Conceptual Blockbusting

A GUIDE TO BETTER IDEAS

Third Edition

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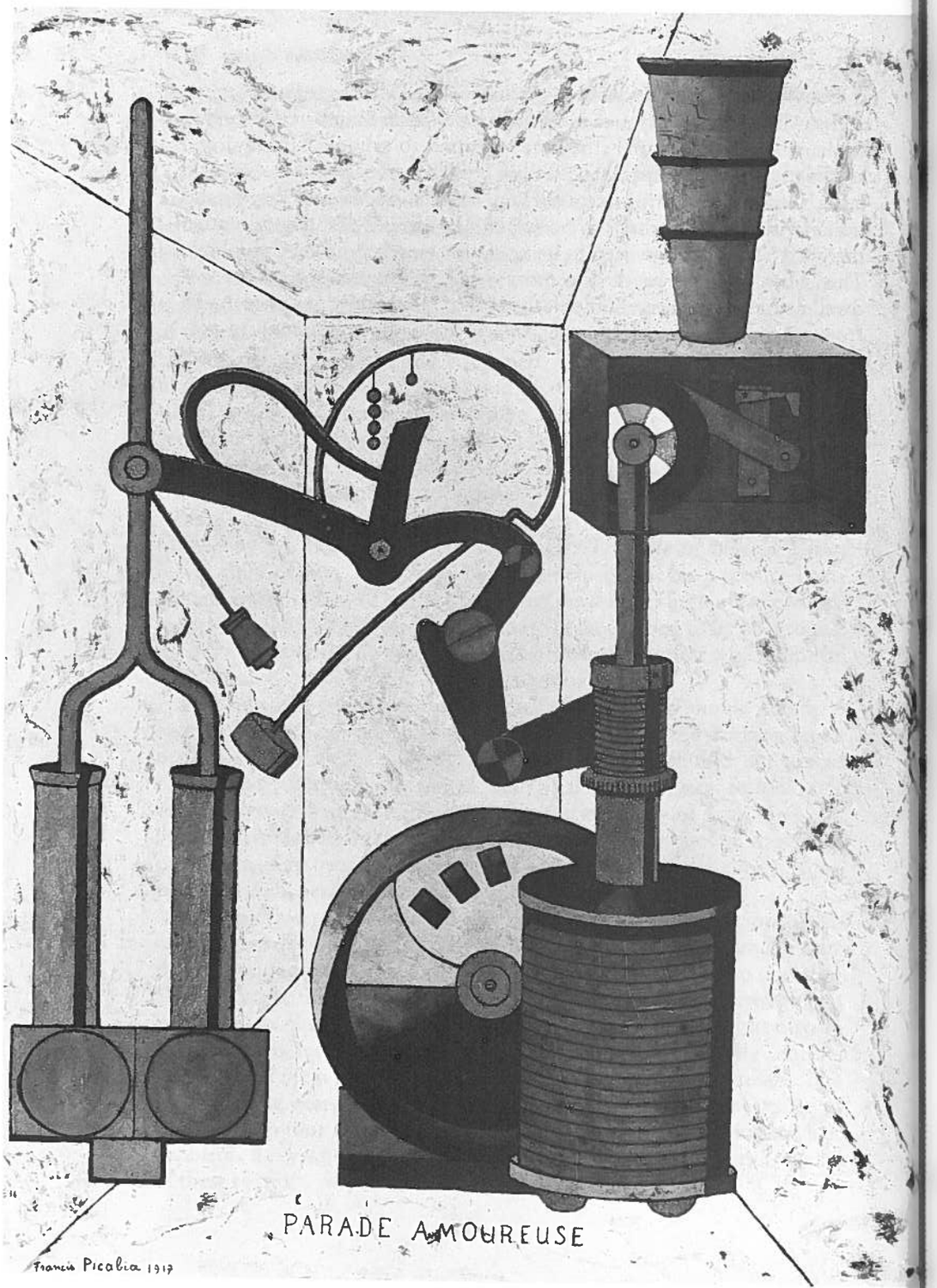
CONTENTS



CHAPTER THREE

EMOTIONAL BLOCKS

THIS CHAPTER WILL BEGIN with a game—a game that requires a group of people, the larger the better, so try it at a party. It was, I think, invented by Bob McKim and is called "Barnyard."

Exercise: Divide your group and assign them to be various animals as follows:

If their last names begin with:	they are:
A-E	sheep
F-K	pigs
L-R	cows
S-Z	turkeys

Now tell each person to find a partner (preferably someone he does not know too well) and to look this partner in the eye. You will then count to three at which time everyone is to make the sound of his animal as loudly as he possibly can. See how loud a barnyard you can build.

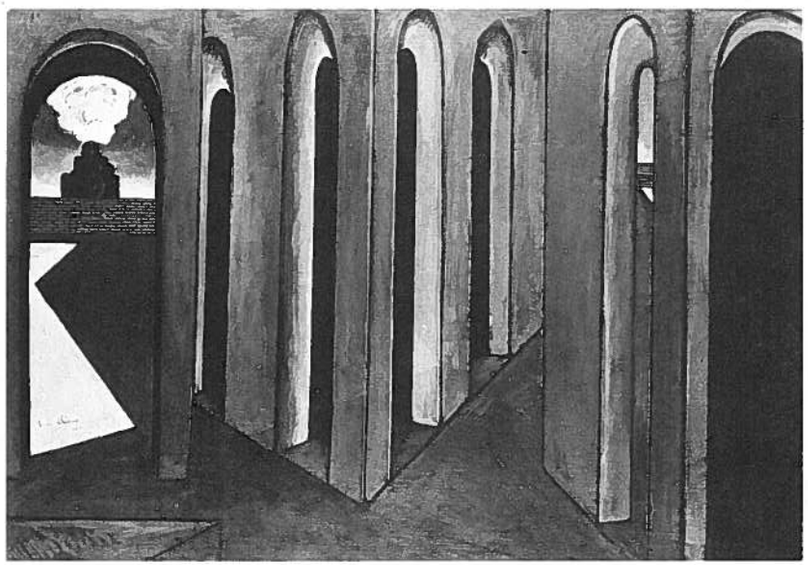
The participants in this game will be able to experience a common emotional block to conceptualization—namely, that of feeling like an ass. If you did not play the game and want to experience the feeling, merely stand alone on any busy corner (or wherever you are right now) and loudly make the sound of one of the animals.

As we will see in the next chapter, conceptualization is risky and new ideas are hard to evaluate. The expression of a new idea, and especially the process of trying to convince someone else it has value, sometimes makes you feel like an ass, since you are doing something that possibly exposes your imperfections. In order to avoid this feeling, people will often avoid conceptualization, or at least avoid publicizing the output.

Before we discuss specific emotional blocks, let me make a few comments about psychological theory. Although, as I stated earlier, psychological theory does not offer a complete model for explaining the conceptual process, many theories exist and have commonalities which are pertinent to understanding emotional blocks. Of particular importance are the theories of Freud and his followers and of the contemporary humanistic psychologists (Rogers, Maslow et al.).

Freud

Much of Freudian theory is based upon conflicts between the *id* (the instinctive animal part of ourselves) and the *ego* (the socially aware and conscious aspect) and *superego* (the moralistic portion of ourselves that forbids and prohibits). The motive force in the Freudian model is the id, which resides in the unconscious and is concerned with satisfying our needs. According to Freud, ideas originating in the unconscious must be subjected to the scrutiny of the ego (which may reject them because we cannot realistically carry them out) and the superego (which may reject them because we should not have let ourselves have such ideas in the first place). If these ideas are rejected, they will either be completely repressed or they will contribute to neurotic behavior because of unresolved conflict. If they are accepted, they will be admitted to the conscious mind. (This acceptance may be accompanied by anxiety, since once the ego and superego identify with an idea one can be hurt by its rejection.) If the ego and superego are overly selective, relatively few creative ideas will reach the conscious mind. If they are not selective enough, a torrent of highly innovative but extremely impractical ideas will emerge.



de Chirico, *The Anxious Journey*, 1913.

Since the time of Freud, his theory has been elaborated upon by his followers. A good example of this can be seen in Lawrence S. Kubie's book *Neurotic Distortion of the Creative Process*. Kubie utilizes the Freudian concept of *preconscious* in his model of creative thinking. He relegates the subconscious portions of creative thought and problem-solving to this preconscious, reserving the unconscious for unsettled conflicts and repressed impulses. In this model, the preconscious mental processes are hindered both by the conscious and the unconscious processes. As Kubie states in *Neurotic Distortion:*

> Preconscious processes are assailed from both sides. From one side they are nagged and prodded into rigid and distorted symbols by unconscious drives which are oriented away from reality and which consist of rigid compromise formations, lacking in fluid inventiveness. From the other side they are driven by literal conscious purpose, checked and corrected by conscious retrospective critique.

Like Freud, Kubie has a model of the mind in which creative thinking is inhibited by the conscious ego and superego and in which creativity occurs at least partly below the conscious level. However, neuroses play a much more villainous role in Kubie's model than in Freud's.

The Humanistic Psychologists

Although humanistic psychologists agree that creativity is a response to basic inner needs in people, they have a somewhat broader hierarchy of needs than the Freudians. They maintain that people create in order to grow and to fulfill themselves, as well as to solve conflicts and to answer the cravings of the id. They are more concerned with reaching upward and outward. Carl Rogers, in an article entitled "Toward a Theory of Creativity" in *Creativity and its Cultivation* (edited by Harold Anderson) explains:

> The mainspring of creativity appears to be the same tendency which we discover so deeply as the curative force in psychotherapy—man's tendency to actualize himself, to become his potentialities. By this I mean the directional trend which is evident in all organic and human life—the urge to expand, extend, develop, mature—the tendency to express and activate all the capacities of the organism, to the extent that such activation enhances the organism or the self. This tendency may become deeply buried under layer after layer of encrusted psychological defenses; it may be hidden behind elaborate facades which deny its existence; it is my belief, however, based on my experience, that it exists in every individual and awaits only the proper conditions to be released and expressed.

The humanistic psychologists feel that the creative person is emotionally healthy and sensitive both to the needs and the capabilities of his unconscious to produce creative ideas. Like Freud's creative person, he possesses a strong ego and a realistic superego which allow him to be a prolific conceptualizer and relatively free of distracting neuroses.

We can now come to several interesting and believable conclusions, based upon our brief discussion of psychology:

1. Man creates for reasons of inner drive, whether it be for purposes of conflict resolution, self-fulfillment, or both. He can, of course, also create for other reasons, such as money.
2. At least part of creativity occurs in a part of the mind which is below the conscious level.
3. Although creativity and neuroses may stem from the same source, creativity tends to flow best in the absence of neuroses.
4. The conscious mind, or ego, is a control valve on creativity.
5. Creativity can provoke anxieties.

Now I will continue with our discussion of emotional blocks.

Emotional blocks may interfere with the freedom with which we explore and manipulate ideas, with our ability to conceptualize fluently and flexibly—and prevent us from communicating ideas to others in a manner which will gain them acceptance. Let me list a few of them, which I will then discuss:

1. Fear to make a mistake, to fail, to risk
2. Inability to tolerate ambiguity; overriding desires for security, order; "no appetite for chaos"

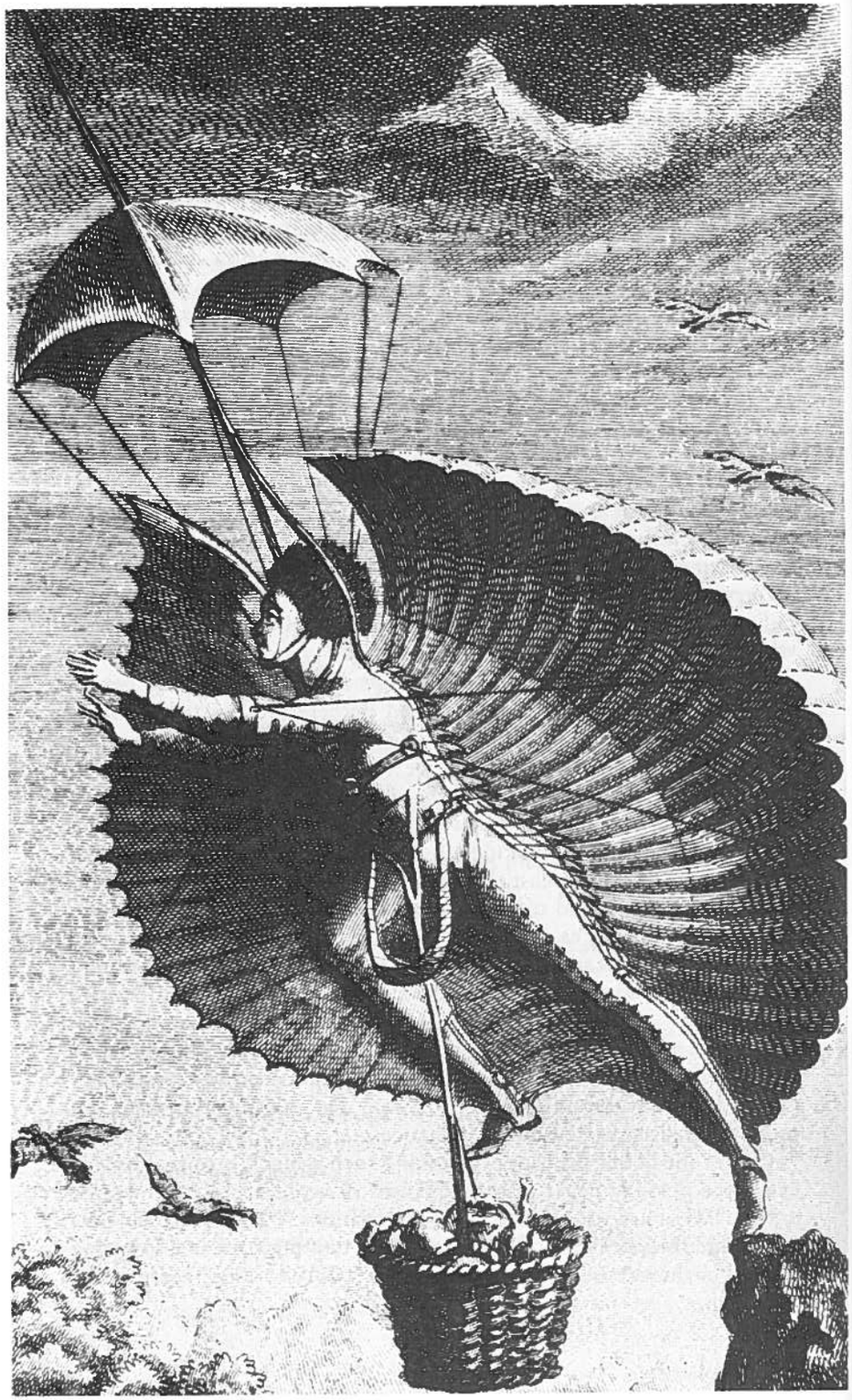
3. Preference for judging ideas, rather than generating them
4. Inability to relax, incubate, and "sleep on it"
5. Lack of challenge (problem fails to engage interest) versus excessive zeal (overmotivation to succeed quickly)
6. Inability to distinguish reality from fantasy

Fear of Taking a Risk

Fear to make a mistake, to fail, or to take a risk is perhaps the most general and common emotional block. Most of us have grown up rewarded when we produce the "right" answer and punished if we make a mistake. When we fail we are made to realize that we have let others down (usually someone we love). Similarly we are taught to live safely (a bird in the hand is worth two in the bush, a penny saved is a penny earned) and avoid risk whenever possible. Obviously, when you produce and try to sell a creative idea you are taking a risk: of making a mistake, failing, making an ass of yourself, losing money, hurting yourself, or whatever.

This type of fear is to a certain extent realistic. Something new is usually a threat to the status quo, and is therefore resisted with appropriate pressure upon its creator. The risks involved with innovation often can result in real hardship. Far be it from me to suggest that people should not be realistic in assessing the costs of creativity. For instance, I spend a great amount of time attempting to explain to students that somehow the process of making money out of a commercially practical idea seems to require at least eight years, quite a bit of physical and emotional degradation, and often the sacrifice of such things as marriages and food. However, as I also try to explain to students, the fears that inhibit conceptualization are often *not* based upon a realistic assumption of the consequences. Certainly, a slightly "far-out" idea submitted as an answer to a class assignment is not going to cost the originator his life, his marriage, or even financial ruin. The only possible difficulty would arise if I, the teacher, were annoyed with his answer (and I happen to like such responses from students). The fear involved here is a more generalized fear of taking a chance.

One of the better ways of overcoming such a block is to realistically assess the possible negative consequences of an idea. As is sometimes asked, "What are your catastrophic expectations?" If you have an idea for a better bicycle lock and are considering quitting a job and founding a small business based upon the lock and a not-yet-conceived product



line to go with it, the risks are considerable (unless you happen to have large sums of money and important commercial contacts). If you invent a new method of flight (say, wings of feathers held together with wax) the risks may also be considerable in perfecting the product. However, if you think of a new way to schedule your day, paint your bathroom, or relate to others in your dormitory, the risks are considerably less.

In my experience, people do not often realistically assess the probable consequences of a creative act. Either they blithely ignore any consequences, or their general fear of failure causes them to attach excessive importance to any "mistake," no matter how minor it will appear in the eyes of future historians. Often the potential negative consequences of exposing a creative idea can be easily endured. If you have an idea that seems risky, it is well worth the time to do a brief study of the possible consequences. During the study, you should include "catastrophic expectations" (assume everything goes badly) and look at the result. By doing this, it will become apparent whether you want to take the risk or not.

> **Exercise:** Next time you are having difficulty deciding whether to push a "creative" idea, write a short (two-page) "catastrophic expectations" report. In it detail as well as you can precisely what would happen to you *if everything went wrong*. By making such information explicit and facing it, you swap your analytical capability for your fear of failure—a good trade.

No Appetite for Chaos

The fear of making a mistake is, of course, rooted in insecurity, which most people suffer from to some extent. Such insecurities are also responsible for the next emotional block, the "Inability to tolerate ambiguity; overriding desire for order; 'no appetite for chaos.' " Once again, some element of this block is rational. I am not suggesting that in order to be creative you should shun order and live in a totally chaotic situation. I am talking more of an excessive fondness for order in all things. The solution of a complex problem is a messy process. Rigorous and logical techniques are often necessary, but not sufficient. You must usually wallow in misleading and ill-fitting data, hazy and difficult-to-test concepts, opinions, values, and other such untidy quantities. In a sense, problem-solving is *bringing order to chaos.* A desire for order is therefore necessary. However, the ability to tolerate chaos is a must.

We all know compulsive people, those who must have everything always in its place and who become quite upset if the order of their physical lives is violated. If this trait carries over into a person's mental process, he is severely impaired in his ability to work with certain types of problems. One reason for extreme ordering of the physical environment is efficiency. Another may be the aesthetic satisfaction of precise physical relationships. However, another reason is insecurity. If your underwear is precisely folded and "dressed right," you have precise control over your underwear, and thus there is one less thing out of control to be threatening. I do not actually care how your underwear is stored. However, if your thoughts are precisely folded and dressed right you are probably a fairly limited problem-solver. The process of bringing widely disparate thoughts together cannot work too well because your mind is not going to allow widely disparate thoughts to coexist long enough to combine.

Judging Rather than Generating Ideas

The next emotional block, the "Preference for judging ideas, rather than generating them," is also the "safe" way to go. Judgment, criticism, tough-mindedness, and practicality are of course essential in problem-solving. However, if applied too early or too indiscriminately in the problem-solving process, they are extremely detrimental to conceptualization. In problem-solving, analysis, judgment, and synthesis are three distinct types of thinking. In *analysis,* there is usually a right answer. I am an engineer: if you pay me to tell you how large a beam is needed to hold up a patio roof, you rightly expect *the* answer. Fortunately, I know how to analyze such things mathematically and can give it to you. *Judgment* is generally used in a problem where there are several answers and one must be chosen. A court case is a good example. A situation such as Watergate is another. Judgments are made by sensible people as to guilt or innocence, and the situation is sufficiently complex that disagreements can occur. *Synthesis* is even more of a multianswer situation. A design problem (design a better way to serve ice cream) has an infinitude of answers, and there are few rigorous techniques to help in deciding between them.

If you analyze or judge too early in the problem-solving process, you will reject many ideas. This is detrimental for two reasons. First of all, newly formed ideas are fragile and imperfect—they need time to mature and acquire the detail needed to make them believable. Secondly, as we will discuss later, ideas often lead to other ideas. Many techniques of

conceptualization, such as brainstorming, depend for their effectiveness on maintaining "way-out" ideas long enough to let them mature and spawn other more realistic ideas. It is sometimes difficult to hold onto such ideas because people generally do not want to be suspected of harboring impractical thoughts. However, in conceptualization one should not judge too quickly.

The judgment of ideas, unfortunately, is an extremely popular and rewarded pastime. One finds more newspaper space devoted to judgment (critic columns, political analyses, editorials, etc.) than to the *creation* of ideas. In the university, much scholarship is devoted to judgment, rather than creativity. One finds that people who heap negative criticism upon all ideas they encounter are often heralded for their practical sense and sophistication. Bad-mouthing everyone else's concepts is in fact a cheap way to attempt to demonstrate your own mental superiority.

If you are a professional idea-haver, your criticism tends to be somewhat more friendly. Professional designers are often much more receptive to the ideas of our students than non-design oriented faculty members. Professional problem-solvers have a working understanding of the difficulty in having ideas and a respect for ideas, even if they are flawed. If you are a compulsive idea-judger you should realize that this is a habit that may exclude ideas from your own mind before they have had time to bear fruit. You are taking little risk (unless you are excluding ideas that could benefit you) and are perhaps feeding your ego somewhat with the thrill of being able to judge the outputs of others, but you are sacrificing some of your own creative potential.

Inability to Incubate

The "inability to relax, incubate, and 'sleep on it' " is also a somewhat common emotional block. There is general agreement that the unconscious plays an extremely important role in problem-solving. Everyone has had the experience of having the answer to a problem suddenly occur in his mind. One maddeningly familiar phenomenon to many people is a late answer to an important problem. You may work for days or weeks on a problem, complete it, and go on to other activities. Then, at some seemingly random point in time, a better answer "appears." Since the original problem was probably completed in order to reach a deadline, this "better" answer often only serves to annoy you that you did not think of it sooner. This better answer came straight from the unconscious as a result of the "incubation" process it was going through. I have found in my own case that this "incubation" process

works and is reliable. I have the confidence to think hard about a problem (charging up my unconscious) and then forget about it for a period of time. When I begin work on it again, new answers are usually present.

Many "symptoms" of incubation are common. There is a widespread belief among students that they do their best work just before deadlines. If, in fact, they work on the material when they receive it long enough to store the data in their unconscious, then incubation can occur, and a better solution may emerge at a later time. Incubation does often seem to produce the right answer at the appropriate time. Students often claim to have come up with a winning idea the morning that it is due, after struggling futilely with the problem for days.

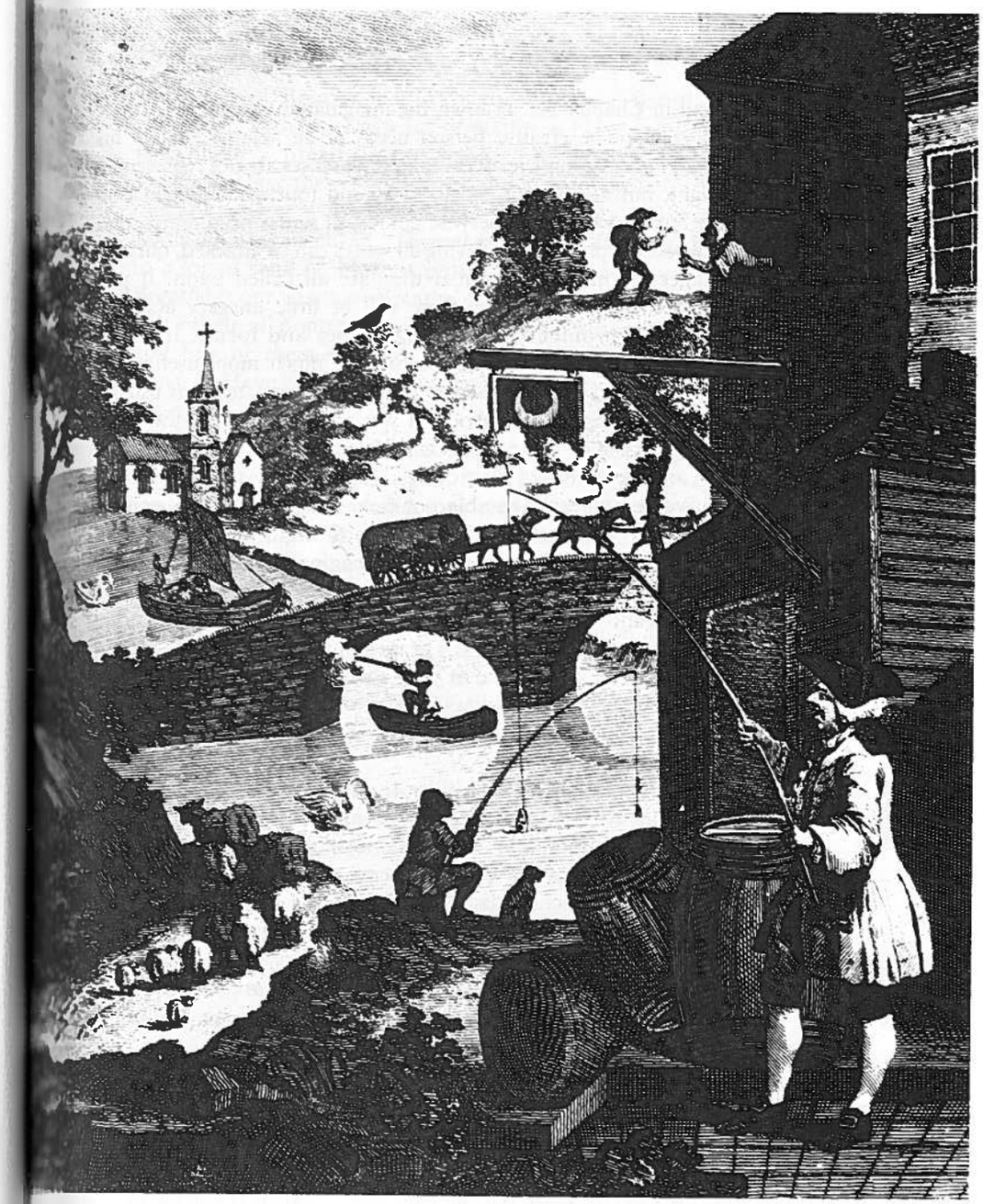
You must allow the unconscious to struggle with problems. Incubation is important in problem-solving. It is poor planning not to allow adequate time for incubation in the solution of an important problem. It is also important to be able to relax in the midst of problem-solving. Your overall compulsiveness is less fanatical when you are relaxed, and the mind is more likely to deal with seemingly "silly" combinations of thoughts. If you are never relaxed, your mind is usually on guard against non-serious activities, with resulting difficulties in the type of thinking necessary for fluent and flexible conceptualization.

Lack of Challenge versus Excessive Zeal

"Lack of challenge" and "excessive zeal" are opposite villains. You cannot do your best on a problem unless you are motivated. Professional problem-solvers learn to be motivated somewhat by money and future work that may come their way if they succeed. However, challenge must be present for at least some of the time, or the process ceases to be rewarding. On the other hand, an excessive motivation to succeed, especially to succeed quickly, can inhibit the creative process. The tortoise-and-the-hare phenomenon is often apparent in problem-solving. The person who thinks up the simple elegant solution, although he may take longer in doing so, often wins. As in the race, the tortoise depends upon an inconsistent performance from the rabbit. And if the rabbit spends so little time on conceptualization that he merely chooses the first answers that occur, such inconsistency is almost guaranteed.

Reality and Fantasy

"Lack of access to areas of imagination," "Lack of imaginative control," and "Inability to distinguish reality from fantasy" will be discussed



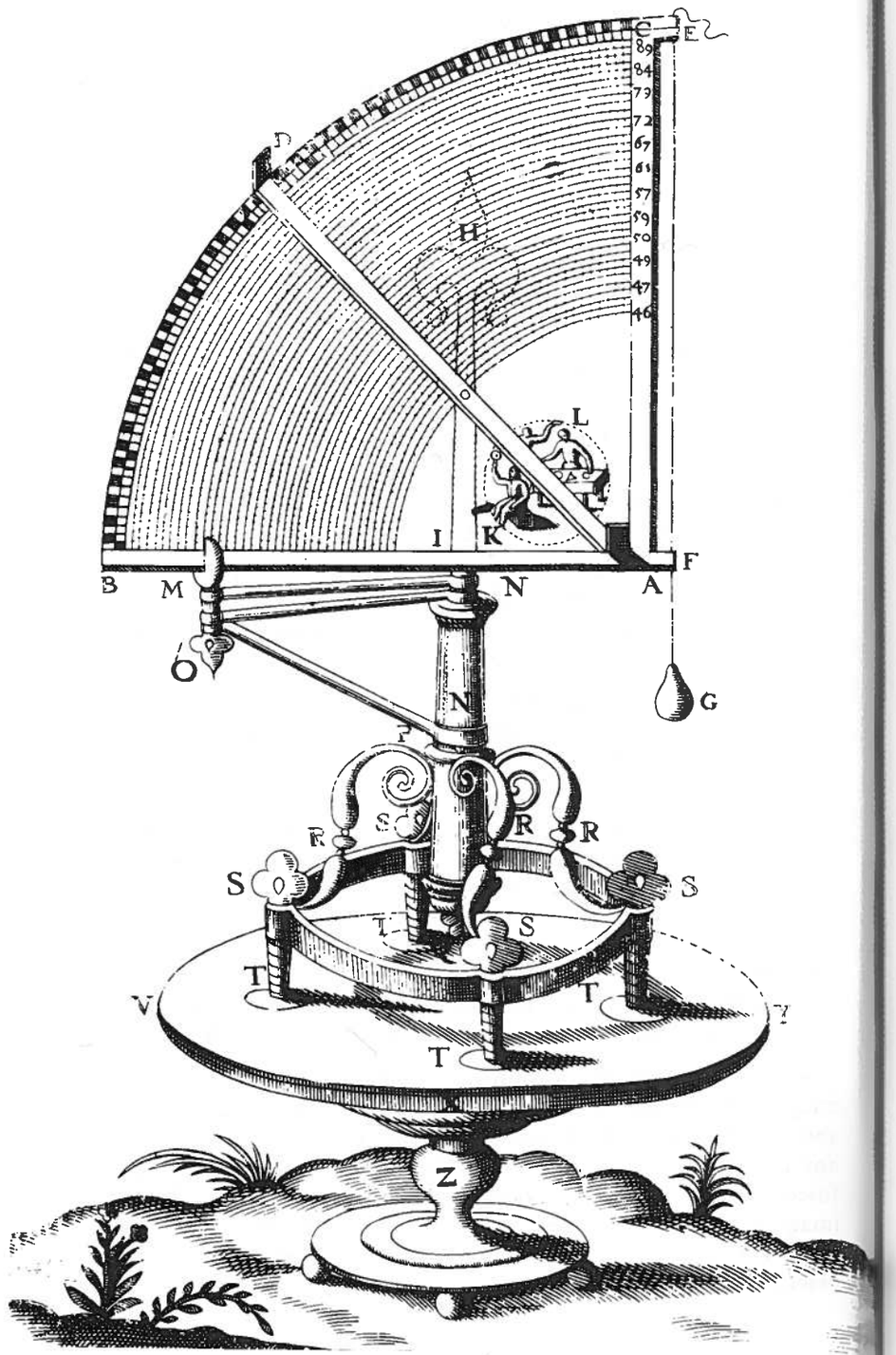
in more detail in Chapter Six. In brief, the imagination attempts to create objects and events. The creative person needs to be able to control his imagination and needs complete access to it. If all senses are not represented (not only sight, but also sound, smell, taste, and touch) his imagination cannot serve him as well as it otherwise could. All senses need representation not only because problems involving all senses can be attacked, but also because imagery is more powerful if they are all called upon. If you think purely verbally, for instance, there will be little imagery available for the solving of problems concerning shapes and forms. If visual imagery is also present, the imagination will be much more useful, but still not as potent as if the other senses are also present. You can usually imagine a ball park much more vividly if you are able to recall the smell of the grass, the taste of the peanuts and beer, the feel of the seats and the sunshine, and the sounds of the crowd.

The creative person must be able not only to vividly form complete images, but also to manipulate them. Creativity requires the ***manipulation*** and ***recombination*** of experience. An imagination that cannot manipulate experience is limiting to the conceptualizer. You should be able to imagine a volcano being born in your ball park, or an airplane landing in it, or the ball park shrinking as the grass simultaneously turns purple, if you are to make maximum use of your imagination. Chapter Six will contain some exercises to allow you to gauge your ability to control your imagination as well as discussions on how to strengthen the "mental muscle" used in imagining.

The creative person needs the ability to fantasize freely and vividly, yet must be able to distinguish reality from fantasy. If his fantasies become too realistic, they may be less controllable. If you cannot go through the following exercise without a sense of acute physical discomfort, you may have difficulty distinguishing reality from fantasy. This exercise is taken from *Put Your Mother on the Ceiling* by Richard de Mille. Stay with each fantasy (marked off by slashes) until you have it fully formed in your imagination. This game is called ***breathing***.

> Let us imagine that we have a goldfish in front of us. Have the fish swim around. / Have the fish swim into your mouth. / Take a deep breath and have the fish go down into your lungs, into your chest. / Have the fish swim around in there. / Let out your breath and have the fish swim out into the room again. /
>
> Now breathe in a lot of tiny goldfish. / Have them swim around in your chest. / Breathe them all out again. /
>
> Let's see what kind of things you can breathe in and out of your chest. / Breathe in a lot of rose petals. / Breathe them out again. / Breathe in a lot of water. / Have it gurgling in your chest. / Breathe it out again. / Breathe in a lot of dry leaves. / Have them blowing around in your chest. / Breathe them out again. / Breathe in a lot of raindrops. / Have them pattering in your chest. / Breathe them out again. / Breathe in a lot of sand. / Have it blowing around in your chest. / Breathe it out again. / Breathe in a lot of little firecrackers. / Have them all popping in your chest. / Breathe out the smoke and bits of them that are left. / Breathe in a lot of little lions. / Have them all roaring in your chest. / Breathe them out again. /
>
> Breathe in some fire. / Have it burning and crackling in your chest. / Breathe it out again. / Breathe in some logs of wood. / Set fire to them in your chest. / Have them roaring as they burn up. / Breathe out the smoke and ashes. /
>
> Have a big tree in front of you. / Breathe fire on the tree and burn it all up. / Have an old castle in front of you. / Breathe fire on the castle and have it fall down. / Have an ocean in front of you. / Breathe fire on the ocean and dry it up. /
>
> What would you like to breathe in now? / All right. / Now what? / All right. / What would you like to burn up by breathing fire on it? / All right. /
>
> Be a fish. / Be in the ocean. / Breathe the water of the ocean, in and out. / How do you like that? / Be a bird. / Be high in the air. / Breathe the cold air, in and out. / How do you like that? / Be a camel. / Be on the desert. / Breathe the hot wind of the desert, in and out. / How does that feel? / Be an old-fashioned steam locomotive. / Breathe out steam and smoke all over everything. / How is that? / Be a stone. / Don't breathe. / How do you like that? / Be a boy (girl). / Breathe the air of this room, in and out. How do you like that?

It would certainly be uncomfortable to inhale sand. Whether you can imagine the feeling of inhaling sand depends somewhat upon your ability to fantasize. No danger exists from imagining such an act, and any pain felt is imagined, not real. However, if your fantasies are confused with reality, it can be very difficult to fantasize such things. The imagination is extremely powerful because it can go beyond reality. But in order to do this, the imagination must be set free of the constraints placed upon *real* acts and events.



CHAPTER FOUR

CULTURAL AND ENVIRONMENTAL BLOCKS

CULTURAL BLOCKS ARE ACQUIRED by exposure to a given set of cultural patterns. Environmental blocks are imposed by our immediate social and physical environment. Since these two types of blocks are somewhat interrelated, we will discuss both of them in this chapter. Some examples of cultural blocks (for our culture) are:

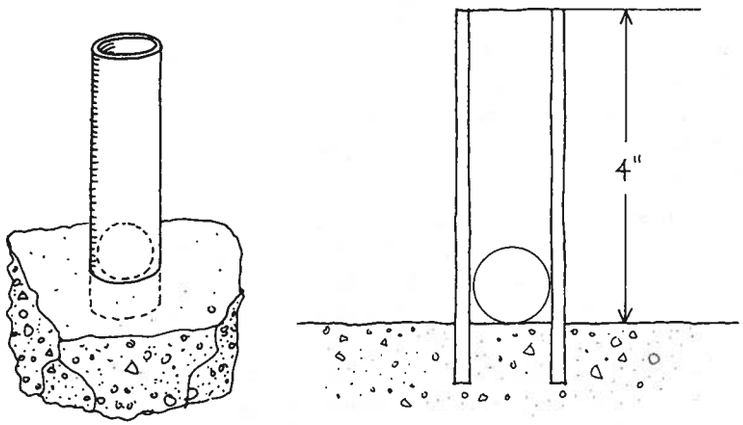
1. Taboos
2. Fantasy and reflection are a waste of time, lazy, even crazy
3. Playfulness is for children only
4. Problem-solving is a serious business and humor is out of place
5. Reason, logic, numbers, utility, practicality are *good*; feeling, intuition, qualitative judgments, pleasure are *bad*
6. Tradition is preferable to change
7. Any problem can be solved by scientific thinking and lots of money

Some examples of environmental blocks are:

1. Lack of cooperation and trust among colleagues
2. Autocratic boss who values only his own ideas; does not reward others
3. Distractions—phone, easy intrusions
4. Lack of support to bring ideas into action

Let us discuss cultural blocks first. We will begin by working a problem that will make the message clearer.

> **Exercise:** Assume that a steel pipe is imbedded in the concrete floor of a bare room as shown below. The inside diameter is .06″ larger than the diameter of a ping-pong ball (1.50″) that is resting gently at the bottom of the pipe. You are one of a group of six people in the room, along with the following objects:
>
> 100′ of clothesline
> A carpenter's hammer
> A chisel
> A box of Wheaties
> A file
> A wire coat hanger
> A monkey wrench
> A light bulb
>
> List as many ways you can think of (in five minutes) to get the ball out of the pipe without damaging the ball, tube, or floor.



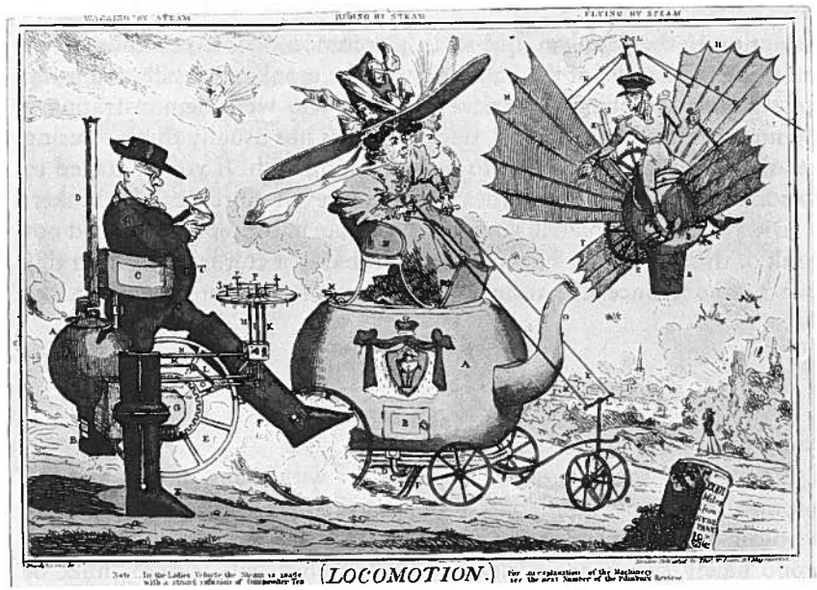
J.P. Guilford, one of the pioneers in the study of creativity, speaks a great deal about fluency and flexibility of thought. *Fluency* refers to the number of concepts one produces in a given length of time. If you are a fluent thinker, you have a long list of methods of retrieving the ball from the pipe. However, quantity is only part of the game. *Flexibility* refers to the diversity of the ideas generated. If you are a flexible thinker, you should have come up with a wide variety of methods. If you thought of filing the wire coat hanger in two, flattening the resulting ends, and making large tweezers to retrieve the ball, you came up with a solution to the problem, but a fairly common one. If you thought of smashing the handle of the hammer with the monkey wrench and using the resulting splinters to retrieve the ball, you were demonstrating a bit more flexibility of thought, since one does not usually think of using a tool as a source of splinters to do something with. If you managed to do something with the Wheaties you are an even more flexible thinker.

Did you think of having your group urinate in the pipe? If you did not think of this, why not? The answer is probably a cultural block, in this case a *taboo*, since urinating is somewhat of a closet activity in the U.S.

Taboos

I have used this ping-pong ball exercise with many groups and the response is not only a function of our culture, but also of the particular people in the group and the particular ambiance of the meeting. A mixed group newly convened in elegant surroundings will seldom think of urinating in the pipe. Even if members in the group do come up with this as a solution, they will keep very quiet about it. A group of people who work together, especially if all-male and if it's at the end of a working session, will instantly break into delighted chortles as they think of this and equally gross solutions. The importance of this answer is not that urinating in the pipe is necessarily the best of all solutions to the problem (although it is certainly a good one), but rather that cultural taboos can remove entire families of solutions from the ready grasp of the problem-solver. Taboos therefore are conceptual blocks. This is not a tirade against taboos. Taboos usually are directed against acts that would cause displeasure to certain members of a society. They therefore play a positive cultural role. However, it is the acts themselves which would offend. If imagined, rather than carried out, the acts are not harmful. Therefore, when working on problems within the privacy of your own mind, you do not have to be concerned with the violation of taboos.

Let us discuss a few more cultural blocks. The first two listed earlier, "Fantasy and reflection are a waste of time, lazy, even crazy" and "Playfulness is for children only," are challenged by quite a bit of evidence to indicate that fantasy, reflection, and mental playfulness are essential to good conceptualization. These are properties that seem to exist in children, and then unfortunately are to some extent socialized out of people in our culture. A four-year-old who amuses himself with an imaginary friend, with whom he shares his experiences and communicates, is cute. A 30-year-old with a similar imaginary friend is something else again.



"Daydreaming" or "woolgathering" is considered to be a symptom of an unproductive person.

As mentioned previously, environmental and cultural blocks are somewhat interrelated. People can fantasize much more easily in a supportive environment. We quite frequently ask students to fantasize as part of a design task, and when assigned the task they do quite well. However, they tend to feel quite guilty if they spend their time in fantasy if it is not an assigned part of the problem, since it often seems to be a diversion. Nevertheless, if you are attempting to solve a problem having to do with bickering children, is it not worth the time and effort to fantasize a situation in which your children do not bicker and proceed to examine the situation closely to see how it works? If you are designing a new recreational vehicle, should you not fantasize what it would be like to use that vehicle?

Many psychologists have concluded that children are more creative than adults. One explanation for this is that the adult is so much more aware of practical constraints. Another explanation, which I believe, is that our culture trains mental playfulness, fantasy, and reflectiveness out of people by placing more stress on the value of channeled mental activities. We spend more time attempting to derive a better world directly from what we have than in imagining a better world and what it would be. Both are important.

Humor in Problem-Solving

Another cultural block mentioned was, "Problem-solving is a serious business and humor is out of place." In an essay, "The Three Domains of Creativity," Arthur Koestler, one of the more important writers who treat conceptualization, identifies these "domains" as *artistic originality* (which he calls the "ah!" reaction), *scientific discovery* (the "aha!" reaction), and *comic inspiration* (the "haha!" reaction). He defines creative acts as *the combination of previously unrelated structures in such a way that you get more out of the emergent whole than you have put in.* He explains comic inspiration, for example, as stemming from "the interaction of two mutually exclusive associative contexts." As in creative artistic and scientific acts, two ideas have to be brought together that are not ordinarily combined. This is one of the essentials of creative thinking. In the particular case of humor, according to Koestler, the interaction causes us "to perceive the situation in two self-consistent but habitually incompatible frames of reference." The joke-teller typically starts a logical chain of events. The punch line then sharply cuts across the chain with a totally unexpected line. The tension developed in the first line is therefore shown to be a put-on and with its release, the audience laughs. Let us look at a couple of jokes:

1. A man, on entering the waiting room of a veterinarian's office with his sick dog, sat next to a lady with a beautiful wolfhound. The wolfhound was extremely high-spirited and happily gamboled around the waiting room, as the man's own dog lay limply on the floor. Finally, curious as to why such an apparently healthy dog should be in a veterinarian's office, he turned to the lady and said:

"You certainly have a beautiful dog."

"Oh, thank you," she replied.

"He looks so healthy," said he, "that I am surprised to see him in a veterinarian's office. What is wrong with him?"

"Oh," she said with some embarrassment, "he has syphilis."

"Syphilis!" he said. "How did he get syphilis?"

"Well," she said, "he claims he got it from a tree."

(attributed to Dorothy Parker)

2. A woman at a formal dinner was quite discomfited to observe that the man across from her was piling his sliced carrots carefully upon his head. She watched with horror as the pile grew higher and higher and the sauce began to drip from his

hair. She could finally stand it no longer, so she leaned toward him and said,

"Pardon me, sir, but why on earth are you piling your carrots on your head?"

"My God," said he, "are they carrots? I thought they were sweet potatoes."

(source unknown)

Is Koestler's explanation of comic inspiration correct? It would seem so in these two examples, since in each case a developing story (causing tension in the listener, who wants to know how it comes out) is smashed by another line of thinking which demonstrates to the listener that the whole thing is a farce. The listener then (we hope) laughs.

The critical point of interest here is that a similar reaction (laughter) may greet an original idea. A concept may be so contrary to the logical progress of the problem solution that it may be a tension release and cause laughter. Since an answer to a problem may release tension anyway, your unbelievably insightful solution to a problem may be greeted with giggles and hoots, not only from others but from yourself.

Creative groups with which I have been associated have been funny. So are creative people I have known. Humor is present in all manner of ways. I am not suggesting that creative activity is all fun, since it is fraught with frustration, detail work, and plain effort. However, humor is an essential ingredient of healthy conceptualization.

Reason and Intuition

The fifth cultural block on our list is "Reason, logic, numbers, utility, practicality are *good*; feeling, intuition, qualitative judgement, pleasure are *bad*." Reason, logic, numbers, utility, and practicality *are* good; but so, too, are feeling, intuition, qualitative judgment, and pleasure—especially if you are conceptualizing. This block against emotion, feeling, pleasure stems from our puritan heritage and our technology-based culture. It is extremely noticeable to me, since I work with large numbers of engineers and managers in situations where they must solve problems with a large amount of emotional content.

One cause for this block, which has complicated matters in the past but is hopefully dying out a little, has been the assigning of various mental activities and qualities to either the male or the female. In the past, it has been the female who was to be sensitive, emotional, appreciative of the fine arts, and intuitive. The male was to be tough, physical, pragmatic, logical, and professionally productive. Adhering to these constraints severely limits both sexes.

Abraham Maslow describes his findings about this block in his essay, "Emotional Blocks to Creativity" (found in *A Source Book for Creative Thinking*, edited by Parnes and Harding):

> One thing I haven't mentioned but have been interested in recently in my work with creative men (and uncreative men too) is the horrible fear of anything that the person himself would call "femininity," or "femaleness," which we immediately call "homosexual." If he's been brought up in a tough environment, "feminine" means practically everything that's creative. Imagination, fantasy, color, poetry, music, tenderness, languishing, and being romantic are walled off as dangerous to one's picture of one's own masculinity. Everything that's called "weak" tends to be repressed in the normal masculine adult adjustment. And many things are *called* weak which we are learning are not weak at all.

The opposite of this block also exists, of course. Many women are culturally conditioned to be as uncomfortable about many traits ascribed to the male (reason, logic, use of numbers, utility) as males are uncomfortable about "feminine" traits. Also, we find the current wave of anti-technology people who blame the technological emphasis in society for many of man's difficulties. These people believe that feeling, intuition, and qualitative judgment are good and that reason, logic, numbers, utility, and practicality are not all that exciting.

Effective conceptualization requires the problem-solver to be able to incorporate all of these characteristics—the use of reason and logic, as well as intuition and feeling. The designer of physical things must be aesthetically sensitive if the quality of our world is going to improve, whether the designer happens to be male or female. Similarly, the designer must be able to view technology honestly and without disciplinary bias whether from an art background or an engineering background. The businessman must use intuition and the social scientist must use mathematics. The man must be sensitive and the woman strong.

Left-Handed and Right-Handed Thinking

In reading the literature associated with conceptualization, one often encounters references to "left- and right-handed thinking." This is discussed particularly well by Jerome Bruner in his book, *On Knowing: Essays for the Left Hand*. The right hand has traditionally been linked with law, order, reason, logic, and mathematics—the left with beauty, sensitivity, playfulness, feeling, openness, subjectivity, and imagery. The

right hand has been symbolic of tools, disciplines, and achievement—the left with imagination, intuition, and subconscious thinking. In Bruner's words:

> . . . the one the doer, the other the dreamer. The right is order and lawfulness, *le droit*. Its beauties are those of geometry and taut implication. Reaching for knowledge with the right hand is science. . . . Of the left hand we say that it is awkward. . . . The French speak of the illegitimate descendant as being *à main gauche*, and though the heart is virtually at the center of the thoracic cavity, we listen for it on the left. Sentiment, intuition, bastardy. And should we say that reaching for knowledge with the left hand is art?

Oddly enough, this historical symbolic alignment of the two hands with two distinct types of thinking is consistent with present understanding of brain function. The left hemisphere of the brain (which controls the right hand) contains the areas which are associated with control of speech and hearing and involved with analytical tasks such as solving an algebra problem. The right hemisphere (which controls the left hand) governs spatial perception, synthesis of ideas, and aesthetic appreciation of art or music. However, this coincidence is not the main message here, which is that the effective conceptualizer must be able to utilize both right-handed and left-handed thinking. C.P. Snow, in his famous book hypothesizing the existence of two cultures, *Two Cultures and the Scientific Revolution*, separates scientists from humanists. Yet, if one *can* separate people that clearly, then the people one has separated are not maximizing their creative potential. The scientists who are responsible for breakthroughs in knowledge cannot operate entirely by extrapolating past work, but must utilize intuition, too. Similarly, the humanists who disregard the logical are doomed to be ineffectual (even counterproductive) in influencing social actions.

An emphasis on either type of thinking—to the disregard of the other—is a cultural block. In the professional world in our culture, the emphasis is placed on right-handed thinking. It is easier to get money to support right-handed thinking than left-handed thinking. More fathers want their sons to be lawyers, doctors, or scientists than painters, poets, or musicians. Until the culture is willing to accept the equal importance of left- and right-handed thinking in both sexes, a large number of its members will continue to suffer from this conceptual block.

> Exercise: Put yourself into a left-handed thinking mode. Stay away from logic, order, mathematics, science. Think about your feelings, beauty, sadness, the inputs that are coming to your senses. You can probably do this better by placing yourself in a conducive environment (under a tree in the springtime, alone in your most comfortable chair). Then switch yourself into a right-handed mode by thinking of a detailed plan to make money out of one of your left-handed thoughts. Are you ambidextrous? Are you able to shift from one type of thinking to the other, and ideally to do both at once? Or are you more comfortable with one type of thinking than the other?

The block entitled "Any problem can be solved by scientific thinking and lots of money" is of course a cultural one related to the emphasis on the importance of right-handed thinking. It is also interesting, because it exists partly as a result of popular misconception about the scientific process. Science depends both upon logical controlled progress (right-handed) and breakthroughs (often somewhat left-handed). Maslow, in his essay, "Emotional Blocks to Creativity," discusses primary creativity, which he describes as the "creativeness which comes out of the unconscious, and which is the source of new discovery (or real novelty) of ideas which depart from what exists at this point." This is the force behind the breakthroughs so necessary to science. He continues by speaking of what he calls secondary creativity, which he explains as follows:

> I am used now to thinking of two kinds of science, and two kinds of technology. Science can be defined, if you want to, as a technique whereby uncreative people can create and discover, by working along with a lot of other people, by standing upon the shoulders of people who have come before them, by being cautious and careful, and so on. That I'll call secondary creativeness and secondary science.

Primary and Secondary Creativity

The present awesome progress in genetics and biochemistry (through a large amount of secondary creativity) rests upon the discovery of RNA and DNA and their functions and structures (primary creativity). For a good treatment of this, read James P. Watson's *The Double Helix*, if you have not already. This is an intriguing book which talks about science in a way that is so contrary to many people's concept of the scientific method that it was very controversial when it first came out. It treats the discovery of the structure of DNA as a very human and very left-handed process. Watson and co-discoverer Francis Crick relied

heavily on inspiration, iteration, and visualization. Even though they were superb biochemists, they had no precedent from which they could logically derive their structure and therefore relied heavily on left-handed thinking. The U.S. space effort during the 1960s was extremely impressive and exemplified the power of science—and technology based on science. However, a great deal of primary creativity and left-handed thinking was involved. Even such basic "scientific" decisions as whether to carry instruments to measure physical quantities or television cameras on the first lunar spacecraft were made in a left-handed way, since there was simply no way to make them with sheer logic. The design of the first spacecraft required a high degree of "art" (backed up, of course, by a great deal of analysis, detail design, and sophisticated fabrication and development) because there was no precedent that the designers could logically extend.

If "scientific thinking" is properly defined, it is extremely powerful for large-scale well-funded attacks on problems; however, right-handed science is only effective if based on established understanding. Right-handed science and lots of money can solve only problems that are solely in the domain of understood phenomena (a relatively small domain). Problems with social and emotional content and high complexity, such as crime in the cities, require a great deal more than right-handed science or secondary creativity.

Unfortunately, left-handed thinking and primary creativity are harder to explain, more difficult to predict, and less consistent than right-handed thinking and secondary creativity. It is therefore more difficult to write proposals that will bring support for such activities. It is easier for me to secure funding to work on the application of some newly discovered scientific phenomena (even though the potential good of the application may be small) than it is to find support for looking for a breakthrough. In the first case, the funding agency and I can be quite confident of the detailed nature of the work that needs to be done, the approximate amount of money needed, the schedule, and that I will in fact come up with something. In the second, there is no such security. The funding agency must judge me on the basis of intangibles such as my previous performance, my motivations, and my knowledge. The second is more of a gamble than the first. Support for science therefore also tends to be biased toward right-handed thinking, since most agencies handing out money must answer to someone and therefore tend to be somewhat conservative.

The "vagueness" of primary creativity and left-handed thinking, of course, also plagues those involved in the humanities and the soft sciences. Many of the soft sciences have sought to become more quantitative and rigorous in order to take better advantage of our cultural bias toward right-handed thinking. It is debatable whether this has been advantageous. Although a scientist, I am very sympathetic to the wails of those in the humanities and social sciences as to the lack of monetary support they receive from our society. At one point in my education (after I had become an engineer) I was enrolled in art school. A painting teacher I knew would from time to time tell me that I had an excellent background for painting. His reasoning was economic. He believed that many painters were hampered in the beginning of their careers by the necessity of holding down low-paying and long-houred jobs in order to support their families. He figured that I should be able to support myself by doing engineering work part-time and would therefore have time and energy available to paint. A strange observation, but perhaps a true one. It is much easier for me to find support for my life-style than it is for friends of mine who want to write or paint. The humanities and the social sciences are extremely vital in a mature society such as ours. Their importance is presently obscured by a massive cultural block.

Tradition and Change

As a final, subtle cultural block, I would like to discuss briefly the concept: "Tradition is preferable to change." In his book *Notes on the Synthesis of Form*, Christopher Alexander discusses two types of culture, one that he calls the unselfconscious culture, and one the self-conscious culture. The unselfconscious culture is tradition oriented. Traditional form and ceremonies are perpetuated, and often taboos and legends work against change. The architect in such a culture would probably serve a long apprenticeship and learn how to make the traditional buildings (the long house, the temple). When he reached a stage in which he was judged competent by his elders, he would presumably become a master and train other apprentices. The United States is hardly such a culture. Any young architect knows better than to study traditional building forms. Ours is a self-conscious culture. New religions, forms, social movements, and styles in dress, talk, entertainment, and living crop up continually. Age and experience are venerated only if "relevant," and long apprenticeships are rapidly becoming extinct. A very high value seems to be placed on innovation.

Yet, strangely enough, many individuals value tradition more than they do change. This is probably good, since in my opinion our culture has little enough tradition. However, as far as good conceptualization is concerned, such an attitude has negative effects. Motivation is essen-

tial to creativity. No matter how talented the problem-solver, frustration and detail work are inescapable in problem-solving. Unless you truly *want* to solve a problem (for pleasure, money, prestige, comfort, or whatever) you probably will not do a very good job. Unless you are convinced that change is needed in a particular area, you are not likely to hypothesize ways of accomplishing that change.

The problem arises when individuals become so universally in favor of tradition that they cannot see the need for and desirability of change in specific areas. The true conservative, I suppose, would fall in this category. Some environmentalists lose their credibility by being totally against change in an area. If a person is truly grounded in the "good old days," and feels strongly that changes in the past 20 or 30 years have diminished rather than enhanced the quality of life, he is unlikely to be *motivated* to be a very good conceptualizer. He is culturally blocked. The person who is in favor of change for change's sake may be a more dangerous animal to have around. Yet, as far as conceptualization (the subject of this book) is concerned, he is probably in fairly good shape.

Thinking Through Blocks

Projects requiring one to think through cultural blocks are among the most popular with our students, since the blocks are so difficult to overcome and yet so obvious once they have been overcome. We often ask our students to design puzzles, games, or situations for each other that require breaking through a cultural block in order to reach a solution. One project that sticks in my mind required that a dollar bill be removed from beneath a precariously balanced object without tipping over the object. This was extremely easy to do if the bill were torn in half. However, for various cultural reasons (it's illegal to deface money, one doesn't usually tear up things of value), no one thought of this particular solution, with the result that no one could remove the dollar. Another project required that one playing card out of a deck of 52 be destroyed. Once again no one thought of perpetrating such a crime (we are a society of card players and most of us do not approve of incomplete decks of cards). Still a third I can remember was perhaps the most basic I have seen. The solution of the problem required that a number of objects be moved around a board in a prearranged sequence in order to reach the desired final configuration. It turned out to be impossible to follow the rules and solve the problem. The cultural block? Following rules! It was simple to attain the desired configuration if the rules were violated.

A less flippant situation occurs when students from more rigid and theory-oriented disciplines take courses in design. Expertise in design is somewhat different from expertise in, say, fluid mechanics. Design is a multi-answer situation and analysis is used to gain an end, not for its own sake. The teacher, although hopefully experienced in the design process and in command of the necessary techniques, is not the usual type of academic expert, in that he or she does not have a monopoly on the "right" answers at the beginning of the course, and in fact may not even always come up with the "best" answer. Grading becomes much more subjective and the student must take more academic risk, since the evaluation standards are less orthodox. Students from a school system in which grading is extremely important, and in which the professor or teacher is an extreme authority figure, sometimes have difficulty in adapting to design courses. They are often preoccupied with "What is the answer?" and "How do I ensure that I will get an A?"—as well they should be, since their background has been exclusively oriented in such directions. The tragedy is that many foreign students from countries that need capable designers and problem-solvers suffer from such blocks. Academic risk-taking is somewhat of a taboo. Another culturally-induced difference between students from the U.S. and those from less industrially developed countries is the difference in their knowledge of, and attitude toward, machines. Students from the U.S., Western Europe, etc. have grown up with cars, motorcycles, and other such devices and are quite at home with them. Students from less industrially developed countries often have had less opportunity in their cultures to be exposed to machinery and are therefore somewhat less experienced and more inhibited in working with it.

Environmental Blocks

Let us now move on to environmental blocks. These are blocks that are imposed by our immediate social and physical environment. The most obvious blocks are the physical. Plainly the physical surroundings of the problem-solver influence his productivity. I am sure that all of you are familiar with the effect of distractions. It is very difficult to work on complicated problems with continual phone interruptions. At times even potential distractions are a problem since when you are in a frustrating phase of problem-solving, you are quite tempted to take advantage of such opportunities. Personally speaking, when involved in problem-solving I will go to heroic efforts to be distracted. Often I have to force myself out of bed at an inhuman hour in the morning to work on a problem when I am sure I can find no alternative activities available

and no one to talk to. Even then, I often just sit hoping that someone will wake up and distract me.

The physical environment affects everyone. Yet, because of the individual habit patterns we all acquire, different individuals are affected differently. With regard to mental activity, some people work better in cold rooms, some in warm rooms, some in cold rooms with their feet wrapped in something warm. Some people work better to music and some in silence; some around others and some in isolation; some in windowless rooms and some in rooms with windows. Some are impervious to their visual surroundings and others are very sensitive to them.

Supportive Environments

In his book, *The Art and Science of Creativity*, George Kneller discusses some of the sometimes bizarre devices many writers have adopted with respect to their working environment: "Schiller, for example, filled his desk with rotten apples; Proust worked in a cork-lined room; Mozart took exercise; Dr. Johnson surrounded himself with a purring cat, orange peel, and tea; Hart Crane played jazz loud on a Victrola. All these are aids to the intense concentration required in creative thinking. An extreme case is Kant, who would work in bed at certain times of the day with the blankets arranged round him in a way he had invented himself. While writing *The Critique of Pure Reason* he would concentrate on a tower visible from his window. When some trees grew up to hide the tower, he became frustrated, and the authorities of Königsberg cut down the trees so that he could continue his work."

Some people may have a particular environment in which they are most effective at conceptual work of any kind. Therefore we sometimes find the all-purpose studio, in which a person may paint, write, sculpt, invent, and whatever. Another person may have one environment in which he can best write, another in which he can best throw pots, and still a third in which he does woodworking. Even though such individual differences exist, we can still say that most individuals do conceptual work best in a particular type of environment.

> Exercise: Take a piece of paper and list the characteristics of the most supportive possible environment you can think of for your own conceptual work (or different types of environment for different types of work). Do the environments in which you work resemble this? If not, why not? Assuming your hypothesized environment is practical for you (not the beaches of an as yet undiscovered South Sea island), change your working environment to more closely resemble your hypothetical one. Does this make an appreciable difference on your conceptual productivity?

Although environment usually has physical connotations, the most important environmental blocks are often not physical. In fact, if anything they verge on the cultural and on the emotional. As discussed in the last chapter, conceptualization involves a certain amount of emotional risk. Change is often threatening; therefore, so are new ideas. They can be quickly squelched, especially when newly born, imperfect, and not reduced to practice. The usual response of society, in fact, *is* to squelch such ideas. There are many ways to do this. One is to over-analyze them. Another is to laugh at them. Still another is to ignore them.

> Exercise: Think up a new idea, maybe an invention, that sounds reasonably plausible. Maybe an electric toilet brush, or a mail campaign to convince the post office to improve its service, or anything else. Then seriously propose this idea to friends and (if you are brave) others you meet from time to time. Note their reactions. Are any, other than your friends, enthusiastic? (Are even your friends really receptive, or are they merely being polite?) This is a poor experiment since some of your ideas may be brilliant and some terrible, and this conceivably could influence the response. However, I do not think that the difference in response will be that large. If you want to improve the experiment, try both a brilliant and a poor idea on the same people.

Accepting and Incorporating Criticism

Non-supportive responses are especially harmful when they come from bosses, colleagues, or friends. In Chapter Eight, we will discuss conceptualization in groups and in organizations. However, a few comments are in order here. An atmosphere of honesty, trust, and support is absolutely necessary if most people are to make the best of their conceptual abilities. There are exceptions, it is true. Many of the outstanding inventors I have known have been quite confident of their abilities and less dependent on support from others. One of the best of these idea-havers worked with me at one time. Given a problem he would instantly throw

together a solution. These solutions were often so poorly thought out that I would almost break out in a rash. He would then happily go to the next office and receive enough criticism on the idea to send me into a depression for several days. He would then incorporate the criticism into his idea and proceed to the next office. In this way, he would literally construct a solution and usually an outstanding one. He was successful because of his ability to accept and incorporate criticism. However, people like this are rare.

Most people are not happy with criticism and, to make matters worse, are somewhat unsure of the quality of their own ideas. They therefore require a supportive environment in which to work. One of our most serious problems with students in design classes is that they hesitate to expose ideas about which they are unsure, not only to the faculty, but also to each other. Since many of their creative ideas fall into this not-sure category (naturally, since they have little else to judge these ideas by) they hesitate to reveal them. We have to convert the class (usually a listening, competitive, no-risk situation) into a friendly, non-competitive, interactive situation in which people will take the risk of exposing their most impractical ideas to each other. Competition and lack of trust destroy such a supportive environment. No one likes to expose his magnificent concept if someone is going to steal it or be jealous.

Autocratic Bosses

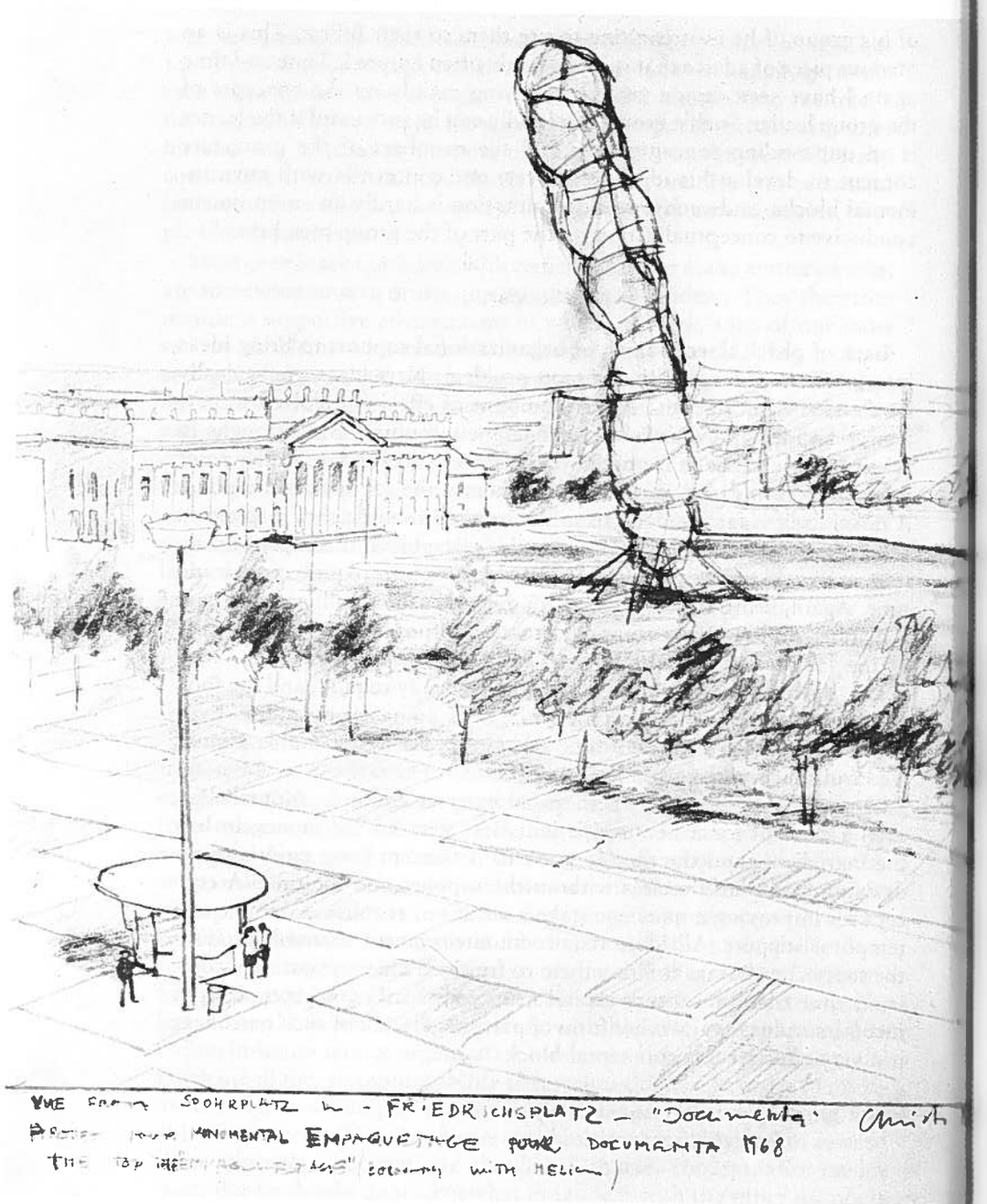
Bosses with answers are a particular problem in the engineering profession. Many productive problem-solvers are strong-headed. They can carry a concept through to completion in spite of apathy or hostility from others and the difficulty of finding support for a new idea. If they happen to have good judgment, they are able to accomplish noticeable achievements in a company environment and are often promoted in management. One therefore often finds that many managers are successful idea-havers who are stubborn enough to push their ideas through to completion. They tend to continue in this mode when managing others. Although a manager such as this can be an effective problem-solver, he is essentially operating with his own conceptual ability and an in-house service organization—he is probably not going to make much use of the conceptual ability of his subordinates. In order to maximize the creative output of a group, a manager must be willing and able to encourage his subordinates to think conceptually and to reward them when they succeed. He should, of course, conceptualize on his own. But he should do it somewhat in tandem with the other members

of his group, if he is attempting to use them to their fullest. This is an obvious piece of advice that is surprisingly often ignored. Time and time again I have seen design groups operating mainly on the concepts of the group leader. Such a group admittedly can be successful if the leader is an outstanding conceptualizer and the members of the group are content to develop his ideas. However, our concern is with environmental blocks, and such a working situation is hardly an environment conducive to conceptualization on the part of the group members.

Non-Support

Lack of physical, economic, or organizational support to bring ideas into action is also another common problem. New ideas are typically hard to bring into action. A great amount of effort is involved in perfecting an idea and then selling it. Many conceptual breakthroughs in science, for instance, have taken years of work to validate to the point where they would elicit interest from others in the scientific community. A novel itself is far removed from the original thought that inspired it. Even after the idea is fleshed out into a believable and complete form, it must be sold to an often skeptical world. This may require money and time. Again, using the inventor as an example: the small inventor is at a distinct disadvantage compared to the corporate inventor because of the fabrication support he may need, the test equipment he may desire, the legal and promotional expertise he may require, and the food and rent his family will consume while he is doing his inventing. Even the best of ideas is doomed if time and money are not available to push it to fruition.

Granted, the inventor is perhaps an extreme example. Nonetheless, even a concept for a new recipe is useless without the money to buy the ingredients and the time to cook it. A concept for a painting or a drawing is similarly useless without the supplies and the time. A concept for improving a marriage (take a vacation) requires economic and temporal support. All ideas require an environment that will produce the support necessary to bring them to fruition. This support may come from your friendly venture-capital firm, your bank, your spouse, your income surplus, or any other form of patronage. Lack of such patronage is a very effective environmental block.



CHAPTER FIVE

INTELLECTUAL AND EXPRESSIVE BLOCKS

INTELLECTUAL BLOCKS RESULT in an inefficient choice of mental tactics or a shortage of intellectual ammunition. Expressive blocks inhibit your vital ability to communicate ideas—not only to others, but to yourself as well. Let us look at the following blocks:

1. Solving the problem using an incorrect language (verbal, mathematical, visual) — as in trying to solve a problem mathematically when it can more easily be accomplished visually
2. Inflexible or inadequate use of intellectual problem-solving strategies
3. Lack of, or incorrect, information
4. Inadequate language skill to express and record ideas (verbally, musically, visually, etc.)

A few examples should help us understand these blocks better. The monk puzzle described in the first chapter of this book is one in which choosing the correct language (visual) leads you rapidly toward a solution. Here is another "language" problem:

> Exercise: Picture a large piece of paper, the thickness of this page. In your imagination, fold it once (now having two lay-

ers), fold it once more (now having four layers), and continue folding it over upon itself 50 times. How thick is the 50-times-folded paper?

It is true that it is impossible to fold any piece of paper, no matter how big or how thick, 50 times. But for the sake of the problem, imagine that you can. When you either have the answer or have given up, continue.

Your *first fold* would result in a stack 2 times the original thickness. Your *second* would give you a stack 2×2 times the original thickness. Your *third:* $2 \times 2 \times 2$ times the original thickness. Extending this, if you are somewhat of a mathematician, you should recognize that the answer to the problem is 2^{50} times the original thickness (2^{50} happens to be about 1,100,000,000,000,000). If the paper is originally the thickness of typing paper, the answer is some 50,000,000 miles or over half the distance from the earth to the sun.

If you tried to attack this particular problem with visual imagery (the clever way to handle the monk puzzle) you probably could not get an answer, since it is next to impossible to accurately visualize 50 folds. If you attacked it verbally, you probably also had trouble. If you are familiar with doubling problems, you knew that the answer was a surprisingly big number, but still could not place a value on it. The correct language in this problem was clearly mathematics.

Choosing Your Problem-Solving Language

Once again, how did you select the mental strategy you used to work on this problem? How did you decide to use visualization, mathematics, or whatever? If you were faked into visualization by our mention of the monk problem, you chose it consciously. If you are really getting the message of this book, you consciously thought about various ways of working the problem and then picked one. However, many of you probably once again *unconsciously* selected a strategy and then unconsciously switched from one strategy to the other. As we said before, most people follow this *habit* pattern in problem-solving. Without conscious thought, a direction will occur in the mind. This direction may or may not be the right one. If it is a wrong one, another may or may not appear.

It is possible to aid this strategy selection by consciously considering the various languages of thought you might use. For instance, you could have read the paper folding problem and then said to yourself, "Let's see, this guy has been trying to sell me visual thinking. Can I solve it visually? I'll try a few folds. [Task becomes difficult.] What else could I try? Verbalization? Probably not—since it is a physical problem asking

for quantitative data. Hey, quantitative—how about mathematics?" At this point, you either solve it by inspection (you're a pro), write out equations and solve them (semi-pro) or ask someone you know who knows math (amateur).

Here is another puzzle. Before you try thinking of the answer, examine the problem and see what mental languages seem appropriate. Then attack the problem in the most appropriate language:

> **Exercise:** A man and a woman standing side by side begin walking so that their right feet hit the ground at the same time. The woman takes three steps for each two steps of the man. How many steps does the man take before their left feet simultaneously reach the ground?

This is a good problem to solve with visual thinking. A live experiment with another person, a drawing, or a musical rhythm analogy will all work well. A mathematical approach will work, although it is somewhat circuitous. Verbalization, once again, will not get you very far. What language did you pick? Did it work? Did you try alternate approaches? How did you know it was time to give up on one and try another? The answer is that their left feet never hit the ground simultaneously.

Choice of the proper problem-solving language is difficult not only because the choice is usually made unconsciously, but also because of the heavy emphasis on verbal thinking (with mathematical thinking a poor second) in our culture. The two problems you just worked were difficult because neither can be easily solved by the application of verbal thinking. Visualization, as expressed through the use of drawings, is almost essential in designing physical things well. One reason for this is that verbal thinking, when applied to the design of physical things, has the strange attribute of allowing you to think that you have an answer when, in fact, you do not. Verbal thinking among articulate persons is fraught with glib generalities. And in design it is not until one backs it up with the visual mode that he can see whether he is fooling himself or not.

One can also talk about the inflexible or inadequate use of problem-solving strategies as a type of awareness block. Interaction Associates, founded by David Straus and Michael Doyle, has for some time been concerned with the effective use of thinking strategies. Interaction Associates trains facilitators for problem-solving groups, offers educational programs, and conducts research in problem-solving. In one of their publications, *Summary of Basic Concepts,* they explain:

Each physical action or operation that we make to solve a problem can be seen in terms of a more general conceptual approach, useful in solving any problem. It is the rationale or purpose behind your actions: the "why" as opposed to the "what." This general, conceptual approach we call a "strategy." In our terms, the concept inherent in a strategy is independent of context. In other words, a strategy should be able to be used in almost all kinds of problems. We find that the strategic level is one of the most useful ways of talking about problem-solving.

Flexibility in Your Use of Strategies

Interaction Associates believes strongly in the effectiveness of becoming aware of specific thinking strategies. They have worked with problem-solving groups in educational, business, and political settings. One of its major techniques with all groups is to keep track of the strategy or strategies being used at any time during a problem-solving session and to suggest changes or additions if the problem-solving process appears to be bogging down or overlooking possible approaches to solutions. In their *Strategy Notebook* they list some 66 strategies, accompanying each with a description of the strategy, a list of its advantages and disadvantages, and a sample exercise. A list of the strategies contained in *Strategy Notebook* is shown below, along with a sample page.

Build up	Display	Simulate
Eliminate	Organize	Test
Work Forward	List	Play
Work Backward	Check	Manipulate
Associate	Diagram	Copy
Classify	Chart	Interpret
Generalize	Verbalize	Transform
Exemplify	Visualize	Translate
Compare	Memorize	Expand
Relate	Recall	Reduce
Commit	Record	Exaggerate
Defer	Retrieve	Understate
Leap In	Search	Adapt
Hold Back	Select	Substitute
Focus	Plan	Combine
Release	Predict	Separate
Force	Assume	Change
Relax	Question	Vary
Dream	Hypothesize	Cycle
Imagine	Guess	Repeat
Purge	Define	Systemize
Incubate	Symbolize	Randomize

Eliminate

POWERS The power of elimination lies in the possibility that you may be more sure of what you don't want than what you do want. This strategy requires beginning with more than you need or want in the solution and eliminating elements according to some determined criteria. There is an element of safety in this strategy because you have not overly extended yourself by deciding what you don't want in the solution.

LIMITATIONS This strategy assumes that within the realm of possibilities you are considering, there is a good solution. However, after you've finished eliminating, it's possible to end up with nothing. Another difficulty is that it is easy to infer that you want the opposite of what you have eliminated (i.e., you don't want rain, therefore you must want sunshine, leaving out the possibilities of snow, fog, hail, etc.). Thus elimination must be tempered by caution and good judgment.

EXERCISE — I GOT RELIGION Have each member of your group build upon the subject of religion. Each member should offer any ideas or associations he has with the subject, and the ideas should be recorded. Once the group is satisfied that they have exhausted their resources, each member of the group should take a piece of paper and a pencil and review the recorded list, eliminating whatever they don't want included in their personal religion or philosophy, and writing down on their lists anything that is left. Once everyone has finished, pin the sheets of paper to a display board so that the members of the group can share each other's ideas. This exercise has the advantage of allowing the participants to get personally involved in the subject matter through use of the strategy of elimination. The exercise can also be modified to encompass a variety of subjects. This may prove to be an effective introductory experience for a humanities or comparative religion class.

Most people have no trouble in understanding such problem-solving strategies, once definitions and examples are made available. In fact, most people have *unconsciously* used all of them at one time or another. However, since the mind is used to selecting strategies subconsciously, it takes awareness of these strategies and *conscious* choice or an outside facilitator to make the best use of them on a specific problem. The In-

troduction to *Process Notebook*, also by Interaction Associates, summarizes the situation as follows:

> Just as we use physical tools for physical tasks, we employ conceptual tools for conceptual tasks. To familiarize yourself with a tool, you may experiment with it, test it in different situations, and evaluate its usefulness. The same method can be applied to conceptual tools. Our ability as thinkers is dependent on our range and skill with our own tools.

It is obvious that a compromise has to be reached in the conscious selection of thinking modes and problem-solving strategies. You should not devote 95 percent of your mental energy to the selection of strategies and thinking modes and reserve only 5 percent for the solving of the problem. Yet you should certainly spend some conscious effort thinking about strategies. First, by selecting strategies consciously you can often find approaches you would never have known about had you left the selection to your subconscious. Second, by becoming aware of various thinking strategies, what they can do, and how to use them, you can ensure that the mind has a larger selection when it utilizes its subconscious selection method. You can essentially become your own "facilitator."

Importance of Correct Information

Lack of, or incorrect, information is a third intellectual block. As we discussed earlier, Arthur Koestler in "The Three Domains of Creativity" states: "The creative act consists in combining previously unrelated structures in such a way that you get more out of the emergent whole than you have put in." Other definitions of creativity also emphasize this "combining" aspect. Plainly we must have the components to combine (information). But let us look at what happens if some of our components are incorrect. We will consider a situation in which each component appears no more than once and in which the order of combination is important.

If we combine two quantities, a and b, we have four possible results (a, b, ab, and ba). If a is incorrect, three of these results contain erroneous information. If both a and b are incorrect, all of them are contaminated. If we combine three quantities, a, b, and c, we have 15 possible results ($abc, acb, bac, bca, cab, cba, ab, ba, ac, ca, bc, cb, a, b, c$). If a is incorrect, 11 of these results contain erroneous information. If both a and b are incorrect, 14 of them are wrong. By playing with a little mathematics, we can come up with a general expression for this contamination tendency.

Let me first briefly refresh the memories of those who have studied math and perhaps enlighten those who have not. Let us assume that we have n elements. Then we see that there are a total of n possible arrangements (permutations) which contain only one element. There are $n(n-1)$ arrangements containing two elements, $n(n-1)(n-2)$ arrangements containing three elements, and so on, until we reach the number of possible arrangements containing *all* n elements. (There are $n!$, read n factorial, which is equal to $n(n-1)(n-2)\ldots(1)$, arrangements containing n elements.) Hence, the total number of arrangements (N) possible for n elements is the *sum* of the above terms. Or mathematically:

$$N = n + n(n-1) + n(n-1)(n-2) + \ldots + n!$$

For example, if we want to know how many arrangements are possible when we have 4 elements (a, b, c, d), the solution is:

$$N_4 = 4 + 4(3) + 4(3)(2) + 4(3)(2)(1) = 64$$

Now to continue. We can use this expression not only to calculate the number of possible arrangements of n elements (N), but also to find the number of them that are affected by erroneous quantities. If *one* quantity of the n is wrong, the number of arrangements which do *not* contain the erroneous element is simply the number of arrangements which can be formed from the sum of all possible arrangements of $(n-1)$ elements. The number of arrangements containing false information is merely N minus this number of arrangements possible from $(n-1)$ elements. Similarly, the number of arrangements containing false information as a result of two erroneous quantities is N minus the number of arrangements possible from $(n-2)$ quantities. An example makes this clearer.

> If $n = 4$, and 1 element is incorrect, then the number of arrangements in N that contain erroneous information can be calculated as follows:
>
> Number of arrangements containing error $= N_4 - N_3$
> $= [4 + 4(3) + 4(3)(2) + 4(3)(2)(1)] - [3 + 3(2) + 3(2)(1)]$
> $= 64 - 15$
> $= 49$ arrangements containing error

The following table contains a few numbers that indicate the advantages of correct information to the problem-solver. The first column represents the number of elements available to combine as Mr. Koestler would like us to. The second column indicates the number of arrange-