

## Education and Learning

“A prettier legend...tells how, on his return from one of the many holiday expeditions which Bach made to Hamburg on foot to hear the great organist Reinken, he sat outside an inn longing for the dinner which he could not afford, when two herring-bone heads were flung out of the window, and he found in each of them a ducat with which he promptly paid his way, not home, but back to Hamburg.” — *Encyclopedia Britannica*, 1942, vol. 2, 869

## **The University Is a Business**

In order to think intelligently about the modern university, you must understand that the university is first and foremost a business. It sells jobs to students and it sells employees to employers. The higher-paying or more prestigious the jobs its graduates have access to, the higher the fees it can charge to its students. The university is in the business of selling prestige.

Observe that we have said nothing about the life of the mind, love of knowledge, love of learning (which need not be the same thing as love of knowledge), about self-development and the call to honesty which the intellectual life must be. The primary concern of the university is *not* the intellectual development of the student.

“Higher education is no less an industry than any other in America’s free enterprise society.” — Wycliff, Don, “Concern Grows on Campuses at Teaching’s Loss of Status”, *New York Times*, Sept. 4, 1990, p. A9.

The reader will find more on the university as a business in James B. Twitchell’s excellent article, “Higher Ed, Inc.” in the Summer 2004 issue of *The Wilson Quarterly*.

## **Academics, Experts, Professionals**

It is in the interest of the university to promote the idea that the only place a person can obtain access to jobs is at the university. In that light, behold the academic.

Above all else he wants us to believe that we can’t learn without him. He sells *knowledge*, but, God forbid, not the skill of self-teaching. He is an expert, meaning, he benefits from our ignorance; he makes his living by charging us, directly or indirectly, for what he knows and what we don’t. He is the last person in the world to want to make his subject “simple” or easy to learn—the harder it is, the more we need him.

The virtues of giving such a person the power of deciding who knows a given subject and who doesn’t are highly questionable.

He is also the last person in the world who wants to admit that those outside the university may be capable of doing important research or making original contributions in his field, since this again suggests that he is not indispensable.

When the astronauts were first beginning to receive widespread public attention, someone wrote a magazine article in which he said that if the typical astronaut was a model of future man, then he, the author, wanted no part of that future. Some of us have the same attitude regarding the typical academic. If this member of the guild, this grammarian, this Custodian of Correctness, this perennial bureaucrat, contemptuous of his inferiors, fawning toward his betters, who wants nothing so much as to write a thicker book and more papers than the bureaucrat in the next office, this lover of solemnity, difficulty, complexity, government grants and prizes, this lover of learning who wouldn’t think of learning something new in which there was the slightest chance of his embarrassing himself — if this is the model of the successful intellectual, then we want no part of the intellectual life.

I have never met an academic who had the slightest interest in developing the abilities of his students (not their knowledge but their abilities). The typical academic lives in a static world in which each student walks in the door with a fixed level of ability which nothing can change: one can only hope to supply the student with more knowledge. Indeed, the business of a professor is to perform the painful but necessary duty of separating the good from the bad, for the purpose of higher education is to find out who will be allowed access to the better jobs and who will not.

I am worried that so few people —so few intellectuals —realize what a perversion this is of the life of the mind. The life of the mind is a call to honesty, a call to pursue those questions that interest us, it is a call to risk-taking, to honoring our own curiosity, to developing ourselves intellectually, to learning how to fashion, or hire, the skills we need, to learning to be our own teachers. It is a call to the best that is in us. It is *not* a means of “proving our worth” to a bunch of bureaucrats, whether in the university or business. It is only incidentally a means of earning a living.

### **The Scholars' Transvaluation of Values**

“1. We are not artists (we are not good at seeing the *shape* of things); we are plodders, we must do things in order, one after the other. Therefore this way of doing things shall be good, indeed shall be a sign of higher intelligence.

“2. Since we are not artists, we must show that artists are really inferior to us. This we will do by spreading the belief that no work of art can be properly understood unless it is analyzed and interpreted by us.

“3. (1) Profound concepts are often difficult to understand. (2) Since we are not artists, our writing is often difficult to understand. (3) Therefore, our writing is always about profound concepts. (4) Therefore those who do not write like us must be characterized as the worst of all possible things to be: superficial.

“4. Most of us have worked hard to achieve our positions. Therefore we must make sure that those who eventually replace us are forced to work at least as hard.

“5. In order to maintain our prestige we must seem never to make a mistake. Therefore we must not risk venturing into new fields. Therefore, a lifetime of doing the same thing will be deemed good. We will call this ‘specialization’, and we will look down on all those with curiosity about more than one subject, calling them dilettantes, and characterizing them as the worst of all possible things to be: superficial.”

### **Talent, Intelligence and IQ**

The following remarks may seem passé, since IQ tests now have far less prestige than they had, say, 30 years ago. But the national obsession with tests, e.g., the SAT’s, as a quick, one- or two-shot means of separating the good from the bad has not diminished, and so I feel these remarks are still in order.

The logic of those who design and give IQ tests:

“If a person with low IQ accomplishes little in life, we are right.

“If a person with low IQ accomplishes a lot, this is because, through discipline and perseverance, he was able to make the most of the modest abilities revealed by our test. We are right.

“If a person with a high IQ accomplishes little in life, this is because he didn’t apply himself. We are right.

“If a person with a high IQ accomplishes a lot, this is because he has a high IQ. Once again, we are right.”

Similarly, one of the “rules” associated with IQ tests was that you weren’t supposed to study for the test. (Because then they would not be able to measure your “true” intelligence.) The fact that this in itself did not raise a hue and cry among supposedly intelligent, critical academics in and out of the testing community, is a further testimony to the corruption that enabled the IQ fraud to persist for so long. If parents made sure that their children got the best pre- and post-kindergarten schooling, was that “studying” for the IQ test? If a father had a good intuitive idea of what sorts of questions appeared on the test, and then unconsciously trained his child to answer such questions, was that “studying” for the IQ test? If, without having any idea of what sorts of questions appeared on the test, a family spoke educated English and encouraged their children to develop their vocabularies, was that “studying” for the test? More importantly, if I, as an adult, train myself — purely by studying published literature on the subject — to achieve very high scores on IQ tests, is there the slightest chance that the test will be able to detect my “cheating”?

The “rule” about not studying gives the IQ testers yet another response for the third item in the previous section, namely,

“If a person with a high IQ accomplishes little in life, this is because he didn’t apply himself, or because he studied for the test.”

Anyone who is inclined (at this late date) to treat IQ tests as though, despite everything, they really do tell who has great potential and who doesn’t, should read the history of the IQ test movement in (Gould, Stephen Jay, *The Mismeasure of Man*, W.W. Norton & Co., New York, 1981). To understate the matter, IQ tests were not developed by the most creative workers in the sciences, mathematics, or the humanities.

To be deemed unfit by a group of creative individuals is one thing, because here we know that the field is still open; if we can’t join them, perhaps we can beat them. We feel that outstanding work will eventually gain their respect. But in the case of the IQ test promoters, who, in addition to everything else, are willing to fake the data (see Gould’s book), we haven’t a chance. Indeed, what hope can you have against a group that will rank Mozart and Kepler lower on their scale than Francis Galton?

Those of us who are lifelong observers of academic “objectivity” can’t help noting that Gould’s son developed a learning disability in grammar school. Thus the shame of shames descended on this brilliant Harvard professor (*Jewish* professor) — namely, the shame of having a child who was undeniably less than brilliant, at least for a time. I don’t know when Gould began working on *The Mismeasure of Man*, but it is hard to believe that his son’s disability was not a strong impetus to his challenging the judges of intelligence. In fact, it is likely that one of the reasons why the value of IQ tests went unchallenged for so long was that no one in the testing priest-

hood had a child with inferior intellectual abilities.

Everyone thinks it is intensely interesting to attempt to teach chimpanzees and porpoises to communicate, but when it comes to low-IQ humans, suddenly the interest shifts to proving it can't be done.

One of the great evils of IQ tests and other assumed predictors of ability is that they discourage initiative, fighting the odds, calling on the best that is in us. Contrast: "There is no hope for me; I have a low IQ" with "I'm going to work on this problem, and what I can't do myself, I'll do with others."

Imagine a child, furious at his lack of skill in playing the piano, beginning to think to himself, "What is 'playing the piano'? It is pressing the keys in a certain way. What presses the keys? Fingers. Are there other things which can press keys? Well, yes: pieces of wood or metal. What could make them press the keys? A machine of some kind..." Similarly with IQ tests: who is the smarter, the more creative: the one who obediently and rapidly answers the questions or the one who answers the questions slowly or not at all because he is wondering if it might not be possible to write a computer program to answer them instead?

Perhaps the full story has yet to be written on the amount of suffering the IQ obsession caused to the very upper class it was designed to protect, an obsession which lives on in, e.g., the anxiety-ridden parents who worry about getting their children into the "right" nursery school, i.e., the nursery school that will best ensure their children's chances of getting into Harvard or Stanford.

Our obsession with lack of intelligence has replaced our forefathers' obsession with sin.

Another great evil of IQ tests is the lesson (the first of many such for a modern student!) that a "correct" solution to a problem is what a figure of authority says it is. Lewis M. Terman, the Stanford professor who revised Binet's original IQ test to produce the Stanford-Binet version, "the standard for virtually all 'IQ' tests that followed" (Gould 1981, p. 175), included the following question in his test:

"An Indian who had come to town for the first time in his life saw a white man riding along the street. As the white man rode by, the Indian said — 'The white man is lazy; he walks sitting down.' What was the white man riding on that caused the Indian to say, 'He walks sitting down.'?"

"Terman accepted 'bicycle' as the only correct response — not cars or other vehicles because legs don't go up and down in them; not horses (the most common 'incorrect' answer) because any self-respecting Indian would have known what he was looking at. (I myself answered 'horse,' because I saw the Indian as a clever ironist, criticizing an effete city relative.) Such original responses as 'a cripple in a wheel chair,' and 'a person riding on someone's back' were also marked wrong." (ibid, p. 176)

I have always felt that a far better test (though, admittedly, a more difficult one to grade) would be one that included among its initial instructions, "For each question, list all the answers which seem correct to you and briefly explain why."

Part of the reaction to the former prestige of IQ tests is the now often-heard remark that “you can’t reduce intelligence to a single number”. But that’s not quite correct. What people mean by this is that intelligence (as we define it) comprises more than one quality, e.g., memory, mathematical reasoning, spatial reasoning, pattern recognition, reading comprehension, social skills, artistic skills. But as every beginning student of mathematics or computer science knows, *any* finite sequence of numbers can be represented by a single number (i.e., integer). Thus, no matter how many qualities we decide are part of intelligence, it is always *possible* to represent a person’s intelligence by a single number. Of course, this representation may be of little use in *comparing* different intelligences without a significant amount of computation.

The following story haunts me: a math professor at a university with one of the best math departments in the country, gave, to a young woman student of his who was in her senior year, and whom he considered to possess marginal ability, an unfavorable recommendation in her application to graduate school. She was rejected, took it as a sign she had only inferior ability, and gave up mathematics. The person who told me the story asked the professor why he did it. He said that several years earlier, he had done just the opposite, and given a recommendation to a marginal student that resulted in the student’s being accepted into a good graduate school. She was unable to perform satisfactorily, and, apparently as a result, committed suicide. He was determined never to be responsible for such a thing again.

The reason why this is a sad anecdote is not that the word of one man was able to keep a student from attending a school she wanted to attend, but that the educational system had so inured her to accept the opinions of experts that the opinions of a handful of them were sufficient to convince her to give up a subject she presumably loved.

The IQ question can never be honestly settled until we have performed experiments such as offering a large sum of money, say, \$50,000, to a person in his late teens with an average IQ if he can improve it by some unlikely amount, say 30 or 40 points, in the next four years. He is to be given tutors, paid room and board, everything possible is to be done to help him, including “teaching for the test”, for who is to say that that does not occur in the homes of those with high IQ’s?

Look at IQ tests from this point of view: suppose you were the Minister of Education in a poor country that was trying to advance itself technologically as rapidly as possible. Educational facilities are extremely limited; furthermore, production requirements permit only a few people to be excused from farm and factory for the initially unproductive years of their education. What would you do? You would want to increase your chances of selecting only those who had certain abilities and aptitudes *ready-made*. You would welcome a test which enabled you to discover such persons. In these circumstances, the notion of IQ tests —the push toward having them —is understandable. Of course, at the very least, you would want some statistical data to convince you that the tests indeed selected the kind of person you wanted. You would also, I hope, be the first to point out that the tests are not designed to measure a person’s eagerness to improve himself, teach himself, make the most of himself, or that they are capable of measuring curiosity or creativity or “inherent worth”. All you want is to find a certain kind of worker as inexpensively as possible.

My mechanic is an expert at fixing my car, but he is not at all expert at describing what he does. Why do we consider him less intelligent than someone who can't fix cars at all but is extremely articulate at explaining why?

“I don't like to read books. They muss up my mind.” — Henry Ford (certainly, among other things, a mechanic of genius), quoted in “The Master of the Scene” in *The Portable Edmund Wilson*, The Viking Press, N.Y., 1983, p. 211.

“When I was a kid growing up in Far Rockaway, I had a friend named Bernie Walker. We both had ‘labs’ at home, and would do various ‘experiments’. One time, we were discussing something — we must have been eleven or twelve at the time — and I said, ‘But thinking is nothing but talking to yourself inside.’

“‘Oh yeah?’ Bernie said. ‘Do you know the crazy shape of the crankshaft in a car?’

“‘Yeah, what of it?’

“‘Good. Now, tell me: how did you describe it when you were talking to yourself?’

“So I learned from Bernie that thoughts can be visual as well as verbal.” — Feynman, Richard, *What Do You Care What Other People Think?*, W. W. Norton & Company, N.Y., 1988, p. 54.

Now that charisma and grant-winning ability are among the prime prerequisites for a successful academic career, we may not be far from the day when a new theory of intelligence will emerge, proclaiming that these talents are almost always found in those of superior intelligence, if not actual genius. Nature will be discovered to distribute these talents in that way, just as, according to an engineer I once knew, evolution, by a remarkable coincidence, began producing engineering talent in the upper classes soon after the start of the Industrial Revolution.

## **How to Be Smart**

Among the many remarkable qualities of our educational system, one is that, although it advertises itself as being in the business of preparing students for careers and success in life, it never teaches students *how to be smart*, a subject that includes techniques for everything from taking tests to psyching out teachers to prevailing in graduate school and academic life to surviving and gaining advancement in business and industry. (Regarding the last, see also the chapter, “Letter to a Young Intellectual about to Enter Industry”.) The following advice may be considered passages from a book titled *How to Be Smart*, which would be written from the point of view that Machiavelli wrote *The Prince*, namely, from the point of view of what *is*, not of what educators want us to believe.

Chapter 1 of the book would be extremely short and simple:

“In order to be smart: (1) Find out what kinds of behavior are considered signs of unusual intelligence in the culture you want to be smart in; (2) Behave like that. The rest of this book is nothing more than an elaboration of this advice.”

## **How to Be Smart in Grammar School and High School**

“In grammar school and high school, the rules are simple: be a good drone. Always do your homework. Be seen to associate with the smart kids. Pretend to love books. If you are having trouble with a subject, make sure the teacher sees how hard you are working to understand it, how terribly embarrassed you are not to be performing well, given the excellence of the teaching. (Of course, it is not suffering that counts, but how much you appear to be suffering.)

“Learn to psych out your teachers: find out what your teachers like and don’t like and act accordingly. In class and out, tell teachers what they want to hear.

Learn to budget your time, to work efficiently, so that school does not interfere any more than it has to with the important things in your life. Remember that your goal in life is to get the most for the least, which in this case means: to get good grades with the least effort.

“Hire a tutor for courses you are having difficulty with, and make sure that your teachers know you have done so.

“Start early in overcoming the paralyzing fear that teachers and the educational system in general want to instill in you whenever you take a test. Consider tests as something to master (there are many books on the subject), something to develop arrogant contempt toward, and not something which hold your fate in their hands. If you live in fear of taking tests, then you are doing your enemies’ dirty work for them. (God knows how many promising contributors to science and scholarship were broken at an early age by their inability to take tests.)

## **How to Be Smart in College and Graduate School**

### **General Advice**

“In college and graduate school, things become a little more difficult. First and foremost, continue your on-going study of how to take tests — how to convince the grader that you know more than you actually do. Always show eagerness for the course. Find out what your professors’ research interests are, and then drop by for an office visit: ‘I was reading your paper on ... One thing I wanted to ask you was ...’ Your business is to make sure they remember you favorably, out of the sea of faces in all their classes, when they go to write down your grade. Always make it seem that nothing in life matters more to you than their subject, and, as long as you can continue the bluff, let them know you are considering an academic career (if only you prove worthy) in their subject.

“Remember that, in graduate school and in all academic careers, your prime purpose is not learning or conducting research, much less teaching, but *being better than*. Therefore, cultivate the art of the put-down. You can always find something negative to say about another human being, particularly an academic. If s/he has published a great deal, call the output shallow and repetitive. If s/he hasn’t published much, call the output a possible sign of lack of brilliance. If s/he has published popular works — well, you know what to say about that. If s/he is an outstanding teacher, call it a sign of lack of depth. If s/he is an inept teacher, point out that his or her published research does not justify such a claim to genius.

“In all academic disciplines, never risk making a mistake. Better to be silent than to be wrong. (Silence implies depth.) If you are only sure of an author’s last name, don’t admit you don’t know his or her first. Cultivate the rather enjoyable intellectual exercise of making the best impression given your inadequate knowledge. Whenever you have to admit your ignorance to a fellow student or colleague, and you know that what you are ignorant of is low in the hierarchy of academic prestige for that subject, make it clear that the only reason you don’t know is that you can’t be bothered to fill your head with such material. Whenever you have an opportunity to demonstrate



that you know something that someone else doesn't (regardless of its position in the prestige hierarchy), take advantage of the opportunity, unless the person has the power to block your progress. In other words: intimidate whenever it is safe.

“Speak rapidly. Always make it seem as though you have so many thoughts that you can't get them out fast enough.

“But speak as little as possible. Try always to be intimidating.

“For how many foolish souls, in my time, has not a frigid and taciturn demeanor served as a mark of wisdom and capability!’ — Montaigne, ‘On the Art of Conversation’

“ Study and learn from the winners.”

### **How to Be Smart in the Liberal Arts**

“In the liberal arts, learn *never to touch* — never to bluntly say what you mean unless that is the enviable thing to do. Learn to pick up everything with delicate, hesitant, fingers. Always leave yourself room to back out, to escape accusations of having an opinion that disagrees with the prevailing sub-culture. Use phrases, always with a dry sense of humor, like, ‘One could say, of course, ..., but on the other hand ...’, or, ‘I am not one who is inclined to place myself on the side of those who ..., but, of course, on the other hand ...’ ‘One finds it hard to be indifferent to the poem, despite its rather questionable prosody...’

“Always know more about some obscure corner of your subject than anyone else in the department. Collect big words, foreign words in the venerated languages, obscure quotes. Always deliver these in quote marks, so that if your professors or colleagues think your use of a term is trite, they will have to deal with the possibility that you are just poking fun at the term — that what you are really saying is, ‘...to use a term which we who are in the know, know is laughably trite’ — whereas if they don't think the term is trite, they will give you extra credit for delivering it with a droll sense of humor.

“ ‘Dr. Cottard was never quite certain of the tone in which he ought to reply to any observation, or whether the speaker was jesting or in earnest. And so in any event he would embellish all his facial expressions with the offer of a conditional, a provisional smile whose expectant subtlety would exonerate him from the charge of being a simpleton, if the remark addressed to him should turn out to have been facetious. But as he must also be prepared to face the alternative, he never dared to allow this smile a definite expression on his features, and you would see there a perpetually flickering uncertainty, in which you might decipher the question that he never dared to ask: “Do you really mean that?” He was no more confident of the manner in which he ought to conduct himself in the street, or indeed in life generally, than he was in the drawing-room; and he might be seen greeting passersby, carriages, and anything that occurred with a malicious smile which absolved his subsequent behavior of all impropriety, since it proved, if it should turn out unsuited to the occasion, that he was well aware of that, and that if he had assumed a smile, the jest was a secret of his own.’” — Proust, Marcel, “Swann in Love”, in *Swann's Way*, The Modern Library, N.Y., 1928, p. 257.

“ Imitate William F. Buckley, Jr.: lots of tut-tut-tut's and tah-tah-tah's. Learn to write in the accepted style: pompous, verbose, deadly serious, obscure, and most of all objective (language creates truth).

Follow the Rule of Ten: always say in ten sentences what can be said in one.

### **How to Be Smart in Mathematics and Other Technical Disciplines**

“Learn to do calculations rapidly in your head. (There are numerous paperbacks that will help you. See also Feynman’s autobiographical books.) But never *ever* venture forth a result unless you are absolutely sure it is correct, because nothing will cause you to lose face more rapidly and certainly than revealing that you can make mistakes. Being able to calculate rapidly in your head is the quickest route to respectability, and will overcome a host of other deficiencies. Don’t even *think* of arguing that in this age of the calculator and computer, such skills may be far less important than they were in the past. (As a private mental exercise, of course, there is nothing wrong with doing mental calculations. But you should always choose the private mental exercise *you* want and need — calculations or solving puzzles or doing simple proofs — and always keep in mind that what you do and how well you do it is none of the world’s business.)

“Always keep a supply of convincing reasons for not working on problems that others throw your way, e.g., claim that you are working on another problem and make sure that it will not be one that others are likely to know much about. Develop an abstracted look, always seem preoccupied and not inclined to suffer interruptions, so that you can brush aside problems you don’t know how to solve quickly. Learn the answers to the well-known puzzles and amusing paradoxes in your discipline.

“Know a little about an obscure, difficult subject in mathematics that you can be reasonably certain those who judge you, know less about. Then, when you have endangered your reputation and, in fact, your career, by having been slower in answering a question than those who judge you think you should have been, you can always remark, in a distracted fashion, that for several days you have been working on an idea in that subject.

### **How to Be Smart in Computer Programming Jobs**

“Learn all the trivia you can — especially the short-cuts — about current operating systems since (1) you will need this knowledge to do your job, and (2) like the ability to do rapid calculations in your head, such knowledge will be taken as a sign of exceptional ability. Never *ever* point out that all knowledge of this type is look-up-able, given properly designed on-line help systems or manuals, and that you prefer not to clutter your brain with it. Learn a little about a programming language that none of your co-workers knows, and then use it as a way of putting down their skill at the prevailing language. For example, say, “Well, of course in LISP you can do this much more easily using the *apply* function.”

### **How to Be Smart in Everyday Life**

“Probably the most important single rule to follow is: Learn to know what you need to know, and what you can afford *not* to know. You definitely do not need to know what the experts — people knowledgeable about cars, or computers, home repairs — think you should know. If you have questions about the use of your computer, and the person you ask says that you need to “take a course”, walk away. The person is an idiot. You have a perfect right — in fact, you have a duty to yourself — not to fill up your brain with trivial information that will be obsolete in a matter of weeks. Find yourself a computer expert who will give you no more than the information you need, and who will respect your right not to know.

“When it comes to cars, first and foremost, *don’t* buy new cars. It is a tremendous waste of

money. Use Consumer Reports to find out what models in what years have proved to be particularly reliable, then go to a repair shop that you have learned from experience that you can trust, and tell them what kind of car you are looking for, inviting their comments on its worth. *Always* have any used car you are thinking of buying, thoroughly checked by a repair shop you can trust.

“Before buying any manufactured product, and particularly home appliances, check Consumer Reports.

“As for home repairs, unless you really enjoy the work, decide what you are willing to do — replace light bulbs, *maybe* replace faucet washers — and devote the remainder of your efforts to finding, e.g., through networking among your friends and neighbors, reliable repair persons who charge fair prices, then call them whenever you need them. Ignore the home-repair shows on TV: their main purpose is to sell you equipment.

“As far as managing your money is concerned, the rules are extremely simple: (1) figure out how much you need to save *each year* so that you will be able to live the way you want in your retirement (there are numerous books on the market that will help you do the calculations; two authors whom I think are trustworthy are Jane Bryant Quinn and Jonathan Pond), then save at least that amount of money each year; (2) invest conservatively and above all diversify your investments, no matter what you hear about can’t-lose opportunities, or about the old economic rules no longer applying.

“Learn how to get along with people, and, yes, how to manipulate people when necessary (but so that they don’t know they are being manipulated). For example, when you are about to ask someone to do something for you, ask yourself, How can I present my request so that there will clearly be something in it for him if he does what I ask? Learn how *not* to be a tyrant. To those who criticize you for being soft, reply, simply, “At the end of the day, you add up your receipts and I’ll add up mine, and then we’ll see who’s ahead.”

“Finally, remember: if the bar is set too high, you can always go under it.”

### **A Test to Determine Which Class Is Smartest: Upper, Middle, or Lower**

It is surprising that those who spend a lot of time on social criticism have not taken the time to develop an annual intelligence test that would be given to randomly selected members of the upper, middle, and lower classes. Questions would be on such subjects as: basic arithmetic, knowledge of current events and history (what the test designers feel a responsible voter should know), shopping (basic consumer skills), elementary financial management.

### **Purpose of the University**

The aim of a technical education should be to provide the student with two skills: the skill of solving technical problems and the skill of self-teaching. Everything else is reference work.

“We go to school to pick up pointers”. The pun is on “pointers”, meaning both “advice on how to do things” and “references”, i.e., *knowledge of where things are*.

“So far as the imparting of mere information is concerned, no university has had any justifica-

tion for existence since the popularization of printing in the fifteenth century.” — Whitehead, Alfred North, *The Aims of Education*, The Free Press, New York, 1967, p. 92

“Your learning is useless to you till you have lost your textbooks, burnt your lecture notes, and forgotten the minutiae which you learnt by heart for the examination. What, in the way of detail, you continually require will stick in your memory as obvious facts like the sun and the moon; and what you casually require can be looked up in any work of reference.” (ibid. 26)

“I heard a man in a Boston restaurant tell another that ‘the money’ was in educating engineers, because ‘five years after an engineer gets his degree he’s out of date’.” (Holt, John, *The Under-achieving School*, Dell Publishing Co., 1969, p. 173)

## **Problem-Solving**

“Now the teaching of programming comprises the teaching of facts —facts about systems, machines, programming languages etc. —and it is very easy to be explicit about them, but the trouble is that these facts represent about 10 per cent. of what has to be taught: the remaining 90 per cent. is problem solving and how to avoid unmastered complexity, in short: the teaching of thinking, no more and no less.” (Dijkstra, Edsger W., “Craftsman or Scientist?”, address to a conference on computing (I do not know which one), 1975, p. 4)

“...mathematical results are published and taught quite openly, but there is very little explicit teaching on how to *do* mathematics, and publishing besides the results also the heuristics that led to them is regarded by many as “unscientific” and therefore, bad style: quite often the editor’s censorship will try to prohibit publication.” (ibid., p. 2)

“As for publications, mathematicians nowadays are almost forced to conceal the way they obtain their results. Evariste Galois, the young French genius who died at the age of 21, in his last letter before his fatal duel, stressed how the real process of discovery is different from what finally appears in print as the process of proof. It is important to repeat this again and again.” (Ulam, S. M., *Adventures of a Mathematician*, Charles Scribners Sons, N.Y., 1976, p. 271)

“...Polya’s larger work on the same subject, *Mathematics and Plausible Reasoning*, has been coolly received by the mathematical community and has had at most a very minor influence on the teaching of mathematics at university level. Its cool reception by the mathematical community says at second thought, however, nothing against the feasibility of Polya’s project. On the contrary! For its cool reception by the mathematical community can also be interpreted as the rejection by the mathematical guild that feels threatened, as all guilds do, when the secrets of their trade are made public. To publish 30 years ago a book about the making of mathematical discoveries was heresy, as it still is in the eyes of many mathematicians today.” (Dijkstra, op cit, p. 5)

The advantage of going to a good university should lie in being able to learn, through exam-

ple, advice, instruction, how the best problem solvers in each field think about and approach problems. That opportunity is what should justify the high cost of going to school. And yet only once have I seen a professor demonstrate to a class how he would attempt to solve a problem whose solution he didn't already know.

I at one time thought that a good way to accomplish this would be for the professor, once a week or once every two weeks, to accept from the students problems he had never seen before, and attempt to solve them in front of the class, thinking out loud as he went. One criticism of this idea was that no professor would consent to do this for fear his failure to solve a problem would damage his reputation in the eyes of the class. (God help students that need that image of professors.) Another criticism was that there are persons (I am one) who cannot solve problems in public. A reasonable alternative would be for the professor to accept problems from the class and solve them in private, keeping a brief record of his efforts. Of course it's not necessary that he always solve the problem—in fact, it would probably be more instructive for students to see how he attacked a problem he couldn't at the moment solve.

## **Teaching in the Classroom**

You can always judge the health of a profession by how eagerly its members are trying to put themselves out of business. Consider, in this light, medicine, law, teaching.

The Deadly Embrace: in the typical university classroom, the professor, who would rather be somewhere else, e.g., doing research, confronts his or her students, who would also rather be somewhere else, e.g., working at the jobs which they have been told they can only do after they have gone through the long painful process of getting a degree. But the buildings have to be maintained, the lawns have to be mowed, the administration's salaries must be paid, and so, year after year, the myth must be kept up: you can only learn certain subjects in a university classroom.

Any student who revealed to his professor that he had the same attitude toward the subject as the professor has toward teaching, would be thrown out of class on the first day. (A bad error of my youth was that of judging academic disciplines by the people who taught them.)

“About half the full professors at the University of California at Berkeley teach one or fewer undergraduate classes each year, the first detailed review of teaching responsibilities at the university shows.

“Moreover, one in five of Berkeley's full professors apparently taught no undergraduate classes at all during one academic year...” — “UC Berkeley Debates Teaching vs. Research”, *San Francisco Chronicle*, Dec. 27, 1993, p. 1.

If tomorrow it were announced there was to be a Nobel Prize, not for teaching technical subjects, but for making them more rapidly accessible with less effort, with a criterion for how well this was accomplished, you would see overnight the most extraordinary changes in the university. (“Well, of course I've always said...”)

No matter what else it may be, teaching should always be an investigation conducted by teacher and students into which methods of teaching work better in that particular course. Part of the job of any class is to pass on improved teaching materials to the next class.

The universities argue that their high fees are justified because they provide the experts and the teaching which the student needs in order to learn. But the skill of teaching counts close to nothing in academic advancement; I have never known an academic who was interested in the way his students learned his subject, or in alternative ways they might learn it, or in his students' opinions as to better ways of teaching it. The universities should at least be honest about this and admit that teaching is an excuse for paying salaries to resident experts. I am all for there being places where experts in various subjects, particularly "useless" subjects, can earn a living by pursuing their own interests; I would much rather have them rewarded for how *little* they had to teach—because of the excellence of the learning resources they had created, and because students had learned to become their own teachers—than how much.

One way to judge a teacher is by how hard he tries to give his students a sense of the importance of each each acre of prose relative to the whole. Few things are more valuable to a student than those seemingly peripheral remarks like, "Now all this is simply a means of establishing  $x$  ...", "Now this is just the details of how  $y$  works...", "Now everything else really follows from this one equation..."

The computer has provided us with a way of measuring intellectual labor: what is easily programmable stands low in the intellectual hierarchy (see "Classification of Intelligent Activities" (Dreyfus, Hubert L., *What Computers Can't Do*, Harper & Row, N.Y., 1979, p. 292)). One of the main goals of an education should be to help each student understand that there is a hierarchy of intellectual labor—that not all mental effort, all problems (e.g., textbook problems), or all parts of the problem-solving process, are equally important—that, in fact, our goal (since our resources are always limited) is to try to do as little as possible to accomplish the task.

For years industry has had a slogan, "Work Smarter, Not Harder". But the university's slogan is just the opposite: "The longer it takes you to accomplish a difficult task, the more you suffer in doing it, the more obscure and long-winded your presentation of the results, the better."

One lesson that computer programming teaches us: what is difficult to understand is not necessarily profound or important.

Before you set foot in college, it is essential that you learn to recognize the types of academic teacher:

Those who consider their business to be that of separating the best students from all the others;

Those who consider their business to be that of making students behave in a certain way;

Those who need to be in control of others who know less than they do (“I’ll teach you anything you want to know as long as you let me be in charge”);

Those who get a kick out of helping people to improve themselves;

Those who get a kick out of introducing people to ideas they never had thought of, or been aware of, before;

Those who are intrigued by the challenge of figuring out how to enable a student to understand something which initially he or she absolutely cannot understand.

Trust no teacher who hasn’t been through what you have been through.

## **Self-Teaching**

If you can read, you can give yourself a liberal arts education.

I wonder if anyone who hasn’t had the experience can imagine what it is to know in the depths of his soul —because he has proved it to himself many times —that he can teach himself almost anything he wants to learn. There is seldom any magic associated with being taught a technical subject by another person, despite what the awesome mechanism of the university would have you believe: in all likelihood, the result will be a worse job than if you had done it for yourself.

Students wanting to learn to be their own teachers benefit most from discussion with those who have taught themselves a variety of different subjects during the course of their lives, not with those who became specialists in a field in their early twenties and remained so forever after. (This is not an argument for doing away with specialization, only a suggestion as to the kinds of persons who best aid one in becoming a self-teacher.)

A technique which can be applied without the benefit of skilled self-teachers is The Teaching Game. Here, the professor agrees to make only minimal replies to the student’s questions, perhaps only yes/no, and furthermore, as at present, is only available for questions for a limited time each week. Thus the student must plan and organize his questions in advance. The student may ask for elaborations, but the teacher volunteers nothing.

The professor steps to the front of the room and automatically pencils and notepads appear; he begins to speak and note-taking begins. He or she — a person of superior intellect and passionate interest in ideas and learning —is not at all embarrassed at perpetrating the hoax year after year: “You need me to stand in front of you in this master-subordinate relationship if you are to learn something of what I know.”

It has been said often but it bears repeating: regardless of the subject matter, what the schools teach is the belief that the only way you can learn is by going to school, and the more expensive the school, the better. Here, as elsewhere, we are taught above all to be good consumers.

My years as a jazz musician spoiled forever any chance of my becoming a good university student. Anyone who has ever been a member of a group of people who are passionately interested in a subject and are teaching themselves everything they can about it, using any means they can, at times challenging each other, but always helping —must find the idea of *having to apply* for admittance to a school, much less the idea of classrooms, courses of study, degrees, and the tyrants that are a necessary part of all this, to be grotesque.

Let no one underestimate the effect of the year-in, year-out message from the schools that learning has no value unless it occurs in a school. To this day, although I have lived with books all my life, and have taught myself some of the fundamentals of computer science and mathematics, my feelings remain what they have always been: that if a student takes a course at Stanford or Harvard or MIT, does the minimal work required, gives not a thought to the subject outside of homework problems and class, and if, on the other hand, I study the same subject on my own, go through an entire textbook, working most of the problems and making an Environment (ala Curtis) as I go, reading on the history of the subject along the way, writing to textbook authors on matters I don't understand, thinking about new directions, new questions that the subject raises, that this is *as nothing* compared to the education in the subject which the other student received. There is not the slightest exaggeration in this statement.

The intellectual life is nothing if not a call to honesty, and that includes the honesty of admitting to yourself when you do not understand something. The idea that there is a minimum speed of understanding for a given concept, and that those who are slower will probably never get it at all, is one of the worst and most destructive attitudes the schools instill in us. *Nothing is more personal than how we learn.* It is as personal as the way we eat. A person eats rapidly or slowly, lefthanded or righthanded, as is natural to him. And so it should be with learning.

One thing we never learn in school is the great pleasure there is in taking your time to learn something, in spending hours, days, weeks, on a single concept until you have understood it on your own terms. We get a sense of making something new in this process, of bringing an understanding *which we have made* into the world.

“‘The authority of those who teach is very often a hindrance to those who wish to learn.’  
[Cicero, *De Natura Deorum*, I, V]

“It is well for a tutor to make his charge trot in front of him, so that he may judge his pace and decide to what extent he should hold back to keep in step with him. If this adjustment is not made we spoil everything. But to strike the right proportion and duly to conform with it is one of the hardest tasks that I know. It takes a lofty and very powerful mind to conform with a child's gate and to guide it. I walk with a steeper and firmer step uphill than down. When, according to our common practice, a teacher undertakes to school several minds of very different structure and



capacity with the same lessons and the same measure of guidance, it is no wonder that, among a whole multitude of children, he scarcely finds two or three who derive any proper profit from their teaching.” — Montaigne, “On the Education of Children”

The rudeness, the arrogance, the *filth* of others presuming that they know how we should learn a subject!

Self-teaching is an art in this sense: we take a difficult subject (the marble) and using the tools we have made for ourselves, we shape an understanding.

Intelligence tests, along with school exams, have become so much the means by which the meritocracy defines the caste we will spend our lives in, that we can't imagine exams actually being *desired* by the person taking them. But any self-teacher knows that there are times when he would be willing to *pay* for the opportunity to take a test — a hard test, carefully corrected by an expert in the field — a test to learn from.

Every person with high ambitions for himself knows the truth: your education is too important to be left in the hands of professors.

The aim of all learning is to make the subject your own! It takes some of us a lifetime to realize how much our opinion of some academic subjects is based on our opinion of the teachers and professors who taught them to us — or on our opinion of others in whose control we once were (parents, former bosses), who deemed these subjects important. I was in my forties before it dawned on me that engineering was, in fact, a beautiful discipline: the application of some of the known laws of Nature to making things useful to man — who could hate a subject like that? What I hated, and still hate, was the baggy-pants, heavy-breather, narrow-minded stupidity of the typical engineer, his indifference to the beauty of mathematics and of all the arts and humanities (and most of the sciences), his fundamental unquestioning nature (“If it works, we don't ask why it works, or under what circumstances it might not work, we use it”), not only in intellectual matters, but in political as well, where, as was once remarked, “a good engineer is just as willing to design racks for torturing babies as he is a machine for treating cancer.”

Every intellectual discipline is now *owned* by one or more groups with strong vested interests; their obsessions coat these disciplines, make them something other than they are. Primary school teachers in Palo Alto hear children of seven and eight worrying aloud to each other about their chances of getting into Stanford. It takes a naivete bordering on the pathological to believe that the concerns of these children are motivated by youthful genius or a wonderfully precocious love of learning. For decades, now, English literature has been *owned* by college professors — if you go to college and study English literature, you know that you will have arrived — really arrived — when you have been published in *The New Yorker*.

The sciences are now *owned* by upper-class fast-track overachievers (and the relentless family pressure that drives them), and, of course, by the Nobel committee. Is there a single young

physicist today who would seriously consider taking a few years off in his early twenties “to think”, meanwhile earning his living, say, in a patent office?

The most important question a student can ask: “*Why is this difficult?*”

There is a certain arrogance in simplification. It takes confidence in the health of one’s own mind and body to say to one’s teachers or bosses, “This is too complicated!”, and then set about simplifying the matter, i.e., reshaping it according to one’s own instincts. To eat what is put on one’s plate, to learn how to “master”, i.e., swallow, complication, is often a sign of lack of self-respect, not a sign of self-discipline.

Become the teacher you wish you had found.

No person is truly educated in his field until he has become a citizen of its history.

Never be ashamed of a mistake. “The man who never made a mistake will never make anything.” — G. B. Shaw

The esthetic approach is the doorway into every new subject. It begins with the question, “What is there here that I can admire?”

Until you have discovered where the beauty of a subject or activity lies, you don’t understand it.

## **Textbooks**

Without question, the best thinker (the *only* thinker!) on the subject of textbooks I know of is William Curtis in his book *How to Improve Your Math Grades* (Occam Press, Berkeley, CA). He rightly points out that a textbook for a technical subject is designed for use in a classroom, very rarely for self-teaching. Yet there are good reasons to believe (and he gives a number of them) that textbooks written in different formats from the usual ones may make possible the far more rapid learning (or “use”, as he puts it) of technical subjects.

Of course, there is very little chance of such experiments being encouraged, much less carried out, by the textbook publishers themselves, since continued profits are best ensured by toadying to the academic community, which has a vested interest in classroom learning. In the grammar and high schools, publishers must toady to state boards of education and those private interest groups who influence them. The student comes in as a poor third.

Curtis proposes a textbook format which amounts to a combination of two formats: that of an encyclopedia and that of a structured program—in other words, every term and concept can be

looked up alphabetically, and then each concept (and theorem proof) is broken down into sub-concepts (and sub-proofs), each of which can in turn be looked up.

Having wasted far too much time in my life struggling with ineptly written textbooks, I am very sympathetic to Curtis's ideas, and have even experimented with versions of them in the past. Nevertheless, his proposed format raises a fundamental question about technical subjects, which is expressed by the question, "Is mathematics a language?" (Since all technical subjects are based on mathematics, we can limit our attention to this subject.)

To understand the significance of the question, consider two ways of attempting to learn a foreign language such as French or German. One way is from books and recordings alone, e.g., from grammars, dictionaries, phrase books, newspapers, detective novels and other books written in the language, plus courses and readings-aloud on cassette tape. One can argue, as Curtis does, that here, "memorization will take care of itself," i.e., the student will find himself having memorized those words he looks up most often, whereas the less frequently used words he can simply look up as necessary. It is likely that eventually he will be able to read at least newspapers and some of the less difficult literature in the language in this way. The trouble is, as anyone knows who has tried it, he will never be able to speak or write the language, i.e., *express himself*, fluently, even though he may explicitly know a great deal about the language's grammar. On the other hand, a native speaker who has no explicit knowledge of the grammar — i.e., no explicit knowledge of the structure of the language — may be able to express himself well indeed.

Now if we regard mathematics as a language, then we can regard a mathematics problem as a request for something to be expressed in the language, namely, a solution. (Each subject in mathematics can be regarded as a formal language, in which every logically deducible (provable) string of symbols in that language, including, of course, every important theorem or corollary (a solution to a problem is simply a proof that the problem has the solution given) is a "word" or "sentence".) But we do not learn to speak a natural language well, i.e., to express rapidly and precisely what we want to express, by proceeding ever more rapidly through a kind of structured analysis of what we want to say, which is essentially what Curtis's method amounts to. For example, to express, "I have no time for that right now" in German, we do not go through a process of looking up the English words "I", "have", "no", etc., find their German equivalents, and then look up the grammatical rules that will tell us how to string these words together grammatically in German. This is the equivalent of Curtis's method. Instead, we either rely on our knowing the entire equivalent German expression by heart, or we rely on our accumulated (memorized, "interiorized") knowledge of the language to enable us to make a good guess at what the equivalent German expression is. And the only way to know a language this way seems to be by repeated conversation with native speakers. The equivalent in mathematics is the repeated solving of textbook problems in a classroom environment, or at the least, in company of other students. Learning mathematics this way is by no means as systematic a process as Curtis's method is, yet in my experience it produces, in the best students, a demonstrable facility in solving problems.

To summarize: there is no question but that Curtis is right in issuing a challenge to the textbook writers and publishers, especially as he also describes a test for evaluating his and other textbooks (it consists essentially of randomly selecting groups of students, each group to solve a given set of problems using a different text). But I am not sure that, *if mathematics is in fact "language-like"*, such a method as his will be a major improvement.

## **Mathematics: Essentially Language or Essentially Geometry?**

“Now although there is a great deal of controversy about this, males may be better at mathematics and mechanical tasks because these tasks are primarily visual-spatial —they depend heavily on the performance of the right hemisphere [of the brain]. And just as boys have difficulty with early *reading*, for example —because it depends on communication between the two hemispheres, a communication for which they’re undersupplied with connections —so girls now have later difficulty with *mathematics*, precisely because they *do* have these connections between the hemispheres with larger verbal access to the right hemisphere, in other words, girls are inclined to apply *verbal* strategies to the solution of visual-spatial problems. And that turns out to be more inefficient.” —Durden-Smith, Jo, and de Simone, Diane, *Sex and the Brain*, Warner Books, N.Y., 1983, p. 66.

A friend of mine who is a junior college math and physics teacher once told me about the difficulties a young woman student of his was having in understanding the concept of “moment of inertia” in physics. Roughly speaking, the term means a body’s resistance to change in speed of rotation. But even with private tutoring, this student seemed unable to grasp the idea, or work simple problems involving it. Then, one day, during conversation with her, the teacher suddenly understood the reason, which also explained many of her other difficulties in technical subjects: for her, the task of understanding technical concepts consisted in understanding how the *name of the concept* was somehow a *description of the concept*. For her, the term “moment” meant a moment of time, and therefore, the problem, as she saw it, was to somehow understand why moments of time somehow made it more difficult for a body with large mass to change its rotational speed than for a body with small mass at the same radius.

I wonder how many other students of mathematics and technical subjects, particularly female students, find these subjects so difficult for similar reasons. A major step forward in helping them would be to guide them to the understanding that, ultimately, all technical subjects are “geometry-like” or “picture-like”, not “language-like”. I mean by this that, in these subjects, there is always a “something” about which we can talk, and the particular language we use to talk about it is irrelevant, so long as it represents the something. The something is “common property”, i.e., it is “the same” to all observers, just as a (labelled) drawing of a machine is “the same” to all observers, meaning, that, if we ask questions like, “Is part A positioned above or below part B?”, or “What is the radius of part C?”, we will get the same answers from all observers. (By “all” observers, I, of course, mean all observers who understand, e.g., perspective drawings, can read the language of the labels, and who are not insane or playing jokes by giving wrong answers.)

The “picture-like” nature of all technical subjects is why the mechanic mentioned earlier under “Talent, Intelligence, and IQ”, can be skilled at repairing my car, and yet be unskilled at explaining how he repaired it —I don’t mean here, explaining the intuitions that guided him in finding the source of the trouble, but merely what the repair consisted of. In fact, we can easily imagine training films for mechanics in which there are very few words, only scenes of a mechanic observing and/or listening to symptoms, then making the repair, with, possibly, slow-motion animations to give an inside view of the cause of the trouble.

I know there are mathematicians who will disagree strongly with this pictorial view of mathematics, pointing out that, e.g., modern algebra (which is, very loosely, the study of sets of numbers in which you can only add and subtract, or only add, subtract and multiply, or add, subtract, multiply and divide) --that modern algebra is not at all pictorial. But I can assure these mathema-

ticians from personal experience that not only can it can be presented pictorially (with, of course, labels!) but that doing so makes it much easier to understand. Furthermore, many mathematicians have admitted that much of their basic thinking is done in pictorial terms. Consider, e.g., the following remark by one of the 20th century's leading mathematicians:

“A heavy warning used to be given [in mathematics classes] that pictures are not rigorous; this has never had its bluff called and has permanently frightened its victims into playing for safety. Some pictures, of course, are not rigorous, but I should say most are (and I use them whenever possible myself)...I recently had to plow through a definition quite comparable to the ‘bad’ one above [in a previously given example], where a graph would have told the whole story in a matter of seconds. — Littlewood, J. E., *Littlewood's Miscellany*, Cambridge University Press, 1990, p. 54.

## **The College Admissions Con**

I consider the following column by David Brooks to be must reading for all high school seniors. I quote it in full.

### **“Stressed for Success?”**

“Many of you high school seniors are in a panic at this time of year, coping with your college acceptance or rejection letters. Since the admissions process has gone totally insane, it's worth reminding yourself that this is not a particularly important moment in your life.

“You are being judged according to criteria that you would never use to judge another person, and which will never again be applied to you once you leave higher ed.

“For example, colleges are taking a hard look at your SAT scores. But if at any moment in your later life you so much as mention your SAT scores in conversation, you will be considered a total jerk. If at age 40 you are still proud of your scores, you may want to contemplate a major life makeover.

“More than anything else, colleges are taking a hard look at your grades. To achieve that marvelous G.P.A., you will have had to demonstrate excellence across a broad range of subjects: math, science, English, languages, etc.

“This will never be necessary again. Once you have reached adulthood, the key to success will not be demonstrating teacher-pleasing competence across fields; it will be finding a few things you love, and then committing yourself passionately to them.

“The traits you used getting good grades might actually hold you back. To get those high marks, while doing all the extracurricular activities colleges are also looking for, you were encouraged to develop a prudential attitude toward learning. You had to calculate which reading was essential and which was not. You could not allow yourself to be obsessed by one subject because if you did, your marks in the other subjects might suffer. You could not take outrageous risks because you might fail.

“You learned to study subjects that are intrinsically boring to you; slowly, you may have stopped thinking about which subjects are boring and which exciting. You just knew that each class was a hoop you must jump through on your way to a first-class university. You learned to thrive in adult-supervised settings.

“If you have done all these things and you are still an interesting person, congratulations, because the system has been trying to whittle you down into a bland, complaisant achievement

machine.

“But in adulthood, you’ll find that a talent for regurgitating what superiors want to hear will take you only halfway up the ladder, and then you’ll stop there. The people who succeed most spectacularly, on the other hand, often had low grades. They are not prudential. They venture out and thrive where there is no supervision, where there are no preset requirements.

“Those admissions officers may know what office you held in school government, but they can make only the vaguest surmises about what matters, even to your worldly success: your perseverance, imagination and trustworthiness. Odds are you don’t even know these things about yourself yet, and you are around you a lot more.

“Even if the admissions criteria are dubious, isn’t it still really important to get into a top school? I wonder. I spend a lot of time meeting with students on college campuses. If you put me in a room with 15 students from any of the top 100 schools in this country and asked me at the end of an hour whether these were Harvard kids or Penn State kids, I would not be able to tell you.

“There are a lot of smart, lively, young people in this country, and you will find them at whatever school you go to. The students at the really elite schools may have more social confidence, but students at less prestigious schools may learn not to let their lives be guided by other people’s status rules — a lesson that is worth the tuition all by itself.

“As to the quality of education, that’s a matter of your actually wanting to learn and being fortunate enough to meet a professor who electrifies your interest in a subject. That can happen at any school because good teachers are spread around, too.

“So remember, the letters you get over the next few weeks don’t determine anything. Picking a college is like picking a spouse. You don’t pick the ‘top-ranked’ one, because that has no meaning. You pick the one with the personality and character that complements your own.

“You may have been preparing for these letters half your life. All I can say is welcome to adulthood, land of the anticlimaxes.”

— Brooks, David, *The New York Times*, Mar. 30, 2004, p. A23.

## **Schools: Filters vs. Resources**

In my first week at one of the best engineering schools in the eastern U.S. in the mid-1950’s, we freshmen were assembled in an auditorium and told by one of the deans: “Take a look on both sides of you: one of you won’t be here in four years.”

My outrage at such a statement being addressed to a group of students beginning what is often called their “higher education” has not diminished with the years. It was clear from that day forward that the institute felt that one of its primary duties —for our own sake —was to keep us in a state of anxiety. To do that to people for any purpose is reprehensible, but to do it in the name of learning is unforgivable.

The same threat was being used on students at UC Berkeley as recently as the ‘80’s.

Schools, in particular universities, are filters, not resources. (“Did you get through?”) Instead of attempting to help each person to accomplish what he or she wants to accomplish, they attempt to filter out the “promising” students from the “unpromising”.

In *my* university, each student would be greeted with a handshake and words to the effect, “Welcome to this university. Tell us what you want to learn and how you want to learn it and we’ll try to help you. If you don’t know what you want to learn, we’ll be glad to provide guided tours through a variety of subjects in the sciences, arts and humanities. If you still can’t make up

your mind, come back any time.”

We must ask ourselves, In what other circumstances do we see behavior like that dean's? Answer: Wherever an elite is being trained to serve the interests of a group.

“A student in a traditional school learns before long in a hundred different ways that the school is not on his side; that it is working, not for him, but for the community and the state; that it is not interested in him except as he serves its purposes; and that among all the reasons for which the adults in the school do things, his happiness, health and growth are by far the least important.” (Holt, John, *Freedom and Beyond*, Dell Publishing Co., Inc., New York City, N.Y., 1972, p. 78)

In that same engineering school I had been reading Whitehead's *Science and the Modern World*, and, filled with inspiration, I decided not to cheat any more in laboratory experiments as I and many of my fellow students did. (We knew what the results were supposed to be, we knew that the professors wanted to see those results or something very close to them, so we worked backwards, generating our data by calculation and then adjusting the experimental apparatus until it yielded something close to the desired values.) I chose as my starting point an experiment having to do with measuring the acceleration of gravity by measuring the period of a pendulum. I took the data with scrupulous honesty and got for a result something around 860 cm/sec/sec instead of the correct 980 cm/sec/sec. I handed in my report exactly as it stood and got a D. When I asked why I was given the low grade, the professor replied that the result was too much in error. The grade stood.

People to whom I have related this story, in particular engineers, have sometimes remarked that I should have compared my results with other students' and tried to account for the difference. That is a valid criticism, but such open comparing of results was emphatically not a normal part of the lab protocol.

“We have learned a lot from experience about how to handle some of the ways we fool ourselves. One example: Millikan measured the charge on an electron by an experiment with falling oil drops, and got an answer which we now know not to be quite right. It's a little bit off, because he had the incorrect value for the viscosity of air. It's interesting to look at the history of measurements of the charge of the electron, after Millikan. If you plot them as a function of time, you find that one is a little bigger than Millikan's, and the next one's a little bit bigger than that, and the next one's a little bit bigger than that, until finally they settle down to a number which is higher.

“Why didn't they discover that the new number was higher right away? It's a thing that scientists are ashamed of — this history — because it's apparent that people did things like this: When they got a number that was too high above Millikan's, they thought something must be wrong — and they would look for and find a reason why something might be wrong. When they got a number closer to Millikan's value they didn't look so hard. And so they eliminated the numbers that were too far off, and did other things like that. We've learned those tricks nowadays, and now we

don't have that kind of a disease.” — Feynman, Richard, “Surely You're Joking, Mr. Feynman!”, W. W. Norton & Company, N.Y., 1985, p. 342.

Probably every student, at least once in his life, has a professor who holds the quaintly mad belief that the academic performance of every class must follow the so-called normal distribution, i.e., a graph of student grades vs. number of students achieving each grade, must follow the Gaussian bell-shaped curve. Such professors insist that, even if every student gets above 90 on an exam, the divine law of the bell-shaped curve requires that only a small percentage of these can receive an A, namely, those whose grades are 100 or close to it; most students must receive a C, and a few, those whose grades are close to 90, must receive, at most, a D.

I remember how I wrestled with this idea when I returned to school in my 30's, still believing that intelligence was a matter of Calvinist predestination. Obviously, it implied that the best strategy was to take courses in which you would be far better than the vast majority of students, in other words, you should always take courses that did not challenge you. Years later, I knew a woman who, just before entering her senior year at Cal Tech, wrote to a curriculum adviser at Stanford, where she hoped to be accepted as a Ph.D candidate. She asked if she should take easy courses which she was certain to get good grades in, or courses which would be of far more use to her in her graduate work but which were also very difficult and hence in which she was likely to get lower grades. The answer was immediate: *always* take the courses you will get the best grades in.

There is a simple means for overcoming the grades-vs.-course-difficulty problem, namely, by weighing the student's grade against the difficulty of the course: a student receiving a C in a very difficult course might then be credited with, say, a B or an A.

As for the bell-shaped curve superstition: it has no basis, first and foremost, unless the *professor* can give a reasonable proof that the performance of the student population from which his class has been selected, does, in fact, follow a bell-shaped curve; furthermore, it has no basis unless he can give a reasonable proof that his class constitutes a random selection from that population; and finally, it has no basis unless each of his exams can be shown to be the equivalent of the exams given by every other professor teaching the equivalent course to members of that population.

## **Education Reform**

“Why does the country with the highest proportion of Education Ph.D.'s relative to number of students, rank among the lowest in international tests of the science and mathematics knowledge of high school students?” (Question asked by a friend)

Although I would die a happy man if, on my deathbed, I were told that that glow on the horizon was the burning of the universities, I must strongly emphasize to every sympathetic reader that the reform of the universities (or the high schools or grammar schools) is a hopeless task—a guaranteed way to waste a lifetime. Furthermore it is not a legitimate task, because, in the last analysis, every education reformer wants to remake the schools into what he wishes they had been for him. But there is no one best way to educate people. What *is* worth fighting for is the right of each student to choose *how* he learns.



Perhaps the wisest words that can be uttered on education (and politics) are these: people have different temperaments: some people prefer to serve a group, others prefer to serve themselves. It is a waste of time trying to change temperaments, far better to find means of accomodating them.

Self-teachers must face the fact that the preference will always go to those who serve the group —to those who learn the accepted subjects in the accepted way. It is a price they pay for the opportunity for greater freedom and integrity in their learning. As long as they are not excluded from a chance at the marketplace (of work or ideas), they should not waste their time over demands for equal consideration, opportunities, etc.; instead they should spend it on the important things.

### **The Professionalization of the Life of the Mind**

Bad things happen when you give a person guaranteed lifetime employment just because they know more than just about anyone else in the world about a subject. They start to believe that anyone who knows less than they do, really has no right to be walking the face of the earth. They start to believe that they are virtually obligated to be intimidating to their inferiors, especially to students, for, after all, haven't the forces of the universe made clear that the tenured are among the chosen few who are alone destined to have real value in the world? In fact, they start to believe that just about any kind of rudeness, arrogance, and bad behavior toward inferiors, not to mention any kind of screwball opinion and prejudice, is fully justified because, after all, the tenured have genius, to which all things are allowed. They start to believe that an idea expressed briefly is no idea at all, and that real brilliance consists in the ability to expand any idea, no matter how trivial, into book length. They start to believe that the only thing they have to fear in this life is to be discovered to be less intelligent, less brilliant, than others in their department, and in their field, because then it might be possible that the forces of the universe made a mistake. And so the life of the mind, for them, becomes simply the life of proving, day-in, day-out, year-in, year-out, that they are better than all the rest.

Those of us who, at an early age, could not imagine ourselves wearing a hat and a cape and lording it over others simply because we knew more than they did about a certain subject, and who therefore chose to take our intellectual destinies into our hands — we perhaps see more clearly than the participants, the absurdity of the current academic scene. Especially those of us who know what it is simply to struggle to learn with others of like mind with a goal of creating or discovering something — as young jazz musicians do, and hobbyists and amateurs with an interest in computers or astronomy or natural history. (There was a time when many more subjects could be added to the list.) Probably only an outsider can appreciate the cost in creativity that results from the present stifling academic culture, in which the first question that every member of that culture asks on being presented with a new idea, is not, Is it any good? Does it appeal to my esthetic sense?, but What school did the person who is presenting this to me graduate from and how many papers has he or she published and is this idea likely to be approved of by those *I* want to be approved by?

Of course, no one can deny that tenure in a major university is a virtual necessity for those

who propose to do certain kinds of research in engineering and the hard sciences and biology, if for no other reason than that is the only place where they can hope to find the equipment they need to perform that research. But otherwise...

When I see a young, ambitious graduate student perfectly willing to spend years of his or her life to accomplish what could be accomplished in a matter of months<sup>1</sup>, I can't help thinking to myself, "You may be very smart, but you are not smart enough to see the system you are working in, for what it is."

Think of it! an entire generation of intellectuals who have never undertaken a difficult project without the approval of some figure of authority, and without the promise of a blue, or even a gold star if the project manages to please the figure of authority. Think of it: never to have been able to stick to one's guns and insist, *If it's not clear to me, then it's not clear*. Never to have been able to insist on taking whatever amount of time was necessary to get a piece of writing the way one felt it should be (or, at the minimum, the least bad that one could make it). Always to be at the beck and call of this or that figure of authority, always eager to serve, to do the right thing, to win praise, to win an award, an important prize. Think of it!

It is abnormal, a kind of perversion, to be willing to be locked up in a big stone box for the rest of your life and have your only reason for being be that you know more than virtually anyone else about something. That is something you should be a little ashamed of, unless you are also bending every effort, during a certain portion of each day or week or month, to help others to know what you know. If you are not willing to bend that effort, then you should be out working for a living.

It bears repeating again and again: some of the greatest intellects in the history of the West were amateurs: Pascal, Fermat, Hume, Gibbons, Darwin, and the early Einstein, just to begin the list. In my opinion, it is much better if people have to work for a living, and that intellectual work is something done in their free time. At the very least, this removes the vast con game surrounding "teaching" in the university. The truth is that very few professors teach willingly, much less enjoy it. But it is what they must do in order to "earn" their salary. (Since it counts next to nothing in their professional advancement, very few professors have the slightest incentive to improve their teaching skills, or, far more important, vastly reducing the time that students need to spend in class. So, what the professors are ostensibly paid to do, they and their bosses care least about, while at the same time using it as a justification for the ever increasing price they charge students for an education.)

Outside of those disciplines in which research requires expensive machinery and laboratories, you don't need a university to do research, especially not now in the age of the Internet. Those

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1. I am speaking primarily here of the liberal arts, and referring to that prolonged jumping-through-hoops that the prestigious bureaucrats in charge somehow feel is essential before one can possibly have anything to say that is worth listening to or reading. The basic ideas underlying the vast majority of liberal arts theses can be summarized in less than five pages. The "research" to back up the ideas is really a demonstration that one can dance the dance — one can use a library, make mountains out of virtually any molehills, take a hundred pages to demonstrate what can be demonstrated in ten, comport oneself with the proper manners, e.g., write in the approved way. In mathematics, the primary goal of graduate school seems to be to convey one message: "This subject is very difficult, and by God you're not getting a degree until we are convinced that you can demonstrate that fact in work of your own, and then to generations of students."

interested in the same research problems do not need to have adjacent offices! Communication via letter was adequate in previous centuries; so much more so is communication via phone and email. Once the pretense has been eliminated that you need to justify your salary by teaching; and once there is no pressure to turn out two or three published papers every year, then you can get down to business. No more posturing, no more need to keep impressing colleagues, no more need to intimidate students, no more politics, no more arrogance. You find others who are interested in your work, if necessary you pay them (out of the income you make in the real world) to read and criticize your papers, you publish on the Internet and invite criticism. The intellectual life carried out honestly.

## **Credentials**

“More than once I have heard or read talk among academic people to the effect that we need a degree beyond the PhD since so many people now have the PhD that it no longer ‘means anything’.

“Clearly there is no end to this. Everything now works to push up the price of education, for learners as well as institutions of learning, because the advantage always goes to the person who has learned whatever it is he knows in the most expensive way possible. Suppose three people are in the market for a certain job. All have about equal knowledge and skill. One has learned what he knows without school, by himself, in libraries, from friends. The next has learned what he knows in school, but a cheap school —night school, or community college, or low ranked state university. The third has learned what he knows in an expensive and prestigious private or state university. Which one will employers hire? Other things being equal, they will pick the third. Many holders of cheap college degrees are not finding jobs right now. Students understand this very well. When they apply for college their first choice is always the fanciest they think they have a chance of getting into. It is time to wind down this spiral, to find ways to give the advantage or at least an even break to institutions that can make knowledge available, and learners who can learn it, as cheaply instead of as expensively as possible.” — Holt, John, *Freedom and Beyond*, Dell Publishing Co., N.Y., 1972, p. 125

Credentials should attest to *what* a person knows and can do, not to how he learned it. It is questionable whether universities ought to give credentials as well as provide means for people to acquire knowledge and skills. “We cannot in any true sense be in the education business and at the same time in the grading and labeling business.” — Holt, John, *Freedom and Beyond*, Dell Publishing Co., Inc., N.Y., 1972, pp. 250-251.

Employees in industry sometimes argue that if a person can do the work, that should be all that counts, but that is not so: an employer has the right to hire not only a skill for the work at hand, but also a global view of the subject, a knowledge of other ways of doing the job, knowledge of the current state-of-the-art. The purpose of a credential is to attest to this knowledge.

What does the PhD signify? That the holder has performed original research. (It is sometimes argued that it also attests to a person’s having a global view of his subject, but the PhD almost

invariably is the result of effort directed to solving a particular problem; therefore it seems that at most it attests to a global view of work that has surrounded that particular problem.)

Why is original research original only when it is performed in certain buildings on a certain piece of ground? Why must it take a certain minimum number of years (*seven* on the average), and why can it only be done following residency of another minimum number of years on the same or other approved pieces of ground? Why does the research become a less reliable indicator of the researcher's creativity and knowledge if someone does the same research independently elsewhere? When does a student cross the threshold of "able to do original research"? How much basic knowledge, and of what kind, does that require? Why shouldn't it be easy to transfer work done toward a PhD from one university to another? In industry, a person is often hired for the original thinking he did under another roof. The idea that he should scrap it all and start again from scratch is rightfully regarded as absurd. Why can't a person be granted a PhD by having one or more papers published in refereed journals? But then why bother with the PhD at all; why not just let the publications constitute the credentials?

"We are not interested in what you know. We are interested only in where you learned it and whether it took as long as we feel it should have taken."

A student's educational experiences should bear some resemblance to the experiences he will face in applying that education. In industry people typically cooperate to solve problems. They most certainly keep their eyes on each other's work, and in fact are encouraged to let others know what they are doing and how they are doing it. In research-and-development departments in the electronics industry, at least, it is seldom as important whether the job is finished at 9 a.m. this Monday or 9 a.m. next Monday as it is how well the job is done. Management-by-objective is the rule: the engineer or programmer is told what the immediate goals are, and given considerable freedom in achieving these goals. He is expected to read at least some of the pertinent literature on the subject, to have some idea what the competition is doing, and to refer to textbooks and reference books as necessary. He is allowed to disagree with his bosses (in the most successful companies), and if he doesn't like their decisions, he can take his skills and ideas elsewhere: no one expects him to throw them out and start from scratch just because he changes companies. In fact, he may well be hired just for the work he has already done on them.

I leave it to current students and recent graduates of the university to decide how similar these circumstances are to those they confront, or confronted, in school.

In the Western world, we no longer believe that mistakes are to be avoided at all costs, or that an error in a scientific experiment—i.e., a result that does not conform to what is expected—is necessarily something bad, since it might open the door to a new way of looking at things. But the PhD industry has still not quite been able to face the fact that not every PhD degree represents the same degree of original thinking—or indeed that in some subjects at some times originality may simply not be possible, or even appropriate, as in historical studies. Why should a PhD examiner look down on a candidate who says, frankly, "This problem has been attacked by some of the best minds in the field for many decades. In my opinion the results have not been significant, and after  $x$  years of work, my results constitute no more than incremental progress toward a solution." Why must the candidate be punished for such an honest assessment of his work?

It is remarkable how often you receive the same reply when you ask a recent recipient of a PhD what he has learned: “Endurance!”

One often hears PhD candidates say they are “looking for a thesis topic”. For those of us who can fill pages with interesting questions, this seems a strange problem. But we have to remember that the phrase also means a thesis topic that will meet the approval of an advisory committee. A lot of good, though unorthodox, questions go by the board in this process.

Graduate schools are finishing schools in more ways than one.

A graduate education is, more than anything else, an education in being a good bureaucrat.

“Graduate school is where you learn to think on your knees.” — college president quoted in Holt, John, *Instead of Education*, Dell Publishing Co., N.Y., 1976, p. 186.

## **Competition**

Gold star in kindergarten, Nobel Prize in middle age —Ah! the life of the mind!

“Whenever I hear a Nobel Prize winner give a speech about the glory of man’s pursuit of truth I always wish the other side could be given equal time: What do the losers think about this noble pursuit —the ones who couldn’t get their PhDs, the ones who simply lacked the talent, the ones who guessed wrong when guessing was the best that anyone could do, the ones who were on the right road but were a few years (or months or days!) behind?” —S. f.

Prizes for intellectual or artistic achievement are like sainthood in the Church: they are a means by which the Establishment buys itself off: “We can continue with business as usual since we can always rectify our errors with a prize later.”

A sense of pride in accomplishment, a modest income for one’s efforts, and someone to talk to about one’s work, should be sufficient reward for any intellectual or artist. If these are not enough, perhaps he or she is in the wrong business.

The Nobel Prize is an honor  
That warms a scientist’s heart.  
Unfortunately, when some receive it  
They’re no longer very smart.

It is the fate of the *losers*, not the winners, that tells us whether an enterprise is worth pursuing. Casino gambling offers the best example of this, but the professionalization of the intellectual life is another example. Most good students assume that without a PhD and a tenured position at a university, it is useless for them to pursue intellectual work on their own — a truly appalling victory of the clerk mentality over the spunk and resourcefulness of the budding independent scholar or thinker.

Always remember that in order to have a race, everyone must agree to run in the same direction.

## **Syntax**

Of the university it can be said, paraphrasing Emerson, that syntax is in the saddle and rides mankind.

“Many students, especially those who are poor, intuitively know what the schools do for them. They school them to confuse process and substance.” (Illich, Ivan, *Deschooling Society*, Harper & Row, N.Y., 1971, p. 1)

I have seen intelligent men and women agonize for years over PhD theses, having not the slightest idea that the major difficulty lay in questions of syntax —in figuring out how to say what they want — usually an idea so boring in its obviousness that you wonder why they have gone to all the trouble — in a way that will please.

One of the worst aspects of this obsession with syntax is that it teaches the student that all intellectual labor has the same value, that everything in the world of ideas is equally important.

## **Specialization**

“No man can be a pure specialist without being in the strict sense an idiot.” — Shaw, G. B., “The Revolutionist’s Handbook and Pocket Companion”, appendix to *Man and Superman*.

The intellectual as well as the physical work of the modern world cannot be done without some sort of division of labor. What I question is the bureaucratization of learning —the notion that it is the mark of a person of superior intellect to choose a specialty at age 25 and stick with it, and indeed grow more narrow in it, for the rest of his life; that all the questions posed by that specialty must have their answers in it; that curiosity about other disciplines is dilettantism. I cannot believe that the truly healthy intellectual can flourish without risking himself, which includes venturing into fields where there is a good chance of his falling flat on his face.

“... a number of [reviews] have pointed out that Watson and Crick were totally ignorant of a great many important fields of knowledge which one would have supposed they needed to know, which in fact they did need to know, in order to discover what they did about the DNA molecule.

By our usual standards of looking at these things they were hopelessly unqualified to discover this. That is to say, by the traditional ways of deciding what qualifications are. Now of course they were supremely well qualified, because they brought to their task qualities which are not picked up in school: a deep and wide-ranging curiosity; a profound, not to say arrogant confidence in their ability to learn and to figure things out; a very considerable resourcefulness at finding out how to find out things. And armed with these valuable resources, and a not inconsiderable amount of knowledge, they were able to discover what they discovered.” — Holt, John, *The Under-Achieving School*, Dell Publishing Co., N.Y., 1969, pp. 173-174.

And let us not forget that the work that inspired Crick (a perennial physics graduate student at the time) to turn to biology and the investigation of DNA, was the work of another physicist, written late in the latter’s life, namely Schroedinger’s *What Is Life?*

## **Publish or Perish**

“I had a thought, it was not published,  
A thought it ceased to be.”  
—lines on waking

“In the real world of quantum physics, *no elementary phenomenon is a phenomenon until it is a recorded phenomenon.*” —Wheeler, John Archibald, quoted in Ferris, Timothy, *Coming of Age in the Milky Way*, Anchor Books, N.Y., 1988, p. 366.

“Two stout volumes are now the minimum for a life of any modern British writer —Orwell, Huxley, Waugh, Forster, Strachey, even Ivy Compton-Burnett. In academic circles, this excess is known as the scholar-over-your-shoulder syndrome. Taking Cheops as their mentor, today’s biographers have concluded that restraint is an unreliable road to immortality. He who doesn’t pile up superfluous data as busily as the pharaohs piled up stones can be sure that someone just behind him will; restraint is what hits the remainder table.” — Prescott, Peter S., “Journey Without Maps”, review of Sherry, Norman, *The Life of Graham Greene: Vol. I: 1904-1939*, in *Newsweek*, June 26, 1989.

A man who had been a professor at a university in southern California and who had left to do research in industry once told me that any professor at his university who wanted tenure was expected to publish three to four refereed papers a year. I said, “Suppose he has one good idea this year, publishes it, then none for a year, then another the following year.” Too bad. He’d better stretch that first idea into six papers. “You play the game or else.”

Anyone who respects his own intellect and his own time, cannot possibly look on such a state of affairs with anything but contempt. There is no excuse, in the world of ideas, for making a virtue out of verbosity.

“In 1987, scholarly journals in this country published 215 articles on John Milton, 132 on Henry James and 554 on William Shakespeare.

“All are major figures, of course, but since their work has been in the public domain for quite a while, one need not be a philistine to wonder if there are 901 new things to say about them.

“Such musings, of course, are beside the point. The folklore of American academia says that publishing and teaching go hand in glove...

“The ideal behind publish-or-perish is noble. Teaching is enhanced by the enthusiasm and skill that come from pushing back the boundaries of knowledge...

“The ideal is rarely reached, however, even at research universities. In his 1987 book, “College” (Harper & Row), Mr. Boyer reported that four of 10 faculty members at such universities spend *no* time teaching undergraduates. Good teaching, it seems, can even hinder a career. The 1986 and 1987 winners of Harvard’s Levenson Award for Outstanding Teaching, Alan Brinkley and Bradford Lee, were both later rejected for tenure....

“The [building of a scholarly resume] can take many forms, including the ‘salami’ technique. ‘You take a finding and, instead of writing it up in a definitive form, you divide it into 20 pieces and write 20 separate articles,’ said Susan Resnick Parr, who as dean of the University of Tulsa has been served dozens of such scholarly sandwiches.

“Multiple scholarship is a convenient way to spread prestige. ‘Can it be that six people at four institutions really ‘authored’ a five-page article?’ asks Gerald Bracey who writes critiques of academic research for the journal *Phi Delta Kappan*...

“[But] most college administrators...go along with the system. One dean at a well-regarded private college in the Northeast was known to assign points for each book, article, book review, and so forth, add them up and then use the total to determine salary increases. Under this system, Isaac Newton and Charles Darwin would have starved.” — Fiske, Edward B., “Lessons”, in the *New York Times*, Aug. 2, 1989, p. B8.

Two questions should be put to the top-rank professors in the humanities, their answers to be published in a form (online or paperback) that is readily accessible to the general reader as well as the academic reader: (1) For a given audience, say, junior and senior undergraduate humanities majors or persons with the equivalent of their knowledge, how long does the expression of an idea need to be, apart from data supporting the idea? (2) How many hours in your life have you spent thinking about this question?

I am very skeptical that the most top-rank humanities professors would even know how to think intelligently about question (1), because they would be forced to confront, probably for the first time in their careers, what the difference is between an idea and its justification — between an idea and its elaboration. They may be forced to confront the possibility that the vast majority of ideas in the humanities can be expressed — for example for the audience indicated — in a few pages. And if these thinkers decide that some ideas, for example, those of Barthes and Derrida, cannot be expressed in fewer pages than Barthes and Derrida required in the first place to set them forth, then they must explain how the works in question differ from art.

Exercises 9 and 10 under “Exercises for Philosophers” in the chapter “Philosophy” of this book, contains a few additional thoughts on this subject.



The Life of the Scholar, or, How to Live on Your Knees.

## **Technical Writing**

Clear writing is a result of clear thinking; therefore there is a payoff in trying to write clearly. On the other hand, every engineer and programmer I have known has hated writing, and since I have had all too much experience being forced to learn things I didn't like, I have no interest in making the ability to write clearly one of the requirements for a technical credential.

One reason why technical people hate writing may be the way it is taught. A technical person typically learns composition from English teachers, i.e., from persons who have studied the artistic use of language, which is a use in which syntax is of paramount importance. English teachers use examples from English literature; writing is presented as an activity which is the result of subconscious processes in men and women of genius; many of the subtleties of language which are pointed out are lost on the technical person.

A more meaningful approach to teaching technical writing could be achieved by adopting some of the techniques of structured programming. This is an ironic suggestion, since structured programming is itself just the process of outlining (known so well to writers of term papers), applied to the task of writing programs.

But structured writing, like structured programming, requires that the writer understand the difference between syntax and semantics (between the how and the what), and that in technical discourse, semantics is more important than syntax. That is, in technical discourse, there are many different ways of saying the same thing, some better than others for particular circumstances, just as there are many different programs for computing the same function. Changing the syntax is not necessarily significant, whereas in literature it usually is.

In structured writing, the writer considers the various sections and sub-sections of an outline as buckets to be filled with what's. These what's can be represented by scribbled notes, phrases, partial sentences, quotes, references. The writer then converts these into the language he wants, always keeping in mind that this is just a matter of choosing what in his opinion is the least bad wording; it is a matter of making (and often unmaking) lots of small decisions. In order not to interrupt his flow of thought, he can write alternative wordings as they occur to him, one after the other on the page, then go back later to cross them out or rearrange them. Again we see the importance of understanding the difference between the how (the marked-up manuscript with its record of trial and error) and the what (the finished result).

The less mysterious this activity is made, the better.

The method of teacher example which I proposed for teaching technical problem solving may be of use here also. The teacher could take a technical writing task on a subject proposed by the students and keep a record of his notes and drafts to show them how he proceeded.

## **Additional Thoughts**

Remember that if you send a person to school, there is always the danger that they might try to apply what they have learned.

You will never make any progress in your thinking about university education until you are perfectly reconciled to the fact that profoundly original contributions to a field are often made by

first-class sons-of-bitches.

Whatever you are studying, just that you will get no farther than.

