# PART I

# 1. Hermes and the Periodic Table

As a boy I spent four years at a boarding school in Massachusetts called Deerfield Academy that had two legends attached to it. The first was its headmaster, Frank L. Boyden. When he was a young man just out of college, in 1902, he accepted a position that only a teacher desperate for a first job might have taken: running a moribund academy in the tiny village of Deerfield. The school had so few boys that the new headmaster had to play on the football and baseball teams himself. By the time I got there, in the mid-1930s, Frank Boyden had built Deerfield into one of the best secondary schools in the country, and when he retired, in 1968, his place in American education secure, he had been headmaster for sixty-six years. During all those years he also coached the football, basketball and baseball teams, continuing as an octogenarian to rap out sharp grounders for infield practice before every game. His favorite baseball strategy was the squeeze play—a mark, perhaps, of his Yankee practicality. He was an unusually small man with a plain New England face, slicked-down black hair, and metal-rimmed glasses; nobody would have noticed him in a crowd or picked him out as a leader. But three generations of boys were shaped for life by his values, and I was one of them.

The second legend was his wife, Helen Childs Boyden. A tall, bony woman with a face even plainer than her husband's, she wore her black hair tied in a bun and she peered out at the world through thick glasses, triumphing over eyesight so bad that it would have immobilized a person of weaker will. Helen Childs had also come to Deerfield as a young teacher, fresh out of Smith College with a science degree. She married Frank Boyden in 1907 and for more than sixty years was a strengthening presence in his life and in the life of the school. She was best known, however, for her senior course in chemistry. The legend was that she could teach chemistry to anybody. As it turned out, she couldn't teach it to me.

The fault was undoubtedly mine. I'm sure I didn't want to learn chemistry. Probably I had also persuaded myself that I couldn't learn chemistry, or any of the hard sciences. Those subjects were for all those people who had an aptitude for them—the ones who carried a slide rule and could take a radio apart. I was a liberal arts snob, illiterate about the physical world I lived in, incurious about how things worked. The courses I felt most comfortable with were English and languages, and in my extracurricular hours I indulged my other two loves—playing baseball and writing for the school newspaper. I did what came easiest and avoided what I might not be able to do well.

My favorite language was Latin. It transported me back to the classical world, and yet it was anything but dead—thousands of its roots were alive and well in English; in fact, no subject has been more useful to me as a writer and an editor. I took Latin for three years at Deerfield until there were no more courses left to take, finally getting beyond Caesar's dreary wars and Cicero's prim orations to Virgil's *Aeneid* and Horace's odes, finally discovering that the wonderful language also had a wonderful literature.

My teacher in that liberating third year was a man so venerable that he seemed to be a

schoolmaster from the nineteenth century. Recalling him now, I think of pictures of Darwin as an old man. Charles Huntington Smith had silky white hair, a white mustache and a white goatee, and he wore the black suit and high collar befitting his age and dignity. But his eyes were young, and so were his passions for what he taught. He had turned his classroom into a small corner of ancient Rome. Large framed photographs of the Forum and the Colosseum hung on the walls, and he had also sent away for plaster reproductions of some of the great statues of antiquity. Hermes on tiptoe, beckoning the gods, was on his desk, and the Winged Victory was nearby, still sending her message about beauty and line across the centuries. Mr. Smith was obviously aware of the power exerted by the icons that inhabit the classrooms of our childhood; when I was in Italy during World War II, the first time I got a few days off I hitchhiked to Rome to see the Forum, though the distance was great and the hours I could spend there were short.

In my senior year reality caught up with me: I had to take Mrs. Boyden's chemistry. I remember her classroom almost as vividly as Mr. Smith's. I can still smell its acrid smells, alien to my humanist nose. I can still see the retorts and beakers and other strangely shaped vessels designed for measuring whatever they were designed to measure. But the icon that dominates my memory is the huge chart of the periodic table of the elements that hung at the front of the room. Those cryptic letters and numbers, so neatly arranged in their boxes and columns, were the Hermes and Venus of the chemistry class—the gods whose laws and whims would rule our lives. Each box contained its own tremendous story of natural forces working out an ordained pattern. What could that story possibly be? I never found out. The periodic table continues to rebuke me for my indolence.

Mrs. Boyden had devised a teaching method that I remember as slightly cute but that obviously worked for three generations of boys. It had something to do with one molecule joining hands with another and going off to form a different combination. I must have resisted these little romances, for by about April someone in authority began to think the unthinkable: I would flunk the college entrance exam in chemistry. This would not only ruin my chances of getting into Princeton; it would besmirch Deerfield's proud record of placing its seniors in America's best colleges.

The solution was for me to take the Latin exam instead. I was released from Mrs. Boyden's charge and told to cram for Latin. The decision was easier made than executed; after a year the intricate carpentry of Virgil's language—the capricious declensions and conjugations, the gerunds and gerundives and the dreaded ablative absolute—had slipped away and had to be hastily stuffed back into my brain. The exam was almost as hard to pass as chemistry would have been. But I was rescued by memory and by an instinct for how languages work and was duly admitted to Princeton.

There I continued to skirt the courses that would have made me a more broadly educated man. I satisfied the science requirement by taking biology, which didn't hold the terrors of chemistry and physics; any boob can dissect a dogfish. Besides, the dogfish and I had many systems in common. Poking about in its innards, I at least knew what I was looking for: heart and lungs and a digestive tract. Unlike the molecule, they could be seen and touched and examined.

On December 7 of my sophomore year, Pearl Harbor ended our reverie of life as an orderly succession of events. Our first impulse was to rush out and enlist, but we were told that "Washington" wanted us to stay in college and get educated for "the war effort." So began the age of "acceleration" at Princeton. Through the winter, spring and summer of 1942 we took courses that were compressed and elided. Our education had the quality of a speeded-up movie; we became part junior before we finished being sophomores and never knew how many credits we were amassing. The main thing was that we were amassing wisdom, which Washington in its own wisdom would harness to smash the Axis. Meanwhile several gruff men on the gymnastics and physical education staff, whom I had naturally never seen before, labored with ill-concealed contempt to build our muscles. Washington wanted us to be tough.

By fall the texture of college life began to unravel. So many professors and students had slipped away that nobody knew who was still around. At the end of the term I also left and enlisted in the army. By then I was more senior than junior, my credits badly tangled. But it could all be straightened out when I came back.

My next three credits I earned just by putting on a uniform. Princeton decided that time spent in the service was time educationally spent, and in my case that was true. My love of remote travel was born on the morning after my troopship landed in Morocco; I awoke to a landscape so startlingly beautiful and exotic—my first glimpse of the Arab world—that I've never forgotten the impact of the moment. We were informed of Princeton's decision about the extra credits in one of the letters that President Dodds periodically wrote to all of us who had gone off to war—letters that caught up with us in places where we had never expected to be. One of them reached me in a sand-blown tent near the Algerian town of Blida, and it enclosed a complete list of Modern Library titles. The university would like to send us three books, President Dodds wrote; we should just check our choices. I did, and my three books reached me six months later in a snow-blown tent near the Italian city of Brindisi.

When the war in Europe ended, in May of 1945, the troopships taking men home were assigned to France and England; the Mediterranean theater would have to wait. In July, however, I heard that the army was establishing a college in Florence to keep at least some of its soldiers occupied. Eager for more credits, whatever odd form they might take, I applied and was allowed to attend. Our campus was an aeronautical academy that Mussolini had built in his best Fascist style.

I knew nothing about art, so I decided to take art history courses. It was the ideal time and place—Florence had just begun to bring back the statues and paintings that had been hidden during the war. Crowds of Florentines gathered to watch these installations, as they had when the works were new; it was a re-Renaissance. For me it was the best of summers. On weekends I hitchhiked to other Tuscan towns that were almost as rich: Pisa, Lucca, San Gimignano and my favorite of them all, Siena. When the summer was over I received three certificates saying that I had passed three courses. But only I knew how much they certified.

In November a huge troopship finally came and took us home. Disgorged into civilian life, I needed to know whether my army credits would give me enough units to graduate. If not, I would have to go back to Princeton for one more term. When I had left I was sure I would want to return. Now I only wanted to be given my degree and to get started on whatever I was going to do next.

My hopes were not high, however, on the morning when I went to Princeton for an interview with the official who would judge my case. The certificates that I was clutching—the pieces of paper so gratifyingly won in Florence—now looked crude, wholly lacking in academic authority. I went into Nassau Hall and was told that my appointment was with Dean Root. Dean Root! I might as well turn around and go back to New York.

Robert K. Root, who was then in his seventies, was dean of the Princeton faculty. I had never met him, but I had taken his sophomore course in English literature and listened week after week to his lectures. They were stern disquisitions, raining on our unappreciative heads the fruits of lifelong

scholarship, excavating with dry precision the buried ironies of Swift and the unsuspected jests of Pope, which even then I continued not to suspect. My only other view of Dean Root was at the head of the procession that commenced the service every Sunday morning in Princeton's chapel. Gray and solemn, bowed under robes representing the highest honors of Academia, he seemed to belong to Oxford or Edinburgh, not to brash young America. Surely such a man, guardian of Princeton's virtue, would scorn the grab bag of credits I now emptied at his feet.

Dean Root studied my Princeton transcript gravely. Then he studied my certificates and said he had never seen anything like them. Next he began adding up my credits. I could tell that he didn't know how much weight to give my army learning. I could also tell that he wasn't optimistic. I remembered that he had a habit of chewing the inside of his cheek, and now his mouth was working rapidly. He shook his head and mumbled that I seemed to be a little short of the necessary total.

Then, imperceptibly, the arid dean disappeared and I was talking with a person. He asked me what I had done in the army, and where I had gone, and what I had thought about. I could hardly believe that it was the same Dean Root. Was this the face that had cowed three generations of students since he had been hired as a young instructor by an earlier president of Princeton, Woodrow Wilson? I found myself talking to him with enthusiasm, describing my travels in North Africa and my trips to Rome and my Renaissance summer in Florence and my visits to Siena and the other Tuscan towns. By then I was sure that I didn't have enough credits and that the official part of my interview was over. Not until later did I realize that this was the only part that mattered to Dean Root.

At the end a look of sadness came into Dean Root's eyes and he said, "Tell me—I suppose Siena was mostly destroyed during the war?" I realized that I was the first messenger to come back from Tuscany. Suddenly I understood what Siena would mean to this quintessential humanist; probably Dean Root had first visited Siena as a young man himself. Suddenly it was possible to understand that Dean Root had once been a young man. I told him that Siena hadn't been touched by the war and that the great striped cathedral was still there.

Dean Root smiled fleetingly and saw me to the door. He said the university would inform me of its decision soon. Not long afterward he wrote to tell me I had met Princeton's requirements for a degree and would be given my diploma at a special graduation for returning servicemen early in 1946. I've always suspected that he waived one or two credits to make my total come out right. I've also thought that if Siena had been destroyed I would have had to go back for another term.

But one thing I'm sure of: My education really began that day in Nassau Hall. Dean Root freed me to get on with my life. Learning, he seemed to be saying, takes a multitude of forms; expect to find them in places where you least expect them to be.

In January I rented a cap and gown and received my dubious B.A. and went out into the world. Several months later I got a job with the *New York Herald Tribune* and began what has turned out to be a career of trying to write clearly and—as an editor and a teacher—to help other people to write clearly. I've become a clarity nut. I've also become a logic nut. I'm far less preoccupied than I once was with individual words and their picturesque roots and origins and with the various fights over which new ones should be admitted into the language. Those are mere skirmishes at the edge of the battlefield; I will no longer man the ramparts to hurl back such barbarians as "hopefully."

What does preoccupy me is the plain declarative sentence. How have we managed to hide it from so much of the population? Far too many Americans are prevented from doing useful work because they never learned to express themselves. Contrary to general belief, writing isn't something that only "writers" do; writing is a basic skill for getting through life. Yet most American adults are terrified of the prospect—ask a middle-aged engineer to write a report and you'll see something close to panic. Writing, however, isn't a special language that belongs to English teachers and a few other sensitive souls who have a "gift for words." Writing is thinking on paper. Anyone who thinks clearly should be able to write clearly—about any subject at all.

How, you might ask, do I know that—I who so diligently avoided all the courses I thought I was too dumb to understand or was too lazy to grapple with? I know it because my work has been the education I avoided. Over the years I've written or edited hundreds of articles on subjects I had never previously thought about. No other job could have exposed me to so many areas of knowledge. I've not only met a wide variety of interesting people doing things that astonished and delighted me. I've found that their ideas were never so specialized that I couldn't grasp them by writing about them or by editing someone else's writing about them: by breaking the ideas down into logical units, called sentences, and putting one sentence after another. Along the way I've also discovered that knowledge is not as compartmented as I thought it was. It's not a hundred different rooms inhabited by strangers; it's all one house. Hermes and the periodic table are equally its household gods, and writing is the key that opens the door.

That's what this book is about.

# 2. Writing Across the Curriculum

One spring day in 1985 I got a telephone call from a professor named Thomas Gover at Gustavus Adolphus College, a small liberal arts college of Lutheran origins in St. Peter, Minnesota. He wanted to tell me about a new program at his college tha he thought would interest me. It did. In fact, it's what got me thinking about this book.

He said that in the fall term Gustavus Adolphus would launch a curriculum in which seventy-five courses, covering the entire spectrum of a baccalaureate education, would be listed with a "W," meaning that writing would be a required part of the course, that it would be a factor in the student's grade, and that the teachers would work with the students on the process of organizing, writing and rewriting their papers and reports. Three "W" courses would be required for graduation.

The call crystallized an idea I realized I felt strongly about: that the teaching of writing should no longer be left just to English teachers but should be made an organic part of every subject. The idea, which goes by the name of "writing across the curriculum," has been very much in the air among educators for at least a decade. But I had never heard of any school or college actually trying it. (I've since heard of many.) That's why the call from Minnesota excited me. It was a chance to see the idea in action and to find out whether it was as important a trend as I thought it was.

Professor Gover asked if I would like to come out to Gustavus Adolphus and talk to the students about writing. I said I would like to come out and talk to the professors; they were the real heroes of the mission. How were they going to undertake a kind of teaching they had never tried before? How were they going to adapt writing to their discipline? How did they think writing would help their students to learn?

I asked Thomas Gover how to get to Gustavus Adolphus. He said that if I flew to Minneapolis he would meet me at the airport. I said I'd see him there.

As baggage I would be taking along a number of strong opinions on why so many Americans don't learn to write and why they live in so much fear of trying.

One of them has to do with English teachers. Under the American system, they are the people who teach our children to write. If they don't, nobody will. They do it with dedication, and I hope they'll be rewarded, if not here on earth, at least in heaven, for there's almost no pedagogical task harder and more tiring than teaching somebody to write. But there are all kinds of reasons why English teachers ought to get some relief. One is that they shouldn't have to assume the whole responsibility for imparting a skill that's basic to every area of life. That should be everybody's job. That's citizenship.

Another reason is that it's not what most English teachers want to do. Their real subject is literature—not how to write, but how to read: how to extract meaning from a written text. That's what they were primarily hired to teach and what they were trained to teach. Inevitably, much of the writing that English teachers assign is based on literature—on what somebody else has already written—and therefore has little reality And what students in turn write for the English teacher is more florid than what they would write for anybody else. They reach for a "literary" style that they think the teacher wants and that they assume is "good English." But this style is no part of who they are. Nor is it necessarily good English; much of what academics write and read is fuzzy and verbose. Students should be learning a strong and unpretentious prose that will carry their thoughts about the world they live in.

Another powerful element in learning to write is motivation. Motivation is crucial to writing—students will write far more willingly if they write about subjects that interest them and that they have an aptitude for. But they don't often get that chance; writing tends to be assigned only in subjects like English or history that are identified with writing.

What also gets imparted in those classes is fear. The fear of writing is planted in countless people at an early age—often, ironically, by English teachers, who make science-minded kids feel stupid for not being "good at words," just as science teachers make people like me feel stupid for not being good at science. Whichever our type, the loss of confidence stays with us for the rest of our lives.

Much of this fear could be eased if writing became a component of how these subjects are taught. A science-minded student, if he were encouraged to write about a scientific or technological subject, would soon find that he could do it. He would discover that writing is primarily an exercise in logic and that words are just tools designed to do a specific job. Similarly, the sciences could be demystified for liberal arts types like me. We could write our way into at least a partial understanding of many subjects whose language of numbers and symbols has scared us away.

The hard part, as in swimming, is to take the plunge. The water looks so cold. Can it be warmed up? I think it can. The way to begin is with imitation.

We all need models, whatever art or craft we're trying to learn. Bach needed a model; Picasso needed a model; they didn't spring full-blown as Bach and Picasso. This is especially true of writers. Writing is learned by imitation. I learned to write mainly by reading writers who were doing the kind of writing I wanted to do and by trying to figure out how they did it. S. J. Perelman told me that when he was starting out he could have been arrested for imitating Ring Lardner. Woody Allen could have been arrested for imitating S. J. Perelman. And who hasn't tried to imitate Woody Allen?

Students often feel guilty about modeling their writing on someone else's writing. They think it's unethical—which is commendable. Or they're afraid they'll lose their own identity. The point, however, is that we eventually move beyond our models; we take what we need and then we shed those skins and become who we are supposed to become. But nobody will write well unless he gets into his ear and into his metabolism a sense of how the language works and what it can be made to do. That's a fundamental premise of this book.

Another is that the essence of writing is rewriting. Very few writers say on their first try exactly what they want to say. Recently I got a form letter from my cable TV company saying, "Next month we will upgrade our phones, so it will be difficult to reach us." A few days later I saw an interoffice memo from a supervisor requesting "a list of all employees broken down by sex." Meaning is remarkably elusive. After a lifetime of writing I still revise every sentence many times and still worry that I haven't caught every ambiguity; I don't want anyone to have to read a sentence of mine twice to find out what it means. If you think you can dash something off and have it come out right, the

people you're trying to reach are almost surely in trouble. H. L. Mencken said that "0.8 percent of the human race is capable of writing something that is instantly understandable." He may have been a little high. Beware of dashing. "Effortless" articles that look as if they were dashed off are the result of strenuous effort. A piece of writing must be viewed as a constantly evolving organism.

Curiously, this hasn't been the prevailing theory in our schools. American children have long been taught to visualize a composition as a finished edifice, its topic sentences all in place, its spelling correct, its appearance tidy. Only lately has there been an important shift. The shift—in the terminology of the trade—is from "product" to "process." It puts the emphasis where it should have been all along: on the successive rewritings and rethinkings that mold an act of writing into the best possible form. If the process is sound, the product will take care of itself.

Finally, in the national furor over "why Johnny can't write," let's not forget to ask why Johnny also can't learn. The two are connected. Writing organizes and clarifies our thoughts. Writing is how we think our way into a subject and make it our own. Writing enables us to find out what we know—and what we don't know—about whatever we're trying to learn. Putting an idea into written words is like defrosting the windshield: The idea, so vague out there in the murk, slowly begins to gather itself into a sensible shape. Whatever we write—a memo, a letter, a note to the baby-sitter—all of us know this moment of finding out what we really want to say by trying in writing to say it.

This was the aspect of "writing across the curriculum" that excited me most of all. It was an idea based on two principles: learning to write and writing to learn.

# 4. Writing to Learn

I regretted my decision to go back to Gustavus Adolphus College in January when the pilot of my plane announced that the temperature in Minneapolis was twenty-five degrees below zero. We were over Lake Michigan and I didn't see any easy way of turning back. Twenty-five below! I could *die* if my rented car broke down while I was driving across the frozen tundra of Minnesota. I was a city boy from New York; I didn't have any of the survival knowledge that Minnesotans are born with, or any of the special equipment they carry in their cars—Sterno stoves and heavy blankets and dried foods—to keep from perishing along the highway. I would just have to take my chances, and I did, hunched against the unbelievable cold, squinting at the snow-blown landscape through the icy windows of my car and guessing at the whereabouts of the road. When I finally got to Gustavus Adolphus the woman who greeted me said, "I hope you at least had a rope in your car. A few years ago six people died not far from here when a sudden blizzard came up and they got out and couldn't find their way back. You should always have a rope that you can tie to your steering column."

I had of course been ropeless, but that didn't matter now. I had survived, and the Gustavus Adolphus faculty quickly warmed me up. For two days professors from every corner of the curriculum came and talked to me. Quite a few were men and women I had met on my previous visit. I asked them how they had taught their "W" courses during the fall term and what they had discovered. Their accounts varied in detail, but on one point they all agreed: Far more learning had been achieved by the addition of a writing requirement.

Many teachers included themselves among the learners. Barbara Simpson, professor of psychology, said: "I wanted to teach a 'W' course because I write very badly myself—in high school I was terrorized by writing. One thing I did last term was to ask students to write a paper in the last five minutes of class, summarizing what I had said in my lecture. It helps them to find out whether they understood what I was talking about. Psychology is a deceptively difficult subject: It sounds like material you've known all your life, but actually it's based on extensive research. And the writing has become far more concrete. In the '60s psychology was still a probabilistic science, so it developed a hedging language. You can't get away with that today."

Fuzzy thinking turned up repeatedly as the main enemy. "Students don't know how to be precise," said Norman Walbek, associate professor of political science. "In my first assignment I asked them to write a paper on 'What are the most important goals of United States policy?' It was a values statement—something nobody had ever asked them to write before; usually students are only asked to describe or to analyze: 'Write an essay on the Declaration of Independence.' Well, their papers were a disaster. They rambled all over. They couldn't formulate a goal or a policy except in the most generalized way—'better communications,' 'world peace'—and in almost every case the comment I found myself making was: 'I don't understand this.' As the term went on I tried to get them to use writing to focus their thoughts on specific ideas and issues. I told them I'd be grading

their papers for clarity, common sense, logic, plausibility and precision, not for the content of their views. At the end of the term I gave them the same assignment on goals and policies. This time their papers were clear and explicit. Their problems were in thinking, not in the mechanics of writing."

Professor Clair McRostie, who teaches International Economics and Management, didn't wait to discover this dismal fact; he knew it already. The prospectus that he handed out to his students left them in no doubt about his priorities—it said that their three required papers would be graded for "quality of writing, grammar, spelling, organization and content." His first three lectures, in fact, were devoted entirely to writing and reasoning.

"Back when some of us were concerned about why Johnny can't write," Professor McRostie told me, "a psychologist put it to us that Johnny can't reason, and I've been preoccupied with that thought ever since. The first two books I assigned last term were *The Art of Thinking*, by Vincent Ruggiero, and *Reasoning*, by Michael Scriven. This is a generation that has spent fifteen thousand hours watching television, and its attention span is short. I'm challenging my students to find their powers of reasoning. I tell them, 'If you don't write reasonably and well on your exam I'll give you a lower grade. But I'll also give you extra time if you need it.' At the end of the term, when they were asked to evaluate the course, they said that the writing component had been an important part of their learning."

I liked the audacity of a professor devoting his first three lectures to subjects that weren't the ones he was supposedly there to teach. It was a way of seizing his students' attention with a radical piece of news: Economics and management are important, but they're not as important as clear reasoning and writing; without them, all the economic theory in the world won't take you far. Professor McRostie had me beat as a logic nut, and his credentials were better. I had merely learned by experience that thinking is the foundation of writing. But I had never thought about thinking as a process. How does it work? Why do some people think straighter than others? What are the factors that prevent us from thinking clearly? Can it be taught? I made a note to buy *The Art of Thinking* when I got back home. I suspected that it would help me to see how so much fuzz gets into the writing machinery and how some of it might be kept out.

"Reading, writing and thinking are all integrated," said Kevin Byrne, associate professor of history. "An idea can have value in itself, but its usefulness diminishes to the extent that you can't articulate it to someone else. What the writing program made *me* realize is that I have to take much more time in class to talk about writing. Teachers have a tremendous tendency to just give writing assignments and let their students sink or swim—which assumes that they've learned to write somewhere else. Very often they haven't. In history we've paid great lip service to the need to write, but we haven't taken the time in our classes to tell students how it's done. We need to rob time from the study of history to do that. It takes a commitment, and I found it very painful because the term is too short anyway to cover all the historical issues I'd like to discuss."

Early in the term Professor Byrne told his students to bring in a historical passage that they considered well written and to explain why. "It forces them to think about the elements that go into good writing," he said, "and it shows them that there are many different kinds of good writing, not just one. I was amazed at what happened when students questioned each other about the *writing* in a historical account. Their ideas became much more focused when the whole class discussed a passage in terms of how it was written."

In all these accounts I heard a pleasant sense of discovery: Writing could get into corners that other teaching tools couldn't reach. But it was a professor of chemistry, Lawrence W. Potts, who took me to the heart of what I had come to find out. During the fall, he said, he had taught a "W" course called "Instrumental Methods of Analysis" for juniors and seniors who hoped to go into chemistry as a profession.

"I've been grading my students' lab reports both for their scientific merit," Professor Potts said, "and for the language in which they tell me what they did, what their results were and how they interpret those results. If they don't write well they lose a full grade. Like all writing, it's an exercise in thinking. The easy way for a chemistry professor to evaluate lab work is just to have students turn in index cards with the numbers they got. But students don't get much out of that—there's an important link they miss.

"I want them to go first to the literature, so they know how the experiment has been done before and what to expect in the lab and how to plan their work. Having to plan their work helps them to write it up as they go along, so that writing becomes woven through the entire class and lab experience. If they fall into a pitfall they can explain how they got there, and that's education. The process also enables *me* to see how their mind worked. By having them describe how they arrived at a result I can comment on it, and they can make use of my comment when they go back to the experiment. There's a feedback that isn't possible when the teacher just grades from numerical answers. Revising helps the students to rethink."

I don't remember whether I cried "Eureka!" when I heard that. Not being Greek, I probably didn't. But I do remember thinking I would probably never get a more concise statement of what writing across the curriculum is all about, or a better illustration of how the act of writing gives the teacher a window into the brain of his student. See Johnny reason! Watch him make a wrong turn! Follow his cogitations as he wonders what to do next!

I thought of all the subjects where the teacher never gets this inside look, where students are graded solely on the basis of a right or a wrong answer. I don't only mean hard sciences, like physics, that deal in numerical answers. The humanities and the social sciences also rely heavily on tests that measure a student's learning by what he knows, not by how he got to know it: multiple-choice exams and "short-answer questions." Economics, for example, is a discipline that rests finally on numbers and projections and probabilities—"answers," as they might be loosely called. But the future economist should be as accountable as the future chemist for describing the steps that took him to his numerical result, and the economics teacher should be no less eager to read about the trip.

Eagerness to read and correct student writing, however, is not a commodity that grows on trees; it's far easier to just check right and wrong answers. Unfortunately, there's no quick and easy way to teach writing. When I first did it I assumed that a good part of the job could be accomplished by explaining in class the elements that constitute good writing. Surely if I assailed my students with my sacred principles of clarity and simplicity and brevity, if I exhorted them to use active verbs and short words and short sentences, if I pointed out the pitfalls that await the writer of a travel piece or a sports piece or an interview, they would go and do what I had told them to do.

No such transfer takes place. Writing teachers are lucky if 10 percent of what they said in class is remembered and applied. The bad habits are just too habitual. They can be cured only by that most painful of surgical procedures: operating on what the writer has actually written. Only there, where a writer is at his most vulnerable, having put some part of himself on paper, does he make the connection between principle and practice. The operation is almost as hard on the teacher. Like the

parent who tells the spanked child that "this hurts me more than it hurts you," the writing teacher wants nothing so much as a paper that's well written—one that won't mire him in endless repairs and emotional debris. I sometimes find myself emitting small moans as I start to read a paper and realize the magnitude of the problems ahead.

Why, then, would anyone in his right mind want to be a writing teacher? The answer is that writing teachers aren't altogether in their right mind. They are in one of the caring professions, no more sane in the allotment of their time and energy than the social worker or the day care worker or the nurse. Whenever I hear them talk about their work, I feel that few forms of teaching are so sacramental; the writing teacher's ministry is not just to the words but to the person who wrote the words. One of my hopes for writing across the curriculum is that teachers in many fields will discover this transaction. Through the writing of our students we are reminded of their individuality. We are reminded, whatever subject we are charged with teaching, that our ultimate charge is to produce broadly educated men and women with a sense of stewardship for the world they live in.

A funny thing happened on the way to that ideal when the first space satellite was launched by the Soviet Union in 1957. Overnight, Sputnik turned us into a nation obsessed by technology and determined to produce a bumper crop of technicians every year. Pure science has been an American deity ever since. Many science professors say that their discipline is now taught without any reference to its past traditions or to its present or future impact on society.

"I was a Sputnik student," Professor Potts told me. "I graduated from Oberlin in 1967, and the chemistry I was taught was all hard-core science. The only time you talked about values was over coffee. As a result, my generation of chemistry teachers has been afraid to get into the background of the subject because we were never exposed to it ourselves. But now colleges like ours are paying more attention to the history and the ethics of science. We're also trying harder to reach the non-science student. This term, for instance, I'm teaching a course on hazardous wastes called 'Chemical Time Bombs,' and I've asked for a paper summing up the legal and ethical issues of Love Canal. That course wouldn't have been taught ten years ago."

If such values aren't imparted in the classroom they will probably never get imparted; college students who are praised and coddled for acquiring technical knowledge aren't likely to have an onset of ethics when they get out in the world of profit and loss. Yet moral dilemmas have never been woven so bewilderingly through American life. Every day we are assaulted by scientific or biomedical questions that we don't even know how to think about, from toxic wastes and "Star Wars" and nuclear energy to acid rain and gene splicing and surrogate motherhood. Many of them are the legacy of scientists who now admit that they didn't understand how their decisions would affect the quality of life, or life itself. Too many sick chickens have come home to roost. Too many lakes and rivers have died, too many fish and birds, too many people in states like Utah who had the bad luck to live downwind from the scientists. Too many names that we had never heard before—Bhopal, Chernobyl, Three Mile Island—have become instant synonyms for technology gone wrong.

That's why I liked the two trends that Professor Potts mentioned: educating future scientists to be more attuned to the impact of their work, and educating the rest of us to be more scientifically literate. It does us no good to just feel a growing sense of jeopardy over what the scientists are "up to." As citizens we're responsible for what we know and what we don't know.

Where does writing figure in all this? Writing is a tool that enables people in every discipline to wrestle with facts and ideas. It's a physical activity, unlike reading. Writing requires us to operate some kind of mechanism—pencil, pen, typewriter, word processor—for getting our thoughts on paper. It compels us by the repeated effort of language to go after those thoughts and to organize them and present them clearly. It forces us to keep asking, "Am I saying what I want to say?" Very often the answer is "No." It's a useful piece of information.

One of the most striking things I heard at Gustavus Adolphus came from a professor of philosophy, Deane Curtin. He said, "Many of my 'A' papers last term were 'failures.' A great paper in philosophy is often one that tells me why the student couldn't get where he wanted to go. That's progress. It's better than deluding yourself that something was proved that really hadn't been."

I liked the example because I've always believed that failure is one of the great teachers, every bit as instructive as success. It's not, however, a point that Americans want to hear. Winning is the national creed. Forget the pursuit of happiness—is the kid an "achiever"? How we love the student who "tests" high. How we hate the football team that loses. Reading the letters in the *Princeton Alumni Weekly*, year after year, I marvel at how bothered this highly educated segment of the populace is by the fact that their alma mater can't field a winning football team. There is no end of ululation in the letters column.

But failure isn't the end of the world, in football or anywhere else. In writing—and therefore in learning—it's often the beginning of wisdom. The point came up again when a professor of religion, Garrett E. Paul, told me about his course in "Ethics in Business and Economics." Early in the term he assigned his students a paper that would be read aloud in class.

"It gets them to write for their peers and not for the teacher," he told me, "and what they learned was a revelation to them. They learned by the presence or absence of response to what they had written. The good paper raised all the right questions, and on those days the paper would teach the class. The poor paper was instantly noticeable. There wouldn't be much in it to discuss—there'd be no place to start, or it was so unclear that we'd have to go back over it and try to figure out what it was about. It made everybody in the class realize that a piece of writing is a piece of thinking. By the end of the term all the students said how much better they understood a subject by having to write about it."

Like his colleagues, Professor Paul had found many models of good writing in his discipline. One of his favorite assignments dealt with the issue of morality in advertising. Students were told to read a chapter on the "dependence effect" from John Kenneth Galbraith's *The Affluent Society* and then to read a rebuttal by Friedrich von Hayek, called "The Non-Sequitur of the Dependence Effect." (Both are in an anthology called *Ethical Theory in Business*.) "What I particularly pointed out," Professor Paul said, "was the elegance of von Hayek's argument. It's elegant in the sense of a geometric argument: Everything that needs to be there is there, and the essay has nothing in it that doesn't support the argument. I also emphasized to the students how short von Hayek's answer is. I'm paying much more attention now to the quality of the writing that we discuss in class."

So my two days at Gustavus Adolphus gave me a glimpse of most of the courses that might be encountered in a liberal education and of the role that writing could play in learning them. Some of the disciplines caught me unaware of how they had changed. A professor of geography, for instance, Robert B. Douglas, said that he now insists on writing as a major component of his classes. "I keep in touch with my recent graduates," he told me, "and they all say that what they really needed in college were writing courses, because they now have jobs in fields like urban planning or retail store

location, or in agencies for economic development or rural land use planning, and they have to write a great many reports, which have to be clear."

To give his students due reverence for the mother tongue, Professor Douglas sends them to the books of his literary hero, J. B. Jackson—books such as *The Necessity of Ruins* and *The Vernacular Landscape*. "Every review of a new book by J. B. Jackson," he said, "begins by calling attention to the clarity of his language, the brevity of his prose and the beauty of his style. I use him in two ways. I might tell a student, 'Let's see what Jackson has to say about the character of small towns in the Midwest, or about the grid plan of city streets.' Later I get them to critique the writing style itself. *Why* is it so effective?"

Hearing from so many academic provinces, I occasionally wondered: What does the English department think of all this? I got my answer from Claude C. Brew, associate professor of English.

"Writing across the curriculum reinforces what we do," he said, "and of course it gives writing a much broader base. That's a healthy direction. In this country the English major has always been defined almost entirely in terms of literature and literary analysis, and therefore English department writing has a strong literary bias. In fact, the teaching of writing has only recently been incorporated in graduate English programs. Our education as English teachers never prepared us to do that.

"I was lucky in coming to Gustavus Adolphus because the college has a tradition that everybody in the English department teaches composition. I taught one course for five years in writing about science, which opened me to criticism from my department colleagues. But I learned something important: I got horribly literary papers from my students, because they thought that's what an English teacher would want. They wrote things in those papers that they would *never* say. I tried to show them that science has a fine literature of its own. I got them reading the essays of Victor Weisskopf and books like Loren Eiseley's *The Immense Journey*, Stephen Jay Gould's *Ever Since Darwin* and Thomas Kuhn's *The Structure of Scientific Revolutions*."

I asked Professor Brew what he thought of the "comp/lit" double grade that many English departments use to distinguish between how a paper is written and what it says.

"I don't approve of it," he told me, "because it emphasizes the split. Writing is not divisible." I was greatly cheered to hear this truth affirmed by a professor of English. Professors of English are by no means unanimously delighted to see "their" subject—writing—parceled out to teachers beyond the tribal walls. *Chemistry* teachers! *Geography* teachers! Many English teachers would rather hold on to the keys. Why, they ask, can't they correct a chemistry paper for its writing and let the chemistry teacher correct it for its chemistry? The answer, of course, is that an act of writing is an act of thinking—an organic compound, as the chemists would say. There's little point in having a teacher clean up the messy syntax in a chemistry paper if he can't also clean up the messy chemistry. The indivisibility of language is what gives writing its authority and its majesty. Lewis Thomas writes eloquently about cell biology because in his bones he is a cell biologist. That he also happens to be a good writer is a bonus.

My last visitors at Gustavus Adolphus were two professors of nursing, Ann Garwick and Marilee Miller. Their appearance at the end of a long parade of academics took me by surprise. I was secure in my knowledge that nurses are primarily technicians and that most of them work in hospitals. What would technicians want with reading or writing or a baccalaureate education?

The two women quickly set me straight. High technology has taken over many nursing tasks in hospitals, they said, and far more nurses are now out in the world of health care, keeping watch on some of our most important frontiers. "The value of a baccalaureate education for nurses today," said Professor Miller, "is that it helps them to become leaders and decision-makers and advocates. The caring role is critical, and often nurses are the only people in a community who are in a position to see what's happening to a family when something goes wrong—for instance, when the child of two working parents gets sick—and to find a solution.

"We push our nurses to be agents of change on health issues: everything from seat belts to day care to the right of employees to know about hazardous substances in their work environment. We're trying to make our nurses more socially aware and more politically astute. One course we require them to take is 'American Minorities.' It's a sociology course that helps them to understand how to work with different cultural groups. There's a big Southeast Asian population in Minneapolis, where many of them will be based."

Both professors make their students do extensive reading and writing. "We're pushing them into the literature," Professor Garwick said. "Among other things, we ask them to make a search of the pertinent journals and then to choose one article that particularly interests them and to write an annotated summary of it. Writing helps them to organize their plan of health care. It also expands their thinking and raises further questions that they ought to be asking. It's exciting to work with our students on their successive drafts. A wonderful thing happens when they realize they don't have to write in isolation—that they have a colleague who will go over their work with them—and when a section that had been giving them trouble just falls into place on the next draft."

Listening to the two women, caught up in their enjoyment of what they were teaching, I suddenly thought it was the most natural thing in the world that they had made reading and writing an integral part of their nursing courses. How else will we get the kind of nurses we need to make a difference in a society groping for decent health care? I had known all along that I liked the idea of writing across the curriculum. But nobody had told me how far across the curriculum it could reach.

# Preface

I wrote this book to try to ease two fears that American education seems to inflict on all of us in some form. One is the fear of writing. Most people have to do some kind of writing just to get through the day—a memo, a report, a letter—and would almost rather die than do it. The other is the fear of subjects we don't think we have an aptitude for. Students with a bent for the humanities are terrified of science and mathematics, and students with an aptitude for science and mathematics are terrified of the humanities—all those subjects like English and philosophy and the arts that can't be pinned down with numbers or formulas. I now think that these fears are largely unnecessary burdens to lug through life.

This book is a personal journey in which I confronted some of my own fears and lived to tell the tale. What started me on it was my interest in the trend in American schools and colleges called "writing across the curriculum," whereby writing is no longer the sole possession of the English teacher but is an organic part of how every subject is taught. It's an idea I like very much. It establishes at an early age the fact that writing is a form of thinking, whatever the subject. It also makes writing more appealing by enabling students to write about subjects that interest them and that they're good at. The chemistry student who freezes at the mention of Shakespeare or Shelley can write surprisingly well about how oxidation causes rust—or could if anyone asked him to.

Up to now most teachers haven't thought of such subjects as being reachable through writing or as having any kind of literature. But every discipline has a literature—a body of good writing that students and teachers can use as a model; writing is learned mainly by imitation. Therefore I decided to look for the literature myself: to collect brief examples of good, accessible writing in a variety of academic disciplines. My hope was to demystify writing for the science types and to demystify science for the humanities types.

One condition I set was to stick close to the formal discipline. I wouldn't look for writing, for instance, by journalists, good though it might be. If the discipline was geology I wanted good writing by a geologist. If it was evolution I wanted Darwin, if it was relativity I wanted Einstein, if it was cell biology I wanted Lewis Thomas. 1 wanted to show that it's not necessary to be a "writer" to write well. Clear writing is the logical arrangement of thought; a scientist who thinks clearly can write as well as the best writer. My book, in short, would be mainly an anthology—a guided tour of good writing in different crannies of the B.A. curriculum.

But something happened when I actually started to write. The book took on a life of its own and told me how it wanted to be written. I found myself yanked back to many corners of my past—to long-forgotten people and projects and travels that together taught me much of what I know. I realized that my life had been a broad education and that I couldn't write a book about learning without saying how much it has meant to me to be a generalist in a land that prefers narrow expertise. The anthology began to look suspiciously like a memoir.

I didn't fight the current. On the contrary, the writing of the book proved one of its central points: that we write to find out what we know and what we want to say. I thought of how often as a writer I had made clear to myself some subject I had previously known nothing about by just putting one sentence after another—by reasoning my way in sequential steps to its meaning. I thought of how often the act of writing even the simplest document—a letter, for instance—had clarified my half-formed ideas. Writing and thinking and learning were the same process.

The light bulb that went on over my head at this discovery told me what my book was *really* about. I saw that "writing across the curriculum" wasn't just a method of getting students to write who were afraid of writing. It was also a method of getting students to learn who were afraid of learning. I was once such a student, morbidly afraid of the sciences and other disciplines that looked alien and forbidding. Now I began to think that I could have written and thereby reasoned my way into those disciplines—far enough, at least, so that they would have lost their terrors.

The only thing I didn't understand was exactly how this would work. How would someone, for instance, write chemistry, or physics, or geology? My journey led me to professors in different parts of the country who told me. Well, then, how about mathematics? Surely *that* couldn't be written. Surely it could. Joan Countryman (Chapter 9) cured even my math anxiety. This is a book full of born teachers.

But above all it's a book full of ideas—other people's ideas—and what I'd like most is for readers to just enjoy those people and those ideas. Nothing about the book is definitive. I've left out many disciplines that other writers might have put in; my purpose is to suggest possible approaches, not to touch every base. Similarly, my examples of good writing are just one man's choices—passages I happened to know about or happened to discover during my trip. One of the pleasures of writing the book, in fact, was not knowing who I would meet.

Once I met them, however, there was no mistaking the men and women I wanted to have along on the ride. They all had the rare gift of enthusiasm. Again and again I was struck by the exuberance that these writers brought to what they were writing about. Whoever the writer and whatever the subject—the biologist Rachel Carson writing about life on the ocean floor, the anthropologist Clifford Geertz writing about a cockfight in Bali, the art historian A. Hyatt Mayor writing about the lithographs of Toulouse-Lautrec, the zoologist Archie Carr writing about the giant sea turtle, the psychiatrist Robert Coles writing about the gallantry of children under stress, the naturalist John Muir writing about an earthquake in Yosemite Valley, the composer Roger Sessions writing about Beethoven and the mystery of composition—the common thread is a sense of high enjoyment, zest and wonder. Perhaps, both in learning to write and in writing to learn, they are the only ingredients that really matter.

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