

## Three Cases of Relative Honor

THE SHARP DOUBLE-KNOCK AT the door had the ring of military authority. My Service days are well behind me, but the stance of the smart young officer who stood on the threshold brought back my parade-ground days so vividly that I almost found myself saluting him.

"Is Mr. Sherlock Holmes at home?"

"No, sir—that is to say, no, he is currently at the French Embassy, but he is expected back in half an hour or so."

"I will call back. Would you be so good as to tell him that Captain Henderson of the Seventh Royal Hussars wishes urgently to see him?"

"May I ask what it pertains to?"

The man's bearing became even more rigid, if possible. "I am shortly to face court-martial. I stand accused of killing twenty men."

"And you believe Sherlock Holmes may be able to prove your innocence?"

"No, I wish him to discover whether I am guilty or not. For I have no idea myself!"

And with that he gave a stiff bow, clicked his heels in an almost Prussian manner, and was gone.

I shook my head. I have studied amnesia: true cases are very rare indeed. Yet those who stand accused so often ask the jury to believe a remarkable lapse of memory! Well, if Henderson was in fact guilty, and had deluded himself that involving Sherlock Holmes in his case would be to his advantage, he was likely to receive his just deserts.

Holmes returned before the half-hour was up. He flung himself into his armchair with a sigh.

"How went it at the Embassy?" I asked.

He buried his head in his hands and groaned. "No luck at all, Watson. And it is hardly surprising. Consider the obstacles I faced!" He counted on his fingers. "First, when the break-in is discovered, the ambassador and his staff make a bungling attempt at detective work. The next day Sûreté detectives arrive from Paris and make a second investigation, which is also fruitless. Only then does the ambassador decide to waive the building's diplomatic immunity and allow Scotland Yard in. Lestrade's men almost pull the building apart in their efforts to convince the French of their zeal to solve the case. Finally, they think to summon me. Really, Watson, it was like trying to find the trail of a mouse in a field where three separate herds of elephants had subsequently run amok!"

I sighed. "And yet Lestrade is convinced it was only a common burglary. Really, Holmes, you should have told them that the matter was beneath your dignity."

"I am certain Lestrade is right, Watson. He even has two suspects in custody. But the French are convinced the matter was more sinister. They believe the burglary was mere cover for a more sinister violation of diplomatic immunity: the copying of secret documents. I became involved because Mycroft begged me. He believes that if the case cannot not be cleared up

promptly, a major deterioration in relations between the Great Powers is imminent. More I cannot tell even you."

"And *was* it a mere burglary, Holmes?"

"Undoubtedly, Watson. Lestrade has the right men: a pair too dim even to realize that the building was an Embassy and the hue and cry that would result. They are called Ludd and Johnson. The first is a former boxer who, punch-drunk, can no longer fight; the second is a street vendor unable to make a living at his honest trade. A fine irony, that two of the stupidest men in London should cause such a furor."

"Well, if they are so dull, surely one of them will slip up in questioning before long, and suspicion will turn to certainty?"

My friend shook his head. "Do not underestimate the power of stupidity, Watson! A stupid man can maintain a stubborn silence where a clever one might be provoked into a slip. They are both hardened criminals, and only a foolish optimist would expect an admission from either."

At that point there came again the sharp military knock on our door, and I realized I had forgotten to warn Holmes of our visitor. Before I could say anything, however, Holmes had sprung up and opened the door himself.

"Mr. Sherlock Holmes? I am Captain Henderson of the Seventh Royal Hussars. I believe that you recently intervened in the court-martial of a soldier called Andrews, very possibly saving him from execution. I also am shortly to face a court-martial."

My friend waved him to a chair. Mindful that Henderson claimed to have killed twenty men, I picked up the poker and pretended to poke at the fireplace with it, before laying it down in easy reach beside my chair.

Holmes coughed. "Please excuse my colleague, Captain. He often feels the need to check the status of our fireplace, in high summer. What is the crime of which you are accused?"

"I am charged with negligently causing the deaths of twenty men under my command."

I perceived that I might have been a trifle hasty with the poker.

"And are you guilty?"

"I do not know."

Before Holmes could reply, I spoke, I am afraid, rather hotly. "Captain, I am a medical man, and I can say in all modesty that I am an expert in amnesia. I am convinced that true cases of complete amnesia are rare—very rare indeed. If you claim such a convenient gap in your memory, I am afraid we will treat your story with great skepticism."

Henderson looked calmly at me. "I am not claiming amnesia. I remember the relevant events with crystal clarity. The deaths certainly occurred, and as a result of my decision. But was my decision negligent—as is now being charged—or was I merely the victim of bad luck? That is the question."

Holmes leaned forward, waving me into silence. "Pray tell us the story."

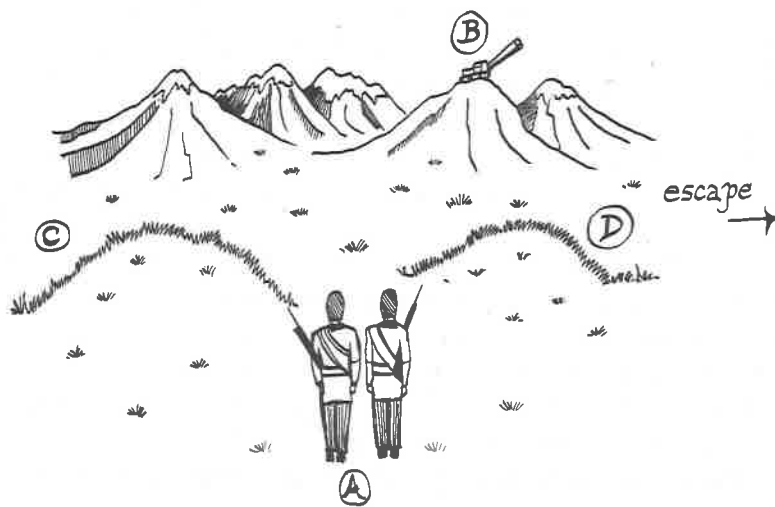
Something in his manner seemed to reassure our visitor, who relaxed somewhat. But at that moment there came a loud crash from the street. A common enough occurrence, yet the effect on Henderson was extraordinary. He sprang to his feet, then flung himself on the floor behind the sofa, hands over his head, quivering all over.

Holmes leapt to the window. "It is only a brewer's cart, striking the curb."

He assisted our visitor back to his chair, while I splashed some brandy into a tumbler. For the first time I felt some sympathy for the young captain. In Afghanistan, I had seen men shot for cowardice whose behavior suggested nervous disorder rather than any ordinary lack of courage. Soldiers who had killed too often at close quarters sometimes suffered "trigger finger": their hands became paralyzed, and they would not or could not continue shooting fellow human beings. And others exhibited "shell-shock" after surviving an explosion nearby. Perhaps someday these would be considered medical conditions, rather than mere lack of courage.

Henderson gulped the brandy and shortly was able to speak again. "My regiment has just returned from a tour of duty in East India. You are doubtless aware that sporadic trouble continues there, led by a tribe known as the Mauras. At the point in question, I was leading a platoon on a reconnaissance patrol that had lasted several days. We were trying to verify rumors that the insurgents, until then lightly armed, were being supplied with heavy weapons from lands to the north. We were crossing a marshy plain, known locally as the Baar Valley, that is overlooked by high mountains to the north."

He pulled a folded piece of paper from his pocket, and spread it to reveal a roughly sketched map.



*The Baar Valley*

"It was early evening, and I was about to call a halt for the day, when one of my corporals shouted that he could see movement on the clifftops to the north. We set up our field telescope, and when I brought it to bear my heart sank. I saw a long rebel column, with horses pulling sizable artillery pieces: the rumors were true. But more alarming still, I could

see signs of a much larger gun that was being towed in several parts. There had been whispers of this monster, said to be capable of firing exploding rounds of a hundredweight each: it was referred to as Big Bertha."

"Why, how extraordinary!" I said. "My service was in Afghanistan, a decade ago, yet rumors of a gun of that name circulated there."

Holmes smiled. "The nickname Big Bertha has been used many times, in different theaters of war, to refer to the largest gun known in those parts, real or imaginary," he said.

"Well, this one was no figment of my imagination. You may think things could hardly have got any worse, but as I watched, I saw signs of excitement in the enemy column. The horses pulled up, men dismounted, and several turned and pointed in our direction. They had spotted us within minutes of our noticing them. Quite possibly it was a careless glint of sunlight on my spyglass that gave us away."

"They would no doubt have sighted you very shortly in any event, out on the open plain as you were," said Holmes soothingly.

"Be that as it may, our position was now extreme. It was impossible to move rapidly over the marshy ground, and once they brought their guns to bear, we should be annihilated. Fortunately, it takes time to deploy big guns, and the light was fading fast. But I knew that if we were still out in the open come dawn, the game would be up.

"There was no hope of getting off the plain by then. But there were two small hills within reach by a forced march. They were not large enough for the locals to have given them names—I have labeled them simply C and D on my map, as you can see—but either would provide enough cover to keep us safe from the enemy's conventional artillery until night fell again. The problem, however, was Big Bertha. A single one of her shells fired at high elevation could plummet down behind either hill and would be sufficient to blast any force hiding there into eternity."

"A hopeless situation, then," I said.

"Not quite! For the great disadvantage of these very big guns is that they cannot be fired at all frequently. For hours after each shot, the barrel is too hot to handle, and then repositioning the gun and sighting it in on a new target is a most laborious process. That is why these huge pieces are really of more propaganda value than actual practical use on the battlefield.

"By the following dawn, we could be concealed behind either hill, and the enemy would not know which one. During the day, there would be time to fire one shot only from Big Bertha. The enemy would have to take a chance on which hill to aim at. The question was which hill we should pick. We had a little time to make our choice, for obviously we should not give away our intentions by starting to move until it was fully dark. I debated the point with my master sergeant: I am not the kind of officer who is too arrogant to think his subordinates may have useful opinions."

"Surely you might as well have tossed a coin," I said. "Evidently one hill was pretty much as good as the other. Debate is one thing, dithering is another. One can end up like the proverbial donkey, starving to death midway between two identical bales of hay because it cannot choose which to go toward."

Henderson shook his head. "The symmetry was not so perfect as you suppose, Doctor. You see, hill D was quite close to the edge of the plain. If we chose hill D, and Big Bertha did not get us the following day, we were home free—we would be able to walk to safety during the night. If on the other hand we chose hill C, then even if we survived Big Bertha, our safety would not be guaranteed. The situation might have changed in our favor or against us: for example, the weather might close in, making long-range artillery sighting impossible, or reinforcements might arrive. The future is ever uncertain. But to a first approximation, if we chose hill C and Big Bertha did not get us, our chance of survival would still only be 50 percent. Whereas if we chose hill D and escaped Big Bertha, our chance of survival would be 100 percent."

"Then hill D is obviously the better choice," I said.

Henderson looked coldly at me. "But the tribesmen above us, knowing the local terrain, were equally aware that hill D was from our point of view the better bet. So it seemed to me that they would be more likely to aim Big Bertha at hill D."

"So then, hill C should have been right for you," I conceded.

"Doctor, the first lesson of military strategy is never to underestimate your enemy. I thought that the tribesmen might well anticipate our reasoning and fire at hill C after all."

"Then you could have done a double-bluff," I said. "If you thought the tribesmen were devious to that degree, hill D should have brought safety the following day and escape the night after."

"And if the tribesmen anticipated that also, would you then try for a triple-bluff?" said Holmes with a smile. "Do you not see, Watson, you are entering an infinite regress. This reasoning will get us nowhere."

Henderson shook his head despairingly. "I carried on a similar debate with my master sergeant on that fateful evening," he said. "He was for hill C, and I was for D. We could reach no sensible conclusion. The thing that particularly troubled me was that the big gun we could see being assembled was undoubtedly of Prussian manufacture, supplied to the rebels by the Germans. Now, where German artillery goes, German military advisers tend to accompany it. I could be sure the decision as to which hill to fire on would be made by a Prussian officer. They are trained far more rigorously in tactics and strategy than we British: I knew his logic would be impeccable in deciding which hill to aim at. If only I could duplicate that logic, and anticipate his decision, we would survive! But the more we argued, the more uncertain the decision seemed.

"In the end I almost resorted to tossing a coin as you suggested, Doctor, but it seemed cowardly to dodge making a decision in that way. I was responsible for the lives of my men; I could hardly delegate so serious a choice to the fall of a

coin. I overrode my sergeant, and we marched to hill D and were well concealed behind it by dawn.

"By midday the next day there had still been no sign from the enemy. But seconds after midday a tremendous thunderclap smote our ears. Big Bertha had fired! We waited in an agony of suspense for what seemed like hours, though in reality it can have been no more than seconds. Then there came to our ears what was at first a faint whistling sound but grew louder rapidly, so rapidly. . . ."

He buried his head in his hands, his shoulders shaking. Holmes splashed a further liberal measure of brandy into our guest's glass and forced it into his hands. But this time Henderson waved it aside. In a few seconds he was himself again.

"I came to my senses in what seemed an eerie silence," he continued. "In fact I had been deafened by the blast, and it was days before my hearing returned to normal. I was surrounded by bodies, freshly turned earth mercifully concealing the details of their features. The enemy had outguessed us, and the shell must have come down right in our midst. By some fluke of the blast pattern, I alone had survived. At first I wished I had died also, but eventually I recalled that I still had a duty to return to my unit and report, and that night I made my way to safety."

"And was your story not believed?" asked Holmes.

"Oh, yes, I was believed. No one suggested I was guilty of desertion. But I have been charged with the lesser, yet still very grave, offense of dereliction of duty. By my recklessness in ignoring my sergeant's advice—and although he was nominally my junior, he was an older and more experienced soldier than myself—I caused the deaths of all my men. My court-martial takes place tomorrow. If I am found guilty, at best I can expect to be reduced to the ranks, and at worst drummed out of the army in disgrace."

He looked Holmes in the eye. "Now, sir, I am no man to shirk responsibility for my decisions. If I was indeed reckless, I will deem my punishment fair. But the question squirrels

round and round in my brain, almost driving me to the point of madness: Was I indeed reckless? Or was I merely the victim of bad luck? For I am no martyr, and if it was only bad luck, then the court-martial is a mere sham of finding a scapegoat for defeat. I cannot decide the matter: I am a man of action, with no claim to be a philosopher or mathematician. But it occurred to me that what was hopelessly baffling to me might be simplicity itself to Mr. Sherlock Holmes."

Holmes rose and clapped the man on the shoulder.

"I will take your case. When does the trial take place? Thursday, at the Old Admiralty buildings by Trafalgar Square. Very well: you may put down my name as an expert witness for the defense. Have confidence; I shall be at your side."

But when I returned from showing Henderson out, it was to find Holmes with a troubled expression.

"Come, Holmes!" I said. "In recent months, your ability to solve these problems of logic and probability has impressed me greatly. Surely this two-choice question does not present you with any difficulty?"

"On the contrary, Watson. The problems we have confronted so far have involved fixed probabilities set by the laws of Nature. Now Nature is subtle, but never malicious, and the calculations have been relatively straightforward. But here we are dealing with an intelligent opponent who is actively trying to evade our analysis and confound the logic of our choice. The rules of this game are much harder."

"It reminds me of a much more innocuous kind of shell game that I played as a child," I said thoughtfully. Holmes cocked an eyebrow inquisitively.

"One child conceals a sweet under either of two seashells, and the second child tries to guess which," I explained. "I am afraid I was rather bad at it. I was usually the hider. I do not believe any cheating took place, but whichever shell I put the sweet under—whether I kept to the same choice as on the previous turn or whether I changed it—I generally seemed to get outguessed."

Holmes smiled. "If you have a fault, Watson, it is perhaps that you are a bit predictable," he said. "My advice comes a little late, but I think you should have resorted to tossing a coin to choose your shell."

"It seemed to me, as to Henderson, that it would be rather lazy to thus dodge the effort of making my own decision."

"Not at all, Watson. We saw in the case of Madam Zelda how bad the unaided human mind is at generating random numbers. It simply cannot avoid falling into a pattern of some kind, be it more or less obvious. Sometimes you need an external source of randomness if you are to avoid predictability. Paradoxically, delegating a decision to the fall of a coin can be the most logical thing to do!

"But this is a more complex case. What should Henderson have done? Follow his more experienced sergeant's hunch? Toss a coin after all? I am blessed if I know. No, pray do not interrupt. This is quite a three-pipe problem, and I shall be most grateful if you will leave me undisturbed to consider it."

When the lunch bell sounded Holmes did not appear, and I went back upstairs to summon him. I found him staring into space with a darkly brooding look, drumming his fingers nervously upon the arm of his chair. Before him was a sheet of paper with a simple diagram.

		H	
		C	D
M	C	0	100
	D	50	0

*C or D?*

"I see you have made some progress, although I cannot quite make it out," I said, indicating the sheet.

He looked at me as though from far away. "Scarcely, Watson. That is merely a chart of the four possible outcomes. The columns represent Henderson's choices and the rows the choices of the Mauras. Henderson can choose C or D to hide behind in darkness; meanwhile, the Mauras are lining their cannon up on C or D. The numbers represent the platoon's percentage chances of survival. If both parties choose C, or if both choose D, it is zero: the platoon is annihilated. If Henderson chooses D and the Mauras C, the platoon gets clean away. If Henderson chooses C and the Mauras D, it is fifty-fifty."

He shook his head ruefully. "It is an absurdly simple diagram. Yet somehow the answer to the conundrum must lie within it."

"Well, at least you have done some work. I think you can knock off for lunch with a clear conscience. After all, Henderson is not on trial for his life."

"In a sense, he may be, Watson. Proud young men like that have been known to fall on their sword in such circumstances, rather than live out the shame. But I confess the problem grips me for another reason also. Henderson's dilemma seemed to ring a faint bell with me: I had some feeling of *déjà vu*. Yet I have never known a case like it. Eventually the source occurred to me."

He pointed to the diagram. "Instead of H for Henderson and M for Mauras, think H for Holmes and M for Moriarty. Does anything suggest itself?"

I stared at the diagram in bafflement.

"Do you remember a day some years ago when we fled London aboard a train for Dover? At that point I knew my only proper refuge from Moriarty was to leave the country; I was planning to take the ferry to France."

"But Moriarty chartered a special train and came after you. He would have killed you had he caught you. How could I forget!"

"Fortunately, the express I was aboard made an intermediate stop, at Canterbury. I had the choice of disembarking there, still in the country, but at least alive for the moment—provided that Moriarty chose Dover as his destination. If Moriarty and I both chose the same destination, I was certain to die. If I went to Dover and he to Canterbury, I was safe. If I went to Canterbury and he to Dover, I had a fifty-fifty chance." He pointed to the diagram. "For H read Holmes, for M read Moriarty, for C read Canterbury, for D read Dover. *That is the very same dilemma I faced that day.* Now, Moriarty was a very clever man, and a mathematician to boot. I knew he would use the most immaculate logic in choosing whether to direct his 'special' to Canterbury or to Dover. Do you know how I chose my destination, Watson? By the fall of a coin!"

"I never saw you toss a coin on our journey."

"I did not need to. I simply put my hand in my pocket and felt the outer side of the first coin I grasped. I have very sensitive fingertips: I can tell the face of a coin by touch alone. It was tails, so we went to Canterbury. I needed you to have faith in my decision, so I did not mention how arbitrary my choice was."

I looked at him in some concern. "Those were indeed desperate days, Holmes. But it is all in the past now. History records that you chose Canterbury, and Moriarty Dover, and Moriarty is long dead at the bottom of the Reichenbach Falls. So put the matter aside, and come and have some dinner, I beg you. Irregularity of mealtimes is not good for the constitution."

"No, thank you, Watson. I find that just as Henderson feels a burning need to know whether bad judgment or bad luck caused his men's deaths, I have an equal need to know: Was my survival that day owing to good judgment—or merely good luck? I will not rest until the matter is clear in my mind."

Having seen him in such moods before, I left him to brood. But when I returned from my afternoon rounds it was to find

the air thick with tobacco smoke and Holmes still sitting rigid with a gaunt, white face, doubtless reliving those awful last days of Moriarty's reign. I decided that the time had come to risk his ire.

"Holmes, this brooding is not good for you. If you will not listen to me as a friend, then hear me in my capacity as your medical advisor. When I come across a case that baffles me, I am not ashamed to consult a specialist in the field, nor should you be. You are a detective, after all, not a mathematician."

Holmes turned an expressionless face toward me. "And whom do you suggest I might consult, Watson?"

"Well, you could try Mycroft. He must dabble in figures all day, in his capacity as special advisor to the Government."

Holmes frowned. I knew he disliked having to appeal to his brother for help—their relationship was not without a certain sibling rivalry!—and I pressed on hastily: "After all, he did not hesitate to ask for your help with this French Embassy case. He would merely be returning the favor."

Holmes looked at me angrily, and I stiffened. Then suddenly he tossed his head back and laughed. "Oh, very well, Watson; your common sense will not be denied! I will take a stroll down to his club and see if he has anything to offer."

He returned sooner than I expected, carrying a large, leather-bound volume prominently stamped "Diogenes Club Library."

"Mycroft was never a man to waste words, Watson. But he advised me to read this."

He proceeded to do so, turning the pages with lightning speed, as was his custom. Doubtless Mycroft had lent him some book on military strategy, I mused, very likely Clausewitz's classic work. Shortly, Holmes took a sheet of paper and commenced to scribble figures on it. At length he put the book down, and I was able to read the title on the spine: *Game Theory*.

"Really, Holmes, I am ashamed of you!" I expostulated. "I thought you were working on Henderson's case, and here you are idling away your time with a book that tells you how to play better bridge, or some such."

He looked at me mildly. "This is not a book about card games."

"Well, backgammon, then."

"I think you have been misled by the book's title, Watson. The mathematical analysis of such pastimes is called *games* theory. *Game* theory, by contrast, concerns itself with more serious things. In particular, the tactics that should be adopted in competitive situations, where you can gain only at the expense of your opponent: such situations are called zero-sum games. They are commonly encountered in business and in war."

"I beg your pardon, Holmes. And has it enlightened you?"

"Very much so. The problem was that Henderson had to aim for one of two hills. But apparently he could not make his choice by logic alone, because it was essential that his actions not be predicted by the enemy—that they be to some extent random.

"My earlier diagram was misleading, because it implied that he had only two choices. Yet, as I suspected, the answer did in a sense lie within it. I had simply written too few rows and columns, ignoring intermediate possibilities. What Henderson really had was a choice of *strategies*, in the sense that he had a choice of what *probability* to assign to heading for hill D rather than hill C.

"That is summarized on this new diagram. Let us suppose Henderson makes his choice by rolling a die. Before throwing it, he decides which faces stand for hill D as opposed to hill C. The seven columns represent Henderson's possible strategies. He can assign a probability ranging from zero out of six to six out of six to heading for hill D, depending on how many faces of the die he designates D.



		H to D with probability:						
		6/6	5/6	4/6	3/6	2/6	1/6	0/6
M to D with probability:	6/6	0	8	17	25	33	42	50
	5/6	17	21	25	29	33	37	42
	4/6	33	33	33	33	33	33	33
	3/6	50	46	42	38	33	29	25
	2/6	67	58	50	42	33	25	17
	1/6	83	71	58	46	33	21	8
	0/6	100	83	67	50	33	17	0
		H's survival probability (%) C or D?						

"But of course the Mauras will be trying to outguess him. They also should randomize their choice to make it unpredictable, and they also have a choice of strategies. Let us suppose that they also throw a die to make their decision. Then the rows of the table represent the Mauras' possible strategies: the probability that they aim Big Bertha at D rather than C."

I blinked at the complex array of figures.

"Henderson wants to choose a column that maximizes his chance of survival. But the Mauras will pick the row that minimizes it. Hence arises the concept of the *minimax*, beloved of game theorists. We must look for the column in which the *lowest* value is as *high* as possible."

I ran my fingers across the columns. "In column 1, the minimum is 0. In column 2, it is 8. In column 3, 17. In column 4, 25. In column 5, 33. In column 6—ah, we are back down to 17 again. And then to 0 in column 7. So Henderson should pick column 5, which means he should head for hill D with probability one-third and for hill C with probability two-thirds."

"Now tell me the Mauras' strategy. The Mauras want to minimize the maximum probability of his survival, of course."

I looked down the rows. "The Mauras should select the third row down and aim for hill D with probability two-thirds and for hill C with probability one-third."

"Congratulations, Watson! That is what each should do. Far from intuitively obvious, was it not?"

I found myself hesitating. "I am not sure it is intuitively obvious to me even now, Holmes. It seems awfully complicated. Would it not come to the same thing if they each tossed a coin to decide?"

"Look at the table, Watson. That is equivalent to choosing the 3/6 row and column. That gives a survival probability of 38 percent, which suits Henderson, but does not suit the Mauras. So they are unlikely to adopt such a scheme."

I nodded. But then a more profound thought struck me.

"If your opponent is a good game theorist, Holmes, then actually it does not matter whether you follow the table. Because if the Mauras play row 3, as according to you they should, then it is irrelevant what Henderson does, because every probability in that row is the same: 33 percent. Similarly if Henderson chooses column 5, as you say he should have done, then the Mauras' strategy makes no difference. It is only if *both* deviate from game theory that there is any change."

I thought a moment and then went on in excitement. "It is a little like the lookout paradox. Every ship at sea, even in mid-Atlantic, is required to keep a continuous watch so as to avoid collision with other ships. But in fact if you trust every *other* ship to obey the law and itself keep a good lookout, then it does not matter whether you do so yourself or not, for the other ships will avoid you."

"Until another captain thinks the same way," interjected Holmes. "No, Watson, you might get away with a lazy strategy decision a single time, or even several times, but once your enemy realizes your choices are insufficiently randomized, you are done for. If in the next Great War British officers toss coins to make decisions when they should use more subtle

calculations, and the enemy realizes this, then the enemy will have the upper hand.

"An example strikes me that is entirely too close for comfort. Recall again that chase eastward from London, where Moriarty and I had to choose between Canterbury and Dover? Moriarty knew we were both clever men, and he may have assumed I knew my game theory. Accordingly, he would have thrown a die, assigning the numbers to give a two-thirds probability of his going to Dover, which is indeed what happened. But in reality I was ignorant of game theory and tossed a coin. In effect, I chose column 4.

"Now, it is possible that Moriarty guessed I did not know game theory and would resort to tossing a coin. In which case Dover was definitely the best bet for him. If Moriarty felt sure I was ignorant of game theory, then he went to Dover not as a result of a dice throw, but as a result of choosing row 1: Dover with 100 percent certainty. Which gave me a probability of survival—the minimax for that column—of just 25 percent: 1 in 4, as opposed to 1 in 3."

"Well, it does not matter now, Holmes. As it turned out, you went to Canterbury, and survived; Moriarty is dead, and can never tell us on what basis he chose Dover. All else is moot."

Holmes looked at me without seeming to see me, his gaze focused somewhere beyond infinity. "Is it, Watson? Do you remember the many-worlds view of reality, endorsed by Chalmers and many other clever physicists, that arises out of quantum theory? That logic indicates we actually inhabit a multiverse in which countless possible realities play themselves out."\*

I shuddered. "I remember that the logic seemed unassailable, but it still makes me dizzy to think about it."

"In that case, the original Sherlock Holmes who tossed a coin on the way to Canterbury gave rise to a huge (but not infinite) number of subsequent versions. Call that number a zillion if all had survived. If I had rolled a die as I should have

\* See Colin Bruce, *The Einstein Paradox, And Other Science Mysteries Solved by Sherlock Holmes* (Perseus Books, 1998).

done, a third of a zillion would be alive now. As it is, there are only a quarter of a zillion. One-twelfth of those other versions of myself were killed by my stupidity."

I gazed into the fireplace for some time, musing like Holmes on philosophical realities almost impossible to grasp. Eventually the chiming of the clock recalled me to the here and now.

"I suppose it will go harshly with Henderson," I said. "He certainly did not select the right tactics."

"On the contrary, my dear fellow; I anticipate that my testimony will exonerate him."

"What! But how?"

"The Empire expects its officers to be very courageous and reasonably intelligent, but it does not expect the impossible. If I appear on the witness stand and testify that in a similar situation, I, Sherlock Holmes, was unable to make the decision correctly, I can hardly imagine they will find him guilty."

He sighed and gestured to the morning paper. The headline, referring to the French Embassy case, read "Sherlock Holmes Baffled by London's Stupidest Burglars."

"I cannot honorably do otherwise, but the press will no doubt have a field day at my expense again. Humiliations rarely come singly. Clearly, the gods feel that I need keeping in my place."

By the end of the week, both of Sherlock Holmes's predictions had come true. Henderson was indeed acquitted. But the Sunday papers were remorseless at my friend's expense. Particularly cruel was a cartoon on the front page of *The Messenger* that showed Holmes wearing a dunce's cap, sitting at the back of a class of police detectives. Fortunately, I reached the breakfast table ahead of him and hid *The Messenger* under a pile of other papers.

Scarcely had Holmes sat down, however, when the door opened again and my friend's expression changed to one of surprise. Turning, I saw Mycroft standing in the doorway.

“Good morning, Sherlock,” he boomed. “I fear you have been having rather a rough time of it of late. The newspapers are absurdly unfair, are they not!” And with a superficially sympathetic smile, he pulled from his coat pocket the very cartoon I had sought to conceal from my friend.

Holmes read the page poker-faced, but I could tell he was affected. Nevertheless, he gestured for his brother to join us at the table and poured him some coffee. “I doubt that you made the journey here just to be amused at my expense, Mycroft. What can we do for you at this early Sunday hour? Has the French Embassy crisis grown still more serious?”

“No, it is blowing over by itself, as these diplomatic flaps tend to do. But it has led to something of interest. I came here primarily to thank you, Sherlock.”

My friend looked blank. “To thank me? For what?”

“Well, your failure to solve the French Embassy case by your industrious manual efforts set me to thinking whether there might not be more cerebral ways to prove criminal guilt. And then when your query the other day reminded me of game theory, the solution was not far behind. Congratulate me, my dear fellow: I have invented a foolproof way to extract full confessions in any case involving two or more suspects working together!”

My friend raised his eyebrows. “That is indeed remarkable. I would be fascinated to hear the details, Mycroft.”

His brother responded by pulling from his pocket a sheet of paper bearing a diagram that looked rather familiar. “Take the crooks Johnson and Ludd. They are both in custody at the moment, due to be tried for several minor burglaries they committed together. They will certainly be found guilty of those and be sentenced to a month each. The French Embassy was a more serious matter: for that, they could expect twelve months each, except that we have no proof.

“You are aware that judges give a reduction in a sentence for what is called ‘turning Queen’s evidence’—that is, for mak-

ing a full and voluntary confession of all crimes and implicating any accomplices.”

“How large a reduction can such a prisoner expect?” I asked.

“It depends very much on the circumstances. Normally a confession merits a sentence reduction of 20 percent or so. But if the prisoner implicates an accomplice who might otherwise have gone unpunished for the crime, he can get his own sentence suspended: he walks free immediately.

“Now, I arranged for Ludd and Johnson to be held at separate police stations so that there could be no possibility of communication between them. Johnson is at Vine Street and Ludd at Bow Street. Then I went to see Johnson, who appears marginally the brighter of the two. He, like his colleague, has so far refused to admit anything. I pointed out that he would certainly get a month for the minor burglaries, and he obviously understands that. I also pointed out that if the Embassy burglary could be proved against him, he would get not one month but twelve. Then I explained the offer I had obtained a judge’s permission to make. If he turned Queen’s evidence, and Ludd did not, he himself would go free, and Ludd would get twelve months. I was quite honest with him, and admitted that if both he and Ludd turned Queen’s evidence, neither would go free. But they would get a slight reduction in their sentences: from twelve down to ten months each, in acknowledgment of their confessions.”

“Well, I would not confess, if I were Johnson,” I said. “Obviously the best thing for both is not to confess, and to wait out the month.”

Mycroft nodded. “I am not surprised to hear you say that, Doctor,” he said. “But I think Sherlock is a little ahead of you. For I explained my next point to Johnson most carefully. From Johnson’s point of view, there were two possible scenarios. Ludd might confess and implicate him, or he might not. But either way, Johnson would be better off confessing! Look at

the diagram. If Ludd has not spilled the beans, then Johnson gets off scot-free by confessing, whereas if he does not confess, he serves a month. On the other hand, if Ludd does spill the beans, then Johnson can still reduce his sentence from twelve months to ten by confessing. So whatever Ludd does, it is logically better for Johnson to confess.

		Ludd	
		Mute	Confess
Johnson	Mute	$J = 1$ $L = 1$	$J = 12$ $L = 0$
	Confess	$J = 0$ $L = 12$	$J = 10$ $L = 10$
<i>Forced Confession?</i>			

"I left Johnson to think it over and went to Bow Street to see Ludd. He is even dimmer than his colleague, but I managed to explain things to him in the same terms." Mycroft simpered. "It is really quite diabolical in its cleverness, is it not? Both would be ten times better off if neither confessed—getting one month each rather than ten—but each individual is compelled to own up by simple logic! The following day, I went back to see each again, confident of full confessions."

Sherlock Holmes smiled. "And with what result?" he asked.

Mycroft slammed his fist down on the table in frustration, spilling my coffee into its saucer. "None whatever!" he cried. "Neither would confess. The problem is evidently that they are so monumentally dense that they are unable to follow simple

logic. It would be in the interests of each to confess, regardless of what the other does, but in practice neither one will."

"So why have you come to me?" asked my colleague.

"Because, Sherlock, even though your intellect sometimes lacks a certain cutting edge when compared to mine," said Mycroft, tactlessly tapping the newspaper cartoon, "you have in one respect an advantage over me. You are good at explaining things to persons of limited intelligence. Why, sometimes you even manage to explain quite abstruse matters to Watson here."

I was reminded why, despite his great intellect, I could never be as fond of Mycroft as of his brother!

Sherlock nodded. "I will be glad to help you, Mycroft. There is indeed a point that needs putting across. Could you meet Watson and me at Bow Street in an hour or so? There is someone there who, I believe, can explain it even better than I."

"I am almost impressed, Holmes, by the proverbial honor among thieves that Ludd and Johnson display," I commented as we walked to our rendezvous. "I can only suppose that, despite their low criminality, they have a kind of ethic that allows them to have implicit trust in each other, negating Mycroft's scheme."

Sherlock Holmes snorted. He appeared to be in high good humor. "I think not, Watson. It is remarkable how even an intellect such as Mycroft's can become so focused on a particular problem that he forgets it is inextricably part of a larger picture—and that it makes sense only in that context. Mycroft is not alone. From the book he lent me, it is evident that some of the greatest mathematicians in the world similarly tried to construct game theory in an abstract void, remote from reality, and caught on to their error only rather late."

We arrived a few minutes early. I had thought we would be meeting one of the bright young inspectors there, but Holmes merely introduced himself at the front desk and made

arrangements for the prisoner Ludd to be transferred from his cell to an interview room. At the appointed hour, Mycroft appeared.

"Your error, Mycroft, and that of other theorists, has been to consider the classic Prisoner's Dilemma as a problem in isolation," said my friend severely as we walked down the police-station corridor. Mycroft turned an annoyed face toward him.

"If Johnson and Ludd knew that after serving their sentences, they were each to be transported to different colonies, so that they would never see one another again, and if they were also certain that no news of their past behavior here in Britain would ever catch up with them, then they would indeed have a dilemma. But of course that is a quite unrealistic and naive scenario. Game theorists frequently cannot understand why parties to a 'deal' do not cheat, when it is apparently in their interests to do so. Yet deals are not once-in-a-lifetime occurrences. A businessman must engage in regular transactions, often with the same partners, to make a living. If he cheats someone, that person will not deal with him again. Moreover, word that he is not to be trusted may get around. Hence, the businessman deals honestly, not out of some ethical sense but out of self-interest. The same applies to a criminal. A burglar who peaches on his mates must face consequences, including a reluctance of those or other persons to partner him in future ventures. The word gets around."

Mycroft frowned thoughtfully. "You are implying," he said carefully, "that a mathematical calculation that takes into account multiple iterations of a situation will arrive at different optimal choices from those that arise in a single isolated interaction."

I must confess I blinked in some confusion, trying to understand this remark. Sherlock Holmes flung open the door to the interview room.

"Well put, Mycroft," he said. "But here is someone who can explain the point even better. Ludd, I believe you have already met Mr. Holmes senior?"

The burly occupant of the room glared at us suspiciously.

"Ludd," said Holmes slowly and patiently, "I am not trying to trick you. You are in no jeopardy, and nothing you say now can be held against you. I would like you to explain to my brother why you do not want to peach on your mate."

Ludd gazed at the expectant Mycroft with the air of one regarding a half-wit, and spoke deliberately: "Cos he'd bash me head in when he got out."

"It is a regrettable sentiment, Watson, *Schadenfreude*. And yet very much part of the human condition," Sherlock Holmes said unexpectedly as we strolled back to Baker Street, this time taking the longer but more pleasant route through Regent's Park.

"I beg your pardon?"

"It is a German word that describes taking pleasure in other people's misfortune. Our hypocritical English language has no word for it, but others do. A Chinese proverb comes also to mind. Loosely translated: 'There is nothing nearly so satisfying as seeing an old friend, dearly beloved and respected, slip in the mud and sit undignifiedly on his behind in the sight of the entire village.'"

He pulled the newspaper cartoon with the dunce's cap from his pocket and regarded it ruefully. "I believe the British public has a certain respect for me, yet it will have enjoyed today's story all the more for it. And similarly, I yield to no one in my respect for mathematicians in general, and Mycroft in particular, yet how wonderful to watch one of London's stupidest men lecturing its cleverest! It has softened the blow to my own pride somewhat.

"But not altogether erased it. Talking of learning from foreign cultures, I see our route takes us past *Le Canard Enchanté*, where I happen to know they have just imported a superb new wine. Let us go and drown our sorrows, Watson. If Mrs. Hudson loses patience and feeds our dinner to the cats, then so be it."