was doing something else, too. At one point Chris Pittaro said that the thing that struck him about Billy—what set him apart from most baseball insiders—was his desire to find players unlike himself. Billy Beane had gone looking for, and found, his antitheses. Young men who failed the first test of looking good in a uniform. Young men who couldn't play anything but baseball. Young men who had gone to college.

The fat scout ambles in. He's one of the older scouts, and like most of the others, he'll leave the Oakland A's at the end of the season, and find a team that cares about what he knows. All these misshapen players coming in will drive all of these old scouts out. But for now the older scouts are, mainly, amused. "Just talked to Kiger," the fat scout says laconically. Mark Kiger plays shortstop for the University of Florida. A machine for wearing down opposing pitchers, and getting himself on base. Too small to play pro ball—or so they said. Now a fifth-round draft choice of the Oakland A's.

"What did he say?" asks Billy

"'Thank you. Thank you. Thank you,'" says the fat scout, and then laughs. "He just wanted to get drafted."

It counted as one of the happiest days of Billy Beane's career. He can't have known whether he had simply found a new way of fixing irrational hopes upon a young man, or if he had, as he hoped, eliminated hope from the equation. But he thought he knew. At the end of the day he actually looked up with a big smile and said, "This is maybe the funnest day I have ever had in baseball." Then he walked out the back door of the draft room and into the Coliseum. He had another, bigger missile to fire at the conventional wisdom of major league baseball. It was called the Oakland A's.

Chapter Six

THE SCIENCE OF WINNING AN UNFAIR GAME

THERE WAS NO simple way to approach the problem that Billy Beane was trying to solve. It read like an extra credit question on an algebra quiz: You have $40 million to spend on twenty-five baseball players. Your opponent has already spent $126 million on its own twenty-five players, and holds perhaps another $100 million in reserve. What do you do with your forty million to avoid humiliating defeat? "What you don't do," said Billy, "is what the Yankees do. If we do what the Yankees do, we lose every time, because they're doing it with three times more money than we are." A poor team couldn't afford to go out shopping for big league stars in the prime of their careers. It couldn't even afford to go out and buy averagely priced players. The average big league salary was $2.3 million. The average A's opening day salary was a bit less than $1.5 million. The poor team was forced to find bargains: young players and whatever older guys the market had undervalued. It would seem highly unlikely, given the wage inflation in pro baseball over the past twenty-five years, that

any established big league player was underpriced. If the market was even close to rational, all the real talent would have been bought up by the rich teams, and the Oakland A's wouldn't have stood a chance. Yet they stood a chance. Why?

Oddly enough, Major League Baseball had asked that very question, in its own half-assed, incurious way. After the 1999 season, Major League Baseball had created something it called the Commissioner's Blue Ribbon Panel on Baseball Economics, whose job it was to produce a document called *The Blue Ribbon Panel Report*. Its stated purpose was to examine "the question of whether baseball's current economic system has created a problem of competitive imbalance in the game." The baseball commissioner, Bud Selig, had invited four men of sound reputation—former U.S. senator George Mitchell, Yale president Richard Levin, the columnist George Will, and former chairman of the U.S. Federal Reserve Paul Volcker—to write a report on the economic inequalities in baseball. Selig owned maybe the most pathetic poor team in all of baseball, the Milwaukee Brewers. He no doubt wanted to believe that the Brewers' trouble was poverty, not stupidity. He had an obvious financial interest in the commission reaching the conclusion that players' salaries needed to be constrained and that rich teams should subsidize poor ones. He expressed this interest by trying to pad the Blue Ribbon Panel Commission with other owners of poor, pathetic baseball teams. But the four eminences objected to this transparent attempt to undermine their authority, and Selig agreed that the owners would merely sit in the room, observing the eminences deliberate.

It didn't matter. In July 2000, the panel did pretty much exactly what Bud Selig hoped it would do: conclude that poor teams didn't stand a chance, that their hopelessness was Bad for Baseball, and that a way must be found to minimize the distinction between rich and poor teams. George Will, the conservative columnist, was, oddly enough, the most outspoken proponent of baseball socialism. One dramatic fact Will often used to incite alarm was

that the ratio of the payrolls of the seven richest and seven poorest teams in baseball was 4:1, while in pro basketball it was 1.75:1 and in pro football 1.5:1. Baseball was the major American sport in which money bought success, he said, and that was a crime against the game. When fans of the Brewers and the Royals and the Devil Rays figured out that their teams existed only so that the New York Yankees might routinely pummel them, they would abandon the sport altogether. At stake was nothing less than the future of professional baseball.

There was something to be said for these arguments but there was also something to be said against them, and, according to two people who watched the proceedings, only one commissioner was willing to say it: Paul Volcker. Volcker was also the only commissioner with a financial background. To the growing annoyance of the others, he kept asking two provocative questions:

1. If poor teams were in such dire financial condition, why did rich guys keep paying higher prices to buy them?
2. If poor teams had no hope, how did the Oakland A's, with the second lowest payroll in all of baseball, win so many games?

The owners didn't have a good answer to the first question, but to answer the second they dragged in Billy Beane to explain himself. The odd thing was that the previous season, 1999, the A's had finished 87–75 and missed the play-offs. Still, they had improved dramatically from 1998, Billy's first year on the job, when they'd gone 74–88. And they were looking even stronger in 2000. Volcker smelled a rat. If results in pro baseball were so clearly determined by financial resources, how could there be even a single exception? How could a poor team improve so dramatically? Paul DePodesta wrote Billy Beane's presentation and Billy flew off to New York to explain to Volcker why he was a fluke. He was happy to do it. He hadn't the slightest interest in stopping the Blue Ribbon Panel from concluding that his life was unfair. He'd be

delighted to see the cost of players constrained, or, even better, the Yankees made to give him some of their money. When he got up before the panel, Billy flashed a slide up on the overhead projector. It read:

> "MAJOR LEAGUE"
> *Movie about the hapless Cleveland Indians
>
> In order to assemble a losing team, the owner distributes a list of players to be invited to spring training. The baseball executives say that most of these players are way past their prime. Fans see the list in the paper and remark, "I've never even heard of half these guys."
>
> Our situation closely resembles the movie.

When it suited his purposes Billy could throw the best pity party this side of the Last Supper. He told the Blue Ribbon Panel that the Oakland A's inability to afford famous stars meant that no matter how well the team performed, the fans stayed away—which was the opposite of the truth. All the A's marketing studies showed that the main thing fans cared about was winning. Win with nobodies and the fans showed up, and the nobodies *became* stars; lose with stars and the fans stayed home, and the stars became nobodies. Assembling nobodies into a ruthlessly efficient machine for winning baseball games, and watching them become stars, was one of the pleasures of running a poor baseball team.

Billy also told the Blue Ribbon Panel that his inability to pay the going rate for baseball players meant that his success was likely to be ephemeral. It might have been what they wanted to hear but it wasn't what he believed. What he believed was what Paul Volcker seemed to suspect, that the market for baseball players was so inefficient, and the general grasp of sound baseball strategy so weak, that superior management could still run circles around taller piles of cash. He then went out and created more evidence in support of his belief. Having won 87 games in 1999, the Oakland A's went on to win 91 games in 2000, and an astonishing 102 games in 2001, and made the play-offs both years.

They weren't getting worse, they were getting better. The rapidly expanding difference between the size of everyone else's money pile and Oakland's had no apparent effect. Each year the Oakland A's seemed more the financial underdog and each year they won more games. Maybe they were just lucky. Or maybe they knew something other people didn't. Maybe they were, as they privately thought, becoming more *efficient*. When, in 2001, for the second year in a row, they lost to the Yankees in the fifth and deciding game of the play-offs, the Oakland front office was certain that theirs had been the better team and that it was the Yankees who had gotten lucky—and that the Yankees front office knew it. And that some fraction of the $120 million the Yankees had paid Jason Giambi after the 2001 play-offs to lure him away from the Oakland A's was to prevent him from ever again playing for the Oakland A's.

At any rate, by the beginning of the 2002 season, the Oakland A's, by winning so much with so little, had become something of an embarrassment to Bud Selig and, by extension, Major League Baseball. "An aberration" is what the baseball commissioner, and the people who worked for him, called the team, and when you asked them what they meant by that nebulous word, they said, though not for attribution, "They've been lucky." This was the year the luck of the A's was meant to run out. The relative size of the team's payroll had shrunk yet again. The *difference* between the Yankees' and A's opening day payrolls had ballooned from $62 million in 1999 to $90 million in 2002. The Blue Ribbon Panel's nightmare scenario for poor teams had become a reality for the 2002 Oakland A's. They had lost to free agency—and thus, to richer teams—three of their proven stars: Jason Isringhausen, Johnny Damon, and Giambi.

To a financial determinist like Bud Selig, the wonder must have

been that they hadn't simply given up. Of course, no one in pro sports ever admits to quitting. But it was perfectly possible to abandon all hope of winning and at the same time show up every day for work to collect a paycheck. Professional sports had a word for this: "rebuilding." That's what half a dozen big league teams did more or less all the time. The Kansas City Royals had been rebuilding for the past four or five years. Bud Selig's Brewers had been taking a dive for at least a decade. The A's didn't do this, for the simple reason that they actually believed they were going to keep on winning—perhaps not so many games as they had in 2001, but enough to get themselves back to the play-offs.

Before the 2002 season, Paul DePodesta had reduced the coming six months to a math problem. He judged how many wins it would take to make the play-offs: 95. He then calculated how many more runs the Oakland A's would need to score than they allowed to win 95 games: 135. (The idea that there was a stable relationship between season run totals and season wins was another Jamesean discovery.) Then, using the A's players' past performance as a guide, he made reasoned arguments about how many runs they would actually score and allow. If they didn't suffer an abnormally large number of injuries, he said, the team would score between 800 and 820 runs and give up between 650 and 670 runs.* From that he predicted the team would win between 93 and 97 games and probably wind up in the play-offs. "There aren't a lot of teams that win ninety-five games and don't make it to the play-offs," he said. "If we win ninety-five games and don't make the play-offs, we're fine with that."

The 2001 Oakland A's had won 102 regular season games. The 2002 Oakland A's entered the season without the three players widely regarded by the market to be among their best and the expected result was a net loss of seven wins. How could that be? The only way to understand the math was to look a bit more

* They wound up scoring 800 and allowing 653.

closely at what, exactly, the team lost, or believed they lost, when other, richer teams hired away each of the three stars.

The first, and easiest, player to understand was their old flame-throwing closer, Jason Isringhausen. When Billy Beane had traded for him in the middle of the 1999 season, Isringhausen was pitching in the minor leagues with the New York Mets. To get him and a more expensive pitcher named Greg McMichael *and* the money to pay McMichael's salary, all Billy Beane had given up was his own established closer, Billy Taylor. Taylor, who ceased to be an effective pitcher more or less immediately upon joining the Mets, Billy Beane had himself plucked from the minor leagues for a few thousand dollars a few years earlier.

The central insight that led him both to turn minor league nobodies into successful big league closers and to refuse to pay them the many millions a year they demanded once they became free agents was that it was more efficient to create a closer than to buy one. Established closers were systematically overpriced, in large part because of the statistic by which closers were judged in the marketplace: "saves." The very word made the guy who achieved them sound vitally important. But the situation typically described by the save—the bases empty in the ninth inning with the team leading—was clearly far less critical than a lot of other situations pitchers faced. The closer's statistic did not have the power of language; it was just a number. You could take a slightly above average pitcher and drop him into the closer's role, let him accumulate some gaudy number of saves, and then sell him off. You could, in essence, buy a stock, pump it up with false publicity, and sell it off for much more than you'd paid for it. Billy Beane had already done it twice, and assumed he could do so over and over again.

Jason Isringhausen's departure wasn't a loss to the Oakland A's but a happy consequence of a money machine known as "Selling the Closer." In return for losing Isringhausen to the St. Louis Cardinals, the A's had received two new assets: the Cardinals' first-

round draft pick, along with a first-round compensation pick. The former they'd used to draft Benjamin Fritz, a pitcher they judged to have a brighter and cheaper future than Isringhausen; the latter, to acquire Jeremy Brown.

The Blue Ribbon Commission had asked the wrong question. The question wasn't whether a baseball team could keep its stars even after they had finished with their six years of indentured servitude and became free agents. The question was: how did a baseball team find stars in the first place, and could it find new ones to replace the old ones it lost? How fungible were baseball players? The short answer was: a lot more fungible than the people who ran baseball teams believed.

Finding pitchers who could become successful closers wasn't all that difficult. To fill the hole at the back of his bullpen Billy had traded to the Toronto Blue Jays a minor league third baseman, Eric Hinske, for Billy Koch, another crude fireballer. He knew that Hinske was very good—he'd wind up being voted 2002 Rookie of the Year in the American League—but the Oakland A's already had an even better third baseman, Eric Chavez. Plus, Billy knew that, barring some disaster, Koch, too, would gain a lot of value as an asset. Koch would get his saves and be perceived by other teams to be a much more critical piece of a successful team than he actually was, whereupon the A's would trade him for something cheaper, younger, and possibly even better.

The loss of Johnny Damon, the A's former center fielder, presented a different sort of problem. When Damon signed with Boston, the A's took the Red Sox's first-round pick (to select Nick Swisher) plus a compensation pick. But Damon left two glaring holes: on defense in center field, on offense in the leadoff spot. Of the two the offense was the easiest to understand, and dismiss. When fans watched Damon, they saw the sort of thrilling leadoff hitter that a team simply had to have if it wanted to be competitive. When the A's front office watched Damon, they saw something else: an imperfect understanding of where runs come from.

Paul DePodesta had been hired by Billy Beane before the 1999 season, but well before that he had studied the question of why teams win. Not long after he'd graduated from Harvard, in the mid-nineties, he'd plugged the statistics of every baseball team from the twentieth century into an equation and tested which of them correlated most closely with winning percentage. He'd found only two, both offensive statistics, inextricably linked to baseball success: on-base percentage and slugging percentage. Everything else was far less important.

Not long after he arrived in Oakland, Paul asked himself a question: what was the relative importance of on-base and slugging percentage? His answer began with a thought experiment: if a team had an on-base percentage of 1.000 (referred to as "a thousand")—that is, every hitter got on base—how many runs would it score?* An infinite number of runs, since the team would never make an out. If a team had a slugging percentage of 1.000—meaning, it gained a base for each hitter that came to the plate—how many runs would it score? That depended on how it was achieved, but it would typically be a lot less than an infinite number. A team might send four hitters to the plate in an inning, for instance. The first man hits a home run, the next three make outs. Four plate appearances have produced four total bases and thus a slugging percentage of 1.000 and yet have scored only one run in the inning.

* These "percentages" are designed to drive anyone who thinks twice about them mad. It's one thing to give 110 percent for the team, but it is another to get on base 1,000 percent of the time. On-base "percentage" is actually on-base "per thousand." A batter who gets on base four out of ten times has an on-base "percentage" of four hundred (.400). Slugging "percentage" is even more mind-bending, as it is actually "per four thousand." A perfect slugging "percentage"—achieved by hitting a home run every time—is four thousand: four bases for every plate appearance. But for practical purposes, on-base and slugging are assumed to be measured on identical scales. At any rate, the majority of big league players have on-base percentages between three hundred (.300) and four hundred (.400) and slugging percentages between three hundred and fifty (.350) and five hundred and fifty (.550).

Baseball fans and announcers were just then getting around to the Jamesean obsession with on-base and slugging percentages. The game, slowly, was turning its attention to the new statistic, OPS (on base plus slugging). OPS was the simple addition of on-base and slugging percentages. Crude as it was, it was a much better indicator than any other offensive statistic of the number of runs a team would score. Simply adding the two statistics together, however, implied they were of equal importance. If the goal was to raise a team's OPS, an extra percentage point of on-base was as good as an extra percentage point of slugging.

Before his thought experiment Paul had felt uneasy with this crude assumption; now he saw that the assumption was absurd. An extra point of on-base percentage was clearly more valuable than an extra point of slugging percentage—but by how much? He proceeded to tinker with his own version of Bill James's "Runs Created" formula. When he was finished, he had a model for predicting run production that was more accurate than any he knew of. In his model an extra point of on-base percentage was worth three times an extra point of slugging percentage.

Paul's argument was radical even by sabermetric standards. Bill James and others had stressed the importance of on-base percentage, but even they didn't think it was worth three times as much as slugging. Most offensive models assumed that an extra point of on-base percentage was worth, at most, one and a half times an extra point of slugging percentage. In major league baseball itself, where on-base percentage was not nearly so highly valued as it was by sabermetricians, Paul's argument was practically heresy.

Paul walked across the hall from his office and laid out his argument to Billy Beane, who thought it was the best argument he had heard in a long time. Heresy was good: heresy meant opportunity. A player's ability to get on base—especially when he got on base in unspectacular ways—tended to be dramatically underpriced in relation to other abilities. Never mind fielding skills and foot speed. The ability to get on base—to avoid making outs—was

underpriced compared to the ability to hit with power. The one attribute most critical to the success of a baseball team was an attribute they could afford to buy. At that moment, what had been a far more than ordinary interest in a player's ability to get on base became, for the Oakland A's front office, an obsession.

To most of baseball Johnny Damon, on offense, was an extraordinarily valuable leadoff hitter with a gift for stealing bases. To Billy Beane and Paul DePodesta, Damon was a delightful human being, a pleasure to have around, but an easily replaceable offensive player. His on-base percentage in 2001 had been .324, or roughly 10 points below the league average. True, he stole some bases, but stealing bases involved taking a risk the Oakland front office did not trust even Johnny Damon to take. The math of the matter changed with the situation, but, broadly speaking, an attempted steal had to succeed about 70 percent of the time before it contributed positively to run totals.

The offense Damon had provided the 2001 Oakland A's was fairly easy to replace; Damon's defense was not. The question was how to measure what the Oakland A's lost when Terrence Long, and not Johnny Damon, played center field. The short answer was that they couldn't, not precisely. But they could get closer than most to an accurate answer—or thought that they could. Something had happened since Bill James first complained about the meaninglessness of fielding statistics. That something was new information, and a new way of thinking about an old problem. Oddly, the impulse to do this thinking had arisen on Wall Street.

In the early 1980s, the U.S. financial markets underwent an astonishing transformation. A combination of computing power and intellectual progress led to the creation of whole new markets in financial futures and options. Options and futures were really just fragments of stocks and bonds, but the fragments soon became so arcane and inexplicable that Wall Street created a sin-

gle word to describe them all: "derivatives." In one big way these new securities differed from traditional stocks and bonds: they had a certain, precisely quantifiable, value. It was impossible for anyone to say what a simple stock or bond should be worth. Their value was a matter of financial opinion; they were worth whatever the market said they were worth. But *fragments* of a stock or bond, when you glued them back together, must be worth exactly what the stock or bond was worth. If they were worth more or less than the original article, the market was said to be "inefficient," and a trader could make a fortune trading the fragments against the original.

For the better part of a decade there were huge, virtually riskless profits to be made by people who figured this out. The sort of people who quickly grasped the math of the matter were not typical traders. They were highly trained mathematicians and statisticians and scientists who had abandoned whatever they were doing at Harvard or Stanford or MIT to make a killing on Wall Street. The fantastic sums of money hauled in by the sophisticated traders transformed the culture on Wall Street, and made quantitative analysis, as opposed to gut feel, the respectable way to go about making bets in the market. The chief economic consequence of the creation of derivative securities was to price risk more accurately, and distribute it more efficiently, than ever before in the long, risk-obsessed history of financial man. The chief social consequence was to hammer into the minds of a generation of extremely ambitious people a new connection between "inefficiency" and "opportunity," and to reinforce an older one, between "brains" and "money."

Ken Mauriello and Jack Armbruster had been part of that generation. Ken analyzed the value of derivative securities, and Jack traded them, for one of the more profitable Chicago trading firms. Their firm priced financial risk as finely as it had ever been priced. "In the late 1980s Kenny started looking at taking the same approach to Major League baseball players," said Armbruster.

"Looking at the places where the stats don't tell the whole truth—or even lie about the situation." Mauriello and Armbruster's goal was to value the events that occurred on a baseball field more accurately than they ever had been valued. In 1994, they stopped analyzing derivatives and formed a company to analyze baseball players, called AVM Systems.

Ken Mauriello had seen a connection between the new complex financial markets and baseball: "the inefficiency caused by sloppy data." As Bill James had shown, baseball data conflated luck and skill, and simply ignored a lot of what happened during a baseball game. With two outs and a runner on second base a pitcher makes a great pitch: the batter hits a bloop into left field that would have been caught had the left fielder not been Albert Belle. The shrewd runner at second base, knowing that Albert Belle is slow not just to the ball but also to the plate, beats the throw home. In the record books the batter was credited with having succeeded, the pitcher with having failed, and the left fielder and the runner with having been present on the scene. This was a grotesque failure of justice. The pitcher and runner deserved to have their accounts credited, the batter and left fielder to have theirs debited (the former should have popped out; the latter somehow had avoided committing an "error" and at the same time put runs on the board for the other team).

There was hardly a play in baseball that, to be precisely valued, didn't need to be adjusted for the players involved, or the ballpark in which it occurred. What AVM's system really wanted to know was: in every event that occurs on a baseball field, how—and how much—should the players involved be held responsible, and therefore debited and credited? Answer the question and you could answer many others. For example: How many doubles does Albert Belle need to hit to make up for the fly balls he doesn't catch?

How to account for a player's performances was obvious: runs. Runs were the money of baseball, the common denominator of everything that occurred on a field. *How much* each tiny event on

a baseball field was worth was a more complicated issue. AVM dealt with it by collecting ten years of data from major league baseball games, of every ball that was put into play. Every event that followed a ball being put into play was compared by the system to what had typically happened during the previous ten years. "No matter what happens in a baseball game," said Armbruster, "it has happened thousands of times before." The performance of the players involved was always judged against the average.

A lot of this was no different from what Bill James and Dick Cramer had set out to do ten years earlier, when they created STATS Inc. The original contribution to new baseball knowledge of AVM Systems was how much more precisely it analyzed data, and how much more exactly it valued the performances of the players. Mauriello and Armbruster began by turning every major league diamond into a mathematical matrix of location points. Every point they marked with a number. They then reclassified every ball that was hit. There was no such thing in their record as a double; that was too sloppy. There were no such thing as pop flies, line drives, and grounders: finer distinctions needed to be made. A ball was hit with a certain velocity and trajectory to a certain grid on the field. In the AVM recording of a baseball game, a line drive double in the left-center gap became a ball hit with a certain force that landed on point #643.

The system then carved up what happened in every baseball play into countless tiny, meaningful fragments. Derivatives. "There are all sorts of things that happen in the context of a baseball play," said Armbruster, "that just never got recorded." A tiny example: after a single to right field a runner who had been on first base, seeing that Raul Mondesi is the right fielder, stops at second base instead of dashing to third. Runners seldom tried to go from first to third on balls hit to right field when Raul Mondesi was playing there. That was obviously worth something: what? Just as it never occurred to anyone on Wall Street to think about the value of pieces of a stock or a bond until there was a pile of money

to be made from the exercise, it never occurred to anyone in the market for baseball players to assign values to the minute components of a baseball player's performance—until baseball players became breathtakingly expensive.

Bill James's work had been all about challenging the traditional understanding of the game, by questioning the meaning of its statistics. The financial experts at AVM took this idea even further, by recording the events that occurred on a baseball field without any reference whatsoever to the traditional statistics. It wasn't just circumstantial statistics such as "RBIs" and "saves" that the AVM model ignored. It ignored all conventional baseball statistics. The system replaced the game seen by the ordinary fan with an abstraction. In AVM's computers the game became a collection of derivatives, a parallel world in which baseball players could be evaluated more accurately than they were evaluated in the real world.

Paul DePodesta was an intern for the Cleveland Indians when he met the former Wall Street traders turned baseball analysts, making their first sales trip around Major League Baseball. He remembers his reaction to their presentation: *Oh my God.* "It opened my eyes for me," said Paul. "The biggest thing that AVM does is extract the element of luck. Everyone in baseball knows how much luck is involved in the game but they all say, 'The luck evens out.' What AVM was saying is that it doesn't. It's not good enough to say, 'Aw, it just evens out.'"

An insight born in the financial markets took root in the minds of a young man who would soon have the power to put it to use inside Major League Baseball. Not long after Billy Beane had hired Paul DePodesta, in 1998, Paul persuaded Billy to hire AVM Systems. "They were still interesting to me," Paul said, "because they weren't churning conventional statistics in unconventional ways, which is what everyone else does." AVM Systems was a luxury only a rich team could afford but that only a poor team, desperate for any edge, would think to use. Billy and Paul used the

AVM system for a couple of years and then, to save money, copied what AVM did. Once Paul finished replicating the parallel world of derivatives, he and Billy could begin to answer more accurately the question about Johnny Damon's defense.

Every event on a baseball field Paul understood as having an "expected run value." You don't need to be able to calculate expected run values to understand them. Everything that happens on a baseball field alters, often very subtly, a team's chances of scoring runs. Every event on a baseball field changes, often imperceptibly, the state of the game. For example, the value of having no runners on base with nobody out and no count on the batter is roughly .55 runs, because that is what a baseball team, on average, will score in that situation. If the batter smacks a double, he changes the "state" of the game: it's now nobody out with a runner on second base. The expected run value of that new "state" is 1.1 runs. It follows that the contribution of a leadoff double to a team's expected runs is .55 runs (1.1 minus .55). If the batter, instead of hitting a double, strikes out, he lowers the team's expected run value to roughly .30 runs. The cost of making that out was therefore .25 runs—the difference between the value of the original state of the game and the state the batter left it in.

But those calculations really only scratch the surface of the problem. If you want to strip out the luck and get to a deeper understanding of the value of a player's performance you have to pose the baseball equivalent of existential questions. For instance: what is a double? It really isn't enough to say that a double is when a runner hits a ball and gets to second base without a fielder's error. Anyone who has seen a baseball game knows that all doubles are not alike. There are doubles that should have been caught—just as there are balls that are hit that should have been doubles but were plucked from the air by preternaturally gifted fielders. There are lucky doubles and unlucky outs. To strip out the luck what you need, really, is something like a Platonic idea of a double.

A set of Platonic ideas is one of the gifts the Wall Street traders gave to Paul DePodesta. The precision of the AVM system, copied by Paul, enabled him to think about every event that occurred on a baseball field in a new and more satisfying way. Any ball hit anyplace on a baseball field had been hit just that way thousands of times before: the average of all those hits was the Platonic idea. Call it a line drive hit at *x* trajectory and *y* speed to point #968. From the ten years worth of data, you can see that there have been 8,642 practically identical hits. You can see that 92 percent of the time the hit went for a double, 4 percent for a single, and 4 percent it was caught. Suppose the average value of that event is .50 of a run. *No matter what actually happened,* the system credits the hitter with having generated .50 of a run, and the pitcher with having given up .50 of a run. If Johnny Damon happens to get one of his trademark jumps and makes a sprawling catch, he is credited with saving his team .50 of a run.

The beauty of the value of that hit (or catch) was that the game gave it to you; the game *told* you how valuable every event was, by telling you how valuable it had been, on average, over the past ten years. By listening to what the game told him about the value of events, Paul could take every ball hit between in the area broadly defined as center field and determine its "expected run value."

Which brings us back to Johnny Damon. Over the 2001 season many hundreds of balls had been hit by opponents of the Oakland A's in the vicinity typically covered by the center fielder. By totaling up the outcomes when Johnny Damon was in the field, and comparing them to the average, Paul was able to see how many runs Damon had saved the team. He was also able to estimate how many runs Damon's likely replacement, Terrence Long, would cost the team. Some of this you could see with the naked eye, of course. You could see Johnny Damon break the instant the ball left the bat. You could see Terrence Long freeze, or even take off in the wrong direction, when the ball was in midflight. You didn't

really need Wall Street traders to tell you which one was the better center fielder. The system born on Wall Street simply helped Paul to put a price on the difference. There was no longer any need to guess. There was no need for gut instinct, or conventional fielding statistics. The total cost of having Terrence Long, rather than Johnny Damon, in center field was fifteen runs, or about a run every ten games.

Fifteen runs was not a trivial number. In the end, Paul concluded that Johnny Damon's fielding was more important than Billy Beane believed—the first pamphlet Billy had read on the subject had said that fielding was "no more than 5%" of baseball—but not so much more that you wanted to pay Johnny Damon the $8 million a year his agent was asking for. And the truth was that you still couldn't make perfectly definitive statements about fielding. "There was still no exact number," Paul said, "because the system doesn't measure where a defensive player started from. It doesn't tell you how far a guy had to go to catch a ball." What looked like superior defense might have been brilliant defensive positioning by the bench coach.

There was one other big glitch: these sorts of calculations could value only past performance. No matter how accurately you valued past performance, it was still an uncertain guide to future performance. Johnny Damon (or Terrence Long) might lose a step. Johnny Damon (or Terrence Long) might take to drink, or get divorced. Johnny Damon (or Terrence Long) might decide that he'd made enough money already and lose his middle-class enthusiasm for running down fly balls. In human behavior there was always uncertainty and risk. The goal of the Oakland front office was simply to minimize the risk. Their solution wasn't perfect, it was just better than the hoary alternative, rendering decisions by gut feeling.

Of one thing they were certain: their system brought you a lot closer to the true value of a player's performances than anything else like it. And it reinforced the Oakland A's working theory that

a guy's hitting ability had a far greater effect than his fielding ability on a team's performance. Albert Belle missed more fly balls than any other left fielder in baseball, but the system proved that he more than made up for it by swatting more doubles. Or as Paul put it, "The variance between the best and worst fielders on the outcome of a game is a lot smaller than the variance between the best hitters and the worst hitters." The market as a whole failed to grasp this fact, and so placed higher prices than it should on defensive skills. Thus the practical answer to the question about Johnny Damon's defense: it would probably cost more to replace than it was worth. Anyone who could play center field so well as Damon was either a lot worse offensively than Damon, or overpriced. The most efficient way to offset the loss of Johnny Damon's defense was to add more offense.

The Blue Ribbon Panel Report believed that a poor team could never survive the loss to free agency of its proven stars. But the business was more complicated than that. The departures of Johnny Damon and Jason Isringhausen, both proven stars, were not great blows to the Oakland A's. The loss of Isringhausen was not really a loss at all but a piece of ruthless profiteering. Damon's was a loss but nothing like the $32 million for four years the Red Sox had guaranteed him. If the Oakland A's had lost just those two players Paul's computer might have predicted that the team in 2002 would win as many games as they had in 2001. But they'd also lost Jason Giambi, and Jason Giambi was another matter. Giambi was maybe the worst defensive first baseman in the big leagues but he was a machine for creating runs, one of the most *efficient* offensive players in the game. Worse, Giambi was back in Oakland, playing for the other team.