

A Red Book for Queen's

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"What we need is the reinvigoration of undergraduate liberal education at a time when it is increasingly under attack in many circles in this country. This requires a broad statement of purpose - a statement of educational philosophy - in a sense a new Red Book. The Red Book, you will remember, was the 1945 study of General Education in a Free Society. I cannot give you this statement or this philosophy today, but I can tell you some of what I think it must contain. It must contain a view of the world in the next decade or in the next 20 or 25 years...

"We need also a view about learning because I think that we must somehow navigate between, on the one hand, the unfettered freedom that has come into the educational process in all American universities today and on the other hand, certain constraints. I do not believe that all subjects are of equal importance. I hope that that does not offend anybody. I also believe that when we say at graduation, "We welcome you to the company of educated men and women," this should mean something. At the moment, to be an educated man or woman doesn't mean anything. It may mean that you've designed your own curriculum; it may mean that you know all about urban this or rural that. But there is no common denominator, and that is what we have to move towards. I think it also requires a view of Harvard's role in society because we cannot be all things to all men and we've got to decide what we are."

Henry Rosovsky
Dean of the Faculty of Arts and Science
Harvard University
Fall, 1975.

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I The Lecture as it is.

But there's no joy in Mudville,
Mighty Casey has struck out.

- E.L. Thayer 1888

I went to a lecture the other day and sat at the back. I was struck by the difference in aspect of the professor and student.

The professor was enthusiastic and lively. His face was a good colour and his eyes shone. His lecture was clear and his material well-organized. He was enjoying the challenge of delivering it.

The students looked tired. Their faces were veiled, their eyes lacked lustre. They scribbled in notebooks almost steadily. Occasionally the professor would digress and they would sit back and look up with relief. But all too soon they would take pen in hand again with a resigned expression. They did not share the professor's excitement.

It is not hard to account for this difference in aspect. The professor is engaged in a creative and demanding task. Last night he worked hard taking notes and organizing this material and today he must bend his talents of exposition to the job of communicating it. He is active. On the other hand the students are simply recording the pieces of knowledge which they can manage to receive, and they have not even the satisfaction of doing this well. Occasionally they try to follow the thread of an idea, but they have not time to look at it closely nor to weave it into any of their garments. They do not share the professor's excitement because they are doing nothing to get excited about. They are passive.

Now it is fun to be active and it is no fun to be passive. My six-year old daughter, in particular, cannot stand being passive,

especially when I am active in front of her. Were I to try to lecture her on how to jump rope she would sit only until I had perhaps jumped twice. Then she would get up and ask for the rope. If I insisted on keeping it and demonstrating some more, she would simply go away and find another rope. She'd probably ask her mother.

Why do the students not get up and go away and find a rope of their own?

Well, here is a possible reason. Students are notoriously poor. Perhaps they are doing it for the money. The professor is enjoying himself so much that he is prepared to pay to have a fine young audience. Prepare yourself, my friend, for a disappointment. There is indeed a flow of money, but in the other direction. Strike one.

Well, here's another reason. See how tired the students look! They are clearly far too weary to go looking for ropes on their own. Rope hunting is too demanding a task for a tired person. Prepare yourself for another surprise. Their weariness is not the cause but the effect of their lack of activity. The less demanding the task, the more the fatigue. Strike two.

Ah, I think I finally have it. You remember those bits of knowledge that the professor is laying out so neatly? Well, the students want to acquire that knowledge, and the best way to do that is to listen to him and write down what he says. Strike three.

II The Acquisition of Knowledge

"Who is a man of knowledge, don Juan?"
 "Any warrior could become a man of knowledge.
 As I told you, a warrior is an impeccable
 hunter that hunts power. If he succeeds in
 his hunting he can be a man of knowledge."

- Carlos Castaneda 1972

The point I wish to make in this section is that knowledge can only be effectively acquired under very special conditions, far more special than most people realize.

First let me explain why I have said "effectively acquired" rather than just "acquired". When I hear people talk about the acquisition of knowledge, I often have the uncomfortable feeling that knowledge to them is a sort of rich brown liquid. While that is not a bad analogy for some purposes, it suggests that if you want to acquire some knowledge, all you have to do is take off your hat and find someone who is willing to hold the pitcher and pour. This vessel-to-be-filled metaphor totally ignores the crucial work that the vessel must perform on the liquid before it can be said to contain it in any effective sense.

Thus knowledge is effectively acquired, not in a passive, but in an active state. What counts is not the knowledge itself (whatever that is, if anything) but the effect it has on the person, the way in which he has made it his own, the way in which he is able to use it.

As an example, consider that there is an enormous difference between "knowing how" to jump rope (knowing the instructions) and "knowing how" to jump rope (being able to do it). The difference, of course, is in the ability to put it all together, to coordinate properly. As an analogy to the sort of knowledge that

is acquired in university, this example is not as limited as it may seem. In particular the concept of co-ordination is a good one.

As another example, still in an elementary setting, let me describe an experiment reported by Jerome Bruner. Young children, age 3 and 4, are shown cards, each with a coloured disk upon a background. The disks can be either red or green, the backgrounds either yellow or grey. All combinations are possible. First they are asked to press a button with their left hand if the disk is red, another button with their right hand if the disk is green. They have no trouble with this. Now they are instructed to ignore the disks and press one button for grey background, the other for yellow. Many have great difficulty with this. They can receive the instructions but cannot make them their own. They have not the apparatus to cope with the disk: in this case to filter it out. Now in the third experiment the disks are replaced by silhouettes of airplanes, still red or green against the same backgrounds of either yellow or grey. Now they can handle the instructions: one button if the airplane can fly (sunny sky) another if it cannot (clouds). They do as well as the first time round.

Now in the more sophisticated university setting, it is no longer possible to provide the right airplane for each student at the right time. There is much less common ground. One man's airplane is another man's mushroom.

Besides it is not even desirable. The whole point of education is to teach us to find our own airplanes. Without this capacity we will never learn anything sophisticated.

And constructing airplanes is a creative and demanding task. It has to be done on our own terms, at a speed we can control. It can be done with a book, or an idea, or a videotape: something we can turn on or off, turn back and replay, anticipate and stalk.

But it cannot be done in a lecture.

To effectively acquire a new idea or a new piece of knowledge, we must have prepared the ground; so we must have wanted it, we must have been seeking it. Having found it we must fit it in, and this requires examining all its aspects and testing it against our expectations. We cannot do this in a lecture. It is simply the wrong medium.

The lecture hall is not the place for the acquisition of knowledge. The conditions aren't right. They're not even close.

III The Art of Writing

I worked on my notes until he woke up a couple of hours later; it was almost dark then. Noticing that I was writing, he sat up straight and, smiling, asked me if I had written myself out of my problem.

- Carlos Castaneda 1971

This a digression from my main development, but an important one. Besides it serves to illustrate some of the ideas we have encountered and to prepare the way for others to follow.

We have all heard the cry that our students cannot write well. Most of us agree that the cry is justified, but we have difficulty coming up with a clear remedy. As a beginning let me observe that there is some evidence the students do not get nearly enough practice at the right kind of writing.

Indeed it was recently reported that a group of Ontario Grade XIII students were asked to write the British A-levels English Composition exam. They scored significantly lower than a comparable British group. When one of the markers was asked the reason for this, he said that he couldn't of course be sure, but it seemed likely that the Canadian students had done very little of this kind of writing. I am not sure what he meant by "this kind of writing" but I have a good idea.

What is it that is wrong with the way our students write? One thing that is often said is that they cannot make grammatically correct sentences and form these properly into paragraphs. This may very well be true, but it is surely not the root of the problem. Good grammar is a framework which enables a writer to express his ideas clearly, unambiguously and with taste. He will embrace this

framework eagerly as soon as he has something which he is anxious to say clearly, unambiguously and with taste. Until that time, there is no reason at all for him to pay any attention to grammar, other than the annoying exhortations, if any, of his teachers.

The root of the problem is that very few of our students have anything that they are anxious to say at all, let alone with clarity and taste. The experience of having an idea, of pondering it, testing it and researching it and finally of yielding to the temptation of setting it boldly down on paper, is for most students extremely rare.

But these are the essential ingredients of good writing. You start with an idea or perhaps the accidental but happy juxtaposition of two ideas. You carry the idea with you for a while and interpret into it your experiences, thus amplifying it and giving it breadth. Gradually you feel the need for knowledge and you enter a period of research. You read and digest, voraciously but selectively. You ask questions and grow impatient when people digress or say too much. You take notes and more notes and throw the old notes out. This taking of notes is not to be confused with the note-taking I watched students do in the lecture of section I. They were simply copying down anything that passed by: each new piece was an extra burden. Your note-taking is directed. It is selective and incisive. Each new note is an important piece of the final score. At last you are ready to write it down for your colleagues to read. You will spare no pains in this final task, for what you are setting down is your own.

If you have written something in this way it is likely to be good. At least, if you have access to good books, it will become good with practice. It will have directness and purpose. It will have clarity and simplicity. It will have authenticity

and honesty. It will have warmth and spirit. These are the hallmarks of good writing.

The students I know do very little of this kind of writing. Their note-taking in lectures is the wrong kind of note-taking. The essays they write are rarely their own ideas that they are anxious to set down. They are the ideas of others that they have tried to reproduce. The exams they write are too horrible to mention.

No wonder they write so badly.

IV The Lecture as it should be.

"This is a place of power," he said, after a moment's pause.

- Carlos Castaneda 1972

We have agreed that the lecture hall is not the place for the acquisition of knowledge. Are we then to scrap lectures, or can we find something else to do with them?

We have already a suggestion from the last section. If ideas are the primordial condition for good writing, then the lecture hall might be used to generate ideas.

Another suggestion comes from looking once again at my 6-year old daughter. She quite wisely refused to sit for more than a few seconds and listen to me lecture on how to jump rope. But I have seen her sit spellbound for a full 60 minutes before an amateur theatre production of Jack and the Beanstalk. Now I am not suggesting we use our lectures merely to entertain. Mere entertainment is boring, even (especially?) for a 6-year old. But a theatre production of Jack and the Beanstalk is much more than entertainment. It is a display of power: in this case, the power of imagination.

These two things: the generation of ideas and the display of power are essential parts of the learning process, and the natural medium for them both is the lecture.

One can find these ideas set forth in an elegant and systematic manner in Whitehead's essays on the Aims of Education. Whitehead identifies three stages in what he calls the Rhythm of Education: the romantic stage, the stage of precision and the stage of generalization. To some extent all our learning proceeds by passing through each of these stages in order. So

that, roughly speaking, the child is dominated by the romantic stage, the youth by the stage of precision, and the mature man by the stage of generalization. Except it is not that simple. The stages actually cycle continuously like eddies in the fast flowing stream of life.

Now the romantic stage is the stage of ferment, novelty and mystery, of hidden possibilities and barely justifiable leaps. This stage, in its fullness, motivates the stage of precision. In this second stage we strive for comprehension and mastery. Ideas must be tamed and organized. This requires care, honesty and restraint. Finally, the stage of generalization is essentially a return to romance, but now with the technique acquired at stage two. Our ideas have new power because we have harnessed them. The great fruit of this ultimate stage of learning is wisdom: the capacity to handle knowledge.

Stages one and three are characterized by freedom, stage two by discipline. Notice however that the two freedoms are quite different. Stage one has the freedom of a child, stage three, the freedom of a man.

Now the central point that Whitehead makes is that the discipline of stage two must not be imposed until the fullness of the romantic stage has prepared the student to accept it. If discipline is imposed prematurely, the knowledge that is obtained will be inert and ineffective.

So here it is in a nutshell. Stage two is of central importance because it opens the path to the power and wisdom of stage three. But it will be barren without the fullness of stage one.

Now let us return to the lecture-hall. The lecture is the wrong medium for the stage of precision, but that's just where

most lectures are aimed. On the other hand the lecture is the quintessential servant of the two great stages of freedom: romance and generalization.

Consider, indeed, the stage of romance. What a natural medium is the lecture! It confers upon learning the same vitality that actors and scenery confer upon a play which would otherwise be read from a book. The lecture displays the professor as a craftsman engaging the process of learning. He can amuse, astonish, mystify and outrage. But always he provokes and invites. Details are not important here and systematics have no place. It is the stage of the tantalizing problem, the unjustified leap and the "fait accompli". The invitation to precision is exciting and compelling.

Let us now watch the action on the great stage of generalization. Here the professor is talking to students who have some elemental mastery of ideas, who have read and pondered. He shows them now how to use these ideas to gain power and further mastery, how to shed details in favour of principles. Together they search for wisdom. Again it is the process, not the product that is on display. Of crucial importance are the false starts and tentative hypotheses as the professor thinks aloud and uses his small share of knowledge to grapple with ideas. It is not the knowledge he imparts but the immediate and direct impact of his thoughts on those of the student which is of value. He shares his explorations with them and shows them how to share with one another. The frustration and pain he suffers is theirs also. His power and joy can be theirs too.

Of course these three stages are never wholly separate. Most lectures will contain elements of both romance and generalization. But, except on express request of students who have already struggled with the ideas at stake, a lecturer should not trespass onto the spare and demanding stage of precision. This is the province of the student's desk with its small yellow light and its books and pencils. Here he spends most of his time. What he does here, he must do for himself.

V What Knowledge?

This meat will sustain us for weeks, months if need be. Chew little bits of it at a time and chew it thoroughly. Let the power sink slowly into your body.

- Don Juan 1961

And what is that knowledge which the student discovers in his study? What are the ideas he grapples with? What are the books he pores over?

In the main, the topics he studies will have been suggested by the professor, or inspired by his lectures. The techniques he strives to master will be directed by the problems the professor has posed. Knowledge the student acquires in this way will not be a burden, rather it will enhance and enliven the structure he is building in his mind. He will thirst after it as for the key to a puzzle.

For this process to work it is of crucial importance that the student not be overburdened with too much knowledge "to be learned". It is equally important that what he is confronted with be good and important and that he be encouraged to study those things thoroughly. This advice has been repeated many times over the past century. Let me quote from works of three exceptional scholars.

Let us now ask how in our system of education we are to guard against this mental dryrot. We enunciate two educational commandments, "Do not teach too many subjects," and again, "What you teach, teach thoroughly."

The result of teaching small parts of a large number of subjects is the passive reception of disconnected ideas, not illumined with any spark

of vitality. Let the main ideas which are introduced into a child's education be few and important, and let them be thrown into every combination possible.

- Whitehead, The Aims of Education 1917

My advice to anyone who wishes to write is to know all the very best literature by heart, and ignore the rest as completely as possible.

- Bertrand Russell to Lucy Donnelly 1902

So, if we are to teach at all, let us teach the right thing, and ever the right thing. There are many attractive qualities inconsistent with rightness - do not let us teach them - let us be content to waive them. There are attractive qualities in Burns, and attractive qualities in Dickens, which neither of those writers would have possessed if the one had been educated, and the other had been studying higher nature than that of cockney London; but those attractive qualities are not such as we should seek in a school of literature. If we want to teach young men a good manner of writing, we should teach it from Shakespeare - not from Dickens. And I believe that our schools of painting are at present inefficient in their action because they have not fixed on this high principle what are the painters to whom to point; nor boldly resolved to point to the best, if determinable. It is becoming a matter of stern necessity that they should give a simple direction to the attention of the student, and that they should say, "This is the mark you are to aim at; and you are not to go about to the print-shops, and peep in, to see how this engraver does that, and the other engraver does the other, and how a nice bit of character has been caught by a new man, and why this odd picture has caught the popular attention. You are to have nothing to do with all that; you are not to mind about popular attention just now; but here is a thing which is eternally right and good: you are to look at that, and see if you cannot do something eternally right and good too."

- John Ruskin, The Unity of Art 1859

In spite of the clear and compelling nature of these passages, their advice remains almost universally ignored. Indeed, the situation today is probably worse than it was at the time any of these passages was written. The reason for this can be found in the increasing autonomy of the departments within the faculty, and in their increasing allegiance to a narrow professionalism. In short the problem lies with the very specialized way in which the major has come to be regarded.

Now there's nothing wrong with the concept of the major per se. It is quite acceptable, indeed laudable, for an undergraduate, towards the beginning of his studies, to decide that he wishes to prepare himself to be a sociologist or a mathematician. And so it is reasonable that he become a Sociology major, or a Mathematics major, and that he finally get a degree in Sociology or Mathematics. But let us be quite clear what this degree ought to mean. It is not the business of the Faculty of Arts and Science to make sociologists or mathematicians and the degrees they give in no way suggest that they have done so. The purpose of the degree is to certify that the student is prepared to embark upon a serious and special study of sociology or mathematics. It is this preparedness that is of vital importance, and I have seen many departments which, in their attempt to create a specialist have sacrificed a crucial measure of this preparedness.

Just what, in particular, this preparedness amounts to, varies markedly from discipline to discipline, and we shall consider two examples in the next section. One can say this much in general. The graduate should be able to read and understand the important basic writings in the field. When he needs some special knowledge he should know how to get it quickly and effectively. He should be able to discuss his ideas

with his colleagues and put them on paper in clear, simple prose. He should have had the experience of interpreting some truly important general ideas into the framework of his own discipline. And, most of all, he should have experienced the spirit and enthusiasm of the scholars in his field.

VI The Major.

Twenty people can gain money for every one person who can use it - and the vital question for individual and for nation is never "How much do they make?" but "To what purpose do they spend?"

- John Ruskin 1860

To better understand the nature of the major in undergraduate education, we will look at two examples.

1) Sociology.

If the objective of the Sociology major were to learn sociology, the university would not be the place for him to be. Apprenticeship with professional sociologists in the field would be much preferable. The very reason that a Sociology Department forms in a university is because some imaginative Sociologists have perceived that the university experience is of great value to a man who would bring his mind to bear upon sociological problems. In particular, such a man should encounter and grapple with the great ideas of those disciplines which give life to the study of sociology: History, Philosophy, Literature, Economics, Psychology, Mathematics, Geography etc. etc. depending upon the interests of the student. Indeed, the main function of the sociology professor is to alert the sociology student to the importance of these great ideas and to their relevance to social problems and institutions.

Now don't jump to the conclusion that I am saying a sociology professor should encourage his students to take courses in everything but sociology. To understand what I am really saying, think, for a moment, about the way we interact with ideas. When

we read, it's not the actual ideas that are sitting in the book (whatever that means) that are significant to us, it is rather the impact they have on our minds. It is the insights they provide to the problems we are currently struggling with, that count and that are retained. In short, ideas are not imprinted in our minds as on a blank page. They revise and augment notes that are already written and that are under active review. Thus, to receive knowledge or handle new ideas effectively, it is important that we be already struggling with a wide range of problems and ideas, and it is the nature of these problems which determines how new ideas are interpreted.

So the purpose of the sociology professor is to provide for the sociology major an orientation and sensitivity to social issues, a special awareness of a particular class of sociological problems, so that when he goes forth to study general ideas he will have this special context in which to interpret them.

Actually that's the first thing the professor does. The second is to give the student the inspiration and encouragement to go forth and study from the resources of the University. Needless to say, for this inspiration to ring true, he must have wide and scholarly interests himself. Here is perhaps one of the crucial characteristics that might distinguish a sociology professor from a professional sociologist.

So these two things: sensitivity to sociological problems and inspiration to go forth and learn, are the proper objectives of sociology lectures given to sociology majors. Any systematic or comprehensive development or excessive attention to special techniques should be left to the post-undergraduate years when the student is in graduate school or in the field. We have already had this advice in the last section in Ruskin's prescription for the British Schools of painting.

2) Mathematics.

I have heard a colleague state that it would be a terrible thing to give a degree in mathematics to a student who did not know what an analytic function was. What he really means, I think, is that he would be rather surprised to meet a man who called himself a mathematician but who had never heard of an analytic function. But that is a long way from saying that in order to be fully prepared to embark upon a serious study of mathematics, one must have "learned" about analytic functions. And it is, of course, this preparedness that we are giving the degree for.

In fact, at the moment, all our mathematics graduates have "learned" about analytic functions; they are required to pass a course in this subject in their third or fourth year. For most of them, all that this means is that they know the definition of analytic function, a few important theorems about them, and the methods used to solve a few typical problems. Actually, at the moment they receive the diploma from our Chancellor, none of them know even that, but that's neither here nor there. The important point is that very few of them could, at that moment, sit down for a few days and discover, on their own, enough about analytic functions, to be able to read about and understand some properties of them that they had never seen before.

Here is a classic case where real preparedness has been sacrificed for shallow sophisticated knowledge. If our undergraduate mathematics courses are to accomplish anything, they must expose the way in which a mathematician grapples with ideas and absorbs new knowledge: what is it about a mathematician's approach to a problem that distinguishes him from his fellow scholars? This type of question can be explored with quite elementary subject matter. In fact if we want the students to acquire some capacity to think mathematically themselves we have no choice but

to stick to elementary subject matter.

Periodically a student who is mathematically gifted will appear in our department. He does not need courses to bring him into contact with sophisticated concepts. He will forge ahead on his own; indeed there's really no way of stopping him. (Incidentally, he is probably the only one of his class who will become a professional mathematician.) The basic principle holds true: the acquisition of sophisticated specialized knowledge should be left to those who are prepared to do it. Thus, such acquisition has no place in the formal undergraduate curriculum.

Mathematics derives much of its inspiration and direction from its fellow sciences and, on aesthetic grounds, from the fine arts. Thus it is of great importance that mathematics professors inspire their students to go forth and grapple with the ideas of science and art and interpret these ideas within the mathematical framework they are erecting. Let me emphasize how important it is that this inspiration come from the mathematics professors. The usual "inter-disciplinary" requirement that a student take a significant number of courses in each of two specified departments is often meaningless and may actually work against the formation of any real "trans-disciplinary" or integrative spirit. If the student fails to detect any interest or competence on the part of his mathematics professor in anything but mathematics, he may decide that the inter-disciplinary requirement is simply a hurdle, and may effectively close his mind to the possibility of any significant interaction between the disciplines.

Thus the only truly effective impetus towards a trans-disciplinary attitude comes not from formal distribution requirements, but from a genuine and infectious enthusiasm on the part of the professors.

I have digressed from mathematics, but this remark would simply not wait any longer.

VII Values

The response to each of these talks has made me realize how hungry people are to know something of the person who is speaking to them or teaching them.

- Carl Rogers 1961

It is becoming clear that in the system we are constructing, the professor has a large influence on the activities of the students. He rouses their interest in knowledge, guides and directs their studies, and inspires them to apply themselves to the pursuit of technical mastery and precision. It should therefore be clear that the professor will as a consequence have a large personal impact upon the character and identity of each student he encounters. His aspect when teaching, and the manner in which he relates to his students, puts a significant personal stamp upon all ideas that are explored in his name. This is true, of course, whether he remains aloof from his ideas, or embraces them with passion.

There is some difference of opinion as to how we should respond to this situation. We can of course ignore it, but that response constitutes a strategy with definite and often unfortunate consequences. Let me offer a quotation.

If pressed to express themselves about institutional values, many faculty members declare a preference for a "rich diversity" from which the student will be free to choose and blend for himself. This approach has merit in proportion to the extent that faculty are willing to think out their contribution to that diversity and expose it to the assessments and correctives of their peers.

But too often the harking to diversity is simply a ploy which, carefully used, frees the instructor from substantive involvement with students and permits him to take refuge in his own specialization. Yet it is impossible to separate knowledge and values, in either our personal or our professional lives; and faculty do in fact have something to say about general norms and values even while they profess to deal only with issues within their separate disciplines.

- W. Martin, *Alternative to Irrelevance*, 1968

I think it is important that we, as professors, confront our students with a set of values that is coherent and true. By coherent, I mean that these values should hang together, and by true, I mean that they must be true to our own lives. In this epoch of professional uncertainty and distrust, such a set of values may be far more important to a student than all the knowledge we might offer.

But this does not mean we should embark upon a program of introspection, and devote 6 lectures per year to preaching! By and large we have already fashioned for ourselves a set of values that is coherent and mature. In order to communicate these to our students it is not necessary to make them explicit; it is sufficient that we arrange life at the university so that we spend a significant amount of the right kind of time with them. Just what this right kind of time turns out to be, will depend on the professor and on the class, but it will often lean toward the informal and the intimate. In designing a curriculum then, we must keep these requirements in mind and should try to order things so the members of the university community are more likely to spend this kind of time together.

Here is an example of the sort of decision we would have to make. In the Faculty of Arts and Science we are given

fixed numbers of students and staff, that is to say, a fixed student/staff ratio. Let us suppose it is about 15/1. Now we are free to choose the average number of students each professor teaches per year. For example, if each student takes 5 courses then this number will be 75. If each student takes 3 courses, it will be 45. Different factors will argue for different alternatives. In my opinion, the considerations of this section speak loudly for the second of the two choices given. If I have 45 students (perhaps organized into 2 courses) I am quite likely to manage to get to know them well and to feel comfortable taking some initiatives toward the spending of some good informal time together. On the other hand, 75 is just too many: the prospect is overwhelming and very little outside of straight lecturing and tutoring (and the odd smoker) is attempted.

VIII The Curriculum

American higher education stands on the brink of chaos. Never have so many spent so long learning so little.

- Steven Cahn 1973

Let us begin to fashion a curriculum from these ideas. Of course the problem of curriculum design is not just that of deciding which topics to include and which to omit. It is unfortunate that our curriculum committees spend practically all their time making such decisions.

Let us first recall what the objectives of our lecture courses were. They were to provoke and invite, to prepare the student to acquire knowledge and to show him how to handle it. They were not to be used for the transmission of specialized knowledge. If we are to have any hope of meeting these objectives, we must first of all unhook lecture courses from the highly specific bodies of knowledge which at the moment hold them with armour-like rigidity. A course must not be defined by a set of topics.

This is an important point. Our lectures, above all, must reflect what is truly important in education, and to tie them in a formal way to the simple accretion of a set of techniques and details serves to mislead the student in the most flagrant manner.

So what is it that describes a course if not a subject matter? The answer is clear: the professor! The course really belongs to the professor. It should carry his identification and none other. Indeed, if you must (and I'm sure you will!)

you can give each professor a number. So that if my number in the Department of Mathematics (code 55) were 23, then 55-123 would describe the course I give at level 1, and 55-423, my level 4 course.

Let me explain the level system. We'd have 4 levels as at present, roughly corresponding to years. The nature of the course offered by a professor will be most significantly determined by the level at which he is aiming. At levels 1 and 2 his thrust is mainly romantic and motivational. At levels 3 and 4 he is assuming some technical mastery and ability to read, and he will use this power to explore sophisticated ideas.

From the student's point of view, there are two phases to his studies. There are the lecture courses he takes and the disciplined reading, writing and thinking he does at his desk. At his desk he organizes knowledge, works out details, struggles with ideas, and attempts to write well. It is here that he does his real learning. The lectures on the other hand are his vital source. They give him insight, direction and encouragement. They give him problems, but only partial solutions if any at all.

They also give him fellow scholars. In the context of the lecture, he enters into a scholarly relationship with his classmates and his professor. This latter relationship is extremely important. The professor must come to know the student, at least well enough to be able to direct him in his reading and evaluate his work. Different students will be at different places, and a certain amount of individual guidance and encouragement is of crucial importance in helping the student to spend his time well. Generally speaking the student will be directed so that his work complements and supports the course of lectures he is following. But the particular topics pursued and the level at which they are examined will vary from student to student depending on interest, background and sophistication.

If it sounds a bit disorganized it is the ordered disarray of the academic procession! To regiment in this instance is lethal, in the very sense of destroying life.

Do we have the manpower to operate in this manner? Are we not making rather more significant demands on the professor than does the usual system? Well, yes, perhaps we are. More significant demands on the student too. We will have to take care that time spent at the student - teacher interface is good time, and this will require some discernment on the part of the teacher and some resourcefulness on the part of the student.

But let's look at the numbers. In the Faculty of Arts and Science at the moment, there are roughly 16 students for each professor. How many lecture courses should a student take? I'd say at most 3. Say, 3 courses per year in the first two years and 2 courses per year for the last two. Thus each student is under 2 or 3 professors for the year, and so each professor has 40-45 students under him. Suppose each professor offers two courses, so that his 45 students are partitioned into 2 classes: say one 25-student low-level course and one 20-student high-level course. The professor has these 45 students for the whole year. I think he should be able to get to know them. He might choose to lecture 2 or 3 times per week to each of his classes. Other times he would spend informally with them, either individually or in groups.

Periodically the professor would read a piece of work from a student provided the student thought that it was of high enough quality to warrant submission. He would offer his evaluation and, if it were good, he would evaluate it carefully. The important thing, of course, is that you have the possibility of a reasonably close and academically significant relationship between the professor and each of his students.

Of course, these numbers represent averages across many departments and there's some imbalance here. Take, for example, a department like Psychology. Evidently there are a very large number of students in the level 1 Psychology course. Can they be handled by the staff at 30 per class?

Well, let us see. I believe there are about 1300 students enrolled this year in Psych 100. Now if each student were taking only 3 lecture courses, there would certainly be less than 1300 students in the level 1 Psychology course. Let's be generous and assume 900 students would choose this course each year. At 30 per class, we need 30 professors, which, allowing for leaves of absence, is approximately the active size of the department staff. Thus, every professor teaches one level 1 course and one higher level course.

Are the Psychology professors going to be dismayed at the prospect of teaching a level 1 course every year? Not at all! Recall that we are not thinking about lecture courses in the old way. Our new type of course, in Psychology, is probably the most exciting at level 1. Here you have students with no previous formal exposure to the subject, rich in curiosity and motivation. The romantic stage in a subject like Psychology is a very fine place to spend time.

Of course if a Psychology professor has something important he wants to say in a few lectures, there's nothing to stop him from holding forth in a lecture theatre to 300 or 1000 students. Such lectures can be very exciting - rather like good theatre. And his department is welcome to give him some "credit" for doing so. But he will not be expected to have any individual responsibility for the students who choose to attend. Nor will they have responsibility to him. It is an academic happening, and it's free.

IX Prerequisites

Two vast and trunkless legs of stone
Stand in the desert Near them, on the sand,
Half sunk, a shattered visage lies ...

- Shelley

At the moment we have a very elaborate topic-oriented prerequisite structure which pyramids knowledge into an Ozymandian sandcastle. We spend long hours in curriculum committee meetings making sure that no student can get into this course unless he has "seen" that topic somewhere else.

The purpose of this system is to save us the time required to explain certain things which we need (in some sense) in order to proceed. It is important to save time, because we're always running out of it. This is because there are a great many topics we have to cover in this course. And this is because it's a prerequisite for the next course.

What type of prerequisite structure will be needed in our new system? To help us answer this question, let us look, for example, at a highly ordered subject like mathematics. My assertion is that we need only require that in order for a student to take a math course at levels 2, 3 or 4 he must have taken one at the level immediately below.

Currently, the mathematics curriculum seems to consist of a sequence of techniques and theorems, each developed and refined over decades or centuries of mathematical thought, presented in a highly ordered and well-organized manner, each theorem or technique followed by a number of problems or (more often) exercises which it can be used to solve. It is not surprising that such a systematic presentation requires a formidable prerequisite structure.

Of course it should be clear by now, that such a curriculum accomplishes very little. Students tend to memorize techniques or statements of theorems and practise recognizing problems by type, so that they can be matched up with the correct theorem. We have in fact paid almost no attention to the crucial romantic stage and therefore, having (rightly) no confidence in the ability of our students to operate effectively at the stage of precision, we simply present them with the fruits of the disciplined work of generations of creative mathematicians. Of course, the students are then quite unable to follow us into the fantastic stage of generalization and theorem formulation where mathematics at the senior level really belongs.

Now the romantic stage in mathematics is unquestionably the stage of problem-solving. At every point in a mathematicians life, the problems that he wishes to solve motivate and guide him, into the stage of precision, and carry him right through to the final stage of formulating theorems. Thus, for probably the first two years we should do very little but confront the student with a series of challenging problems. We can help him relate these problems one to another, and we can discuss his solutions and even give him hints. Our big job is discover the right problems for him to work on: they must be hard enough, but not unreasonable, and they must lead him forward.

We must avoid giving him theorems or systematic knowledge, or the details of any sophisticated problem-solving machine, for these things contradict the spirit of the romantic stage. Of course we should encourage him to ponder the solutions he has obtained, organize them, distill their essence, make conjectures, and formulate general results. And most important, he must begin to read, not in a systematic, text-book fashion, but in a highly directed manner, using books and questions to provide the missing pieces he seems at that moment to need. Thus he is

becoming acquainted with the process of mathematics, and discovering how to receive in an effective way mathematical knowledge.

So that by level 3, the student should be an experienced actor on the stage of precision and will have already on his own made brief personal appearances on the great stage of generalization. Now perhaps the time has come for the professor himself to step upon this stage in the full view of his class and start to build before their eyes, and with their help, a coherent mathematical theory. For now, having struggled themselves with problems in an ad hoc manner, and having begun to glimpse the power of general results and techniques for solving problems, they are ready for systematics.

Now the crucial prerequisites for such a curriculum are in terms of sophistication, not content. What is important is that the level of the course match the level of the students and level is measured in terms of the extent and quality of the experience of the class on each stage. Thus a student should not take a mathematics course at level 3 until he has had one at level 2. And so forth.

At the lower levels, the material that the problems depend on will be essentially elementary, for our objective is to communicate the spirit and excitement of the process. Increasingly as we rise in level, the ideas we work with will become more sophisticated and will involve an increasing body of mathematical knowledge. But the prerequisite of having taken the lower level courses will have given the student, not the necessary facts, but the capacity and maturity to find these facts and organize them. And this is what is, in fact, of permanent value to him long after the details have disappeared.

I can illustrate with an example. Recently a colleague of mine who was teaching a freshman algebra class for the first time, came into the lounge quite discouraged. "They haven't even seen the Binomial Theorem", he said, lifting his hands in despair, "What can you do?" Well the Binomial Theorem is a simple formula for expanding a polynomial. It can be put on the board and fully explained in ten minutes to anyone who is equipped (in terms of sophistication) to face the problem of how you expand a polynomial (apologies to Moriarity). Now either the class is equipped to face this problem or not. If so, then there's no difficulty. Ten minutes is not much time to spend in a full year's course. On the other hand, if they're not so equipped, it really doesn't matter whether they've "seen" the Binomial Theorem or not. They don't understand what it accomplishes and they certainly won't understand or enjoy what the lecturer is going to use it for.

Of course, we'll cover a lot less ground in this system, certainly if measured in terms of topics covered.

Yes, and thank goodness for that.

X Mechanisms of Evaluation

"To smoke", he answered. "It is quite a three pipe problem, and I beg that you won't speak to me for fifty minutes".

- Sherlock Holmes

It is about time we considered the concept of evaluation. It is an important subject, because in some sense the nature of the evaluation process determines the activity of both student and teacher.

The main purpose of a system of evaluation is to provide feedback to the student. Good quality feedback guides him in his subsequent efforts, and helps him to develop the capacity to form sound judgements of his own work. There are other ancillary purposes of evaluation. One is motivational: the prospect of evaluation encourages the student to work hard and well, at least if he can see some benefit from a high evaluation. Another relates to certification. Society is sometimes interested in our opinion of the student's work.

Now there is really only one important principle to bear in mind when considering evaluation, and it is this: the process of evaluation must measure the extent to which the student has progressed in the directions determined by the objectives of the educational system. A corollary to this principle is that the conditions under which the student performs, when being evaluated, must be such as to give him the best possible chance to display his progress in those directions.

Already we see a strong indictment against the present system of final examinations. If we retain them at all, it must be in some modified form. Let us first look at the situation rather generally. We shall identify three general instruments of evaluation, each of a somewhat separate nature. They will be called papers, tests, and examinations.

Papers are submissions made freely by the student. They represent his very best work. One of the most significant products of a student's work is his writing. Here it is especially important that he be encouraged to develop high standards in terms of clarity, simplicity and elegance. Whether he writing a philosophical essay, a technical report, or the solution to a problem, or simply organizing his ideas, he should always strive to write well. Most of his writing is for his own reference. Some of it will be produced for the approbation of his peers, and should be read and criticized by them. Occasionally he will produce a document of such high quality that he will decide to submit it to his professor. It then becomes what we have called a paper and the professor must read and evaluate it. It is of crucial importance that papers represent the very best effort of the student. In terms of feedback this allows the professor to concentrate his time at the important threshold; in terms of judgement, the professor is evaluating the student at his best. The evaluation should be qualitative rather than quantitative. Marks between 0 and 100 have little meaning here.

Although the professor can suggest topics for papers and suggest that he'd like to see at least one before Christmas, it is important, I feel, that he not assign topics or make deadlines. The student must be thrown on his own in this instance. If he cannot do his best job on a certain topic or problem, or cannot

do it by a certain time, he must be free (indeed encouraged) not to submit a paper. This is an important part of academic maturity and responsibility.

It may be that in some cases an oral presentation is more suitable than one that is written. A time is then arranged with the professor. Exactly the same rules apply; we will still refer to this as a paper.

Now let's look at tests. Tests are what they sound like. The student has to respond to a list of questions or demands from the professor. The time allowed is usually short (up to 3 hours) and the questions are based on a fairly well-defined set of topics or techniques which the student has prepared beforehand. Tests are voluntary. Ideally they should be requested by the student, but in practice the professor will often suggest that a test on such and such a topic might be a good idea. Their purpose is motivational and diagnostic: the prospect of a test forces the student to the mastery of a certain well-defined collection of techniques or details, and the results of the test give the student some indication of his success. Tests are proctored by the student himself and marked by the professor, or by the student after answers have been provided. The mark is solely for the benefit of the student and is not recorded by the professor.

A test may be written by an entire class all at once. For example, the professor may perceive in order to benefit from a few lectures he will give in two weeks time, the students should have mastered a certain set of basic ideas. He may then suggest a test for the preceding lecture slot. Often, however, a test will be written by an individual student. The professor might diagnose that a student's weak grasp of a particular area was hindering his general performance. He might suggest one or more tests. The student would show up when ready, and the

professor would jot a few questions down. Then off the student goes for an hour or two.

So tests are essentially a casual, ad hoc affair. They are a service provided by the professor for the benefit of the student.

The purpose of an examination is to examine the student as a product of the educational process. An examination is an extremely important event in a student's calendar. It is his opportunity to demonstrate his mastery of the discipline and his capacity to take knowledge and ideas into an unknown situation and make them work effectively for him. Thus it is not the extent of his knowledge that is examined, rather his ability to wield it. This is perhaps the most important thing to notice about these examinations: they are process-oriented, not topic oriented.

A student prepares for an examination not in a week, or during a single course, but over many years. He fashions his answers to the examination questions not by proxy of his professor, but rather from ideas that he has made his own. What he writes during the exam, he can defend, if necessary, after it, both in content and style. Of course, he must have time to write such an exam, presumably several days, and access to his books and perhaps his professors from whom he may seek some consultation or clarification.

The examination script will be evaluated by his professors, by those professors who know him well, who have taught him courses and read his papers. Their opinion will go on record.

It is not clear how often a student should be examined. There is no particular reason why examinations should be tied to lecture courses, but it may turn out that this is a convenient

way to administer them. It might turn out that a student writes one examination at the conclusion of each lecture course he takes, but there's no reason to suppose the subject matter of the examination will be based on the topics which were dealt with by the course. At the lower levels however, the sorts of things the student is asked to do in the examination will obviously be related to the sorts of things he was encouraged to do during the course. Examinations at these levels can be looked upon as preparatory experiences for the student and preliminary estimates for the professor. At the higher levels examinations become much more significant and will require him to draw upon resources obtained from several years of study of the discipline.

Let us look at the business of grading. One should aim for as coarse a system of grading as possible, which still discriminates where some selection is really needed. Honours-pass-fail isn't bad, but not quite adequate. I should like to see a 5 letter system, but used slightly differently from at present. Almost everyone should be a C student. This means he's doing good work. There's really no point in discriminating sublevels in this crowd. First class work earns a B. Poor or unsatisfactory work earns a D. The extreme grades A and E are reserved for extreme situations. Scholarship work deserves an A: here is a potential Ph.D. Failure to do anything worthwhile deserves an E. These are the students who might well be asked to leave the university.

At the end, the student goes forth into society armed with a degree and a transcript. The transcript contains some 10 letter grades and brief comments from a few professors. There is the possibility of soliciting more detailed knowledge by letter.

This is quite adequate for society's needs. Most graduates will go forth with virtually identical grades - straight C's, and virtually identical comments. This is as it should be. Those who think that there is a significant difference between a 65 average and a 75 average in terms of potential to hold a particular job are fooling themselves. The real differences are likely to defy numerical measurement, but might, on occasion, have been perceived by a professor or two. Of course, the candidates for graduate school and scholarship will require much finer selection, and this will certainly be available on the basis both of grades and of extended comment. For the professor is likely to have known these students best.

XI Details

"I have now in my hands," my companion said, confidently, "all the threads which have formed such a tangle. There are, of course, details to be filled in ..."

- Sherlock Holmes

There's no point in continuing to discuss these ideas unless we have some reason to believe they can be implemented and made to work. It is not my purpose in this document to provide a comprehensive mechanics for the system: this must evolve over time with the help of many heads. However certain details have already been touched upon. By way of review, I might mention these and expand on them.

A student would take 10 - 12 courses; the usual number would be 10. Of these he would probably take 3 in each of his first two years, and 2 in each of his final two years. (We will not consider how everything should be modified for a 3 - year student. He would probably, for example, take a total of 8 courses.) In a given department he will take a course at any given level at most once. Also to take a course at level n ($n \geq 2$) the normal prerequisite is a course at level $n - 1$ in the same department.

The requirement for a major in a given department is a level 4 course in that department. For a medial, it is a level 3 course. One can imagine that to get an honours degree, a student must offer one major (this commits 4 of his 10 courses) or two medials (this commits 6 of 10 courses). There may also be requirements as to the grade obtained in some of these courses. A department may also wish to set a comprehensive examination (see section X for a definition of examination) at the end of the

major and/or medial program. In short, the decision of the award of a degree will be made by those professors in the department(s) concerned who have had a good opportunity to evaluate the work of the student.

Let me give two sample honours programs.

| <u>Year</u> | <u>Math Major</u> | <u>Math-Economics Medials</u> |
|-------------|--------------------------|-------------------------------|
| 1 | Math 1, Bio 1, Chem 1 | Math 1, Ec 1, Psych 1 |
| 2 | Math 2, Bio 2, Biochem 1 | Math 2, Ec 2, Polsci 1 |
| 3 | Math 3, Phil 1 | Math 3, Hist 1 |
| 4 | Math 4, Phil 2 | Ec 3, Soc 1 |

Given either of the above programs, the only choice the student must exercise is in regard to section: that is, he must choose his professor. For example, at least 30 professors will be offering Math 1. They will represent a wide diversity of styles and emphases. The student will need some guidance in choosing a section appropriate for him.

Of course there will be a calendar. It is a reasonably stable document which is mailed out year after year to prospective students and schools. It describes the University, and the Faculty: its facilities, regulations, staff, departments and programs. It does not contain, as does our present calendar, deadly descriptions of hundreds of special courses.

The document that is invaluable to the current students is the sub-calendar. This is a fresh and lively document, "printed on newsprint," and available each fall. It is organized by department and level. The Math 1 section will contain a catalogue of the professors who are offering a mathematics course at level 1 that year, and each professor will have a paragraph to describe his orientation, his objectives, and the type of

student he hopes to attract. This document, together with some counselling from academic advisors, will provide the basis upon which the student will make his selection.

As an illustration, let us continue to pursue the example of Math 1. There is little doubt that, because of its overwhelming importance to the development of modern mathematics, all the professors offering Math 1 will explore, in their lectures, the very basic ideas of the differential and integral calculus. But this is probably all that they will have in common. Some will want to show how these ideas led to a new and powerful concept of mathematical rigour in analysis. Others will want to tie their explorations to modern algebra. Others will wish to relate the ideas of calculus to problems in other disciplines: physics, economics or biology. They will hope to attract majors from these disciplines. It goes without saying that they will want to know something about these disciplines and be in touch with some of the professors in these departments.

(Let me remark, parenthetically, that at present, the Department of Mathematics offers courses in Statistics. It seems clear, that for the purposes of course offerings, the Statistics Group might want to form its own Department with its four courses Statistics 1, 2, 3 and 4).

Of course, a certain amount of informal co-ordination is needed at the departmental level to ensure that there are the right number of offerings at each level, and that the needs of the student body as a whole are being met by the spectrum of emphasis offered that year. There is room for informal negotiation. If the Economics Department would like a few sections of Math 1 to have an emphasis that would benefit Economics majors, they will open up negotiations with a few math professors who might be interested. A new project may be born.

XII Breaking Away from Content

Knowledge keeps no better than fish

- Whitehead 1932

When I consider the practical problem of getting a system such as I have described accepted in a Faculty of Arts and Science, I must ask what the main difficulties will be. There is no doubt that the greatest difficulty by far will be for me to persuade my colleagues to break away from the pronounced content orientation of their courses. So, I should like to look again at this problem and perhaps anticipate some of their objections.

The problem is very deep-rooted. It is not simply that we have come to identify curriculum with subject matter; our entire apparatus for measuring day-to-day progress in the classroom works on the basis of topics covered. The basic coffee-lounge question of how is your section doing is automatically answered in terms of the topics covered up to that day, and future aspirations are made in the very same terms. In fact, how are we to have any confidence that our class has progressed unless we can point to a new topic covered? How can we justify picking up our pay-check this month if our class cannot recite 5 new definitions and 4 new theorems?

The problem has many guises. One is embedded in the concept of the service course. Suppose the Economics Department encourages all its majors to take a level 1 Mathematics course. It will want to make sure that there are some sections of Math 1

which are suitable for their potential students, and it would do well to keep in touch with the professors teaching these sections. But, and we must guard against this most carefully, we must avoid the temptation of composing, over the years, a list of topics which are important things for an Economics major to know and which become legislated into "Economics" sections of Math 1. I am not saying this just to be perverse: there is an important reason quite apart from the general evils of content-oriented courses.

The reason is this. Let us suppose that one of these topics is the integration of simple functions. Presumably certain Economics professors would like to perform a simple integration at some point in their level 2 Economics course, and they want to be able to assume that the student has seen these things done before. Now I want the Economics professor to look very hard and perceptively at this application of simple integration in the development of his ideas. There are two possibilities. One is that the concept of integration is not really essential to the economics: the integral is actually little more than a slick piece of notation which enables an argument to be presented more neatly or completely. The other possibility is that the concept of integration is an essential part of the economic idea and some mastery of this concept is absolutely required for proper understanding. Now in the first case, the professor should simply put the integrals on the board and remark that they provide a neat way of finishing off the problem. It doesn't matter whether the students have seen an integral or not. Those who wish to follow up his remark may do so. However, in the second case something quite exciting is afoot. Here we have two important ideas, one in Mathematics and the other in Economics and one is essential to proper understanding of the other! What an occasion for a rich and thorough exploration! What, indeed, is it about these ideas, apparently from different

parts of the universe, which binds them together? Here and nowhere else is the locus of integrative education. The professor should spend what time is needed to come to satisfactory terms with both ideas and expose their inter-relation. To do any less is tragic.

And to think that with an interdisciplinary prerequisite structure, this might never happen.

Pressures for more rigid content control will also be felt within the program of a single department. The cry will go out for effective monitoring at low levels so that professors at high levels know "what they can assume". This cry if heeded can only lead to the current shameful glut of highly specialized knowledge.

"But I think analytic functions are an important and beautiful part of mathematics. How can I teach anything significant about analytic functions at level 4 if some of my students have hardly seen calculus?"

This question will be asked again and again and should always be answered the same way. Go ahead and begin your course in analytic functions. Remember that at level 4 your students have some mathematical ability (3 years' worth, indeed). Whenever you want to use something that you would have liked covered at a lower level, decide whether it is essential or not. If not, simply mention it. If so, explore it thoroughly. You will cover a lot of ground. And so will your students.

XIII High School

New York's board of regents last week voted unanimously to require all high school students in the state to pass a ninth-grade reading and mathematics examination in order to graduate. Several of the regents hailed the new standard as a "giant leap forward."

Perhaps other giant leaps forward are in the offing. An eleventh-grade examination for a bachelor's degree? A twelfth-grade examination for a Ph.D.?

- Time Magazine April 5, 1976

The system we are building will make more significant demands on the student than does the university at present. So it is important that our students be well prepared for university. As professors we have a natural concern for what they experience in high school. Indeed we have this concern simply as citizens.

In this section I will build on the following principle. It is valid at all levels, but I will be especially concerned with its interpretation at the high school level. It is this. Students are primarily influenced not by what the teacher says but by what the teacher does. It is not the knowledge conveyed by his words, but the wisdom conveyed by his actions, his posture and his style that the students eagerly absorb.

The conclusion we can draw is this. If the teacher wants his students to devote a significant amount of time and enthusiasm to the pursuit of learning, he must spend significant time this way himself. I am convinced that high school teachers spend too much time preparing lessons, marking papers and showing their students how to do things, and too little time learning new things and exploring ideas with their colleagues. I am suggesting

that a significant part of their working year should be spent in an organized and active pursuit of learning.

Of course this is more or less why professional development days were introduced, is it not? Well, yes, to some extent that is true. But, as far as I'm concerned, the present system of professional development days is mere tokenism. They are too few and dissipated to give the teacher any chance for a single-minded assault on a serious project. So they can do very little with these days except discuss student problems, or pedagogical matters, or gather together and listen to some university professor tell them how to put life into their classroom.

I have been to some of these gatherings. Let me describe for you what happens. The teachers all sit down in a large room and some experienced high-school teacher or college teacher gets up front and displays a number of tricks or gadgets which will make the student really want to learn Grade XI algebra. (Big emphasis here on motivation). The teachers pull out their notebooks and busily copy everything down, despairing that they could develop these things themselves: they've simply no time. Notice well what these teachers are doing: they are appropriating these gadgets for use by proxy in their classroom in exactly the same way their students appropriate knowledge from them for use by proxy on tests. It is the big mirror at work again.

This observation cannot be made too strongly: the teacher often fails to effectively challenge the student to learn, because he does not himself feel effectively challenged to learn.

Here's what we must do. We must scrap the professional development days and replace them with concentrated sessions, say, twice a year of, say, two weeks duration each. These sessions are organized courses designed to challenge the participants.

During the day there are lectures and seminars to provoke and invite. At night there is hard study to be done. The subject matter will be relevant to the high school curriculum and to the teacher's interests, but the thrust is certainly not pedagogical. The search is for knowledge and understanding.

The sessions are organized locally by universities, or community colleges or by the teachers themselves. Staff is obtained from the same sources. Teachers go where their interest takes them.

Now there's less teaching done this way. The high-school teacher has a month less before his students and so does the university professor who might staff some of the sessions. Of course, the high school students who are without their teachers will still carry on. The good students will be asked to lead the class. It will be an excellent experience for everyone. Throughout the entire community, then, there is less teaching and more learning. Good.

And what about the rest of the year? Hopefully the teacher will carry the spirit and liveliness of these sessions throughout the year. Hopefully he will spend less time preparing classes and more time in search of ideas. Hopefully he will resist laying knowledge out before the students and start prodding them with problems. Hopefully he will throw away the text books and carefully prepared handouts and ask the students to start writing their own. (Text books are to be written, not read.)

Indeed we can rightly expect a qualitative change in the nature of the teacher's activity. No longer is he purveying topics imposed by the ministry. Rather he is exploring ideas out of an inner conviction of their importance, and his orientation is formed by his own research. It is exciting to teach this way

and it makes learning exciting too. But one must have the self-confidence that is borne of reflection and experience. Given this, no other preparation is required. The teacher offers good problems to the class and with an instinct borne of his own struggle with these problems and with a light touch he guides them forward.

The biannual sessions are of crucial importance for this. On the one hand they give him new ideas, new problems, and renew his discipline of mind. On the other hand, the opportunity to exchange experience with his colleagues will provide for a measure (just enough) of uniformity of curriculum within the schools.

It should not be hard to sell these ideas to the high schools. The teachers will gain: their lives and their profession will acquire a new richness. The students will gain too. Unless you have observed these things closely, you will not appreciate how important it is for a student to have a teacher who is, at that very moment in his life, struggling to master an idea.

XIV Admissions

Who are you, said St Peter,
Are you humble and contrite?
I'm a friend of Lady Astor's
Well OK, that's quite alright.

- Harry Pollock

The problem of who should be admitted to university is discussed from time to time. I am not in favour of simply admitting anyone who wants to come. We cannot care properly for too many students. We must have some criteria of selection. Obviously any student with excellent marks from high school has a good case for admission. What about the remaining places?

Evidently there are a lot of students whose high school marks are merely good, who don't belong in university at all (at least not till they are older). On the other hand there are just as many whose marks are poor, but who, because of imagination and ability might profit greatly at university. Now the high school teachers are by far in the best position (potentially at any rate) to identify these students: students who have a real flame burning, but have just never made it in the cold mechanical world of marks and grades.

Observe that the system of sessions I have described in section XIII is just what is needed to establish and maintain close professional and personal contacts between certain university professors and high school teachers (certainly those teaching Grade XIII will gravitate towards the university-oriented sessions). These contacts could and should be used for purposes of university admissions. The operational principle here, surely

a valid one, is that I will accept in my classroom any student forwarded to me with the recommendation of a teacher I know and respect.

In addition, this kind of contact will provide continuing specific feedback, as the teacher is able to follow the progress of his former student. Over the years, the teacher will become more effective in his role as associate admissions officer, for he will be able to observe those qualities of his students which seem to flourish in the university. And, incidently, he will come to a clearer idea of what those qualities are which are worth developing in all his students.

The teacher can also use these contacts to get advice on a discipline-specific problem or to get assistance in evaluating the work of a student. It is not unusual for a high-school student to produce an exotic paper on some subject, usually wild and disorganized, but often showing imagination and even genius. It is difficult to evaluate these papers and direct the student in further work, but often the right advice, in terms of which ideas to tame and consolidate, is crucial for the development of the student, just as the wrong advice (I can't make head or tail of this; settle down and try to pass a test for a change) can be destructive. A university professor has a perspective to offer which might sometimes be of help. He is pleased to assist in this way, because he may be helping a good student and a university to get together who might otherwise never meet.

Let me emphasize how important it is, for all this to happen properly, that this form of continuing communication between high school and university operate not at an official administrative level, but at the informal personal level of teacher and professor as professional colleagues.

XV Queen's

If we are to forego the advantages of greater size, we must be very sure that we have actually the merits which we claim.

- Principal Mackintosh 1951

Queen's is a rather special university. It is both large and small, both close and widely spread. I think that a system along the lines I have outlined can be implemented at Queen's. It will not be easy. At the beginning we will lose many of our students for many reasons. But gradually we will find our feet and we will become known and it will be quite simply true that the best students in Canada will come to Queen's. And a university's most precious resource is the quality of its students.

It will take time and persistence. But we will never get there if we don't begin.

XVI Acknowledgements

My mind, he said, rebels at stagnation. Give me problems, give me work, give me the most abstruse cryptogram, or the most intricate analysis and I am in my own proper atmosphere. I can dispense then with artificial stimulants.

- Sherlock Holmes

My greatest debt is to the students who have come and talked to me for hours about the things they want to learn and the way they want to do it. This paper has been written for them.

I have been strongly influenced by the books I have listed below. I have made almost no attempt to trace particular ideas to particular books; it would have been difficult to do so. Whitehead's superb book has had the greatest impact on me. Anyone who has not read the first three chapters this year should do so, and discover how well these ideas can be set down. The only depressing thing about Whitehead's essays is that they were written 50 years ago, and little has changed for the better. But I have some hope that these essays might now be timely. Martin, in his relatively recent book listed below, suggests that university faculty are ready to move away from the specialized "guild-oriented" concept of higher education, toward a more general, integrative and humanistic one.

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