little bit deeper.

Gates's father was a wealthy lawyer in Seattle, and his mother was the daughter of a well-to-do banker. As

a child Bill was precocious and easily bored by his studies. So his parents took him out of public school and, at the beginning of seventh grade, sent him to Lakeside, a private school that catered to Seattle's elite families. Midway through Gates's second year at Lakeside, the school started a computer club.

"The Mothers' Club at school did a rummage sale every year, and there was always the question of what the money would go to," Gates remembers. "Some went to the summer program, where inner-city kids would come up to the campus. Some of it would go for teachers. That year, they put three thousand dollars into a computer terminal down in this funny little room that we subsequently took control of. It was kind of an amazing thing."

It was an "amazing thing," of course, because this was 1968. Most *colleges* didn't have computer clubs in the 1960s. Even more remarkable was the kind of computer Lakeside bought. The school didn't have its students learn programming by the laborious computer-card system, like virtually everyone else was doing in the 1960s. Instead, Lakeside installed what was called an ASR-33 Teletype, which was a time-sharing terminal with a direct link to a mainframe computer in downtown Seattle. "The whole idea of time-sharing only got invented in nineteen sixty-five," Gates continued. "Someone was pretty forward-looking." Bill Joy got an extraordinary, early opportunity to learn programming on a time-share system as a freshman in college, in 1971. Bill Gates got to do real-time programming *as an eighth grader in 1968.*

From that moment forward, Gates lived in the computer

room. He and a number of others began to teach themselves how to use this strange new device. Buying time on the mainframe computer the ASR was hooked up to was, of course, expensive—even for a wealthy institution like Lakeside—and it wasn't long before the $3,000 put up by the Mothers' Club ran out. The parents raised more money. The students spent it. Then a group of programmers at the University of Washington formed an outfit called Computer Center Corporation (or C-Cubed), which leased computer time to local companies. As luck would have it, one of the founders of the firm—Monique Rona—had a son at Lakeside, a year ahead of Gates. Would the Lakeside computer club, Rona wondered, like to test out the company's software programs on the weekends in exchange for free programming time? Absolutely! After school, Gates took the bus to the C-Cubed offices and programmed long into the evening.

C-Cubed eventually went bankrupt, so Gates and his friends began hanging around the computer center at the University of Washington. Before long, they latched onto an outfit called ISI (Information Sciences Inc.), which agreed to let them have free computer time in exchange for working on a piece of software that could be used to automate company payrolls. In one seven-month period in 1971, Gates and his cohorts ran up 1,575 hours of computer time on the ISI mainframe, which averages out to eight hours a day, seven days a week.

"It was my obsession," Gates says of his early high school years. "I skipped athletics. I went up there at night. We were programming on weekends. It would be a rare week that we wouldn't get twenty or thirty hours in. There was

a period where Paul Allen and I got in trouble for stealing a bunch of passwords and crashing the system. We got kicked out. I didn't get to use the computer the whole summer. This is when I was fifteen and sixteen. Then I found out Paul had found a computer that was free at the University of Washington. They had these machines in the medical center and the physics department. They were on a twenty-four-hour schedule, but with this big slack period, so that between three and six in the morning they never scheduled anything." Gates laughed. "I'd leave at night, after my bedtime. I could walk up to the University of Washington from my house. Or I'd take the bus. That's why I'm always so generous to the University of Washington, because they let me steal so much computer time." (Years later, Gates's mother said, "We always wondered why it was so hard for him to get up in the morning.")

One of the founders of ISI, Bud Pembroke, then got a call from the technology company TRW, which had just signed a contract to set up a computer system at the huge Bonneville Power station in southern Washington State. TRW desperately needed programmers familiar with the particular software the power station used. In these early days of the computer revolution, programmers with that kind of specialized experience were hard to find. But Pembroke knew exactly whom to call: those high school kids from Lakeside who had been running up thousands of hours of computer time on the ISI mainframe. Gates was now in his senior year, and somehow he managed to convince his teachers to let him decamp for Bonneville under the guise of an independent study project. There he spent the spring writing code, supervised by a man named

John Norton, who Gates says taught him as much about programming as almost anyone he'd ever met.

Those five years, from eighth grade through the end of high school, were Bill Gates's Hamburg, and by any measure, he was presented with an even more extraordinary series of opportunities than Bill Joy.

Opportunity number one was that Gates got sent to Lakeside. How many high schools in the world had access to a time-sharing terminal in 1968? Opportunity number two was that the mothers of Lakeside had enough money to pay for the school's computer fees. Number three was that, when that money ran out, one of the parents happened to work at C-Cubed, which happened to need someone to check its code on the weekends, and which also happened not to care if weekends turned into weeknights. Number four was that Gates just happened to find out about ISI, and ISI just happened to need someone to work on its payroll software. Number five was that Gates happened to live within walking distance of the University of Washington. Number six was that the university happened to have free computer time between three and six in the morning. Number seven was that TRW happened to call Bud Pembroke. Number eight was that the best programmers Pembroke knew for that particular problem happened to be two high school kids. And number nine was that Lakeside was willing to let those kids spend their spring term miles away, writing code.

And what did virtually all of those opportunities have in common? They gave Bill Gates extra time to practice. By the time Gates dropped out of Harvard after his sophomore year to try his hand at his own software company,

he'd been programming practically nonstop for seven consecutive years. He was *way* past ten thousand hours. How many teenagers in the world had the kind of experience Gates had? "If there were fifty in the world, I'd be stunned," he says. "There was C-Cubed and the payroll stuff we did, then TRW—all those things came together. I had a better exposure to software development at a young age than I think anyone did in that period of time, and all because of an incredibly lucky series of events."

6.

If we put the stories of hockey players and the Beatles and Bill Joy and Bill Gates together, I think we get a more complete picture of the path to success. Joy and Gates and the Beatles are all undeniably talented. Lennon and McCartney had a musical gift of the sort that comes along once in a generation, and Bill Joy, let us not forget, had a mind so quick that he was able to make up a complicated algorithm on the fly that left his professors in awe. That much is obvious.

But what truly distinguishes their histories is not their extraordinary talent but their extraordinary opportunities. The Beatles, for the most random of reasons, got invited to go to Hamburg. Without Hamburg, the Beatles might well have taken a different path. "I was very lucky," Bill Gates said at the beginning of our interview. That doesn't mean he isn't brilliant or an extraordinary entrepreneur. It just means that he understands what incredible good fortune it was to be at Lakeside in 1968.

All the outliers we've looked at so far were the beneficiaries of some kind of unusual opportunity. Lucky breaks don't seem like the exception with software billionaires and rock bands and star athletes. They seem like the rule.

Let me give you one final example of the hidden opportunities that outliers benefit from. Suppose we do another version of the calendar analysis we did in the previous chapter with hockey players, only this time looking at birth years, not birth months. To start with, take a close look at the following list of the seventy-five richest people in human history. The net worth of each person is calculated in current US dollars. As you can see, it includes queens and kings and pharaohs from centuries past, as well as contemporary billionaires, such as Warren Buffett and Carlos Slim.

No.	Name	Wealth in Billions (USD)	Origin	Company or Source of Wealth
1	John D. Rockefeller	318.3	United States	Standard Oil
2	Andrew Carnegie	298.3	Scotland	Carnegie Steel Company
3	Nicholas II of Russia	253.5	Russia	House of Romanov
4	William Henry Vanderbilt	231.6	United States	Chicago, Burlington and Quincy Railroad
5	Osman Ali Khan, Asaf Jah VII	210.8	Hyderabad	Monarchy

No.	Name	Wealth in Billions (USD)	Origin	Company or Source of Wealth
6	Andrew W. Mellon	188.8	United States	Gulf Oil
7	Henry Ford	188.1	United States	Ford Motor Company
8	Marcus Licinius Crassus	169.8	Roman Republic	Roman Senate
9	Basil II	169.4	Byzantine Empire	Monarchy
10	Cornelius Vanderbilt	167.4	United States	New York and Harlem Railroad
11	Alanus Rufus	166.9	England	Investments
12	Amenophis III	155.2	Ancient Egypt	Pharaoh
13	William de Warenne, 1st Earl of Surrey	153.6	England	Earl of Surrey
14	William II of England	151.7	England	Monarchy
15	Elizabeth I	142.9	England	House of Tudor
16	John D. Rockefeller Jr.	141.4	United States	Standard Oil
17	Sam Walton	128.0	United States	Wal-Mart
18	John Jacob Astor	115.0	Germany	American Fur Company
19	Odo of Bayeux	110.2	England	Monarchy
20	Stephen Girard	99.5	France	First Bank of the United States
21	Cleopatra	95.8	Ancient Egypt	Ptolemaic Inheritance
22	Stephen Van Rensselaer III	88.8	United States	Rensselaerswyck Estate

No.	Name	Wealth in Billions (USD)	Origin	Company or Source of Wealth
23	Richard B. Mellon	86.3	United States	Gulf Oil
24	Alexander Turney Stewart	84.7	Ireland	Long Island Rail Road
25	William Backhouse Astor Jr.	84.7	United States	Inheritance
26	Don Simon Iturbi Patiño	81.2	Bolivia	Huanuni tin mine
27	Sultan Hassanal Bolkiah	80.7	Brunei	Kral
28	Frederick Weyerhaeuser	80.4	Germany	Weyerhaeuser Corporation
29	Moses Taylor	79.3	United States	Citibank
30	Vincent Astor	73.9	United States	Inheritance
31	Carlos Slim Helú	72.4	Mexico	Telmex
32	T. V. Soong	67.8	China	Central Bank of China
33	Jay Gould	67.1	United States	Union Pacific
34	Marshall Field	66.3	United States	Marshall Field and Company
35	George F. Baker	63.6	United States	Central Railroad of New Jersey
36	Hetty Green	58.8	United States	Seaboard National Bank
37	Bill Gates	58.0	United States	Microsoft
38	Lawrence Joseph Ellison	58.0	United States	Oracle Corporation
39	Richard Arkwright	56.2	England	Derwent Valley Mills

No.	Name	Wealth in Billions (USD)	Origin	Company or Source of Wealth
40	Mukesh Ambani	55.8	India	Reliance Industries
41	Warren Buffett	52.4	United States	Berkshire Hathaway
42	Lakshmi Mittal	51.0	India	Mittal Steel Company
43	J. Paul Getty	50.1	United States	Getty Oil Company
44	James G. Fair	47.2	United States	Consolidated Virginia Mining Company
45	William Weightman	46.1	United States	Merck & Company
46	Russell Sage	45.1	United States	Western Union
47	John Blair	45.1	United States	Union Pacific
48	Anil Ambani	45.0	India	Reliance Communications
49	Leland Stanford	44.9	United States	Central Pacific Railroad
50	Howard Hughes Jr.	43.4	United States	Hughes Tool Company, Hughes Aircraft Company, Summa Corporation, TWA
51	Cyrus Curtis	43.2	United States	Curtis Publishing Company
52	John Insley Blair	42.4	United States	Delaware, Lackawanna and Western Railroad
53	Edward Henry Harriman	40.9	United States	Union Pacific Railroad

No.	Name	Wealth in Billions (USD)	Origin	Company or Source of Wealth
54	Henry H. Rogers	40.9	United States	Standard Oil Company
55	Paul Allen	40.0	United States	Microsoft, Vulcan Inc.
56	John Kluge	40.0	Germany	Metropolitan Broadcasting Company
57	J. P. Morgan	39.8	United States	General Electric, US Steel
58	Oliver H. Payne	38.8	United States	Standard Oil Company
59	Yoshiaki Tsutsumi	38.1	Japan	Seibu Corporation
60	Henry Clay Frick	37.7	United States	Carnegie Steel Company
61	John Jacob Astor IV	37.0	United States	Inheritance
62	George Pullman	35.6	United States	Pullman Company
63	Collis Potter Huntington	34.6	United States	Central Pacific Railroad
64	Peter Arrell Brown Widener	33.4	United States	American Tobacco Company
65	Philip Danforth Armour	33.4	United States	Armour Refrigerator Line
66	William S. O'Brien	33.3	United States	Consolidated Virginia Mining Company
67	Ingvar Kamprad	33.0	Sweden	IKEA

No.	Name	Wealth in Billions (USD)	Origin	Company or Source of Wealth
68	K. P. Singh	32.9	India	DLF Universal Limited
69	James C. Flood	32.5	United States	Consolidated Virginia Mining Company
70	Li Ka-shing	32.0	China	Hutchison Whampoa Limited
71	Anthony N. Brady	31.7	United States	Brooklyn Rapid Transit
72	Elias Hasket Derby	31.4	United States	Shipping
73	Mark Hopkins	30.9	United States	Central Pacific Railroad
74	Edward Clark	30.2	United States	Singer Sewing Machine
75	Prince Al-Waleed bin Talal	29.5	Saudi Arabia	Kingdom Holding Company

Do you know what's interesting about that list? Of the seventy-five names, an astonishing fourteen are Americans born within nine years of one another in the mid-nineteenth century. Think about that for a moment. Historians start with Cleopatra and the pharaohs and comb through every year in human history every since, looking in every corner of the world for evidence of extraordinary wealth, and almost 20 percent of the names they end up with come from a single generation in a single country.

Here's the list of those Americans and their birth years:

1. John D. Rockefeller, 1839
2. Andrew Carnegie, 1835
28. Frederick Weyerhaeuser, 1834
33. Jay Gould, 1836
34. Marshall Field, 1834
35. George F. Baker, 1840
36. Hetty Green, 1834
44. James G. Fair, 1831
54. Henry H. Rogers, 1840
57. J. P. Morgan, 1837
58. Oliver H. Payne, 1839
62. George Pullman, 1831
64. Peter Arrell Brown Widener, 1834
65. Philip Danforth Armour, 1832

What's going on here? The answer becomes obvious if you think about it. In the 1860s and 1870s, the American economy went through perhaps the greatest transformation in its history. This was when the railroads were being built and when Wall Street emerged. It was when industrial manufacturing started in earnest. It was when all the rules by which the traditional economy had functioned were broken and remade. What this list says is that it really matters how old you were when that transformation happened.

If you were born in the late 1840s you missed it. You were too young to take advantage of that moment. If you were born in the 1820s you were too old: your mind-set was shaped by the pre–Civil War paradigm. But there was a particular, narrow nine-year window that was just perfect for seeing the potential that the future held. All of the fourteen men and women on the list above had vision and talent. But they also were given an extraordinary opportunity, in the same way that hockey and soccer players born in January, February, and March are given an extraordinary opportunity.*

Now let's do the same kind of analysis for people like Bill Joy and Bill Gates.

If you talk to veterans of Silicon Valley, they'll tell you that the most important date in the history of the personal computer revolution was January 1975. That was when the magazine *Popular Electronics* ran a cover story on an extraordinary machine called the Altair 8800. The Altair cost $397. It was a do-it-yourself contraption that you could assemble at home. The headline on the story read: "PROJECT BREAKTHROUGH! World's First Minicomputer Kit to Rival Commercial Models."

To the readers of *Popular Electronics,* in those days the bible of the fledgling software and computer world, that headline was a revelation. Computers up to that point had

* The sociologist C. Wright Mills made an additional observation about that special cohort from the 1830s. He looked at the backgrounds of the American business elite from the Colonial Era to the twentieth century. In most cases, not surprisingly, he found that business leaders tended to come from privileged backgrounds. The one exception? The 1830s group. That shows how big the advantage was of being born in that decade. It was the only time in American history when those born in modest circumstances had a realistic shot at real riches. He writes: "The best time during the history of the United States for the poor boy ambitious for high business success to have been born was around the year 1835."

been the massive, expensive mainframes of the sort sitting in the white expanse of the Michigan Computer Center. For years, every hacker and electronics whiz had dreamt of the day when a computer would come along that was small and inexpensive enough for an ordinary person to use and own. That day had finally arrived.

If January 1975 was the dawn of the personal computer age, then who would be in the best position to take advantage of it? The same principles apply here that applied to the era of John Rockefeller and Andrew Carnegie.

"If you're too old in nineteen seventy-five, then you'd already have a job at IBM out of college, and once people started at IBM, they had a real hard time making the transition to the new world," says Nathan Myhrvold, who was a top executive at Microsoft for many years. "You had this multibillion-dollar company making mainframes, and if you were part of that, you'd think, Why screw around with these little pathetic computers? That was the computer industry to those people, and it had nothing to do with this new revolution. They were blinded by that being the only vision of computing. They made a nice living. It's just that there was no opportunity to become a zillionaire and make an impact on the world."

If you were more than a few years out of college in 1975, then you belonged to the old paradigm. You had just bought a house. You're married. A baby is on the way. You're in no position to give up a good job and pension for some pie-in-the-sky $397 computer kit. So let's rule out all those born before, say, 1952.

At the same time, though, you don't want to be too

young. You really want to get in on the ground floor, right in 1975, and you can't do that if you're still in high school. So let's also rule out anyone born after, say, 1958. The perfect age to be in 1975, in other words, is old enough to be a part of the coming revolution but not so old that you missed it. Ideally, you want to be twenty or twenty-one, which is to say, born in 1954 or 1955.

There is an easy way to test this theory. When was Bill Gates born?

Bill Gates: October 28, 1955

That's the perfect birth date! Gates is the hockey player born on January 1. Gates's best friend at Lakeside was Paul Allen. He also hung out in the computer room with Gates and shared those long evenings at ISI and C-Cubed. Allen went on to found Microsoft with Bill Gates. When was Paul Allen born?

Paul Allen: January 21, 1953

The third-richest man at Microsoft is the one who has been running the company on a day-to-day basis since 2000, one of the most respected executives in the software world, Steve Ballmer. Ballmer's birth date?

Steve Ballmer: March 24, 1956

Let's not forget a man every bit as famous as Gates: Steve Jobs, the cofounder of Apple Computer. Unlike Gates,

Jobs wasn't from a rich family and he didn't go to Michigan, like Joy. But it doesn't take much investigation of his upbringing to realize that he had his Hamburg too. He grew up in Mountain View, California, just south of San Francisco, which is the absolute epicenter of Silicon Valley. His neighborhood was filled with engineers from Hewlett-Packard, then as now one of the most important electronics firms in the world. As a teenager he prowled the flea markets of Mountain View, where electronics hobbyists and tinkerers sold spare parts. Jobs came of age breathing the air of the very business he would later dominate.

This paragraph from *Accidental Millionaire,* one of the many Jobs biographies, gives us a sense of how extraordinary his childhood experiences were. Jobs

> attended evening talks by Hewlett-Packard scientists. The talks were about the latest advances in electronics and Jobs, exercising a style that was a trademark of his personality, collared Hewlett-Packard engineers and drew additional information from them. Once he even called Bill Hewlett, one of the company's founders, to request parts. Jobs not only received the parts he asked for, he managed to wrangle a summer job. Jobs worked on an assembly line to build computers and was so fascinated that he tried to design his own...

Wait. *Bill Hewlett gave him spare parts?* That's on a par with Bill Gates getting unlimited access to a time-share terminal at age thirteen. It's as if you were interested in fashion and your neighbor when you were growing up happened to be Giorgio Armani. And when was Jobs born?

Steve Jobs: February 24, 1955

Another of the pioneers of the software revolution was Eric Schmidt. He ran Novell, one of Silicon Valley's most important software firms, and in 2001, he became the chief executive officer of Google. Birth date?

Eric Schmidt: April 27, 1955

I don't mean to suggest, of course, that every software tycoon in Silicon Valley was born in 1955. Some weren't, just as not every business titan in the United States was born in the mid-1830s. But there are very clearly patterns here, and what's striking is how little we seem to want to acknowledge them. We pretend that success is exclusively a matter of individual merit. But there's nothing in any of the histories we've looked at so far to suggest things are that simple. These are stories, instead, about people who were given a special opportunity to work really hard and seized it, and who happened to come of age at a time when that extraordinary effort was rewarded by the rest of society. Their success was not just of their own making. It was a product of the world in which they grew up.

By the way, let's not forget Bill Joy. Had he been just a little bit older and had he had to face the drudgery of programming with computer cards, he says, he would have studied science. Bill Joy the computer legend would have been Bill Joy the biologist. And had he come along a few years later, the little window that gave him the chance to write the supporting code for the Internet would have

closed. Again, Bill Joy the computer legend might well have been Bill Joy the biologist. When was Bill Joy born?

Bill Joy: November 8, 1954

Joy would go on, after his stint at Berkeley, to become one of the four founders of Sun Microsystems, one of the oldest and most important of Silicon Valley's software companies. And if you still think that accidents of time and place and birth don't matter all that much, here are the birthdays of the three other founders of Sun Microsystems:

Scott McNealy: November 13, 1954
Vinod Khosla: January 28, 1955
Andy Bechtolsheim: September 30, 1955

CHAPTER THREE

The Trouble with Geniuses, Part 1

"KNOWLEDGE OF A BOY'S IQ IS OF LITTLE HELP IF YOU ARE FACED WITH A FORMFUL OF CLEVER BOYS."

1.

In the fifth episode of the 2008 season, the American television quiz show *1 vs. 100* had as its special guest a man named Christopher Langan.

The television show *1 vs. 100* is one of many that sprang up in the wake of the phenomenal success of *Who Wants to Be a Millionaire*. It features a permanent gallery of one hundred ordinary people who serve as what is called the "mob." Each week they match wits with a special invited guest. At stake is a million dollars. The guest has to be smart enough to answer more questions correctly than his or her one hundred adversaries—and by that standard, few have ever seemed as superbly qualified as Christopher Langan.

"Tonight the mob takes on their fiercest competition yet," the voice-over began. "Meet Chris Langan, who many