TWO

MEMORIES OF THE FUTURE

A GROUP OF TWENTY snowmobilers had just completed a search and rescue mission to bring out three others, who'd had engine trouble and become stranded overnight at Middle Kootenay Pass in Alberta, Canada. After successfully locating the three, eight of the rescuers sped off to return them to civilization, while the remaining dozen mucked about in the snow with the broken machine. On the way back, an additional fragmentation of that group occurred, because eight of the dozen had been seized by the need for speed and just raced on ahead.

They eventually stopped to wait for their slower companions. They were at an old well site, sitting on their snow machines on a broad, flat area beneath a hill. The hill was well known as a great one for hill climbing, which is also called hammer-heading or high-marking. The idea is to accelerate across the flat terrain and race up the hill as fast as you can until gravity stops you or until you turn back downhill. It's a competitive game to see who can go the highest.

The official report would eventually remind us that "They had

all been specifically told that there was a high avalanche danger and that high-marking or 'hammer-heading' was out of the question that day."

But sitting there in the chill air with the view and the spicy juniper smell of the mountains was intoxicating. The big wide clearing led up to tremendous vaulted peaks, which seemed to leap through the gently falling snow and into the low deck of clouds like a ramp to heaven. The desire to ride a fast, open machine such as a motorcycle or a snowmobile is evidence of a certain propensity toward sensation seeking, as the psychologists call it. In addition, that particular group had demonstrated poor impulse control (boldness, or a willingness to take risks, if you like) by racing ahead of the others. Now there they were, with their throttles in their fists and all that physical power ready at a touch. There was more sensory input to urge them on: the throaty animal roar of the engines. The horsepower throbbing between their thighs. And there was Mother Nature rising into the gauzy curtains of falling snow, which both concealed and revealed her great, concupiscent backside in the swaying fabric of the clouds.

Suddenly, something clicked in one of their brains. The others watched, startled, as he cut loose, flat out, across the open ground. He could feel the spinning cleats dig in, as the G's loaded up in his center of mass. It was a familiar solid feeling of power, as he was propelled up and up and up the slope, across the 5 inches of new snow that had fallen in the last two days, which lay on top of 2 inches of rain-saturated snow pack, which in turn sat on another 2 feet of snow that had accumulated in the past two months. All of that was balanced precariously on top of a weak layer of faceted wet grains, which are peculiar formations in nature with roughly the friction coefficient of tiny ball bearings. The whole system was angled downward at about 35 degrees, which happens to be the critical angle at which most avalanches occur. On steeper slopes, the snow tends to slide off before it can consolidate into a slab. On shallower ones, it remains fairly stable.

The snowmobiler hadn't quite reached the top of the hill when he became bogged down in deep snow. The others below could see him up there like a ballistic nylon bug against the creamy white flank of the mountain and could hear the faint buzzing of his engine as he struggled to get free.

The thrill of the hunt, like so many moods, was contagious. A second snowmobiler goosed his engine, too, and went hell-bent for high ground, right up the crack in Mother Nature's fine white fanny.

It was about twenty minutes to noon, and some of the others must have been wondering: *What are they thinking?*

The second snowmobiler had nearly reached his buddy with this vague, half-formed idea in his head of what he was doing and this little voice, way off, saying, "high avalanche danger" and "hammer-heading is out of the question." It seemed almost as if he had two brains and they were having an argument over his body.

Now those who were still waiting below could read the tally like a great natural scoreboard, the first streak going straight up and ending in a kind of blob, a hole, and the second one growing longer and longer as the roar of the engine dwindled to a faint buzzing, and the black bug grew small against the white slope. Then they heard the rifle-shot crack that typically accompanies the release of a big slab avalanche.

According to the official report: "At about 11:40, Snowmobiler 2 also sped up the slope and when he was about two thirds of the way up a size 3 avalanche released. Snowmobiler 2 was able to ride out to the side of the avalanche and escape. At the bottom of the slope the other six had seen the avalanche start and five of them managed to ride out of the path of the slide." But there was one guy down there who just froze.

The avalanche released a 450-foot-wide swath of snow, 32 inches thick, all the way from the top of the ridge. Once it started, it rushed down 400 yards, cascading on those ball-bearing grains like eight lanes of concrete Interstate highway sloughing off in an old-fashioned San Francisco earthquake.

The first man, the one who became bogged down, was swept all the way down the hill and covered over by 9 feet of snow. But the poor guy down below, the one who froze, he watched, probably mystified, as that wall of snow inundated him in 6 feet of snow like wet concrete. Freezing is a classic emotional response of all mammals. A bystander happened to be videotaping the crowd when a bomb went off at the Olympic games in Atlanta in 1996, and the freezing (and crouching) response of the people is a dramatic illustration of a primary emotion.

The snowmobilers were all wearing transceivers (radio devices meant for locating victims buried by avalanches), so they obviously had some knowledge of the phenomenon, even apart from the warning they'd received. They may, for example, have known that to be buried under even a few inches of snow is a dodgy proposition. Snow is very heavy and sets up in seconds after the avalanche stops moving. The faceted grains refracture as the snow slides and then interlock tightly when they come to rest. The slope in this case dumped 2 million pounds of snow into a terrain trap.

Because they had transceivers, those who were not buried were able to locate the victims immediately, which is a good first step in avalanche rescue. In addition, help from the nearby ski area arrived within minutes at 11:55 A.M. Most victims don't get attention that quickly. But digging 6 to 9 feet of wet snow out of an avalanche deposit, even with everyone there and all the catecholamines pumping, is like digging up a city sidewalk. It took twenty-five minutes to uncover Snowmobiler 3, the one who'd been sitting there flat-footed at the bottom of the hill, gaping up in wonder as the whole mountain came apart before his eyes. He was, of course, blue and not breathing. Snowmobiler 1 wasn't dug out for forty minutes. By then a doctor had arrived to pronounce the two officially dead at two o'clock in the afternoon on the day before Valentine's Day 1994.

The report added: "One of the original search party afterwards questioned, 'Why did they do it? We were told not to.'"

Why, indeed.

As William Faulkner wrote in *Light in August*, "Man knows so little about his fellows. In his eyes all men or women act upon what he believes would motivate him if he were mad enough to do what that other man or woman is doing."

But in the light of recent research, neuroscience can propose a better answer to the question that is asked so often after such accidents: *What were they thinking?*

You have to begin by asking why anyone would want to ride a snowmobile in the first place. It's not as if they had somewhere to go. (They did, but it wasn't up that hill.) You have to ask what could possibly motivate a rational, well-informed person to ride up a slope when he knew that all he could do was come straight back down, having burned through some expensive fossil fuel.

The answer would seem self-evident: It's fun. But then you need to know what makes a completely pointless activity fun. If, as the research tells us, all behavior can be traced to survival strategies, you must ask where the survival value is in that act. We know, for example, why sex is fun: It keeps the species going. If it weren't irresistible, no one would be mad enough to do it.

But modern neuroscience would explain it another way. Like Remarque's soldiers throwing themselves down without thinking at the faintest whistling of an incoming shell, the snowmobilers who went up the hill were acting out a secondary emotion. They had developed it by experiencing it, by synaptic learning. Perhaps it was an emotion that motivates running down prey, a thrilling bodily response that requires speed and swift action to pursue, catch, and kill. Perhaps it was an emotion involved with mating. Perhaps several emotional states were pulled together into a new combination, a heady elixir of chemicals that pour forth when one rides a snowmobile. (Since young, brain-dead, male motorcycle riders supply many of the hearts transplanted in the United States, we know that the same is likely true of that experience.) As generic as emotions tend to be at some levels, the important point

is the feeling that resulted and the fact that it was instantly available, without conscious thought.

There's a common confusion about the words "emotion" and "feeling." William James, the father of psychology, was the first to point out that we do not run because we're afraid of bears, we're afraid of bears because we run. The emotion comes first—it's the bodily response (freezing, flight, sexual arousal). The feeling follows (fear, anger, love). The fear associated with being in an earthquake may produce some chemical reactions that are similar to those produced during sexual arousal. But the two experiences are quite different. "The earth moved" can have different meanings in different circumstances. That's why risky behavior can be fun. Fear can be fun. It can make you feel more alive, because it is an integral part of saving your own life. And if the context is one that you perceive as safe, then it's easy to make the decision to take the risk. Your body can make it for you.

But killing yourself is no fun, and so you still have to ask why, when the snowmobilers knew how high the chance of an avalanche was, they decided to take the risk anyway. Even though it is now possible to understand why going up the hill would be fun, it's still not clear how those two who ran up the hill made that decision when they knew it was likely to kill them.

Think of chess masters and how they play. Let's imagine that life is a board game. Some people like to play checkers, some people like to play chess. And those of us who go into the wilderness and engage in dangerous sports are playing chess with Mother Nature.

A computer uses pure logic to play, trying millions of conceivable moves, not every move, but known patterns of moves, put in by chess-playing programmers. People not only don't do that, they can't. In fact, neither people nor computers can play chess by logic alone. There are only a few simple rules to the game but an estimated 10^{120} possible moves in any game of chess. That number is so large that it might as well be infinite. As James Gleick pointed

out in his book *Chaos*, there are neither that many elementary particles in the universe nor have there been that many microseconds of time since its creation perhaps 13 billion (1.3×10^9) years ago. Logic doesn't work well for such nonlinear systems as chess and life.

So there they are, in the board game of life, with billions of bits of information stored and new ones coming in fast and furious, and they're at a decision point. How do they decide what to do?

The act of riding a snowmobile up a steep hill had come to elicit an emotional response. Those riders had done it before and had been rewarded with a good feeling. It was a physical feeling, and the body liked it, so it was bookmarked, so to speak. *Note to self: Try hammer-heading again.* The brain creates such bookmarks (technically known as "somatic markers," a term coined by Antonio Damasio) because logic and reason are much too slow if we are to get around in this big old goofy world.

Consider what eating would be like if you used a purely deductive process. Say your brain suddenly turned into a computer and had only logic to work with. It's Sunday afternoon. You're sitting at your desk in your study at home, catching up on some paperwork. You feel hunger. (Here's why computers are so frustrating to people.) First you try eating the telephone. That doesn't taste good, so you try the paperweight. Bad idea. Then you gnaw on the keyboard for a while. Kind of bland. Chew the edge of the desk, the chair, lick the floor . . . Eventually, perhaps a week later, you have gone through the house in search of food, using the system of pure reason, and you reach the refrigerator. After chewing on the handle for a time, you open the door and find that there's some leftover pizza . . . Ah, success!

It sounds ridiculous. You might say, "Of course, I wouldn't try to eat the telephone. I know where the food is." But chimpanzees that have had certain emotional components of their brains removed do something not unlike that. To have reason cut off

from the high-speed, jump-cut assistance of emotion is virtually incapacitating, as many neuroscientists have shown with patients who have suffered brain damage. Those patients can perform all sorts of logical functions; they have normal memory; and yet they are incapable of scheduling an appointment because their pure reason makes it impossible for them to decide. They can't bookmark feelings. They have no intuition, no gut feelings. They've been cut off from their bodies in a sense. The most remarkable discovery of modern neuroscience is that the body controls the brain as much as the brain controls the body.

Most decisions are not made using logic, and we all recognize that fact at least at an unconscious level. LeDoux writes, "Unconscious operations of the brain is . . . the rule rather than the exception throughout the evolutionary history of the animal kingdom" and "include almost everything the brain does." In finding food, you have bookmarked a place where the good feeling of satisfying hunger comes out of opening the refrigerator door and grabbing something inside. You remember that the refrigerator is there to hold food, but you don't need to think through it. You can be on automatic pilot, reading something, as you mosey over to the kitchen, open the door, and only then look up to do the conscious part—grab a slice of pizza instead of leftover Thai barbecue. The search for food occurs without anything you'd call cognition, deduction, or logic. Your hunger, your body, leads you there.

When a decision to act must be made instantly, it is made through a system of emotional bookmarks. The emotional system reacts to circumstances, finds bookmarks that flag similar experiences in your past and your response to them, and allows you to recall the feelings, good or bad, of the outcomes of your actions. Those gut feelings give you an instant reading on how to behave. If a previous experience was bad, you avoid that option. When it was good, "it becomes a beacon of incentive," to use Damasio's words. In a similar fashion, the smell of roses can transport me to

my grandmother Rosa's house in San Antonio in 1958. You don't have to have sensory input to trigger the effect. You can have an idea or a memory instead.

That instant physical feedback, those feelings that are located through emotional bookmarks, will more or less force a decision unless checked by higher consciousness. It explains why the Navy fighter pilot who was low and slow wound up hitting the stern of the aircraft carrier. He had no idea why he kept coming in the face of clear information telling him not to.

Damasio wrote, "When the bad outcome connected with a given response . . . comes into mind, however fleetingly, you experience an unpleasant gut feeling." Using that system, you can choose very quickly and may be unable to explain your choice afterward. The best and worst decisions are made that way. You don't have to think about it. It just feels right.

The good feeling of riding snowmobiles had become bookmarked for instant reference by the emotional system. That activity, while irrelevant to survival, became as pleasurable as the experience of the primary emotion, because it harnessed the real thing. There are no fake emotions.

Because the system is designed to work without the assistance of logic or reason, there's now an answer to the question: *What were they thinking?* They weren't. The whole point of the system is that you don't have to think.

A CLASSIC experiment was performed in Switzerland in 1911 by a psychologist named Edouard Claparède. Claparède's forty-seven-year-old patient had no short-term memory. One day, Claparède went in and shook hands with her, as he had always done. Only this time, he had a pin in his hand, which stuck her. Although she had no memory of it after a few minutes, she would never shake hands with Claparéde again. She had no idea why. She just got a bad feeling when he stuck out his hand. There was some residue

of her painful experience that had connected itself to the sight of Claparède sticking out his hand, and she had what, in a normal person, we could call an intuition, a gut feeling. A normal woman couldn't explain those feelings either, but a few milliseconds later she'd remember.

Thinking logically could not assist the patient in deciding whether or not to shake Claparède's hand. But somewhere in her brain and body, her experience had caused her to bookmark the bad feeling of an emotion. She'd involuntarily jerked her hand back when she felt the pain. The feelings that followed the emotional response of jerking her hand back were powerful and unpleasant—shock, surprise, fear. Certainly her heartbeat and breathing sped up. Perhaps her face flushed. She may have cried out. And although she had no conscious recollection of the events or feelings, she was forever after compelled by that emotional bookmark to select the same response. It was a momentous discovery on Claparède's part: his patient could learn without explicit memory or thought. It was as if her body could learn. It hinted at a whole hidden system within her. The very system by which the two snowmobilers decided to rush up the hill against all reason.

On the other hand, while the patient's learned response was correct in one circumstance, her lack of explicit memory had robbed her of the ability to adapt the response for other circumstances. When there was no danger, she still jerked her hand back. A normal person would have laughed and said, "Now, Doc, you don't have a pin in your hand this time, right?" But she'd lost the flexibility that makes *Homo sapiens* unique in the animal world.

Voluntary actions on the right side of the body begin in the motor cortex in the left hemisphere of the brain and go through the pyramidal tract, a great bunch of axons that issues from it. If you have a stroke that destroys the motor cortex, you'll be paralyzed on the right side of your body. Everything will stop working, including your facial muscles. If someone tells you to smile, you'll produce a grotesque, lopsided grimace. But if you hear something

funny that causes you to laugh involuntarily, you'll produce a normal, symmetrical smile. The reason is that emotional reactions are controlled through the anterior cingulate, the medial temporal lobe, and the basal ganglia, which were not destroyed by the hypothetical stroke. That effect can be reproduced in patients with brain damage. There are at least two separate brain systems that can generate behavior. The way they work, the way you capture experiences and turn them into learning (memories), can influence your ability to survive.

M. Ephimia Morphew, a psychologist and founder of the Society for Human Performance in Extreme Environments, told me of a series of accidents she'd been studying in which scuba divers were found dead with air in their tanks and perfectly functional regulators. "Only they had pulled the regulators out of their mouths and drowned. It took a long time for researchers to figure out what was going on." It appears that certain people suffer an intense feeling of suffocation when their mouths are covered. That led to an overpowering impulse to uncover the mouth and nose.

The victims had followed an emotional response that was in general a good one for the organism, to get air. But it was the wrong response under the special, non-natural, circumstances of scuba diving. It's possible that the impulse, the feeling of suffocation, was formed as an implicit memory by some previous experience that was not available to conscious (explicit) memory. And the divers had no way of knowing that the one thing that would keep them alive, covering the nose and mouth, was the one thing the organism would not tolerate. At the critical moment of decision, reason was not enough to overcome emotion. For no one would say that those divers believed they could breathe under water without a regulator.

Morphew and the other researchers wanted to know what the divers were thinking when they removed their regulators and tried to breath without them. The answer is: you don't need to think. That's what emotions and implicit memories are all about. By tradition, reason is regarded as the highest function. People are named after it: *Homo sapiens* (from the Latin *sapere*, to taste, as in "to taste the world"). But from the point of view of an organism in desperate trouble, an organism that evolved by relying on emotions as the first line of defense, cognition is irrelevant and gets set aside. It's slow and clunky. As Remarque said, there's no time for it.

Most of the mystifying accidents that happen in the course of risky recreation, the seemingly illogical decisions, actions, and outcomes, can be explained by the same interplay of emotions and cognition that shapes all human behavior. What the scuba divers did made perfect sense from the point of view of the organism's survival: The impulse to get air is automatic and can be overpoweringly strong. Those who can control that impulse to survive, live. Those who can't, die. And that's the simplest way to explain survival, whether the venue is night carrier landings or being lost in the jungle.

When I was teaching my daughter Amelia how to snowboard, she caught her edge exactly twice and never did it again. When you catch the downhill edge of your snowboard, it slams you to the ground with such force you feel as if somebody just dropped a safe on you. It hurts everywhere. After the first time you do it, you have to think consciously about tensing the muscles in your legs to keep your edge up as you ride. Then you get tired, lazy, or distracted, you catch your edge again, and it practically knocks you out. Generally, after that second experience, you have developed a deeply ingrained emotional bookmark. Then, whenever you start to relax those muscles, you get a really bad feeling, like somebody's going to drop a safe on you, and those muscles tighten right up. You never have to think about it again.

The elegant and seamless assistance of those bookmarked feelings is essential in using the more linear tools of logic and reason. But in certain circumstances, usually ones where we are exposed to unfamiliar or extreme hazards, it can also be a trap.