

into ordinary lay terms. And that's one of the things I've done I'm most proud of. I've had engineers tell me that for the first time they had a clear picture of thermodynamics from it. So I enjoy that a great deal. I enjoy communicating. Same with speaking. I do a lot of speaking. And I really enjoy seeing the audience paying attention—listening, understanding it.

One thing about creative work is that it's never done. In different words, every person we interviewed said that it was equally true that they had worked every minute of their careers, and that they had never worked a day in all their lives. They experienced even the most focused immersion in extremely difficult tasks as a lark, an exhilarating and playful adventure.

It is easy to resent this attitude and see the inner freedom of the creative person as an elite privilege. While the rest of us are struggling at boring jobs, they have the luxury of doing what they love to do, not knowing whether it is work or play. There might be an element of truth in this. But far more important, in my opinion, is the message that the creative person is sending us: You, too, can spend your life doing what you love to do. After all, most of the people we interviewed were not born with a silver spoon in their mouth; many came from humble origins and struggled to create a career that allowed them to keep exploring their interests. Even if we don't have the good fortune to discover a new chemical element or write a great story, the love of the creative process for its own sake is available to all. It is difficult to imagine a richer life.

FIVE

THE FLOW OF CREATIVITY

Creative persons differ from one another in a variety of ways, but in one respect they are unanimous: They all love what they do. It is not the hope of achieving fame or making money that drives them; rather, it is the opportunity to do the work that they enjoy doing. Jacob Rabinow explains: "You invent for the hell of it. I don't start with the idea, 'What will make money?' This is a rough world; money's important. But if I have to trade between what's fun for me and what's money-making, I'll take what's fun." The novelist Naguib Mahfouz concurs in more genteel tones: "I love my work more than I love what it produces. I am dedicated to the work regardless of its consequences." We found the same sentiments in every single interview.

What is extraordinary in this case is that we talked to engineers and chemists, writers and musicians, businesspersons and social reformers, historians and architects, sociologists and physicians—and they all agree that they do what they do primarily because it's fun. Yet many others in the same occupations don't enjoy what they do. So we have to assume that it is not *what* these people do that counts but *how* they do it. Being an engineer or a carpenter is not in itself

enjoyable. But if one does these things a certain way, then they become intrinsically rewarding, worth doing for their own sake. What is the secret of transforming activities so that they are rewarding in and of themselves?

PROGRAMMED FOR CREATIVITY

When people are asked to choose from a list the best description of how they feel when doing whatever they enjoy doing most—reading, climbing mountains, playing chess, whatever—the answer most frequently chosen is “designing or discovering something new.” At first, it seems strange that dancers, rock climbers, and composers all agree that their most enjoyable experiences resemble a process of discovery. But when we think about it some more, it seems perfectly reasonable that at least some people should enjoy discovering and creating above all else.

To see the logic of this, try a simple thought experiment. Suppose that you want to build an organism, an artificial life form, that will have the best chance of surviving in a complex and unpredictable environment, such as that on Earth. You want to build into this organism some mechanism that will prepare it to confront as many of the sudden dangers and to take advantage of as many of the opportunities that arise as possible. How would you go about doing this? Certainly you would want to design an organism that is basically conservative, one that learns the best solutions from the past and keeps repeating them, trying to save energy, to be cautious and go with the tried-and-true patterns of behavior.

But the best solution would also include a relay system in a few organisms that would give a positive reinforcement every time they discovered something new or came up with a novel idea or behavior, whether or not it was immediately useful. It is especially important to make sure that the organism was not rewarded only for useful discoveries, otherwise it would be severely handicapped in meeting the future. For no earthly builder could anticipate the kind of situations the species of new organisms might encounter tomorrow, next year, or in the next decade. So the best program is one that makes the organism feel good whenever something new is discovered, regardless of its present usefulness. And this is what seems to have happened with our race through evolution.

By random mutations, some individuals must have developed a nervous system in which the discovery of novelty stimulates the pleasure centers in the brain. Just as some individuals derive a keener pleasure from sex and others from food, so some must have been born who derived a keener pleasure from learning something new. It is possible that children who were more curious ran more risks and so were more likely to die early than their more stolid companions. But it is also probable that those human groups that learned to appreciate the curious children among them, and helped to protect and reward them so that they could grow to maturity and have children of their own, were more successful than groups that ignored the potentially creative in their midst.

If this is true, we are the descendants of ancestors who recognized the importance of novelty, protected those individuals who enjoyed being creative, and learned from them. Because they had among them individuals who enjoyed exploring and inventing, they were better prepared to face the unpredictable conditions that threatened their survival. So we too share this propensity for enjoying whatever we do, provided we can do it in a new way, provided we can discover or design something new in doing it. This is why creativity, no matter in what domain it takes place, is so enjoyable. This is why Brenda Milner, among many others, said: “I would say that I am impartial about what is important or great, because every new little discovery, even a tiny one, is exciting at the moment of discovery.”

But this is only part of the story. Another force motivates us, and it is more primitive and more powerful than the urge to create: the force of entropy. This too is a survival mechanism built into our genes by evolution. It gives us pleasure when we are comfortable, when we relax, when we can get away with feeling good without expending energy. If we didn't have this built-in regulator, we could easily kill ourselves by running ragged and then not having enough reserves of strength, body fat, or nervous energy to face the unexpected.

This is the reason why the urge to relax, to curl up comfortably on the sofa whenever we can get away with it, is so strong. Because this conservative urge is so powerful, for most people “free time” means a chance to wind down, to park the mind in neutral. When there are no external demands, entropy kicks in, and unless we understand what is happening, it takes over our body and our mind.

We are generally torn between two opposite sets of instructions programmed into the brain: the least-effort imperative on one side, and the claims of creativity on the other.

In most individuals entropy seems to be stronger, and they enjoy comfort more than the challenge of discovery. A few, like the ones who tell their stories in this book, are more responsive to the rewards of discovery. But we all respond to both of these rewards; the tendencies toward conserving energy as well as using it constructively are simultaneously part of our inheritance. Which one wins depends not only on our genetic makeup but also presumably on our early experiences. However, unless enough people are motivated by the enjoyment that comes from confronting challenges, by discovering new ways of being and doing, there is no evolution of culture, no progress in thought or feeling. It is important, therefore, to understand better what enjoyment consists of and how creativity can produce it.

WHAT IS ENJOYMENT?

In order to answer that question, many years ago I started to study people who seemed to be doing things that they enjoyed but were not rewarded for with money or fame. Chess players, rock climbers, dancers, and composers devoted many hours a week to their avocations. Why were they doing it? It was clear from talking to them that what kept them motivated was the quality of experience they felt when they were involved with the activity. This feeling didn't come when they were relaxing, when they were taking drugs or alcohol, or when they were consuming the expensive privileges of wealth. Rather, it often involved painful, risky, difficult activities that stretched the person's capacity and involved an element of novelty and discovery. This optimal experience is what I have called *flow*, because many of the respondents described the feeling when things were going well as an almost automatic, effortless, yet highly focused state of consciousness.

The flow experience was described in almost identical terms regardless of the activity that produced it. Athletes, artists, religious mystics, scientists, and ordinary working people described their most rewarding experiences with very similar words. And the description did not vary much by culture, gender, or age; old and young, rich

and poor, men and women, Americans and Japanese seem to experience enjoyment in the same way, even though they may be doing very different things to attain it. Nine main elements were mentioned over and over again to describe how it feels when an experience is enjoyable.

1. *There are clear goals every step of the way.* In contrast to what happens in everyday life, on the job or at home, where often there are contradictory demands and our purpose is unsure, in flow we always know what needs to be done. The musician knows what notes to play next, the rock climber knows the next moves to make. When a job is enjoyable, it also has clear goals: The surgeon is aware how the incision should proceed moment by moment; the farmer has a plan for how to carry out the planting.

2. *There is immediate feedback to one's actions.* Again, in contrast to the usual state of affairs, in a flow experience we know how well we are doing. The musician hears right away whether the note played is the one. The rock climber finds out immediately whether the move was correct because he or she is still hanging in there and hasn't fallen to the bottom of the valley. The surgeon sees there is no blood in the cavity, and the farmer sees the furrows lining up neatly in the field.

3. *There is a balance between challenges and skills.* In flow, we feel that our abilities are well matched to the opportunities for action. In everyday life we sometimes feel that the challenges are too high in relation to our skills, and then we feel frustrated and anxious. Or we feel that our potential is greater than the opportunities to express it, and then we feel bored. Playing tennis or chess against a much better opponent leads to frustration; against a much weaker opponent, to boredom. In a really enjoyable game, the players are balanced on the fine line between boredom and anxiety. The same is true when work, or a conversation, or a relationship is going well.

4. *Action and awareness are merged.* It is typical of everyday experience that our minds are disjointed from what we do. Sitting in class, students may appear to be paying attention to the teacher, but

they are actually thinking about lunch, or last night's date. The worker thinks about the weekend; the mother cleaning house is worried about her child; the golfer's mind is preoccupied with how his swing looks to his friends. In flow, however, our concentration is focused on what we do. One-pointedness of mind is required by the close match between challenges and skills, and it is made possible by the clarity of goals and the constant availability of feedback.

5. *Distractions are excluded from consciousness.* Another typical element of flow is that we are aware only of what is relevant here and now. If the musician thinks of his health or tax problems when playing, he is likely to hit a wrong note. If the surgeon's mind wanders during an operation, the patient's life is in danger. Flow is the result of intense concentration on the present, which relieves us of the usual fears that cause depression and anxiety in everyday life.

6. *There is no worry of failure.* While in flow, we are too involved to be concerned with failure. Some people describe it as a feeling of total control; but actually we are not in control, it's just that the issue does not even come up. If it did, we would not be concentrating totally, because our attention would be split between what we did and the feeling of control. The reason that failure is not an issue is that in flow it is clear what has to be done, and our skills are potentially adequate to the challenges.

7. *Self-consciousness disappears.* In everyday life, we are always monitoring how we appear to other people; we are on the alert to defend ourselves from potential slights and anxious to make a favorable impression. Typically this awareness of self is a burden. In flow we are too involved in what we are doing to care about protecting the ego. Yet after an episode of flow is over, we generally emerge from it with a stronger self-concept; we know that we have succeeded in meeting a difficult challenge. We might even feel that we have stepped out of the boundaries of the ego and have become part, at least temporarily, of a larger entity. The musician feels at one with the harmony of the cosmos, the athlete moves at

one with the team, the reader of a novel lives for a few hours in a different reality. Paradoxically, the self expands through acts of self-forgetfulness.

8. *The sense of time becomes distorted.* Generally in flow we forget time, and hours may pass by in what seem like a few minutes. Or the opposite happens: A figure skater may report that a quick turn that in real time takes only a second seems to stretch out for ten times as long. In other words, clock time no longer marks equal lengths of experienced time; our sense of how much time passes depends on what we are doing.

9. *The activity becomes autotelic.* Whenever most of these conditions are present, we begin to enjoy whatever it is that produces such an experience. I may be scared of using a computer and learn to do it only because my job depends on it. But as my skills increase, and I recognize what the computer allows me to do, I may begin to enjoy using the computer for its own sake as well. At this point the activity becomes *autotelic*, which is Greek for something that is an end in itself. Some activities such as art, music, and sports are usually autotelic: There is no reason for doing them except to feel the experience they provide. Most things in life are *exotelic*: We do them not because we enjoy them but in order to get at some later goal. And some activities are both: The violinist gets paid for playing, and the surgeon gets status and good money for operating, as well as getting enjoyment from doing what they do. In many ways, the secret to a happy life is to learn to get flow from as many of the things we have to do as possible. If work and family life become autotelic, then there is nothing wasted in life, and everything we do is worth doing for its own sake.

THE CONDITIONS FOR FLOW IN CREATIVITY

Creativity involves the production of novelty. The process of discovery involved in creating something new appears to be one of the most enjoyable activities any human can be involved in. In fact, it is easy to recognize the conditions of flow in the accounts of our respondents, as they describe how it feels to do the sort of things they do.

The Clarity of Goals

In certain conditions, the creative process begins with the goal of solving a problem that is given to the person by someone else or is suggested by the state of the art in the domain. Moreover, anything that does not work as well as it could can provide a clear goal to the inventor. This is what Frank Offner describes:

Oh, I love to solve problems. If it is why our dishwasher does not work, or why the automobile does not work, or how the nerve works, or anything. Now I am working on how the hair cells work, and ah . . . it is so very interesting. I don't care what kind of problem it is. If I can solve it, it is fun. It is really a lot of fun to solve problems, isn't it? Isn't that what is interesting in life? Especially if people say one thing and you show that they have been wrong for twenty years and you can solve it in five minutes.

Or the goal may emerge as a problem in the domain—a gap in the network of knowledge, a contradiction among the findings, a puzzling result. Here the goal is to restore harmony in the system by reconciling the apparent disparities. The physicist Viktor Weisskopf describes the enjoyment involved in this process:

Well, in science, obviously, if I understand something, you know, a new discovery, it need not be my own, a discovery of somebody else, where I say, "Aha, now I understand natural processes that I did not understand before," that is the joy of insight.

In music it is the insight into what the piece means. What it tells you, what the composer wanted to tell you, the beauty or expression or religious feelings, things like that.

For artists the goal of the activity is not so easily found. In fact, the more creative the problem, the less clear it is what needs to be done. Discovered problems, the ones that generate the greatest changes in the domain, are also the most difficult to enjoy working on because of their elusiveness. In such cases, the creative person somehow must develop an unconscious mechanism that tells him or her what to do. The poet György Faludy usually does not start writing until a "voice" tells him, often in the middle of the night, "György, it's time to start writing." He adds ruefully: "That voice has my number, but I

don't have his." The ancients called that voice the Muse. Or it can be a vision, as it is for Robertson Davies:

You are always writing, and you're always fantasizing. What I find very much in my own work, though I don't know if it applies to the work of other people, is that an idea for a novel seizes me and will not let me go until I have given it careful consideration. And that is not to say that a complete story appears in my head, but very often what appears is a picture which seems somehow significant and which must be considered. Now, a great many years ago, I found that whenever I stopped thinking about something in particular, a picture kept coming up in my head. It was a picture of a street, and I knew what street it was; it was the street on which I was born in a small Ontario village. And there were two boys playing in the snow, and one threw a snowball at the other.

Readers of Davies's oeuvre will recognize in this picture the opening scene of *Fifth Business*, the first volume of his famous Deptford trilogy. In many ways, the writing of the book consisted in finding out what that image, charged with emotion and nostalgia, portended. The goal was to find out what were the consequences of throwing that snowball. Probably if Davies had told himself rationally that this is what the book would be about he would have thought it a trivial goal, not worth all the time and effort. But fortunately the goal presented itself as a vision, a mysterious call that he felt impelled to follow. Very often this is how the Muse communicates—through a glass darkly, as it were. It is a splendid arrangement, for if the artist were not tricked by the mystery, he or she might never venture into the unexplored territory.

Knowing How Well One Is Doing

Games are designed so that we can keep score and know how well we are doing. Most jobs give some sort of information about performance: The salesman can add up daily sales, the assembly worker can count pieces produced. If all else fails, the boss may tell you how well you are doing. But the artist, the scientist, and the inventor are moving on very different timelines. How do they know, day in and day out, whether they are wasting their time or actually accomplishing something?

This is indeed a difficult problem. Many artists give up because it is just too excruciating to wait until critics or galleries take notice and pass judgment on their canvases. Research scientists drift away from pure science because they cannot tolerate the long cycles of insecurity before reviewers and editors evaluate their results. So how can they experience flow without external information about their performance?

The solution seems to be that those individuals who keep doing creative work are those who succeed in internalizing the field's criteria of judgment to the extent that they can give feedback to themselves, without having to wait to hear from experts. The poet who keeps enjoying writing verse is the one who knows how good each line is, how appropriate is each word chosen. The scientist who enjoys her work is the one who has a sense of what a good experiment is like and who appreciates it when a test is well run or when a report is clearly written. Then she need not wait until October to see if her name is on the Nobel Prize list.

Many creative scientists say that the difference between them and their less creative peers is the ability to separate bad ideas from good ones, so that they don't waste much time exploring blind alleys. Everyone has both bad and good ideas all the time, they say. But some people can't tell them apart until it's too late, until they have already invested a great deal of time in the unprofitable hunches. This is another form of the ability to give oneself feedback: to know in advance what is feasible and what will work, without having to suffer the consequences of bad judgment. At Linus Pauling's sixtieth birthday celebration, a student asked him, "Dr. Pauling, how does one go about having good ideas?" He replied, "You have a lot of ideas and throw away the bad ones." To do that, of course, one has to have a very well internalized picture of what the domain is like and what constitutes "good" and "bad" ideas according to the field.

Balancing Challenges and Skills

The pursuit of a creative problem is rarely easy. In fact, in order to be enjoyable it should be hard, and of course so it is, almost by definition. It is never easy to break new ground, to venture into the unknown. When one starts out, the difficulties may seem almost overwhelming. Here is how Freeman Dyson describes this aspect of the process:

Well, I think that you have to describe it as sort of a struggle. I have to always force myself to write, and also to work harder at a science problem. You have to put blood, sweat, and tears into it first. And it is awfully hard to get started. I think most writers have this problem. I mean, it's part of the business. You may work very hard for a week producing the first page. That's really blood, tears, and sweat, and there is nothing else to describe it. You have to force yourself to push and push and push with the hope that something good will come out. And you have to go through that process before it really starts to flow easily, and without that preliminary forcing and pushing probably nothing would ever happen. So, I think that is what distinguishes it from just having a good time—you have a good time once you are really in the flowing phase, but you have to overcome some sort of barrier to get there. That is why I say it is unconscious, because you don't know actually whether you are really getting anywhere or not. In that phase it just seems to be unadulterated torture.

The creative person is not immune to the conflict between the two programs we all carry in our genetic inheritance. As Dyson knows, even the most creative persons must overcome the barrier of entropy. It is impossible to accomplish something that is truly new and worthwhile without struggling with it. It isn't just in competitive sports that the saying "no pain, no gain" applies. The less well defined the problem, the more ambitious it is, and the harder it is for the creative person to get a handle on it. Barry Commoner points out:

I enjoy doing things that other people won't do. Because what are they? They're usually things that are difficult and important—and that people shy away from. I have a general approach to thinking of the way in which issues develop. I'm interested in the origins of problems. And so I have a pretty good idea of where things are going, and what's important and what isn't important. And I try very hard to be at the cutting edge of problems. Very often that puts me so far out in front that people are upset about it, but that's OK.

To be able to cope with such problems, the creative person has to have a great many personality traits that are conducive to discovery

and hard work, including the ability to internalize the rules of the domain and the judgments of the field. Commoner also gives a hint of another skill that creative individuals develop: a personal approach, an internal model that allows them to put the problem into a manageable context. The same idea is expressed by Linus Pauling:

I think one thing that I do is to bring ideas from one field of knowledge into another field of knowledge. And, I've often said I don't think that I'm smarter than a lot of other scientists, but perhaps I think more about the problems. I have a picture, a sort of general theory of the universe in my mind that I've built up over the decades. If I read an article, or hear someone give a seminar talk, or in some other way get some piece of information about science that I hadn't had before, I ask myself, "How does that fit into my picture of the universe?" and if it doesn't fit, I ask, "Why doesn't it fit in?"

The strategies creative individuals develop are not always successful. They take risks, and what is risk without an occasional failure? When the challenges become too great for the person to cope with, a sense of frustration rather than joy creeps in—at least for a while. Our interview with John Reed took place a few years after Citicorp was bloodied in the market; its shares lost a great deal of their value almost overnight. Reed blamed himself for not foreseeing the contingency that caused the loss. As a result, at the time he felt that some of the fun had gone out of his job. What used to be spontaneous turned into hard work; he had to force himself to be more of an accountant than a builder and leader; and the new skill he had to acquire required unfamiliar discipline.

The Merging of Action and Awareness

But when the challenges are just right, the creative process begins to hum, and all other concerns are temporarily shelved in the deep involvement with the activity. Here is Dyson again, describing how it feels after the initial struggle is over:

I always find that when I am writing, it is really the fingers that are doing it and not the brain. Somehow the writing takes charge. And the same thing happens of course with equations. You don't

really think of what you are going to write. You just scribble, the equations lead the way, and what you are doing is sort of architectural. You have to have a design in view, in which you design a chapter, or a proof of a theorem, as the case may be. Then you have to put it together out of words or out of symbols as the case may be, but if you don't have a clear architecture in mind then the thing won't end up being any good. The trick is to start from both ends and to meet in the middle, which is essentially like building a bridge. That seems to me the way that I think, anyhow. So the original design is somehow accidental and you don't know how it comes into your head. It just sort of happens, maybe when you are shaving or taking a walk, then you sit down and actually work through and that is when the hard work is done. And that is very largely a matter of putting pieces together, finding out what works and what doesn't.

Barry Commoner uses similar terms to describe the almost automatic quality of the flow experience when writing, expressing the feeling of merging action and awareness through the image of the flowing ink and the flowing of ideas:

I write with this pen [he removes a fountain pen from his breast pocket and holds it up]. And it's very clear to me that my ability to think and write at the same time depends on the flow of ink. The thing I enjoy most is the flow of my own ideas and getting them down on paper. I will not write with a ballpoint pen, because it doesn't really flow. That's why I use a fountain pen. And only a fountain pen that really works very well.

The novelist Richard Stern gives a classic description of how it feels to become lost in the process of writing and to feel the rightness of one's actions in terms of what is happening in that special world of one's own creation:

At your best you're not thinking, How am I making my way ahead in the world by doing this? No. You're concentrated on your characters, on the situation, on the form of the book, on the words which are coming out. And their shape. You've lost . . . you're not an ego at that point. It's not competitive. It's . . . I would use the

word *pure*. You know that this is right. I don't mean that it works in the world, or that it adds up, but that it's right in this place. In this story. It belongs to it. It's right for that person, that character.

Avoiding Distractions

Many of the peculiarities attributed to creative persons are really just ways to protect the focus of concentration so that they may lose themselves in the creative process. Distractions interrupt flow, and it may take hours to recover the peace of mind one needs to get on with the work. The more ambitious the task, the longer it takes to lose oneself in it, and the easier it is to get distracted. A scientist working on an arcane problem must detach himself from the "normal" world and roam with his mind in a world of disembodied symbols that now you see, now you don't. Any intrusion from the solid world of everyday reality can make that world disappear in an instant. It is for this reason that Freeman Dyson "hides" in the library when he's writing and why Marcel Proust used to seclude himself in a windowless room lined with cork when he sat down to write *À la recherche du temps perdu*. Even the slightest noise could break the thread of his teetering imagination.

More serious health, family, or financial problems could occupy the mind of a person so insistently that he or she is no longer able to devote enough attention to work. Then a long period of drought may follow, a writer's block, a burnout, which may even end a creative career. It is this kind of distraction that Jacob Rabinow talks about:

Freedom from worry is one thing—that you don't have any problem of health or sickness in the family or something that occupies your mind. Or financial worries, that you're going crazy about how you're going to pay the next bill. Or children's worries, or drugs or something. No, it's nice to be free of responsibility. That doesn't mean you have no responsibility to the project, but to be free of other things. And you're not likely to be an inventor if you're very sick. You're too busy with your problems, too many pains.

Many of our respondents were thankful to their spouses for providing a buffer from exactly these kinds of distractions. This was

especially true of the men; the women sometimes mentioned pointedly that they also would have liked to have had a wife to spare them from worries that interfered with their concentration on work.

Forgetting Self, Time, and Surroundings

When distractions are out of the way and the other conditions for flow are in place, the creative process acquires all the dimensions of flow. Here it is described by the poet Mark Strand:

Well, you're right in the work, you lose your sense of time, you're completely enraptured, you're completely caught up in what you're doing, and you're sort of swayed by the possibilities you see in this work. If that becomes too powerful, then you get up, because the excitement is too great. You can't continue to work or continue to see the end of the work because you're jumping ahead of yourself all the time. The idea is to be so . . . so *saturated* with it that there's no future or past, it's just an extended present in which you're, uh, making meaning. And dismantling meaning, and remaking it. Without undue regard for the words you're using. It's meaning carried to a high order. It's not just essential communication, daily communication; it's a *total* communication. When you're working on something and you're working well, you have the feeling that there's no other way of saying what you're saying.

He captures precisely the sense of flowing along this extended present and the powerful sense of doing exactly the right thing the only way it could be done. It may not happen often, but when it does the beauty of it justifies all the hard work.

Creativity as Autotelic Experience

This then brings us back to where we started this chapter and the observation that all of the respondents placed the joy of working ahead of any extrinsic rewards they may receive from it. Like most of the others, the psychologist Donald Campbell gives unambiguous advice to young people entering the field:

I would say: "Don't go into science if you are interested in money. Don't go into science if you will not enjoy it even if you

do not become famous. Let fame be something that you accept graciously if you get it, but make sure that it is a career that you can enjoy. That requires intrinsic motivation. And try to pick a setting in which you can work on the problems that intrinsically motivate you even if they are not exciting to others. Try to have the situational setting so that you can enjoy that work intrinsically, even if you are out of step with the time."

Scientists often describe the autotelic aspects of their work as the exhilaration that comes from the pursuit of truth and of beauty. What they seem to describe, however, is the joy of discovery, of solving a problem, of being able to express an observed relationship in a simple and elegant form. So what is rewarding is not a mysterious and ineffable external goal but the activity of science itself. It is the *pursuit* that counts, not the attainment. Of course this distinction is to a certain extent misleading, because without occasional successes the scientist might become discouraged. But what makes science intrinsically rewarding is the everyday practice, not the rare success. This is how Subrahmanyan Chandrasekhar, the Nobel laureate physicist, describes his own motivation:

There are two things about me which people generally don't know. I've never worked in anything which is glamorous in any sense. That's point number one. Point number two: I have always worked in areas which, during the time I have worked on them, did not attract attention.

The word *success* is an ambiguous word. Success with respect to the outside? Or success with respect to oneself? And if it is a success with respect to the outside, then how do you evaluate it? Very often outside success is irrelevant, wrong, and misplaced. So how can one talk about it? Externally, you may think I am successful because people write about some aspects of my work. But that is an external judgment. And I have no idea as to how to value that judgment.

Success is not one of my motives. Because success stands in contrast to failure. But no worthwhile effort in one's life is either a success or a failure. What do you mean by success? You take a problem and you want to solve it. Well, if you solve it, in a limited sense it is a success. But it may be a trivial problem. So a judgment

about success is not something about which I've ever been serious about in any sense whatever.

Certainly all of these people seem to have heeded their own advice. None pursued money and fame. Some became comfortably wealthy from their inventions or their books, but none of them felt fortunate because of it. What they felt fortunate about was that they could get paid for something they had such fun doing and that in the bargain they could feel that what they did might help the human condition along. It is indeed lucky to be able to justify one's life activity with words such as those of C. Vann Woodward, who explains why he writes history:

It interests me. It is a source of satisfaction. Achieving something that one thinks is important. Without such a consciousness or motivation it seems to me that life could be rather dull and purposeless, and I wouldn't want to attempt that kind of life. Of complete leisure, say, of having absolutely nothing to do that one felt was worth doing—that strikes me as a rather desperate situation to be in.

FLOW AND HAPPINESS

What is the relation between flow and happiness? This is a very interesting and delicate question. At first, it is easy to conclude that the two must be the same thing. But actually the connection is a bit more complex. First of all, when we are in flow, we do not usually feel happy—for the simple reason that in flow we feel only what is relevant to the activity. Happiness is a distraction. The poet in the middle of writing or the scientist working out equations does not feel happy, at least not without losing the thread of his or her thought.

It is only after we get out of flow, at the end of a session or in moments of distraction within it, that we might indulge in feeling happy. And then there is the rush of well-being, of satisfaction that comes when the poem is completed or the theorem is proved. In the long run, the more flow we experience in daily life, the more likely we are to feel happy overall. But this also depends on what activity provides flow. Unfortunately, many people find the only challenges

they can respond to are violence, gambling, random sex, or drugs. Some of these experiences can be enjoyable, but these episodes of flow do not add up to a sense of satisfaction and happiness over time. Pleasure does not lead to creativity, but soon turns into addiction—the thrall of entropy.

So the link between flow and happiness depends on whether the flow-producing activity is complex, whether it leads to new challenges and hence to personal as well as cultural growth. Thus we might conclude that all our respondents must be happy, because they do enjoy their work, and their work is certainly complex. But there are further complications to consider. For instance, what if a person enjoyed being a physicist for thirty years, and then found out that his work resulted in a nuclear device that killed millions of people? How would Jonas Salk have felt if his vaccine, instead of saving lives, had been used by others for biological warfare? Certainly these are not idle questions in today's world, and they suggest that it is possible for complex activities that produce flow to cause long-range unhappiness. Yet when all is said and done, it is much easier to be happy when one's life has been enjoyable.

FLOW AND THE EVOLUTION OF CONSCIOUSNESS

There are many things that people enjoy: the pleasures of the body, power and fame, material possessions. Some enjoy collecting different beer bottles, and a few even enjoy causing pain to themselves or to others. Strangely enough, even though the means to obtain it are widely different, the resulting feeling of well-being is very much the same. Does that mean that all forms of enjoyment are equally worth pursuing?

Twenty-five centuries ago, Plato wrote that the most important task for a society was to teach the young to find pleasure in the right objects. Now Plato was conservative even for his times, so he had rather definite ideas about what those "right things" were that young people should learn to enjoy. We are much too sophisticated in this day and age to have strong feelings in the matter. Yet we probably agree that we would feel better if our children learned to enjoy cooperation rather than violence; reading rather than stealing; chess rather than dice; hiking rather than watching television. In other words, no matter how relativistic and tolerant we have become, we

still have priorities. And we do want the next generation to share those priorities. Finally, many of us suspect that the next generation will not preserve what we value unless they now enjoy it to some extent.

The problem is that it is easier to find pleasure in things that *are* easier, in activities like sex and violence that are already programmed into our genes. Hunting, fishing, eating, and mating have privileged places in our nervous system. It is also easy to enjoy making money, or discovering new lands, or conquering new territories, or building elaborate palaces, temples, or tombs because these projects are in synchrony with survival strategies established long ago in our physiological makeup. It is much more difficult to learn to enjoy doing things that were discovered recently in our evolution, like manipulating symbolic systems by doing math or science or writing poetry or music, and learning from doing these things about the world and about ourselves.

Children grow up believing that football players and rock singers must be happy and envy the stars of the entertainment world for what they think must be fabulous, fulfilling lives. Asked what they would like to do when they grow up, most of them would choose to be athletes and entertainers. They don't realize until much later, if at all, that the glamour of those lives is vulgar tinsel, that to be like them leads anywhere but to happiness.

Neither parents nor schools are very effective at teaching the young to find pleasure in the right things. Adults, themselves often deluded by infatuation with fatuous models, conspire in the deception. They make serious tasks seem dull and hard, and frivolous ones exciting and easy. Schools generally fail to teach how exciting, how mesmerizingly beautiful science or mathematics can be; they teach the routine of literature or history rather than the adventure.

It is in this sense that creative individuals live exemplary lives. They show how joyful and interesting complex symbolic activity is. They have struggled through marshes of ignorance, deserts of disinterest, and with the help of parents and a few visionary teachers they have found themselves on the other side of the known. They have become pioneers of culture, models for what men and women of the future will be—if there is to be a future at all. It is by following their example that human consciousness will grow beyond the limitations

of the past, the programs that genes and cultures have wired into our brains. Perhaps our children, or their children, will feel more joy in writing poetry and solving theorems than in being passively entertained. The lives of these creative individuals reassure us that it is not impossible.

CREATIVE SURROUNDINGS

Even the most abstract mind is affected by the surroundings of the body. No one is immune to the impressions that impinge on the senses from the outside. Creative individuals may seem to disregard their environment and work happily in even the most dismal surroundings: Michelangelo contorted on his scaffold below the Sistine ceiling, the Curies freezing in their shabby Parisian lab, and an infinitude of poets scribbling away in dingy rented rooms. But in reality, the spatiotemporal context in which creative persons live has consequences that often go unnoticed. The right milieu is important in more ways than one. It can affect the production of novelty as well as its acceptance; therefore, it is not surprising that creative individuals tend to gravitate toward centers of vital activity, where their work has the chance of succeeding. From time immemorial artists, poets, scholars, and scientists have sought out places of natural beauty expecting to be inspired by the majestic peaks or the thundering sea. But in the last analysis, what sets creative individuals apart is that regardless of whether the conditions in which they find themselves are luxurious or miserable, they manage to give their surroundings a personal pattern that echoes the rhythm of their thoughts and habits