



A PARABLE



The Dutchman Roggeveen discovered Easter Island, a wink of land far from all the major island groups of the Pacific, on Easter Day 1722. Along with the island, he discovered a mystery. Scattered across the terrain were enormous stone faces with torsos, many tumbled down but, in Roggeveen's day, some few still standing on pedestals. The upright ones wore on their heads large topknots of a differently colored stone. In 1840, the last one to be toppled still looked over the treeless vista of the island. Perched on a wall the height of a man, its thirty-two-foot-tall body weighed about fifty tons. The topknot, weighing perhaps ten tons, had a volume of something like two hundred cubic feet. The main figure was two and a half miles from the quarry where it had been carved.

How were the figures transported? How were they erected? How were the enormous topknots raised thirty feet in the air and settled squarely on the heads of the idols? Such questions defined the enigma of Easter Island. Whatever skills lay behind this massive engineering effort seemed to have been lost. The archeological record showed that, in a social upheaval long before, the old faith had been denied and its symbols, the great faces, tumbled down one by one. Stone tools lay about the quarry, abandoned as though in the midst of work. Here it was clear enough how the job had been done. But as to the rest?

Easter Island posed not only a mystery but what might be called a "high mystery." The obscure religion, the great staring faces, the seeming physical and technological inadequacy of the

inhabitants for feats of such magnitude, all conspired to suggest that something beyond human ken might be at work. Indeed, some have been quick to argue just this. In his notorious *Chariots of the Gods?* Erich von Däniken devoted a short chapter to Easter Island. "Humanly impossible" was the gist of his conclusion. It might be, von Däniken suggested, that ancient and alien astronauts visited our primitive planet, giving our ignorant forebears a genetic boost, starting civilization off, inspiring cults and lending a hand in the making of suitably respectful monuments.

A comparison with the way the mystery of creativity has been approached is not so farfetched. Creativity has often been taken as one of those "high mysteries." How a person has captured the insight and conjured the energy to paint a masterpiece, devise a revolutionary scientific theory, make music in a way that moves listeners down the ages, has been thought beyond the reach of human understanding, stubbornly inscrutable, essentially ineffable. Moreover, creativity has had its von Dänikens. Plato was one of them, putting into the mouth of Socrates a classic account of invention:

For the poets tell us, don't they, that the melodies they bring us are gathered from rills that run with honey, out of glens and gardens of the Muses, and they bring them as the bees do honey, flying like the bees? And what they say is true, for a poet is a light and winged thing, and holy, and never able to compose until he has become inspired, and is beside himself and reason is no longer in him . . . for not by art do they utter these, but by power divine.

Now, to compare Plato with von Däniken is downright scurrilous, not only because of Plato's profound philosophical accomplishments and cultural influence but because of von Däniken's misrepresentations. When *Chariots of the Gods?* was first published in German in 1968, the solution to the mystery of Easter Island had been known for eleven years. The discoverer was the Norwegian student of Pacific cultures, Thor Heyerdahl, who published a popular account of his inquiries at Easter Island

under the title *Aku-Aku*. This was the very source von Däniken cited in his book. However, not once in the seven pages devoted to the island does von Däniken mention how Heyerdahl persuaded the contemporary inhabitants to demonstrate the "impossible" feats of their ancestors.

So the parable continues. The shenanigans of von Däniken will turn out to have their parallel, sorry to say, in some misleading descriptions of creating. But what about the mystery of Easter Island? Consider just a piece of it: the erection of the stone figures. After some thought, Thor Heyerdahl adopted a clever strategy. He told the mayor of the island, a descendant of the earlier inhabitants, that one hundred dollars would go to him when the largest of the old statues on a certain site was again upright on its pedestal. The mayor explained how, as a child, he had been drilled in an oral tradition of recipes for such matters until he could repeat them exactly. Why had he never disclosed the mystery before? No one had asked him, was the answer. Or perhaps no one had asked him so persuasively. The mayor and eleven other men, using three long stout wooden poles and a number of stones, raised the largest statue in eighteen days. More than twice the height of a man, the statue weighed about thirty tons.

The method was ingenious. First, the helpers worked together on the poles to lever up the statue slightly. Usually it seemed not to move at all, sometimes to budge just a little. Meanwhile the mayor was busy placing small stones under the edges of the fallen statue as his helpers heaved. Then the small stones were replaced with slightly larger stones. The process of levering plus building up continued, and at the end of the first day of work, the thirty-ton idol of Easter Island lay with its head on a mound of stones three feet above the surface of the ground, a feat of levitation as deft in its way as the work of magicians.

Speaking of creativity, some person or persons early in the island's history had been remarkably ingenious in evolving a way to shift monumental chunks of rock. Their invention had not been forgotten. By the tenth day, the statue lay prone on a pile of stones more than twelve feet high, and over the next days the figure was maneuvered gradually toward the pedestal, where in a few moments of carefully controlled climax it slid neatly into place.

There you have it, the mystery of Easter Island resolved by artful engineering. Now I want to point out something that easily could be overlooked: the clarity of this explanation. We can readily imagine how the eleven men could have pried up the statue slightly. We can envision the mayor placing the pebbles and larger rocks under the statue to preserve the millimeters of progress. We can appreciate how this cycle, repeated over and over, could erect the monument. Although the mayor's plan certainly was not obvious before he revealed it, once revealed its logic is plain. The puzzle of how the statues were erected reduces to common sense.

I hope for something like that clarity with the subject of this book. I want to make the strange familiar. I want to show how creating in the arts and sciences is a natural comprehensible extension and orchestration of ordinary everyday abilities of perception, understanding, memory, and so on, just as the erecting of the Easter Island statues was a comprehensible extension and orchestration of human muscle, the principle of the prop, and the principle of the lever. I want to argue that many significant insights can be explained as occurring in essentially the same way, by means of essentially the same psychological mechanisms, as the ordinary everyday act of understanding a Woody Allen joke. Many moments of discovery can be understood as exercising essentially the same psychological mechanisms that operate when we casually notice a dime on the street and pick it up. Many amazing scientific and artistic accomplishments can be understood as products of the kind of searching we do when we systematically pick lint off a sweater. In short, too often we have missed the connections between the marvelous and the mundane.

For this task, I will need the help of a number of ideas and experiments from contemporary psychology: the concept of pattern recognition, the concept of search through a space of alternatives, the concept of schema, findings on the role of fluency in creative thought, on the process of incubation in problem solving, and on efforts designed to teach problem-solving skills, to name just a few. Many pages will be spent reviewing and interpreting such studies.

But I will not go deeply into the technical theories designed to account for the details of such superficially simple acts as walking or talking or remembering. The concern is not to explain these everyday activities themselves, just as it was no business of the mayor of Easter Island, or Thor Heyerdahl either, to explain the psychology of how the natives saw with their eyes or moved their bodies in erecting the statue, or the physics of the levers they used. Such matters were taken for granted there. They functioned as givens in terms of which the accomplishment could be understood. The present strategy is similar. Often I will emphasize important "operating characteristics" of perception, understanding, and memory, some that have been prominent and some neglected in contemporary psychological inquiry. But I will not often examine accounts of how those mental processes do their work because this understanding simply is not necessary. The aim is to comprehend creating in terms of commonplace resources of mind and some of their familiar and less familiar operating characteristics, but not particularly to explain those resources themselves.

This should be a relief to the reader, and certainly has been a relief to me. In a way, the real challenge of psychological inquiry today is not so much to explain the marvelous, which with some thought and some investigation reduces readily enough to the mundane. The real challenge is to explain the mundane. It is a mission I will cheerfully sidestep for the length of this book.

The mystery of Easter Island posed a "how" question – how did the inhabitants accomplish their feats? The same emphasis applies here. This book is not about creativity. It is about creating. Most books that concern the inventive work of artists, scientists, or businesspeople are about creativity, a personal trait. "Creating," on the other hand, is a name for a process. It asks how the creative person *thinks*, not what the creative person *is*.

Moreover, this book is not about the felt experience of creating. After a look at certain of the following chapters, someone might well object "But that's not what it feels like!" I would often agree. That's not what it feels like – but that's how it works. Einstein is said to have said something of this sort: "The chemical analysis of a cup of soup should not be expected to taste like the soup."

But what is creating? I mean the process of producing outcomes that we normally judge to be creative. Then what is meant by "creative"? A familiar and often repeated definition will do well here: creative means original and of high quality. Thus a stereotyped product does not count as creative, however fine it may be. Likewise, a product with nothing else to recommend it does not count as creative, however original it may be. Such products are just superficially novel. With these definitions in mind, explaining creating means explaining how the originality and the quality "get into" or "get put into" the developing creative outcome during the making process.

The definitions of creating and creative are admittedly vague, but inevitably vague too. What we mean by "original" and what we mean by "quality" vary drastically from context to context. Also, they are often judged in tacit rather than explicit ways within a context. Thus a good-quality advertisement is good in virtue of different features than is a good-quality astronomical theory or a good-quality dance. An original advertisement is original in virtue of different features than is an original astronomical theory or an original dance. There is no way that an account of "creating" or "creative" can get explicit about the many partly tacit criteria of originality and quality that apply in different contexts, especially when invention often makes its own standards of quality, by leading people to discover kinds of quality they had little awareness of before. This is the way it is, and we will simply have to live with it.

Must creating involve a product? First it should be said that "product" or "outcome" can apply in a very general sense, including poems, paintings, scientific theories, puns, performances, gardens, conversations, dreams, desserts. A creative way of life need not be one that emphasizes the outcomes we conventionally think of as creative. However, I do think that some kind of product or outcome must be involved in creating. "To create" is a transitive verb. It is the fundamental nature of the concept that creating involves creating something, and to speak of creating when there is nothing understood as the thing created is not really intelligible.

The emphasis in this book will be on creating in the arts and the sciences, with products such as poems, paintings, scientific discoveries and theories. Also, there will be some attention to puzzles of various sorts because they provide a controlled way of investigating certain aspects of creativity. This choice does not imply that everything done within the arts and the sciences is creative. On the contrary, mediocre, unimaginative science and art are the rule more than the exception, just as mediocre and unimaginative work is in any area of human endeavor. However, the sciences and the arts are good choices for this discussion since many achievements in these domains count among the most creative accomplishments of humankind and since traditions of scholarship in the history and psychology of these areas can inform this book.

Finally, like Easter Island, this book has a few unusual features the traveler ought to know about in advance. First of all, I have found it helpful to organize most chapter sections around "propositions" and "revised propositions." A proposition, which usually occurs near the beginning of a section, is a concise statement of a familiar or plausible view about creating. The revised proposition, arriving near the end of a section, is another statement on the same issue, sometimes a direct contradiction of the original proposition and sometimes a qualification of it. The text of the sections is mostly a journey by way of evidence and argument from the original to the revised proposition. This device has helped me to keep the issues explicit and focal.

The second feature is the "personal experiments" that occur in most chapter sections. These are activities the reader can attempt, if he or she desires. They usually couple a task with some sort of introspection into the workings of the mind. Sometimes the task is a problem or puzzle to solve, although the real point is never the solution but the process of trying to reach it. These personal experiments are not meant for amusement, although most of them are fun. Neither are they presented as exercises, although I often have assigned them as exercises in classes. Their main function is something else entirely: they are part of the argument. Many of the points made in the following pages are most meaningful, best

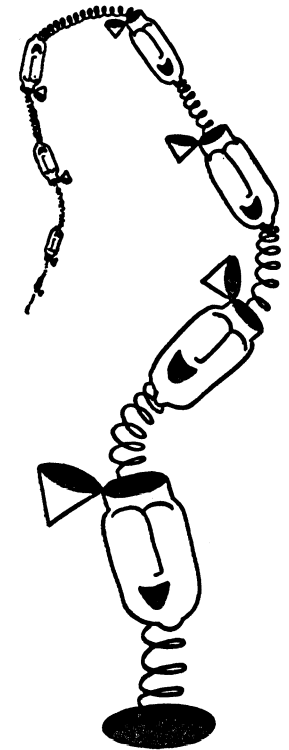
appreciated, and best considered critically, given some kind of direct personal experience of the phenomena.

Finally, there are my drawings. They appear mostly for fun, paper idols honoring some good and bad ideas about creating.



WITNESSES TO INVENTION

If we can believe it, a man on business from the town of Porlock scuttled one of the great poetic statements in the English language on a certain day in the summer of 1797. The story of this “one that got away” has a triple meaning in this book. First of all, Samuel Taylor Coleridge, describing how a fragment of his dream poem “Kubla Khan” came to be written down and the rest of it lost, offers us a compelling image of creation. Invention appears almost as suddenly and completely as a jack-in-the-box comes out of its cubbyhole. Second, here also is a maker bearing witness to his own process. Coleridge’s testimony demonstrates one of the few ways we can expect to learn about the workings of the mind during invention. Finally, a moral can be drawn from the unfortunate arrival of the man from Porlock. What he did unwittingly, any brash inquiry into the creative life might do with witless disregard for the delicacy of invention. We have to be circumspect. Otherwise, we would be nothing but a bumbling crowd of men and women from Porlock, destroying the very processes we want to disclose. That is, if we can believe it.



The story goes like this. In 1816, Samuel Taylor Coleridge published a curious poem entitled "Kubla Khan: Or, a Vision in a Dream." Introducing the poem itself was a brief preface in which Coleridge described how he had come to write the poem nearly twenty years before.

In the summer of the year 1797, the Author, then in ill health, had retired to a lonely farm-house between Porlock and Linton, on the Exmoor confines of Somerset and Devonshire. In consequence of a slight indisposition, an anodyne had been prescribed, from the effects of which he fell asleep in his chair at the moment that he was reading the following sentence, or words of the same substance, in "Purchas's Pilgrimage": "Here the Khan Kubla commanded a palace to be built, and a stately garden thereunto. And thus ten miles of fertile ground were inclosed with a wall." The Author continued for about three hours in a profound sleep, at least of the external senses, during which time he has the most vivid confidence, that he could not have composed less than from two to three hundred lines; if that indeed can be called composition in which all the images rose up before him as *things*, with a parallel production of the correspondent expressions, without any sensation or consciousness of effort. On awaking he appeared to himself to have a distinct recollection of the whole, and taking his pen, ink, and paper, instantly and eagerly wrote down the lines that are here preserved. At this moment he was unfortunately called out by a person on business from Porlock, and detained by him above an hour, and on his return to his room, found, to his no small surprise and mortification, that though he still retained some vague and dim recollection of the general purport of the vision, yet, with the exception of some eight or ten scattered lines and images, all the rest had passed away.

In studying how people create, the most natural way in the world is to collect those writings where creative persons have tried to give an account of themselves. Then one can try to construct

a theory to match what they report. Indeed, Coleridge's famous episode inspired a nearly as famous book, *The Road to Xanadu: A Study in the Ways of the Imagination*, published in 1927 by John Livingston Lowes. In his treatment of Coleridge's writing process and the Xanadu episode, Lowes argued that, far from receiving "Kubla Khan" out of the blue, Coleridge drew upon several sources from his extensive reading. These sources provided the images and sometimes the very phrases that made up the poem. It was not that Coleridge deliberately crafted the verses. Rather, his mind was so enriched by his readings as to be ready for this spontaneous rush of invention.

One trouble with such a biographical approach to creative process is that different people say different things. For example, there is hardly a statement about the creative process more opposed to the spirit and letter of Coleridge's experience than Edgar Allan Poe's 1846 essay "The Philosophy of Composition." In this article, Poe commented generally on the process of poetry writing and discussed in details his own creation of "The Raven," a work that had achieved an enormous literary success. A few quotes will show how uneasily Poe's account sits with Coleridge's, if we want to take them as reflecting some single way in which people create. On composition in general, Poe has this to say:

Most writers—poets in especial—prefer having it understood that they compose by a species of fine frenzy—an ecstatic intuition—and would positively shudder at letting the public take a peep behind the scenes at the elaborate and vacillating crudities of thought—at the true purposes seized only at the last moment—at the innumerable glimpses of idea that arrived not at the maturity of full view—at the fully matured fancies discarded in despair as unmanageable—at the cautious selections and rejections—at the painful erasures and interpolations—in a word, at the wheels and pinions—the tackle for scene-shifting—the step-ladders and demon-traps—the cock's feathers, the red paint and the black patches, which, in ninety-nine cases out of the hundred, constitute the properties of the literary *histrion*.

Concerning the creation of "The Raven," Poe takes pains to emphasize the logical, deductive character of the process. There is a strong reminder of Poe's great literary creation Monsieur C. Auguste Dupin, the sometimes detective who solved the mystery of "The Murders in the Rue Morgue" and the puzzle of "The Purloined Letter." Like Arthur Conan Doyle's Sherlock Holmes, Dupin was the cool creature of reason, calmly calculating his way to the resolution of problems where others would only bumble about. Poe too was a clever reasoner and solver of puzzles and liked others to know it. He addressed the problems of poetic creation with the same calculation, or so he said. For instance, Poe asserted about "The Raven," "It is my design to render it manifest that no one point in its composition is referable either to accident or intuition – that the work proceeded, step by step, to its completion with the precision and rigid consequence of a mathematical problem."

Poe backed up his generalization by describing how particular features of the poem were, well, deduced. He had this to say about the refrain word "nevermore" and the idea of the raven itself:

The sound of the refrain being thus determined, it became necessary to select a word embodying this sound, and at the same time in the fullest possible keeping with that melancholy which I had predetermined as the tone of the poem. In such a search it would have been absolutely impossible to overlook the word "Nevermore." In fact, it was the very first which presented itself.

The next *desideratum* was a pretext for the continuous use of the one word "Nevermore." In observing the difficulty which I at once found in inventing a sufficiently plausible reason for its continuous repetition, I did not fail to perceive that this difficulty arose solely from the pre-assumption that the word was to be so continuously or monotonously spoken by a human being – I did not fail to perceive, in short, that the difficulty lay in the reconciliation of this monotony with the exercise of reason on the part of the creature repeating the word. Here, then, immediately arose the idea of a non-

reasoning creature capable of speech; and, very naturally, a parrot, in the first instance, suggested itself, but was superseded forthwith by a Raven, as equally capable of speech, and infinitely more in keeping with the intended tone.

That "species of fine frenzy – an ecstatic intuition" that Poe so slanders seems to fit Coleridge very well. Poe's logical methodical progress with "The Raven" gives a very different picture of creative process than Coleridge's free and facile invention. Poe plays the tortoise to Coleridge's hare. The question is who wins the race, the race for the best account of the nature of human invention. Do we go with the hard-headed Poe? Or do we credit more the romantic image of invention presented by Coleridge, who of course does not argue that the "Kubla Khan" episode was typical but whose example has often been taken to be the quintessential example of creating? Or is some sort of duality or compromise or synthesis needed? Such problems as these come up whenever one tries to study the ways of the creative mind by relying on the after-the-fact testimonies of creative men and women.

But to ask those very questions is to get ahead of ourselves. There is a prior question that no lawyer worth his salt would overlook: Are these witnesses to invention trustworthy? If they are, such cases present dilemmas like the above. But if they are not, the dilemmas disappear, although other ways of investigating creating need to be found.

KUBLA KHAN AND THE RAVEN

Proposition: Samuel Taylor Coleridge, Edgar Allan Poe, and others who have reported episodes of creating can be trusted to have provided honest, careful, well-remembered accounts undistorted by preconceptions about the nature of creativity.

Simply putting this so baldly makes it sound unlikely. In fact, in the cases of Coleridge and Poe, the worst occurs. Neither man can be trusted.

The "Kubla Khan" episode inspired not only the classic work of Lowes but later and somewhat more critical studies. A fine example is a 1953 book by Elizabeth Schneider, *Coleridge, Opium and Kubla Khan*. Schneider presents a number of arguments which challenge the story of "Kubla Khan" as Coleridge originally told it. Perhaps most striking is this: In 1934, an alternative version of the poem and its history came to light. The undated manuscript was in Coleridge's own hand: "This fragment with a good deal more, not recoverable, composed in a sort of Reverie brought on by two grains of Opium, taken to check a dysentary, at a Farm House between Porlock and Linton, a quarter of a mile from Culbone Church, in the fall of the year 1797." Notice the contrasts between Coleridge's original public statement and this private version. The "profound sleep, at least of the external senses" of the public version was here a wakeful reverie, a very different thing. The "slight indisposition" was more specifically "a dysentary," the "anodyne" was "two grains of Opium." Although in the public account, Coleridge "wrote down the lines that are here preserved," the version of the poem discovered in 1934 differed in a number of minor ways from the published "Kubla Khan." In at least three cases, the variations lay closer to their sources in "Purchas's Pilgrimage" and also in *Paradise Lost*, suggesting that the newly discovered version was an earlier one.

Coleridge's story of the writing of "Kubla Khan" seems all the more doubtful for not appearing before 1816. Coleridge had a strong interest in dreams and mental processes generally and often discussed and wrote letters mentioning such matters. He reported dreaming four rather mundane lines of verse in an 1803 letter. He often recorded dreams and sentences from dreams in his notebooks. In 1803, he participated in a long discussion concerning dreams and poetry, a discussion later described by another participant. An 1811 or 1812 account of Coleridge's reciting "Kubla Khan" mentions the poem's concern with a dream palace and a consequent discussion of dreams. Yet not one of these sources mentions anything about "Kubla Khan"'s being created in a dream.

Finally, it has to be said that Coleridge often misrepresented the history of his compositions. Several of his contemporaries

commented generally on his untrustworthiness. On a number of occasions he is known to have claimed a date of composition considerably earlier than the actual date. On one occasion, he implied a degree of fluency contrary to the facts. The subtitle of a four-hundred-line poem "Religious Musings" described it as "A Desultory Poem, written on the Christmas Eve of 1794." In fact, serious work on the poem had stretched over two years. If we extend the benefit of the doubt to Coleridge, and suppose that he wasn't deliberately misrepresenting the origins of "Kubla Khan," then in any case there would be problems of memory in his 1816 statement. Although Coleridge's own reported 1797 date of composition is in question, the poem is known to have been in existence by October 1800. Besides not being overscrupulous about correct reporting, Coleridge had sixteen years for his memory of the occasion to grow dim and plastic.

So the researches of Schneider and others suggest that slow-and-steady Poe may have won his race by default, the opposition disqualified. But in fact Poe's account also can be challenged. First of all, there is something close to an internal inconsistency. As Poe describes it, the process of composition involves much vacillation, selection and rejection, erasure and interpolation. Yet when Poe comes to "The Raven" things are different. Poe himself proceeded methodically from general considerations to infer the desired character of the poem and even some of its words. Only in admitting that he thought of parrots before ravens does Poe acknowledge any trial and error at all. In short, Poe really offers two contrary visions of poetic process, one emphasizing trial and error, the other emphasizing systematic inference.

A number of historical sources cast doubt upon the latter. As



Poe describes it, "The Raven" sounds as if it were produced methodically in an afternoon, or at most a week. Poe labored over the poem for years. The poem appeared in several journals at once, early in 1845. However, a draft existed in the summer of 1842. Poe had shown it to someone, as he would continue to do through years of reworking. In the winter of 1843-44, Poe tried unsuccessfully to sell a version of the poem. In the spring of 1844, he read variations to friends and acquaintances in a tavern he frequented and elsewhere, trying this and that and requesting evaluations and suggestions. The poem was brought into its final form over the summer and fall of 1844, when Poe occupied a residence containing a bust of Pallas which, in the poem, provided a perch for the raven. In short, despite his claims in his "Philosophy of Composition," there is every sign that Poe worked very much in the trial-and-error manner he attributed to others.

There is also information about the origin of the raven and the refrain "nevermore." One perhaps dubious claim is that the raven was originally an owl. A more plausible source appears in a review of Charles Dickens' *Barnaby Rudge* that Poe published in 1841 and, in an extended version, in 1842. The novel's cast of characters included a raven named Grip, which Poe singled out for special comment. Poe saw opportunities in the bird that Dickens had not. "The raven, too, intensely amusing as it is, might have been made, more than we now see it, a portion of the conception of the fantastic Barnaby. Its croakings might have been *prophetically* heard in the course of the drama." Later, in "The Raven," the bird would be addressed as "Prophet! Thing of evil! – prophet still, if bird or devil!"

As for "nevermore," the work of other contemporary poets Poe is known to have seen probably gave Poe an assist. For example, there are these lines from Thomas Holly Chivers' "Lament on the Death of My Mother":

Nor on the borders of the great deep sea,
Wilt thou return again from heaven to me –
No, nevermore!

And from Chivers' "To Allegra in Heaven":

Thy dear father will to-morrow lay thy body with deep sorrow,
In the grave which is so narrow, there to rest forevermore.

There would be no problem about these sources had Poe not told the tale as he did in "The Philosophy of Composition." Poets do have their sources. But Poe said he arrived at "nevermore" from general considerations of sound and expression and then sought a creature who reasonably could repeat the word. The sources mentioned suggest somewhat less logic and somewhat more borrowing.

Finally, the cool, detached tone of Poe's method as he described it invites comment. Throughout the period of work on "The Raven," Poe was under great stress. In January 1842 his wife burst a blood vessel while singing. The case was quickly diagnosed as one of advanced tuberculosis. Although his wife hung on until well after the publication of "The Raven," her condition cycled through periods of some improvement and serious relapse. At the same time, the Poes suffered great poverty, even after Poe had attained considerable fame. Poe chronically fell into bouts of drinking and other episodes of erratic behavior. There is no doubt that, despite all this, Poe remained a skilled craftsman. But clearly his agonized state of mind over his wife's declining health found expression through the grim vision of "The Raven." So Poe seems to have been very much slower and very much less steady than his slow-and-steady portrait of himself.

None of this means that there is no truth at all in what Coleridge and Poe reported. The parts of Coleridge's story confirmed by the handwritten note about "a sort of reverie" sound plausible enough. Poe's general trial-and-error version of poetic composition matches his behavior, even if his image of Poe-as-Dupin-as-poet does not. But surely, these cases stand as warning that one can't uncritically credit the accounts notable figures in science and art have given, voluntarily and much after the fact, about episodes of invention.

There's no need to be paranoid about this. I'm not going to say that autobiographical accounts should never be used in inquires like this one. In fact, I'll use them myself a number of times in the following chapters, sometimes critically and sometimes with ac-

ceptance. But, all in all, we need another method. We need one that will cut more deeply and cleanly through the snarl of accidental and calculated confusion surrounding creative process.

Revised proposition: After-the-fact accounts of episodes of invention have questionable validity and require careful critical scrutiny to make anything of them; there is too much opportunity for forgetting, faulty reconstruction, and even outright misrepresentation.

HARD EVIDENCE

There is another classic solution to the problem of studying creative process, one pursued by generations of scholars. The solution is to use the scratchwork and early drafts, the notebooks, sketches, and discarded versions that often exist along with a creative product of consequence. Like the footprints of shy night creatures, the physical trace of progress on a work of science or art may tell us more about its making than the maker could or would or did. There are various advantages that come with the use of such tracks. They often are all that we have, for one. For another, there is no investigative meddling of the sort discussed in the following section – the sort I finally will opt for. Finally, the problems of witnessing just discussed are worth remembering here. Unlike the testimony of the maker, the tracks cannot misconstrue, overgeneralize, conform to popular theories, promote a public image. Their very logical status makes this impossible. They are not claims about the work or its making, but physical pieces of the work's history. There is no need to get too smug about this, of course. The physical record might be incomplete, ambiguous, misleading, and coarse-grained. If it cannot misconstrue, certainly it can be misconstrued. Still, the real advantages shouldn't be overlooked. Let's be as optimistic as possible and say:

Proposition: A good physical record of an episode of invention provides an adequate basis for answering most of the questions we really want answered about creating.

A case in point. Under the title *Picasso's Guernica*, Rudolf Arnheim took advantage of a remarkable opportunity to follow the tracks of an episode of creation. Picasso himself gave Arnheim the chance by his own habits of record keeping. Picasso routinely numbered and dated his works. In the case of *Guernica*, he left sixty-one sketches and more complete works in various media which related to *Guernica*. The first forty-five apparently figured directly in *Guernica's* making. The others developed pictorial motifs from *Guernica* even after it was complete. In addition, seven photographs of the work were taken as it progressed. The richness of the visual record presented an ideal occasion for the hard-evidence approach.

However, I want to know much more about the creative process than Picasso's record tells us. But before explaining what's missing, let me acknowledge what's there. A mere glance at the sketches and the photographs reveals neither instant creation as in Coleridge's story of "Kubla Khan" nor methodical deduction as in Poe's story of "The Raven." Poe's trial-and-error view of creating seems closer to the mark. Picasso explored alternatives by means of numerous sketches, and *Guernica* evolved through several versions into its final form. But Arnheim's thoughtful scrutiny goes some way beyond that. For one general conclusion, he sees Picasso's process as a dialectic rather than a steady differentiation: "An interplay of interferences, modifications, restrictions, and compensations leads gradually to the unity and complexity of the total composition. Therefore the work of art cannot unfold straightforwardly from its seed, like an organism, but must grow in what looks like erratic leaps, forward and backward, from the whole to the part and vice versa." Arnheim also ponders the role of formal considerations. He notes that they lead to solutions that "are always more than formal." Always the broadened, deepened, and sharpened meaning of the work is a concern; merely compositional improvements would not do, at least not for Picasso.

So far so good. But now we ought to consider questions about creative process not so easily answered from Picasso's sketches and photographs. Consider an episode from the making of *Guernica*, the invention of the folded bull. In the final *Guernica*, a bull

stands in the leftmost quarter of the work, his body facing inward, but his head looking leftward away from the carnage in the center. The flat cubist style makes the bull appear folded at the neck. But the bull wasn't always so. In the first three photographs, not only the bull's head but the bull's body faces leftward, the body sprawling back over nearly half of the painting. In the fourth state, the final disposition of the bull suddenly appears.

Arnheim praises the logic of this move. "The gain is remarkable . . . the bull now faces the scene, yet his head is turned away; the empty space at the left is filled with the eloquent tail; mother and child are enveloped and bolstered by the protective torso; the animal's hindquarters are removed from the center. Truly an ingenious invention." The change pays off also in letting Picasso lift the agonized head of the horse, earlier lost in the tangle of the center, up to scream at us. As Arnheim says, "the horse could not raise its head unless there was space in which to put it."

But now for those uncertainties. The first concerns Picasso's critical judgments. Arnheim offers us his analysis of why the folded bull makes sense, and Arnheim's conclusions sound reasonable to me. But he does not presume to tell us what Picasso had in mind at the time in keeping the folded bull. And what did he have in mind – all of these reasons, some of them, something else entirely? As Arnheim acknowledges in Chapter 2 of his book, hard evidence forces conjecture, which may miss the maker's actual reasons entirely. It requires the interpreter to model the maker's judgments upon his or her own, a risky enterprise (though one for which I would sooner trust Rudolf Arnheim than most people).

To underscore the point, let me mention another factor about the folded bull which might have pleased Picasso. The "body language" of the bull is radically changed by the fold. Before, head and body face decisively away from the carnage, and the bull might be said to be standing above and looking beyond the momentary disaster. Indeed, something like this is Arnheim's reading for the folded bull as well. The bull is a symbol of timeless Spain. "Guernica is not victory but defeat – sprawling chaos, shown as temporary by the dynamic appeal to the towering,

timeless figure of the kingly beast. And "the bull's body faces the victims but his head is turned away from them, and his glance transcends the space of the scene entirely, focused as it is upon the infinite." To my eyes, though, the fold has made the bull both more dynamic and more ambiguous. Directing his body toward the center, the bull has turned his head aside. Instead of a *stance*, as in the earlier versions, there is now a *gesture*. What does this gesture express? It could be the transcendence Arnheim suggests. Or the bull could be averting his eyes from the dreadful scene; this perception is most dominant for me, although not constant. Also, the bull could be scanning the scene from side to side. Perhaps one of these latter readings was what Picasso saw and wanted to preserve. Or perhaps it was the very ambiguity he valued. After all, none of the three readings is incompatible with the painting's statement, and in that sense, as so often is the case in art, the ambiguity enriches rather than confuses.

So far, only judgment has been considered, the grounds for Picasso's liking and keeping the folded bull. The uncertainty of *aims* presents a second difficulty. It's too easy to conclude that if a change accomplishes a certain thing, the change was conceived with that end in mind. According to such a theory, advances are always treatments of the obvious ills of the work so far. But Arnheim sees the ambiguity and hedges. In the prior version, the extreme left was empty, occupied only by an obvious filler. "Did the need for a filler suggest the turning about of the bull?" Arnheim asks. "This may well have been what logicians call the proximate cause, which, however, could hardly have brought about the action, had it not solved the problem of the bull's position." But so might the proximate cause have been the desire to get the bull's butt out of the center, the horse's head raised, a more ambiguous posture, or something else again. Which of these sparked the idea, and what others led Picasso to see the idea was a "keeper"? There seems no way of telling, but at issue here is the role of accident and intention, the balance of luck and foresight in creative process.

Uncertainty concerning alternatives is another problem. Picasso's record shows him exploring alternative designs for some features of *Guernica* – the head of the horse, for instance. But

alternatives may also be conceived and reviewed in the mind of the artist. Arnheim notes, "there can be no real continuity in the sketches. Much thinking must have occurred that required no visible records." Was Picasso's placement of the bull in the fourth version the final choice of many alternatives or the immediate apprehension of the right thing to do in the circumstances? Again, there is no way of telling.

Moreover, if it is uncertain just what judgments, aims, and alternatives were involved, all the more uncertain are the processes yielding those judgments, aim, and alternatives. For example, whatever Picasso's aim was concerning the bull, how did it come to him—through hard pondering, sudden insight, the gradual consequence of living with the work? We shouldn't assume that the difficulties with the original bull were obvious. They may well appear obvious now only because we see them contrasted with the final product. Picasso no doubt had his reasons for first placing the bull as he did. We don't have to break away from that original concept because we don't know it.



The Illusion of Evidence



A while ago, someone put this riddle to a group I was in. As it happens no one got the riddle, and we all finally had to be told. It went like this: There is a man at home. The man is wearing a mask. There is a man coming home. What is happening here?

In a way, presenting the riddle in print is unfair because you can't ask questions of the riddler. To help just a little, let me answer some of the questions that might be asked. Is the man at his own home? No. Does the mask cover his whole face? Yes. Does the mask have something to do with his profession? Yes. Is the man a criminal of some sort? No. Is the man a repairman of some sort, like a welder? No. Does the man at home know that someone is coming? Yes. Does the man coming home know that someone is there? Yes.

Too bad if you solved this little puzzle (but congrats-

tions) because the real point I want to make concerns how people *do not* get such puzzles rather than how they do. Probably upon reading the riddle, you immediately began to develop a concept of what was happening. Perhaps there was a mental image of a man standing in a living room, his face covered in some unclear way. Perhaps there was an image of another man on the bus, or walking along a sidewalk, heading home. The reason people have difficulty with riddles of this sort is that even such vague fillings in as that are premature. They make assumptions not really warranted by the situation as stated. A scene in a baseball game is what the riddle describes.

Picasso's tracks are like the riddle, only more so. They quickly lead us into an illusion not just of partial understanding but of fairly full understanding. They do this because the record reveals so well what could have happened. The bull's body could have seemed obviously awkward to Picasso. He could simply have noticed this and sought a solution; fairly soon, he could have thought of folding the bull, since this would move the undesirable part out of the way. Because we fill out such scenarios so readily and automatically given the evidence, the evidence seems to speak very definitely and fully about the episode. However, as in the case of the riddle, we may be making far too many assumptions far too quickly.

Stating the assumptions behind the above way of telling Picasso's story will make the danger evident: Problems are always obvious to the sensitive maker, recognized problems point directly to possible solutions, and candidate solutions are clearly appropriate or not. According to these premises, creativity boils down to sensitivity; everything else takes care of itself. Now certainly no creative effort would get far without sensitivity. But just as certainly to settle for that is to beg too many questions. Problems aren't always obvious, nor possible solutions clearly indicated, nor their appropriateness apparent at a glance.

I don't mean these words to be critical of Rudolf Arnheim's analysis. The quotes show him to be well aware of the uncertain-

ties; when Arnheim speculates, he lets us know about it. The conclusions he draws appear modest and well warranted by the data. Furthermore, one would hardly refuse the gift Picasso offered to our understanding simply because it did not tell us as much as we might like to know. Nonetheless, the gaps in the data and the risk of an illusory understanding must be recognized and respected while we gather what insights we can.

Those gaps contain what might be called the texture of creative process: the blow-by-blow progress of the developing product. Describing that texture means generalizing about how ideas emerge in the mind, how much trial and error contributes, whether critical judgment occurs spontaneously or through deliberate analytical attention to the work in progress, and so on. If we are to learn about such matters, hard evidence won't be the teacher.

Revised proposition: Even quite good physical traces of episodes of invention disclose little about the judgments, aims, and alternatives making up the process and the ways these emerge in the mind of the maker.

A VOICE FOR THE MIND

In the words of a folksy metaphor, psychological inquiry into creative process seems caught between the frying pan and the fire. On the one hand, the after-the-fact testimony of creative men and women presents many difficulties—problems of misremembering, misrepresentation, and such. But when the disgruntled investigator turns to hard evidence, gaps in the record and ambiguities of interpretation keep back answers to some important questions, questions the creator might be able to answer directly. So what are we to do?

From time to time over the past fifty years, psychologists have tried yet another approach to the secrets of invention, an approach that revives the role of maker as witness and solicits testimony in a radically intrusive way. Since the 1930s several psychologists have asked people doing various tasks to think aloud at the same time or to report their thoughts right after-

wards, not a day or fifteen years later. I have used such introspective methods to study the thinking of poets, artists, and others, and I'll discuss my own approach in the next section. The present business, however, concerns a natural objection to any such rummaging in the mind.

Proposition: Asking people to report their thoughts during or right after a mental activity disrupts the activity or yields a distorted description.

Disruption is the concern most people worry most about. We have some entrenched ideas about the nature of creative thinking, one of which says that invention is a delicate undertaking, a sort of night flower that promptly withers under the flashlight of inspection. To put this in other words, I can hardly do better than to steal a remark of Paul Valéry's quoted in Picasso's *Guernica*:

there are functions that prefer the shadow to the light, or at least the twilight – that is, that minimum of conscious awareness which is necessary and sufficient to make these acts come about or to bait them. If failure or blocking is to be avoided, the cycle of sensation and motor activity must take its course without observations or interruptions, from origin to the physiological limit of the performed act. This jealousy, this kind of modesty of our automatisms, is quite remarkable. One could derive a complete philosophy from it, which I would summarize by saying: Sometimes I think, and sometimes I am.

Here, of course, Valéry plays on Descartes' *Cogito, ergo sum* by suggesting just the opposite. But even supposing that at least sometimes thinking and being get along together, there remains another problem: accurate reporting. The person thinking aloud or reporting right after the fact must still try to give an undistorted account. Can this be taken for granted? In a 1953 essay on introspection, Edwin Boring emphasized a crucial point. The notion that introspective reports reflect some kind of direct unmediated access to mental events should be left behind with Wundt and the other so-called introspectionist psychologists of

the late nineteenth and early twentieth centuries. Introspective reports are observations subject to the same kinds of distortions that affect observations of external events – problems of memory loss, bias, unwarranted filling in of gaps in plausible ways, and so on. Studies of eyewitness testimony have demonstrated how serious such distortions can get. For one striking example, subjects in an investigation reported by Gordon Allport were briefly shown a drawing of several people on a subway train, including a seated black man and a standing white man holding a razor. Fifty percent of the subjects later reported that the black man held the razor. Findings of this sort are more the rule than the exception.

Such results give as much reason for suspicion as the tall tales Coleridge and Poe told long after the fact. But what about reports gathered on the spot? More cause for alarm comes from a 1977 article by Richard Nisbett and Timothy Wilson, one of the few articles directly concerned with problems of introspection. The authors reviewed a number of experiments, conducted by themselves and others, in which subjects were asked to explain the thoughts behind their decisions or actions. In the experiments conducted by others, this request for explanation usually was incidental to the main method of the study, but Nisbett and Wilson were able to take advantage of its presence. Again and again, such experiments revealed that the subjects had little awareness of the real influences on their actions. Though most of the experiments did not concern creative or problem-solving behavior of the sort discussed here, I'll describe two experiments that come close to my concerns.

In one, conducted by Nisbett and Wilson themselves, subjects were asked to choose from four pairs of stockings, laid in a row, the best-quality pair. The statistics revealed a strong and surprising position effect. Although in fact the stockings were identical, the rightmost pair was preferred over the leftmost by a factor of almost four to one. But when asked about reasons directly, no subject ever mentioned position as a factor. Furthermore, when position was suggested as an influence, almost all the subjects denied the possibility.

The other example is Norman Maier's classic two-string problem, first reported in 1931. Two strings were hung from the ceil-

ing in a cluttered laboratory. The task was simply to tie the two ends of the strings together, but there was a catch: while holding onto one string, a person couldn't reach the other. The subjects were supposed to solve the problem in several ways, some of them easy to find. One, though, evaded most of the participants. This was to tie a weight to one of the cords, swing it, and catch the end on the upswing while holding the other cord. Maier also determined that the typical subject would get this solution if Maier dropped a hint seemingly by accident. He would brush past one of the strings and set it swinging. Soon the pendulum solution would be discovered. However, Maier established that, on questioning, only about a third of the subjects could report the swinging string as a clue. Moreover, Maier was able to trick some subjects into thinking that another clue entirely had been important. For some subjects, before brushing the string, he twirled a weight on a cord. These subjects always reported that the latter was the tip-off. Yet Maier was able to show by giving this clue by itself that in fact it didn't help at all. In general, Nisbett and Wilson concluded that people really had little access to their mental processes. Instead, people simply reported how they thought they must have done something.

Despite these causes for concern, since the 1930s a number of investigators have made major use of introspective methods to examine the work of the mind during creative and problem-solving activities. In the thirties, Catherine Patrick asked poets and artists to think aloud while developing works, recorded their remarks in shorthand, and analyzed the transcripts, seeking signs of certain stages of thought that Graham Wallas had proposed in 1926. Around 1940, A. D. de Groot started to study chess playing by gathering transcripts from competent amateur and master-level players as they considered a next move. Allen Newell, Herbert Simon, and their associates began to collect think-aloud reports concerning human problem solving around 1956. Their work came to include studies of chess playing, and solving cryptarithmic and symbolic logic problems, and in 1972 yielded their *Human Problem Solving*, surely one of the major statements on the topic. Such techniques have been applied in recent studies of the process of medical diagnosis. Since 1971, I have used in-

introspective methods in several studies of poets and artists at work and in studies of metaphor making, achieving personal insights, and solving so-called insight problems. I will say more about my approach to such work in the next section. Here I list these investigations simply to affirm that a number of individuals have taken introspective methods very seriously and used them with apparent success, in the sense of producing writings acceptable for publication in professional journals. Can it really be that such methods are so misleading?

Let me begin with the supposed problem of disruption. Likely as this problem sounds, I want to argue that the risks of disruption are largely a cultural myth, something so plausible-seeming and so often repeated that people take it as fact even though there is hardly any evidence for it. Indeed, there is evidence against it.



The Game of Centipede



A personal experiment makes a good beginning. We have all heard the dangers of disruption expressed in a metaphor to this effect: if a centipede thought about how it walked, it would get into a tangle. This is a simple enough claim to test, if one can test it on people instead of centipedes.

To begin with, just walk across the room.



Now walk across the room deliberately trying to control every muscle. Probably this will seem very slow and awkward.

Now walk across the room letting your legs do what they want to do. However, pay attention to what they do. Notice

the action of the foot, the ankle, the knee. Ask yourself: What contribution do the toes make? What if there were no toes, what difference would there be? Most people find that thinking about what they are doing in this way doesn't disrupt their walking.

The moral of this simple demonstration is just as simple: everything depends on what "thinking about" means. If it means trying to seize control of a physical activity muscle by muscle, that certainly will be disruptive. But if "thinking about" just means observing, that need not be disruptive at all. "Thinking about" might mean other things too – the kind of self-consciousness, say, where there is not only attention to but some kind of anxiety concerning the activity. Even so, it's worth noting that self-consciousness usually doesn't disrupt an activity drastically, although it may well "take the edge off." Still another sense of "thinking about" might be pondering while doing. Certainly, if you attempt to ponder a course of thought underway, you will bring to a halt the original course of thought. However, "pondering while doing" is not what psychologists using introspective techniques ask subjects to attempt. Subjects are supposed simply to express their thoughts while engaging in an activity, not to think about their thinking.

In addition, experimental evidence suggests that disruption is no great problem. *The coherence of reports:* Subjects' reports typically describe a fairly coherent course of thought. There are often gaps or changes of direction, but on the whole one can follow more or less what a subject was doing, and typically the reports show progress on the task at hand. If introspection disrupted the process, there should be, instead, complaints of confusion and frustration and little progress on the task. *Objective comparison of outcomes:* Comparisons of outcomes when people are introspecting and not have shown few effects of introspection. Catherine Patrick in her studies of poets and artists reported that the products done for her were in much the same style and of much the same quality as the participants' usual work. A 1953 dissertation by David Karpf involved a study of hypothesis testing

and used a think-aloud method. Karpf found no differences in the success of groups thinking aloud and silently. *Objective comparison of process:* Sometimes overt symptoms of a process can be used to compare people introspecting and not. A very simple symptom is time spent. An investigation of mental arithmetic revealed that those thinking aloud arrived at solutions just as quickly as those working silently. Scratchwork is another source of information. Newell and Simon studied students who instructed an experimenter what written manipulations to try on a blackboard in a formal task. Some thought aloud and some silently, but their scratchwork, carried out for them on the blackboard, provided a way of comparing their procedures. Both groups apparently explored alternatives in much the same way. *Subjects' impressions:* People can be debriefed concerning the introspective experience and whether they felt it influenced their procedures and progress. Patrick reported that her poets and artists reacted favorably, indicating little disruption and more or less normal progress. In my own studies, participants characteristically have mentioned *slightly* slower than normal progress, slightly greater tension, and no other disruption, although in a very few cases both unusually good and unusually disappointing experiences were reported.

To my mind, the above demonstration and arguments show that disruption is not a serious problem. But there remain the ominous findings of Nisbett and Wilson about distortion in introspective reports. Here some welcome help comes from an article by Eliot Smith and Frederick Miller which criticized the position of Nisbett and Wilson. Smith and Miller acknowledged that the earlier article had some telling points to make, but they also saw a need for qualifications. For one thing, they showed that Nisbett and Wilson were mistaken in their analysis of certain experiments, although not the ones I described earlier. For another, most of Nisbett's and Wilson's examples concerned activities that people don't normally engage in very consciously, activities such as forming an impression of another's personality.

The stockings experiment smacks more of deliberate problem solving than many of the results Nisbett and Wilson reported. So it helps to find that Smith and Miller had some special bones to

pick with it, reservations that might apply to some other cases as well. Smith and Miller were unimpressed by the subjects' failure to report rightmost position as a reason for their choice. Suppose, they argued, the subjects were following a procedure something like this. A subject would begin on the left, compare adjacent sets of stockings, and if the next appeared at least as good as the first, go on. Such a procedure would lead to the rightmost pair being chosen. But of course subjects would deny that this was the reason for their choice. It was not a reason in the usual sense – a quality in virtue of which stockings should be selected; the position effect was an accidental result of the comparison procedure. Of course, Smith and Miller do not claim to know what the subjects really did, but their point is an important one. In general, not everything correlated with a decision is a "cause of" or "reason for" the decision in the usual way of speaking. When asked about such reasons, no wonder people often don't acknowledge them, or even know about them.

Another point ought to be mentioned. Not even the most ardent introspectionist expects introspective reports to reveal everything, certainly not the firing of neurons in the nervous system but not even necessarily such things as what clue triggered an insight. In fact, a little experience with think-aloud techniques quickly teaches that people simply do not have time to report everything that happens consciously if they are to get on with the task. So, in the Maier string experiment, it is of no great concern that two thirds of the subjects couldn't report the clue of the swinging string. More worrisome is the way Maier misled subjects into believing that another clue was what had helped when in fact it had not. But here again there is something very important to be said. When investigators deliberately insert factors designed to distract and fool, of course they often will succeed, just as magicians routinely succeed in fooling audiences of thousands. But neither the tricks of magicians nor the tricks of such investigators demonstrate that, in general, we seriously misapprehend.

In fact, if the question were put to Maier's problem solvers in the right way, they might not have been fooled at all. When people are asked to explain what led to a decision or an insight, how do they understand the query? My own experience with think-

aloud and retrospective methods tells me that people often assume an explanation is wanted – their best reconstruction of what happened. So that's what they try to provide. However, if subjects are instructed not to try to explain but just to report what they remember, something quite different occurs. They start making distinctions between what they actually remember and what appears plausible. This doesn't mean that they succeed in sorting the one from the other perfectly, but it is clear that they are doing something in that direction. Maier's subjects might have done better had they been warned against explaining and urged just to remember.

In summary, there are many reasons why the cases Nisbett and Wilson review aren't that much of a threat to introspective methods. In some cases, there are mistaken analyses, in others odd notions of cause or reason. Nisbett and Wilson don't for the most part address challenging intellectual activities. Proper introspective techniques differ from the kind of "please explain" reports that Nisbett and Wilson discuss, and differ in a direction that ought to help with accuracy. And so on. None of these points proves that the effects Nisbett and Wilson worry about could not possibly occur. Of course they could, and occasionally probably do. But there is no reason to believe on present evidence that they seriously confound the accuracy of introspective reports used as described.

Revised proposition: Asking people to think aloud or report their thoughts immediately after episodes of invention does not substantially disrupt the activity or yield substantially distorted accounts.

THE ART OF INTROSPECTION

Is introspection easy? One might draw that conclusion from reading the research reports of most investigators who have used introspective methods. Usually, little is said about how the participants were instructed to manage so rare a performance. So perhaps there's nothing to it.

Proposition: Satisfactory introspective reports can be had simply by asking someone to think aloud.

I'm not even going to defend that before denying it. There is an

art to helping people to share their minds with an investigator, and I want to devote a few paragraphs to describing that art.

When a person is merely asked to think aloud, one of two things often goes wrong. Either the person will overexplain, interrupting the activity to give not a report of the thinking but a speculative analysis of it, or if that doesn't happen, often the person will comment sparsely. Especially as the task becomes involving, a person may sometimes let thirty seconds or more elapse without a word. In addition, other more minor snags occur regularly. Such experiences when I first began to use introspective methods led me to try to develop a better way. There may be other "better ways," too, as well as ways to improve this one. But in any case, here it is.

The method begins with instructions organized into six principles. The first three promote a complete record and the second three discourage overexplanation.

1. Say whatever's on your mind. Don't hold back hunches, guesses, wild ideas, images, intentions.
2. Speak as continuously as possible. Say something at least once every five seconds, even if only, "I'm drawing a blank."
3. Speak audibly. Watch out for your voice dropping as you become involved.
4. Speak as telegraphically as you please. Don't worry about complete sentences and eloquence.
5. Don't overexplain or justify. Analyze no more than you would normally.
6. Don't elaborate past events. Get into the pattern of saying what you're thinking now, not of thinking for a while and then describing your thoughts.

Simply informing people of these six principles helps considerably. It's also useful to provide five minutes or so of practice on some light task unrelated to the experiment. People can be reassured by telling them about the strong warm-up effect that almost always occurs. While the first minute or two of thinking

aloud may feel awkward, as one becomes used to the speaking and absorbed in the activity, the reporting becomes more and more fluent.

In the best of all possible worlds, participants in such experiments would follow the six principles faithfully and produce perfect data. In actuality, it's usually necessary to encourage people a little. The researcher should sit unobtrusively to one side but not behind the participant, at some distance, and prompt about rules 2, 3, and 5 if he or she falters. Rule 2, especially, requires attention, and a simple "What are you thinking now?" is an adequate reminder. It's natural to worry that constant prodding would distract a participant. Surprisingly, experience teaches that this isn't so. After a few prompts, people learn to maintain continuous reporting and so further reminders are rarely needed. However, if the researcher refrains from prompting, many people will relax into the patterns of behavior that the six rules are designed to discourage.

A person's remarks are tape-recorded for later transcription and analysis. An audio recording plus preservation of any scratchwork suffices for activities such as solving puzzles or writing poetry, activities that don't involve much overt physical expression. In contrast, for activities like painting, a videotape record is important. Here the reported thoughts are often meaningless without the visual record. I am often asked if painters, in contrast to poets, can put into words what they are thinking about. The answer is that they can – providing the words can have reference to the image. Their remarks do not so much fully package their concerns as point to where their concerns appear visually in the work in progress.

An example will make clearer the sort of material this method obtains. The following is an episode from an actual session. The sample comes from a poet who had completed several lines of a poem begun during the session. The excerpt commences just as she had completed the words, *If the chaos of the night becomes forboding we can* . . . Her aim was to finish the *we can* in a way that would connect back to the motif of rain which was to continue throughout the poem. Thinking aloud, she reported:

Oh, I can get back into the rain, somehow. Reads: *if the night becomes forboding / we can* (pause). Writes: *slide* – I'll use *slip* again. Writes: *into the dancing of the rain*. I'm not sure *dancing* is the right motion. It's too up and down, and rain only comes down. Reads: *we can slide into the* (pause) – not *falling*, because that's too hopeless (pause). Reads: *if the chaos of the night becomes forboding / we can slide into* – well, make it *comfort*. Reads: *into the*. Writes: *comfort*. Reads: *of the rain*. Um (pause), I'll copy this whole thing over, as far as I've gotten, see if I can feel continuity to it.

This excerpt illustrates nicely what thinking aloud ought to be. The poet is plainly getting on with her job and at the same time telling us a bit about it. She mentions a general aim, invents a phrase, *into the dancing of the rain*, to fulfill her aim, finds *dancing* unsuitable, then, while preserving the rest of the phrase, conceives and rejects *falling*, and finally settles on *comfort*. We see where she began, where she ended up, and how she traveled from one place to the other. I don't mean to imply that the poet has expressed every thought consciously accessible to her during this episode of invention. She may well have considered fleetingly another option or had in mind definite reasons for accepting *comfort* which she didn't relate. Also, much mental processing is inaccessible. Nonetheless, such records as this clearly inform us about some of the ways and byways of invention.



Speaking Your Mind



More perspective on the think-aloud technique discussed here comes from the personal experiment of trying the technique for yourself. The instructions have already been given, principles one through six above. The only other requirements are a tape recorder and a problem to address. Before I provide a problem, the tape recorder should be set up and turned on to record.

Now here is the problem, not the sort one might expect. Try to remember what you were doing on this same date one year ago today. Does this seem impossible? It isn't. Often people can pinpoint just what they were doing and, if not that, then get a general idea. Begin now, starting to think aloud. Remember to try to say something every five seconds at least. Make an effort to maintain a fairly continuous flow of speech.

After doing the best you can with the problem, rewind the tape recorder and listen to the verbal record of your thinking. What patterns of thought become apparent? What gaps are there? Were the six principles followed? Judging from the tape and the remembered experience, was it difficult? If so, in what ways? Not infrequently, perhaps a quarter or a fifth of the time, people do encounter some difficulties with the think-aloud technique when attempting it without the help of an experienced investigator. Usually this is because one of the six principles has been neglected or not rightly understood. With an investigator to help, such problems seldom arise. In my experience, perhaps only one out of fifteen subjects has special difficulty with the think-aloud method, enough difficulty to warrant giving up.

If there were no such problems, the tape recording should tell quite a tale about how the mind can recover and assemble information. This problem often is used to demonstrate the deliberate and constructive character of some kinds of remembering, where a person must reason from partial recollections in order to reach a conclusion.

I have mentioned a couple of times that the mind works somewhat faster than the mouth. In fact, during moments of insight, a person often arrives at a conclusion much too quickly to give an adequate account "on the fly," as the think-aloud method requires. For probing such moments, there is a better way: a retrospective report. Usually, after-the-fact reports have been used as a coarser-grained substitute for thinking aloud, to avoid burdening people during the activity. But a few investigators have

used retrospective reports as a finer-grained improvement over thinking aloud, one designed to collect a more detailed account of the last minute or so of thinking. The opportunity to do this arises from a remarkable circumstance: people can remember a great deal about the last few moments of thinking if they stop and take the time to review.

Of course, requests for retrospection have to be infrequent or one would constantly interrupt the activity. A good way to handle this is to ask people to think aloud and occasionally, when their speech indicates an insight, to request a retrospection. Another way is to set problems that are worked on silently, especially problems that tend to be solved in a flash after laboring for a while, and to ask for a retrospection immediately after an answer occurs.

A request for retrospection can be phrased something like this: "Can you tell me (or write down) what thought led to the next over the last several seconds up to the point you just arrived at? Try to indicate what happened step by step. But only report what you actually remember now, not what you think might plausibly have happened." After collecting a response to this, the investigator can refine it with further queries. Going over the events mentioned, the investigator might ask questions like "How sure are you that you actually remember this – rate yourself on a five-point scale ranging from very unsure to very sure," or, "Do you remember any mental images associated with this event," or "Do you now remember any thoughts coming after this, but before the next event you mentioned?" Whether and what questions to ask varies with the circumstances.

I won't quote an example of a retrospective report or give an exercise in producing one since both occur as part of the next chapter, which explores the nature of moments of insight. Let me just emphasize how the instructions and follow-up questions for a retrospective report encourage remembering rather than reconstruction. With retrospectives much more than with thinking aloud, people tend to offer plausible explanations, explanations that weave together their bits of memory to provide a fully coherent and motivated account of what happened. But making sense of the record is the business of the investigator, not the subject.

Revised proposition: Satisfactory introspective reports are most reliably obtained only with the help of good tactics, including careful instructions that warn against explaining or filling in, but encourage as continuous a report as memory and other factors permit.

CREATION AND CONSCIOUSNESS

It is standard lore that the business of creation is the business of the unconscious mind. Whatever conscious thoughts there might be are as irrelevant as the ripples on the surface of a pond, or so the story goes. The introspective methods discussed in this chapter seem to challenge this familiar idea. They reveal that makers of things or theories can say much more about their activities than people usually suppose. Perhaps creating is not so unconscious after all. But perhaps it is. In one way or another, I will have to return to this question several times over the following chapters.

Earlier, in the discussion of whether introspection disrupted an activity, it was important to sort out some different meanings of "thinking about" what one was doing. I want to do some more sorting here. A person can be conscious of an action in different senses. Suppose, for instance, I'm feeling like Don Rickles one day and I deliver an insult. Maybe it is fully premeditated. Both well before and as I say it, I know just what I'm doing. But maybe instead it is an opportunity suddenly seen and seized; I grow aware of, and have time to quash, the impulse, although it tends to flow toward its conclusion. Or maybe the putdown is wholly spontaneous; in the very saying, I recognize the sting and even regret it. Or then again, this same reaction might come not with but just after the remark. Or I may say something insulting without meaning to at all, and recognize it after the fact because of the victim's reaction, or never. Why this parade of possibilities? Simply to make the point that, introspective methods aside, awareness of the same superficial action can vary drastically in the natural course of events.

Deliberate introspection brings into awareness mental events

which normally proceed without attention. As with the game of centipede, one can become conscious of automatic behavior like walking which does not need the support of consciousness to follow its familiar pattern. But while in such personal experiments attention may only watch and not lend a hand, attention of a somewhat different kind sometimes cuts in because it can and must help out. We walk down a summer sidewalk with no need for special attention, but an icy and rutted winter sidewalk captures our full awareness. We place our feet with conscious precision. Thus the border between the conscious and the unconscious shifts with need and circumstance, whether the needs and circumstances are those of the investigator of a slippery topic or the walker on a slippery road.

None of this means that the boundary of consciousness is wholly elastic. That walker on ice may control exquisitely where he places his feet, but he doesn't do so by guiding his muscles individually. Any effort to do this, or even to achieve a passive awareness of precisely which muscles are doing what, is very difficult. Simple acts of remembering provide another example. We all can remember our telephone numbers. They surface in our minds as dutifully as trained seals. But when we try to introspect how we search out that information, nothing comes. Whatever the mind does to look up such information in whatever sort of directory it has, the process is wholly covert.

So what about the issue we started with: Is creating unconscious or not? Even the above off-the-cuff examples warn that we need to be wary of glib answers. If creating is supposed to be unconscious, does this mean that the course of thought behind the achievement was not deliberately carried out, or not in fact conscious at the time, or never conscious even afterwards, or closed in principle to awareness? What people usually seem to have in mind is that the creative process is wholly closed to awareness. But plainly the effectiveness of introspective methods contradicts that. People *do* reveal significant things about things about their inventive thinking. A more reasonable sense in which the creative process is unconscious might be this: not surprisingly, makers are not routinely conscious of how they proceed. They attend to their work, not to the thought processes that are getting

the work done. The success of introspective methods measures not what creators are usually aware of, but what they can be aware of without too much trouble.

But what about what they can't be aware of? What about mental processes like remembering your telephone number which hide wholly from consciousness? Maybe there, exactly there, is where most of the action occurs in creative thinking. In a sense, this has to be so. Not only creative thinking, but everything we do including taking out the garbage and polishing our shoes requires the support of hundreds of covert mental processes. What we are aware of, and even what we can be aware of, are only fragments of the ensemble. The unconscious is always where most of the action is, for anything.

But such an answer is somewhat beside the point, the present point at least. I have emphasized that my aim was not to explain the mundane miracles of human behavior, achievements like speaking or walking that we take for granted. Instead, I would hope to say something about how some things we usually recognize as marvelous, like the writing of a fine poem or the devising of a revolutionary scientific theory, can be understood in terms of those mundane miracles. That same philosophy applies here. The real question is not whether introspective reports explain everything about the course of thought. Certainly they don't. The real question is whether introspective reports reveal enough to reduce those marvelous accomplishments of the inventive mind to everyday if nonetheless mysterious mechanisms.

One clarification before I leave this topic. The following chapters call on many methods besides introspective ones, including cheerful thievery, with due acknowledgment, from whatever prior writers have said that is helpful. Probably not even a quarter of what I will have to say relies on introspective methods. Yet I wanted to take the time in this chapter to lay out what they were, how they worked, and what they were good for. All that with a simple enough motive: this is no doubt the most controversial source of information I will use.



CREATIVE MOMENTS

One of the most intriguing creative moments I know was described by the French mathematician Henri Poincaré. Poincaré had been developing a theory of a group of mathematical functions he came to call the Fuchsian functions. Among several moments of insight Poincaré related in connection with this work, the following especially fascinates:

Just at this time I left Caen, where I was then living, to go on a geologic excursion under the auspices of the school of mines. The changes of travel made me forget my mathematical work. Having reached Coutances, we entered an omnibus to go some place or other. At the moment when I put my foot on the step the idea came to me, without anything in my former thoughts seeming to have paved the way for it, that the transformations I had used to define the Fuchsian functions were identical with those of non-Euclidean geometry. I did not verify the idea; I should not have had time, as upon taking my seat in the omnibus, I went on with a conversation already commenced, but I felt a perfect certainty. On my return to Caen, for conscience' sake I verified the result at my leisure.

There are many well-known moments of insight in the history of science. This is one of the most spare. Stepping onto the bus, Poincaré got his idea and that was all there was to it.

It's interesting to compare this with some other famous moments of creation – Charles Darwin's for instance. Darwin in