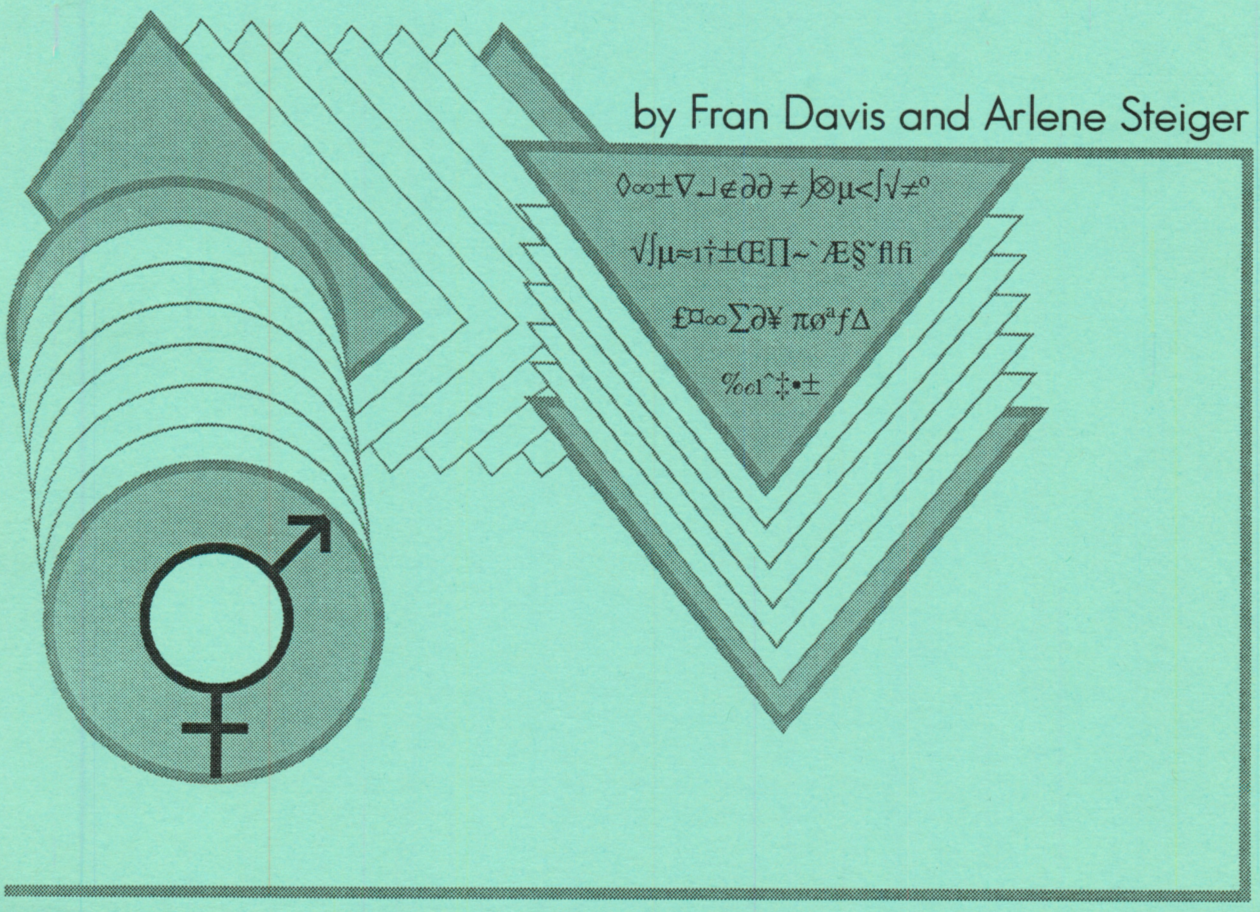
Gender and Persistence in the Sciences

by Fran Davis and Arlene Steiger



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Fran Davis
Arlene Steiger
June 1996

ABSTRACT

This research was undertaken to explore the reasons for women's under-representation in science, particularly in pure and applied areas of science. The study was based upon two hypotheses: first, that there is a complex set of gender differences in attitudes to science learning, and second, that the vision of science held by instructors interacts with these gender differences in ways which serve to perpetuate the ratio of men to women in the sciences.

With a view to testing the first hypothesis, a cohort of 64 students entering science at Vanier College was interviewed and asked to complete an attitude inventory in A'93. This sample included men and women in both Health and Pure and Applied Sciences as well as some in a remedial science programme and some in an enriched stream. Interviews focused upon student motivation for studying science, attitudes to such study, and their experience of this aspect of their education. In their second and third semesters, these students were regularly contacted by the researchers, and those who transfered to other Cegep programmes were asked to come for concluding interviews and attitude inventories at once. The rest of the group was interviewed and completed attitude inventories just before they graduated, most in their fourth semester, but some in their fifth.

The interviews were carefully transcribed to preserve the words and tones of each student. These transcripts were then coded in such a way as to extract from each the important aspects of motivation, attitude and experience. These coded interviews provided the researchers with sufficent information to ascertain certain specific persistence patterns which, in turn, began to explain why students make the decisions they make, what are the prevailing attitudes to science and how these attitudes shape behaviour, and how the study of science is experienced by students of different background, gender, ethnicity and achievement level. Attitude inventory data echoed and enriched this narrative.

With a view to testing the second hypothesis, 13 science teachers from all science subjects were interviewed as to their views on the kinds of motivations, attitudes and behaviours which successful science students ought to demonstrate. These teacher attitudes were then compared with those of the students to ascertain which students, if any, matched the profile provided by the teachers.

The study suggests very strongly that a complex set of gender differences among students not only exists, but can be seen to shape persistence patterns in the sciences. While the men in the study were motivated mainly by desires for specific prestigious careers and thus had not only instrumental attitudes to their learning but a particular kind of determination to persist, the women tended to look for a more transformative experience and were thus more sensitive to and shaped by the day to day aspects of their education. Teacher attitudes tended to be largely instrumental, like the men's, and the teachers tended to value those behaviours which were most congruent with those of persisters in the pure and applied sciences.

I. INTRODUCTION

A. BACKGROUND

The research project reported in these pages was undertaken in the fall of 1993 as part of an effort to better understand the factors influencing the persistence of women in the sciences. This work has been motivated by a range of concerns about the pattern of women's participation in the sciences, and most particularly, about their under-representation in the area of pure and applied science at the post-secondary level. Recent statistics confirm that the number of women in these areas remains disproportionately low at the university level, in spite of the large increases in the proportion of women students in most other disciplines (Canada, 1991). Unlike the figures for women's participation in post-secondary education in general, the number of women in engineering and the physical sciences has increased only marginally since 1975, and at a rate which is unlikely to alter substantially the relative absence of women in decision-making positions in these areas at the university level. At the master's and doctoral levels in these areas, women are grossly under-represented. Although the proportion of master's degrees awarded to women across Canada rose to 45% in 1989, and the proportion of doctoral degrees earned by women reached 30%, in engineering and the applied sciences only 12% of the master's degrees and 6% of the Ph.D.'s went to women (Canada, 1991). Furthermore, what increase there has been in the proportion of women in these areas throughout the eighties and early nineties may reflect an increase in special funding and affirmative action for women. However, between December 1994 and February 1995, many special scholarships and grants ear-marked for women students, such as those administered by the AUCC and NSERC, were cancelled (Berkowitz, 1995).

Here in Quebec, there is evidence to suggest that the under-representation of women in this area of science is likely to persist. While 20% of the students enrolled in the bachelor of engineering programme at the Ecole Polytechnique de Montréal in the Fall of 1994 were women (Université de Montréal, 1994), it is instructive to consider that the proportion of women entering engineering and architecture at McGill University has remained stable at the 20% mark since the mid-eighties (McGill University, 1994). Furthermore, statistics such as these are often misleading since they tend to group engineering and architecture students together, a manipulation which obscures the fact that women are more equitably represented in faculties of architecture. One university registrar with whom we spoke wondered privately whether we have not reached a standstill in the recruitment of women into the applied sciences. Indeed, in the United States, where the patterns of women's participation in the sciences are similar to those in Canada (Rosser, 1995), researchers report that, after an initial increase in the number of women majoring in computer science, we are now witnessing a decrease in their numbers.

In this project, we have sought to explore the extent to which women's orientation to and experience of science education at the Cegep level might help us to understand their lower rates of participation in the pure and applied sciences at the university level. We therefore undertook to document gender differences in the experience of science education among approximately 60 students over a two year period at Cegep and to relate these differences to their persistence in the sciences through the Cegep years and into university. Thus, although our concern is with the participation of women in the sciences, men have been included in the sample population from the beginning of the research. We have insisted upon this inclusion for several reasons. While it is certainly legitimate to opt to explore the experiences of women by looking exclusively at these experiences, it seems to us that when we talk about women's experiences and women's needs in science education, there is, in fact, an implicit comparison with those of men, and we would do well to make that comparison

explicit. This we have sought to do; however, the reader will discover that, in our view, gender is a category which enters the analysis in ways more complex than the notion of "difference" implies. In fact, we have sought to develop a framework which would allow for the appreciation of the diversity of gendered experiences in the belief that it is this diversity which science education has thus far failed to adequately accommodate.

Another reason for including men in the sample is related to our view that men's experiences in science must also be treated as problematic if we are to avoid adopting them as the implicit norm by which women's experiences are evaluated. By the same token, it seems to us that the ideological models which shape science education also need to be interrogated and understood. Hence, the present research design includes analysis of a set of interviews with a representative group of science teachers who remind us of the extent to which ideas about science education are constructed. Their visions of science, how it is practised, and how it can best be learned, take on particular significance in the context of what the students have to say.

B. SAMPLE

The cohort of students whom we have followed since their entry into Cegep in the Fall of 1993 is a self-selected group, drawn from a larger sample. In June of 1993, we sent a letter (Appendix 1) to 120 students inviting them to participate in the research project. The names of these 120 students were selected at random from among the names of students who had been accepted into one of the science programmes at Vanier College, although we did control for sex as well as type of science programme (Health, Pure and Applied, or Access) during the selection process. By August of 1993, 64 students had indicated that they would be willing to participate. In August of 1994, one of these students left the country and was subsequently dropped from the sample. As Table 1 reveals, the sample is thus made up of 40 women and 23 men, distributed between the Health and Pure and Applied Science Programmes, with four students coming from the Access Programme, a one semester programme designed to help students with lower marks meet the entrance requirements of the science programmes.

Table 1: The Sample, 1993

TABLE OF ENTRY BY GENDER			
ENTRY	**GENDER**		
Programme	**Women**	**Men**	**Total**
Access	2 50.00% 5.00%	2 50.00% 8.70%	4 6.35%
Health Sciences	18 72.00% 45.00%	7 28.00% 0.43%	25 39.68%
Pure & Applied Sciences	20 58.82% 50.00%	14 41.18% 60.87%	34 53.97%
Total	40 63.49%	23 36.51%	63 100.00%

Clearly, it would have been preferable to have obtained a sample in which men and women were more equitably represented. Had we known then what we do now about the ways in which men connect to the college milieu, we might have more accurately predicted the shortfall of men volunteers. Be that as it may, however, we decided to proceed with the sample our selection process had yielded. On the positive side, our "volunteers" proved to be an extremely reliable group and not a single student failed to appear for her or his interviews or to provide the necessary survey information.

By September of 1993, all of the students who had indicated a willingness to participate in the research had been contacted by one of us, had signed or had organized to have a parent sign a consent form, and had completed a standardized inventory of their attitudes to physics (Appendix 2). By mid-October all 64 of the participating students had been interviewed by one of us, using a pre-tested interview schedule (Appendix 3). These interviews, which generally lasted between 40 minutes and one hour, were recorded and transcribed. The procedure for coding and analysing this data is discussed more fully below.

Over the next several semesters, we maintained systematic telephone contact with each of the participating students. By the end of the first semester, a few of these students had already made the decision to leave the science programme in which they were enrolled. We opted to interview them as soon as possible after they had completed their programme transfers in an attempt to capture their experience of science education while it still felt fresh and relevant. Thus, each of the students was interviewed twice; however, the second interview did not take place in the same semester for each student and, as a general rule, only those students who received DEC's in either Health or Pure and Applied Sciences were actually interviewed in the final semester of their Cegep careers. The interview schedules used in these final interviews are presented in Appendix 4 and 5. At the time of the final interview, each student once again completed a Physics Attitude Inventory.

C. CLASSIFICATION OF THE STUDENT INTERVIEWS

By the Fall of 1995, therefore, using college records and the information which we had obtained directly from the students themselves, we were able to identify the "non-persisters" in this group. Since we were interested in understanding women's persistence in science beyond Cegep and into university, we defined non-persisters as those students who had switched out of a science programme during the course of the Cegep years, OR, having obtained their DEC's in either Health or Pure and Applied Sciences, reported that they did not plan to continue in the sciences after Cegep. Persisters were divided between the health and biological sciences and the pure and applied sciences based upon their declared intentions for their next stage of study. Thus, for example, a young woman who graduated from Cegep with a DEC in Pure and Applied Science but who planned to pursue a bachelor's degree in biology at university was classified as being a health and biological sciences persister. Using this classification scheme, we created three broad persistence "pathways" to describe our student sample at the end of the study. Table 2 illustrates the persistence pathways, chosen by men and women, using these broad and general categories. This fairly simple analysis helped us to begin to identify those areas in which gender differences seemed to be significant.

Table 2: Persistence Pathways for Graduating Students

EXIT	GENDER		
Pathway	Women	Men	Total
Health and Biological Sciences	21 84.00% 52.50%	4 16.00% 17.39%	25 39.68%
Non Persistence	15 62.50% 37.50%	9 37.50% 39.13%	24 38.10%
Pure and Applied Sciences	4 28.57% 10.00%	10 71.43% 43.48%	14 22.22%
Total	40 63.49%	23 36.51%	63 100.00%

On the basis of this data, for example, we began to see that, while the proportion of men and women who failed to go on to university in the sciences was roughly equal, significant gender differences did emerge when we looked at how students chose to persist in the sciences. As Table 3 illustrates, 72% of the women who entered Cegep in Health Science obtained DEC's and opted to continue to university in that area. On the other hand, 35% of the women who entered Cegep in Pure and Applied Science also ended up in the health and biological sciences by university.

Table 3: Persistence Pathways for Women

ENTRY	EXIT			
Programme	Pathway			
	Health Sciences	Non-Persistence	Pure & Applied Science	Total
Health Sciences	13 34.21% 72.22% 65.00%	5 13.16% 27.78% 35.71%	0 0.00% 0.00% 0.00%	18 47.37%
Pure and Applied Sciences	7 18.42% 35.00% 35.00%	9 23.68% 45.00% 64.29%	4 10.53% 20.00% 100.00%	20 52.63%
Total	20 52.63%	14 36.84%	4 10.53%	38 100.00%

The 10% of women who remained in Pure and Applied Science stood in sharp contrast to the 42% of men who opted to continue in the area (Table 4).

Table 4: Persistence Pathways for Men

ENTRY	EXIT			
Programme	Pathway			
	Health Science	Non-Persistence	Pure & Applied Science	Total
Health Science	2 9.52 % 28.57 % 50.00 %	3 4.29% 42.86% 37.50%	2 9.52% 28.57% 22.22%	7 33.33%
Pure and Applied Science	2 9.52 % 14.29 % 50.00 %	5 23.81 % 35.71 % 62.50%	7 33.33 % 50.00 % 77.78 %	14 66.67%
Total	4 19.05 %	8 38.10%	9 42.86%	21 100.00%

We began to see that this shift from pure and applied science to the health and biological sciences was a way of persisting in the sciences which was linked to gender for women, and we began to suspect that such persistence "pathways" in the sciences might be one of the keys to understanding how gender issues are related to the decisions reflected in the national statistics. Persistence pathways became the basis for organizing our data as we turned to analyse the interviews. Using this data, we created groupings which allowed us to focus on the similarities and differences among students who shared a single persistence experience and these groupings, in fact, structure the chapters of this report. All of this, however, was preceded by a good deal of work developing and refining a methodology to code and analyse the hours of interview material which had been recorded and transcribed.

D. METHODOLOGY

The first stage of the coding process involved the generation of coding categories. In this work, as in the later stages of coding and analysis, we were very much influenced by the "grounded theory" approach to qualitative research, particularly as it has been articulated by Strauss and Corbin (1990) and as it has been adapted to feminist research concerns by Kirby and McKenna (1989). In keeping with the commitment of these researchers to allow the data to structure the theory, we constructed out of the students' discourse the categories which were to become the building blocks of the analysis, applying a process which Strauss and Corbin call "open coding". We used a small sample of interviews to generate the central coding categories and to begin to delineate the dimensions in terms of which these categories could be understood. For example, it soon became apparent that it would be important to carefully record the ways in which students connected to the sciences. Hence, the first coding category "interest in science" was generated with its attendant dimensions, allowing us to identify both qualitative and quantitative aspects of that interest. The next category "science career" quickly followed. By the fourth or fifth interview, we felt that we had a set of coding categories which could be meaningfully applied to the rest of the interviews in the sample. Occasion-

ally it was necessary to add new categories and new dimensions to our repertory but this became an increasingly rare occurence as the work progressed. The categories used for the coding stage of the analysis are presented in Appendix 6.

In practice, when a piece of student discourse was coded, it was physically transferred from the text of the transcript, along with an identification code, to a card bearing the name of the category and the identification code of the student. We worked very hard to preserve the integrity of student speech and to respect the coherence of their ideas by reproducing significant portions of text verbatim. The entire coding procedure, repeated once again for the final interviews with each of the students, was immensely time consuming, even with the use of the computer for the blocking and transfer of text. However, the very intensity of the process allowed us to enter the students' lives and to share in their understandings in a way which might not have been afforded by a less "hands on" methodology. As we prepared to begin the final stages of the analysis, we were able to use information from the coding process to further refine our persistence groupings. This coding process helped us to see that students who entered Cegep in health sciences and who graduated with the intention of continuing in this area of the sciences had a different persistence story to tell than those who began their careers in pure and applied science. It also became clear that there were students whose persistence in the sciences had been so very much shaped by a desire to go to medical school that they represented a distinct group. Among the non-persisters, we distinguished those who left the sciences for another programme at Cegep from those who achieved DEC's in the sciences but went on to programmes of study outside of the sciences. After careful consideration, we also opted to treat the students who had been highly successful in the sciences but had entered university in different disciplines as a separate group. The resulting organization of data is, as has already been mentioned, represented by the chapter headings of this report and each chapter can and should be read as a different persistence story.

To create these stories, we adapted Strauss and Corbin's approach to the building of a paradigm model in the analysis of qualitative data. Here our goal was to recombine coding categories in such a way as to create a narrative structure which would help us to understand how a particular set of motivations, attitudes, and experiences were connected to a particular path through the sciences (or out of the sciences). The stories would, of course, also be shaped by the longitudinal nature of the research, as represented by the two interviews which we had transcribed and coded. As we worked on this aspect of the analysis, it became clear that in the movement to increasingly abstract levels of analysis, we risked losing the individual stories out of which the analysis had grown. In the interests of preserving the particularity of the individual histories for further research and in an effort to render the entire process by which generalizations are drawn more transparent to the reader, we opted for a narration which placed the individual students firmly at the centre of the story. The result is a narration rich in detail, we think, but also more cumbersome than a more constructed product. As a compromise, we offer those readers who may be less inclined to pursue the details of the biographies of each student on each persistence pathway a two page summary at the beginning of each chapter, highlighting the characteristics which distinguish the particular group under discussion.

From the beginning of the research, we suspected that physics as a subject played a particular role in students' decisions with respect to persistence in the pure and applied sciences. Since our suspicions were echoed by both students and teachers who described physics as a gatekeeper to this area of the sciences, we asked students participating in the research to complete a standardized inventory of their attitudes toward physics at both the beginning and the end of the research. For this purpose we chose to use an adaptation of the Mathematics Attitude Inventory developed by Richard

Sandmann (1979) with which we had had considerable experience. Clearly the information yielded by such an instrument in the context of a small sample such as ours is of limited value; however, it did seem to us that this data might serve as a means to verify some of the patterns which we felt were emerging from the interviews. We focused particular attention on the changes in students' attitudes toward physics over the course of the Cegep years as these were measured by the inventory, and we checked to see how these were affected by gender, students' marks, and the persistence groupings which we had established. The results, once again to be read without attaching undue importance to them, suggested that we were on the right track in our organization of the data. We were not surprised to discover that on three of the six scales of the inventory (Perception of the physics teacher, Enjoyment of physics, and Motivation toward physics) students' marks had a significant effect on changes in their attitudes. As Table 5 indicates, these changes were in the direction one might logically expect within what has become a familiar pattern; that is, the students' attitudes toward physics tended to become more negative as they were exposed to the subject, and the students with the lowest marks were the ones who reported the largest negative shifts in attitude.

Table 5: Significant Effects of Students' Marks in Physics on the Physics Attitude Inventory

Scale I: Perception of the Physics Teacher	
Average Physics Mark	CHANGE 1
90-100	-1.58333333
80-89	-0.60076923
70-79	-1.37515385
60-69	-2.52100000
Below 60	-7.53507143
Scale V: Enjoyment of Physics	
Average Physics Mark	CHANGE 5
90-100	-1.83333333
80-89	-1.53846154
70-79	-0.61538462
60-69	-3.61800000
Below 60	-5.85714286
Scale VI: Motivation Toward Physics	
Average Physics Mark	CHANGE 6
90-100	-2.66666667
80-89	-3.26923077
70-79	-1.35653846
60-69	-3.19492308
Below 60	-5.64285714

We were, however, interested to note that our persistence groupings, adjusted to allow for statistical manipulation by eliminating the smallest of the groups, also significantly influenced two of the sub-scales (Anxiety and Enjoyment). It is consistent with our interview information, to which we shall shortly turn, that it is the students who enter and exit Cegep in Pure and Applied Science who should register the least amount of change on these scales (Table 6). The substantial drop in scores on the enjoyment scale for both groups of non-persisters, that is non-persisters who enter Cegep in Health Science and those who enter in Pure and Applied Science, matched by the drop recorded for students who persist in the health sciences, also served to confirm our sense that attitudes to physics were related in important ways to patterns of persistence (Table 6).

Table 6: Significant Effects of Persistence Pathways on the Physics Attitude Inventory

Scale II: Anxiety / subgroups of ENTRY-EXIT* (entex)

ENTEX	CHANGE 2
H–H	4.75000000
H–N	1.28571429
P–H	1.77777778
P–N	4.03571429
P–P	0.54545455

Scale V: Enjoyment / subgroups of ENTRY-EXIT* (entex)

ENTEX	CHANGE 5
H–H	-3.62500000
H–N	-3.22414286
P–H	-1.27388889
P–N	-5.14285714
P–P	-0.09090909

***Note:** H = Health Sciences
N = Non-persistence
P = Pure and Applied Sciences

Gender seemed to have the least effect on changes in attitude over the Cegep years (Table 7), with a significant difference in the rate of change occurring only on the scale measuring the perception of the physics teacher. We were interested to note that it is the men in the sample who experienced the largest negative shift in attitude toward the teacher. While speculation about the causes and implications of this finding are tempting, we are inclined to resist, given what has already been said about the difficulty of drawing conclusions from data based on such a small sample.

Table 7: Significant Effects of Gender on the Physics Attitude Inventory

Scale I: Perception of the Physics Teacher

Gender	CHANGE 1 / LSMEAN
Women	-1.91257895
Men	-4.79871429

D. THEORETICAL FRAMEWORK

Gender enters the analysis in two different but not unrelated ways. On one hand, we have found that by looking at students in terms of the way they persist in the sciences, we can speak meaningfully of a constellation of motivations, attitudes, and experiences, which admit of individual differences but also speak to the existence of a group coherence. Thus, for example, our analysis suggests that there are important ways in which students who continue in pure and applied sciences distinguish themselves from students who persist in the area of health and biological sciences. It seems important to focus on this group coherence, as part of an effort to understand which students are selected into the sciences and on what terms. Gender here finds expression, we think, in the fact that women are over-represented in some groups and under-represented in others. On the other hand, within the various persistence categories and across these categories, we find evidence of gender differences, too consistent to be ignored. Some of these differences emerge as part of the interview data and we save discussion of these for the end of this report when the reader is more familiar with the students and their stories. Other gender differences, however, emerged from the statistical profiles which we drew of the students and they allow us here to address a few of the central issues involved in the framing of the analysis.

For example, it has become commonplace to recognize that women's achievement in the sciences equals that of men (Lafortune, 1986; Lafortune and Kayler, 1992; Rosser, 1995). Indeed, our own sample in which the women's marks equalled and, in fact, surpassed those of the men, reflects this general tendency. In reviewing the relationship between achievement level and persistence in our sample, we were particularly drawn to focus upon the marks which students achieved in their physics courses over their Cegep careers because of the previously mentioned gate-keeping function of physics. Using average marks in physics as one marker of achievement, we were able to begin to trace interesting gender differences in the way that achievement is associated with various patterns of persistence for these students (Tables 8 and 9). For example, we were struck by the fact that while all four of the young women who were persisters in the pure and applied sciences achieved physics marks of over 80% (Table 8), achievement in physics as measured by such marks seemed to be less important for the men who planned to continue in this area (Table 9). In fact, one of these young men had an average physics mark of under 60%. We would caution here that these statistics reflect the particular reality of a small sample. They serve nonetheless as a suggestive point of departure because they echo the findings of other researchers in the field who identify high achievement as one of the factors affecting persistence in science for women (Zuckerman, Cole, and Bruer, 1991).

Table 8: Average Physics Marks and Persistence Pathways for Women

Average Physics Mark	EXIT Pathway			
	Health Science	Non-Persistence	Pure & Applied Science	Total
90-100	4 66.67% 20.00%	1 16.67% 7.14%	1 16.67% 25.00%	6 15.79%
80-89	4 44.44% 20.00%	2 22.22% 14.29%	3 33.33% 75.00%	9 23.68%
70-90	8 80.00% 40.00%	2 20.00% 14.29%	0 0.00 0.00	10 26.32%
60-69	1 20.00% 5.00%	4 80.00% 28.57%	0 0.00 0.00	5 13.16%
Below 60	3 37.50% 15.00%	5 62.50% 35.71%	0 0.00 0.00	8 21.05%
Total	20 52.63%	14 36.84%	4 10.53%	38 100.00%

Table 9: Average Physics Marks and Persistence Pathways for Men

Average Physics Mark		EXIT	Pathway	
	Health Science	Non-Persistence	Pure & Applied Science	Total
80-89	1 25.00% 25.00%	0 0.00 0.00	3 75.00% 33.33%	4 19.05%
70-79	1 33.33% 25.00%	0 0.00 0.00	2 66.67% 22.22%	3 14.29%
60-69	2 28.57% 50.00%	2 28.57% 25.00%	3 42.86% 33.33%	7 33.33%
Below 60	0 0.00 0.00	6 85.71% 75.00%	1 14.29% 11.11%	7 33.33%
Total	4 19.05%	8 38.10%	9 42.86%	21 100.00%

Many explanations, too many to review here with any degree of fairness, have been offerred for why this pattern, in which only the "best" women persist, should hold sway. In recent years, those models which see in this pattern an index of the relatively lower levels of confidence among women have exercised considerable influence in the area of pedagogical research (American Association of University Women, 1990; Mura, 1986; Robertson, 1990; Zuckerman, Cole, and Bruer, 1991). Indeed, as we listened to the stories which these students told about their experiences in and perceptions of science education, we found evidence to substantiate this view. The women in our sample do, in general, regard their futures more tentatively than do the men in the sense that they see their achievements as being more fragile, their successes as being more susceptible of reversal. They are more likely to complain about being constantly anxious; they worry more about their performances and suffer more from self-doubt. However, without dismissing the importance of these issues in these women's lives, we want to caution against a too hasty embrace of low self-confidence as an explanatory model for the relative absence of women in the sciences. We have written elsewhere (Davis and Steiger, 1994 and 1995) about some of the difficulties which we have encountered in applying this construct in this area of research. What we would particularly emphasize here is that by focusing on low self-confidence in women, we are discouraged from asking questions which seem at this stage to be of equal importance. For example, if we look only at the young people represented in Tables 8 and 9, one might legitimately ask how it is that the men, with very modest achievement records in physics, feel that they can and should persist in the pure and applied sciences. Or one might be drawn to the cases of the three young women, represented in the centre column of Table 8, who, with physics marks averaging over 80%, (and very similar marks in their other science courses) become "non-persisters". Our research suggests that we need to give serious consideration to the ways in which such instances of non-persistence are, in fact, based upon reflective, purposeful decision-making. The interviews shed light upon the circumstances and the terms in which such decisions are made. They have sensitized us to hear similar themes in the stories of other students, overwhelmingly women, who, though they remain in the sciences, at least at this stage, leave the pure and applied area in large measure because they cannot relate to its subject matter. In short, we would argue that self-confidence is only one factor here and that, among our students, it is rarely determinant. Our interview data suggest that the interests and visions which students bring to their studies are of equal, indeed greater importance, in the matter of persistence, and this same data offer compelling evidence of the positive role which such students might play in a science better able to accommodate them.

As we were drawn into the stories of these young people's lives, we came increasingly to feel that a broad conception of gender, one more closely related to the idea of culture, was the one best suited to analysing our data. Using this approach, we have explored what the students say as expressions of people participating in different gender cultures, their actions conditioned by different systems of value and expectation, and also by the ways in which gender is bound up with relations of power in the society. As we thought about gender in this way, we began to see that persistence in the sciences might represent a form of achievement with different gender meanings, that the act of persistence itself might be mediated differently by different gender cultures. One of the students whom we interviewed speaks about her experience in this regard:

> I feel I have more of a motivation than a man does. You know? A man is like, okay, well, many men have been there but I'm doing this and saying to myself, well I'm going to try and change this. You know? I'm going to try and be one of those women that's going to be up there and do that job just like a man can. Like a man feels like he's expected to. There's nothing much to it when you see another

> man. You know? I see my friend and he has a different motivation which is totally personal. As far as a man from a woman, men have already done that, have already so to speak proven themselves. I'm trying to prove myself and I'm trying to prove it for the women as well.

It is important to say that not all of the women who participated in the research share this woman's feelings about their achievements; nor do they all understand the impact of gender in their lives in the same way. Indeed this is precisely the point, since our work in this area reveals a continuum of gendered experiences more frequently than a dichotomy of masculine and feminine behaviours and roles.

This conception of gender has allowed us to pursue several different strands in the research data. For example, in the students' stories, as in the students' lives, issues of gender are very much involved with issues of race, class, and ethnicity and we have attempted, as much as possible, to capture the interpenetration of these different "cultures". The notion of culture has also provided us with a tool for problematizing the entry of men and women into the sciences. In this respect, our own work has been particularly influenced by those researchers who have emphasized the historical and constructed nature of the scientific disciplines and the ways in which masculine bias has been part of their development (Barad, 1995; Easlea, 1987; Harding, 1986; Keller, 1985 and 1992; Merchant, 1980). Researchers such as Hacker (1989), Tobias (1990), and Finkbeiner (1994) have explored the ways in which specific scientific cultures privilege certain forms of masculinity, disadvantaging those whose behaviours and orientations have been shaped by other experiences. Our own research moves in the same direction. Their conclusions find resonance in our own findings as we examine what teachers have to say about their teaching in this area. We begin, however, with the voices of the students.

II. STUDENTS ENTERING AND PERSISTING IN PURE AND APPLIED SCIENCE

A. SUMMARY

There are 11 students in this group: seven men and four women. They all enter Cegep in the Pure and Applied Science Programme (though one man and two women are in the enriched portion of this programme) and at the time of the last interview they all report plans to continue their studies in the area of pure and applied sciences (including computer sciences) at university. All the students in this group expect to receive a DEC in Pure and Applied Science, though one of the students plans to leave Cegep before completion of the DEC in order to take up a soccer scholarship. Because he anticipates continuing to build a science profile at this school and because he plans to enter university in architecture, we include him in this group. The students in this group span a wide range of achievement levels. At the lowest end of the spectrum are students with science averages which are below 60%. At the time of the last interview, these students are still struggling to amass sufficient credits to graduate. Three students finish their Cegep educations with science averages in the 70's and the rest of the students in the group achieve science averages of between 80% and 90%. The group includes some students from private high schools; however the majority of the students in this group attended public high schools before coming to Cegep. A range of ethnic groups is also represented and more than half of the students report speaking a language in addition to English or French.

The students in this group resemble Tobias' "first tier" in that they have personal and often fairly intense connections to the subject matter of science, usually in an area of pure and applied sciences. This is particularly true for the men in the group who talk about "always " loving science, tinkering with electronic gadgetry, living for as long as they can remember with a curiosity about how things work. The women, too, clearly enjoy science and take pleasure in the discoveries which they have experienced through it. They feel a connection to the subject matter of this area although they differ from the men in that their interest in science is more school mediated and less integrated into their daily lives. In the first interview, women as well as men say, with a great deal of certainty, that they want careers in the pure and applied sciences, particularly engineering. Of all the students, only one young woman expresses any degree of ambivalence about the appropriateness of this choice for her. In the students' stories, it is clear that their commitment to this area of science, grown out of interests and preoccupations which are important to them, is sustained by many aspects of their lives. Three of the men have fathers who were themselves trained in the sciences, two as engineers, and all of the students see their own entry into this area as a promise of security. In fact, many of the students understand the superior status of science in terms of job prospects, earning potential, etc. For the men, these career aspirations are further reinforced by fairly conventional desires with respect to marriage and family. They want to be "good providers". Moreover, with the exception of one woman in this group, all of the students have little interest in and, in fact considerable antipathy for, their non-science subjects. The majority of them identify physics as among their favourite subjects; they describe the sciences almost exclusively in terms of the physical sciences with which they are already familiar; and, although many would agree that there is work involved in being a successful science student, many more feel that abilities and talents which they sense they possess also play an important role.

They therefore embark upon their Cegep educations with a sense of being in the right place. They turn to their studies with a strong sense of preparing for career and they approach their work with a highly instrumental sense of what needs to be done. They pace themselves strategically

in terms of their expenditure of energies; seek out relations with peers to facilitate note-taking and problem solving; look to teachers to provide clear, uncluttered explanations of material in the classroom and helpful support outside of class when peer networks fail. Significantly, the majority of the students in this group report working only moderately in order to keep up. However, women students are over-represented among those who complain about workload and anxiety.

The two years of Cegep education serve to confirm these students in their original intentions, and this is true even for those students whose achievement levels are so low that persistence seems entirely problematic to an outsider. In fairness, it must be said that these low achieving students are among the minority of students in this group who express mixed feelings about the sciences at the second interview. Two women are also in this group. The dominant theme, however, is consolidation. Most of the students have chosen their careers quite precisely and speak about these choices with animation and a fair amount of knowledge. Their science educations have reinforced their sense of belonging in this area and, in fact, one finds little evidence that the students ever assume much distance from this world. Their friendship networks are remarkably confined to students in the sciences. Even outside interests are used to renew the energies which are then re-invested in academic work and one of the young men tells us that he avoids relationships with peers which might be distracting. Only the three lowest achieving students are drawn out of their studies by friendships and extra-curricular activities.

By the final and most specialized courses of the Cegep years, these students come to experience the fact that women are under-represented in the pure and applied sciences. They have interesting observations to make about the impact of gender in this area and significantly, among the high achieving students, it is the women who express a sense of marginality with respect to their futures.

For all of these students, the science subjects are the absolute centre of their academic experience and physics retains and expands its appeal. Many of these students do come, nonetheless, to take pleasure in their non-science courses; however, the science courses are the clear focus of their energies. They approach these with the instrumental orientation with which they began and which has served most of them extremely well, adjusting the amount of work they put into study in terms of their assessment of what is required. For some few, such adjustments have lightened the load; for most more hours are spent doing homework, although two men continue to talk about "a gift" which helps them do well in some subjects with a minimum of work. The students' discussion of their study habits sheds a good deal of light upon the relationship between their methods of study and their ability to sustain a sense of being in control. Once again, the women are over-represented among those to express anxieties and doubts in this area.

B. INTERVIEW ONE

1. Motivation

As the students discuss their motivations for entering Pure and Applied Sciences at the Cegep, the degree of consistency in their stories is striking. In fact, the range of reasons for studying science which they offer is narrow. Manuel explains:

> Let me put it this way. I've **always** thought about why things used to start since I was a child. Of course, I never actually applied...why they used to stand or why they used to lean or....Oh yes, I always used to ask that to myself. I always wanted to know the who, why, the 5 W's. I'm curious. But I never actually tabulated

> anything because I didn't have any physics in me when I was that young. But as time continued I started getting more background and more background and I could actually see why...my questions were answered, I'll put it that way.

Manuel's introductory remarks contain many of the themes which are central to our discussion. We emphasize first of all the way in which he locates his interest in the sciences in a distant past, in his own childhood. The word "always" appears frequently when these students discuss their interests in the sciences and these are often bound up with relaxation activities, hobbies, and games. "I've always been interested in just tinkering with things," says James "and so now it's more or less developing into the study of engineering." Occasionally a parent or a relative is involved in the pursuit. Alex mentions his mother when he talks about puzzles and mazes; Anthony says: "I really like planes .... My uncle started me on it and it just grew bigger and bigger. I want to go into technology and build better and bigger...." However, even when these others are present, it seems to us that the relationship between these students and the sciences is really a personal one, at times intensely so. Alberto tells his version of this story: "I like to build things. At home I have little papers and when I have nothing to do I build my future house and this and that ... I play around like that." It must be said, however, that these are the stories of the men in the group. All seven of them tell them. There are no exceptions.

The women also talk about interests in science that stretch back over time. However, they locate these interests, which are clearly of personal significance, in their school experiences. Anna traces her interest in pure and applied science to a tenth grade science fair project on satellites, begun with the encouragement of a cousin, which "went on and on". For Sharon, the source is numerous school projects, beginning in at least grade four. Mei Li explains her commitment to studies in the domain by saying "I like to do math and I like doing experiments." Later in this interview she returns to this attachment to math and, in the process, her discussion rejoins the importance of curiosity with which Manuel began:

> You like to discover something and I don't know how to put it....And a thing that's so ordinary that you think about it while you're learning and there's great theory in it. I like to know those things.

It is interesting that the orientations to learning of Mei Li and Manuel are quite different. Mei Li does not see herself as the possessor of a series of questions for which science has the answers. She celebrates the way in which theory can bring one to see the world differently. However, in Manuel's story, learning does not change him in any way. He has the questions; science has the answers.

The only other motivation for entering the sciences which occurs with any degree of frequency is related to career aspiration. Of the 11 students in this group, seven say that they want to be engineers of various sorts. There is also one architect, one physicist, and one computer scientist. It is striking how little ambivalence is expressed by these students when they talk about their future plans. Only three students report having given thought to an alternative career in the sciences, namely medicine, and by the first semester of their Cegep careers, two of these students have already abandoned this idea completely. If one thinks about these career aspirations as an index of how these students orient themselves to the future, then it seems fair to say that their approach is above all practical, and this is particularly true for the men.

While the women, like the men, see their career plans as growing out of their science interests (Anna describes a project which she enjoyed doing for school, the associated reading, and then the discovery that "there's actually a job that could involve sciences and math"), the men explain their career choices in other terms as well. Nick expresses the issues most clearly: "Well, I was inter-

ested in doing something important when I finish my studies ... something that makes good money to support a family and have a nice life." He continues: "I want to be going to work with a suit on or whatever....A good job....I don't know how to say it...a good job." Joseph, too, clearly has interest in the sciences per se, particularly things that have to do with electronics; nonetheless, finding a career which will allow him a "decent" income is an important motive for his choices. As he himself says: "[it was] pretty much all that was left that had the potential to give me some money in the future...." He elaborates on his desires to integrate these two criteria: interest and security. "Something concerning electronics ... something that's rare. I don't want something that 5,000 people are on a long waiting list for and even if they have Ph.D. they still can't find a job. That's useless. I want something that's in demand. I'm still looking for that."

In this respect the men's connections to the sciences are reinforced by fairly traditional aspirations in terms of marriage and families. All seven of the men say that they do want families some day. Alex's response is typical of the men in this group: "Yeah, I see myself with a family and, hopefully a good paying job and being able to support my family, you know, give my family what they want". The issue of supporting a family never comes up among the women. Susie says:

> I hope I'll be married. I want to have a job though. I don't want to stay at home as a housewife. I don't like being dependent on people. I want to work for myself. If after something happens when I'm married I can go back to the workforce and support myself instead of having the man always supporting me.

Although they all say that they would like to have children, they all recognize this desire as the source of potential conflict in their lives. At least, this is the way that we read the hesitation in their responses: "I don't know if I'm going to do that but I'm pretty sure I'll have my career first," says Sharon and Susie speculates: "...maybe one or two kids....I know probably the first year I would stay with them. Maybe I would put them in daycare or something or babysitters....I don't know." The problematic nature of the undertaking surely also underlies Anna's resolve: "I would make it work. I would like both."

Three of the students also mention that they have enjoyed good grades in the sciences and that this played a role in their decisions to continue in the sciences. However, the discussion of grades is really tangential to the importance of liking the sciences. Alex says: "I really liked taking the science courses. I did very well in chemistry and physics. And, so, like when it came time to do my selections, I wasn't sure what I wanted to do, but I knew I liked sciences...." In the same way, Manuel mentions, almost in passing: "My grades were fairly high last year so I thought I would be able to do it. Of course, I enjoy sciences and I see that they're related in our everyday life situation."

Of the eleven students, only one expresses ambiguous feelings about the sciences and that is Susie. She begins: "I'm not sure why I'm in the sciences now. I went in but now I don't know if I should be in there. I don't know where to go so for now I'm just going to stay in there until I find out what I want to go into." She elaborates in some detail:

> I don't know if I like it [science] or if it's because I'm doing good in it. I guess I'm dividing everything into what I don't want to go into. I'm putting out the stuff I really don't want to go into like law - for sure, I'm not going there - and I don't want to go to health. The only two things left for me is business or science but I don't know if I want to go into accounting because I know a lot of people are in accounting ...and they don't have much jobs....

Finally she says: "there are a lot of things I don't know. There are a lot of things in science that I'm learning but I don't see how I'm going to use it in life....I do it because I have to do it because if I don't

know how to do it I don't get my marks." For the moment, Susie clings without much conviction to her brother's suggestion that she go into computer science. "I don't know if I want to sit in front of a computer for the rest of my life," she worries. On the other hand she reasons: "I don't see myself designing and building and thinking of technology for airplanes and things." In the final analysis, she reassures herself: "If I go in the sciences it's easier to switch to another field. Like you have the highest academic thing, I guess...."

Of the other students in this group only Anna talks about interests which might take her out of the sciences. She tells us of her interest in video communication and her achievements in English. "I love writing," she says. For the rest of the students, however, the strength of their attachment to the content of the sciences is matched by the intensity of their aversion to their non-science subjects. As they describe their experiences in their non-science courses, one is struck once again by the similarity of their perceptions. Alberto says:

> I hate English, not that I hate English, I do good in English but I don't like English....I like math because it's right or it's wrong....In English, oh, it could have been this, it could have been that, you could write this, you could write a little bit more on that, you have to read between the lines....You know?

Anthony says: "Humanities I can't stand....My English, well, English is normal, you read. I don't think I'll really need that. I mostly concentrate on my concentration courses and I don't do a lot of work on the others." "I'll put it this way," says Manuel, "I put my math and physics and chemistry first and then my other subjects." Alex and Joseph also make it clear that they find nothing to capture the imagination in the non-science world. "I like classes that have, like, you know, a formula kind of thing," explains Alex. "...You have to figure something out....I don't like things where you have to remember dates and people and everything." Some of the students do talk about working in their non-science courses; however, their descriptions make it clear that for them the work is a struggle. Joseph observes: "I try and give it all I have" but then he goes on to explain:

> Let's say I look at something on T.V. or I read about something I always wonder about how it works - whether it's physics or chemistry because it depends on what I'm reading. I wonder how it works and what makes it tick. In English there's no such thing. It's just an explanation or by heart and that's it. Just understanding. But in mechanics and chemistry there's something...like something that makes it move.

Susie complains: "In English you have to use your imagination. You take stories take parts because there's a lot of symbolism and imagery and all that stuff but I don't pick it up....I like sciences better than English. I hate languages. I don't know why." Since most of the students come to these courses with low motivation, they count, with little real optimism, upon the teacher to sustain their interest. James says of his experiences in English, "it's a very monotone subject and if they don't bother explaining it well then students get turned off." As Mei Li says: "...if I'm not in science, I will get very boring. I just don't want to go to class. If I am in science I really enjoy the class and I like to be in the class."

As already suggested, several of the students say that their spare time is spent doing what they perceive as science related activities. "Some of it. Well you could say most of it," says James. Joseph describes doing various kinds of tinkering and repairs around his house. He also reports enjoying reading but "I'm not much for novels like those big 500 page books and all that," he points out. He reads Popular Mechanics, Popular Science and "science articles or anything concerning

science". This seems to be particularly true for the men. Nonetheless, Sharon also reminisces about a time when she raised tropical fish with great interest and she tells us that recently she has been doing some reading in the area of quantum physics on her own. Aside from these activities all of the men report being interested in sports. Most of them pursue some sport actively, and, of course, Alberto is a serious soccer player. The women seem to have a slightly wider range of pastimes, including piano, gymnastics, reading, and travel. Anna tells us "you have to have a life. You have to try and fit that in. You can't just be in school and that's it...." It seems fair to say that for all of these students, science education is seen as an investment in the future and because of this they attempt to give it priority, quite self-consciously balancing it against other claims: a part-time job in Alex's case, a heavy schedule of practices and games for Alberto, work in a family business for Joseph. Most of them see their education as following a straight course which ends where career begins. Although two of the women talk about the need to refresh one's knowledge in order to keep up with technological change, only Sharon voices a conception of education which goes beyond preparation for career: "[I hope for it] to go on and on and on," she says.

The view of science education as a route to security is one which many of the students see as being shared by their families. Manuel, who would be the first university graduate in his family, explains his parents' ideas here: "It [education] has to be a good thing if you're going to do something with it. If you're just in school for the sake of it they disagree with that." Susie says: "[My mother] wants me to have a good education so that I can get a good job and support myself after if anything happens like in the family." Within this context, she thinks about following in her brother's footsteps into engineering, in spite of his suggestion that she enter computer science. A few students mention relatives or family friends who are seen as having been influential in making the field of engineering seem attractive. Three of the students have parents who were themselves trained in some area of the sciences, two in engineering; however, at this stage, only James identifies his father as a source of specific encouragement: "My Dad has always been interested because he's an engineer and so he's gotten me interested in the same thing." We are told that Nick's father is also an engineer.

2. Attitude

The students' discussion of the sciences and of science curriculum is, not surprisingly, shaped by their experience to date in this domain. For the most part, they define science as physics, math, and chemistry and they are, even at this relatively early stage in their educations, convinced of the relationship between the subjects which they study. James says: "I'd say it's anything to do with basically physics and chemistry. Anything having to do with those subjects say are in the sciences" or as Susie says in searching for a way to define science:

> I don't know how you explain it. I think of it more as the pure sciences. How the world works and how everything...for physics...everything we do has some physics in it. The way you walk, how you stop, why things are there...I guess it's more like how everything in the world and the universe functions. I don't know....

"[Science subjects] are connected," insists Joseph.

> Like the physics teacher said very clearly that calculus is made for physics. And I see it....Chemistry I don't see the relation between math and chemistry and physics. There is a bit between physics and chemistry of course. Maybe I haven't learned enough yet but I've seen a bit there. There has to be some. They are connected in some way.

Alex ventures this explanation: "They give you those basic three because they're the ones that give you the most information on topics...."

As we listen to these students we come to see them as people who are embarking upon their science educations with a basic sense of themselves as being well-suited to this endeavour. The majority of the students share Joseph's sense of a basic fit between science students and their educations. In response to a question about improving science education to make it more attractive to young people, he says:

> I don't think you can...If you have good teachers who are motivating .... A student has to like the subject ....Some are more inclined to music and art and some towards commerce. You know like business and you work in groups to make something work. Others like science and they like the logical procedure in the scientific method and all that....They like it. So a good teacher and a student who wants to succeed is all you need I guess.

There is also a consciousness that Pure and Applied Science has an elite status in the academic milieu. As Alberto observes: "I find that people hear in Pure and Applied and Health Science or anything in the sciences it's like, wow! That's big." "They think you're really smart," says Susie. Although they seldom claim to be smarter than other students, these students do have a sense of themselves as possessing traits and abilities which contribute to success in this domain. For some students the precise nature of these abilities is difficult to capture in words. Here is Alex describing them:

> Like, you know, some of my friends think, because, you know, some of my friends think, you know, they don't do as well in school as me, you know, like I don't know, they kind of think of me as smarter sort of, but they don't...like in different ways, you know, maybe when it comes to schoolwork but in other ways they're more intelligent than me, maybe, you know....

Other students are clearer about what it takes. Joseph, for example, suggests:

> Well, me, I don't know....I notice I can't....When I ask a question I don't like getting an answer "because"... there's no "because". There's always a reason. you know? I like looking for the reason. Even if I have to do it alone....I like looking why....Where does it come from? I always like to have an explanation.

Only Alberto insists that "anybody can be successful in the sciences if they want to. It does take work. You've got to really want to do it." Anthony also emphasizes the importance of hard work: "...you always have to keep up with the new material because if you don't you're going to struggle." Interestingly enough, however, he adds that, without the work, "you're going to still make it but you're going to have a rougher time." In fact, in various ways, most of these students share this view. Hard work is a condition, but it is only one condition, of their achievement. Susie explains: "Well, in order to be in science you have to work very hard. I think you have to know how to abstract...abstract thinking. How to take certain information and apply formulas....I don't know." Then she turns to consider the particular aptitude which she feels that she possesses, to express something of its mystery.

> There are some people I know and they don't really understand how to take a story problem into math or something and take little bits of information and apply like five formulas to it and we get the answer. Somehow I don't know why but I can just read a question and just do it automatically. Know how to do it. I think it's hard for others to just understand how to figure out the answer.

James calls this his "knack". Manuel says "basically you have to know what you're doing" and when asked about the way in which he comes to know this, he responds: "It came naturally." While he points out that "some homework must be done," Sharon ascribes her success almost entirely to innate ability. Discussing what makes a successful science student, she reflects: "I guess they just have a more natural talent and aptitude kind of thing for the concepts. For me personally it couldn't be studying. I do not study." Nick, a student who is already beginning to suspect that he is going to have difficulty in his courses, wonders if there is a "science type". It is with considerable discouragement that he admits: "I don't know....I don't know. There could be. From what I've seen there could be."

All of the students deny that gender is related to success in the sciences, although James observes that "there's not that many girls who are interested in computers." The students are particularly keen to debunk the view that women are disadvantaged in any way. In fact, where they do observe gender differences with respect to behaviour, they say that it is the women who demonstrate greater investment in their studies. Joseph, for example, says: "...maybe there are more boys who aren't really interested and who give up faster. if they don't understand it, forget, push it aside and go to something else. But the girls like to go further and they like to learn more. They're more inclined to study. I don't know why but that's the way it seems."

Mei Li, Susie, and Anna all agree and Alberto makes the same observation, although he minimizes its impact: "I find maybe the girls are more willing to ask questions and the guy is like, okay, I've got an image to protect and I don't want this girl to think that I'm....You know? But basically it's around the same thing". Only Manuel says that in his experience "the boys are more involved" and "are still on top."

What particularly characterizes this group of Pure and Applied Science students is the number of them who identify physics as among their favourite subjects. In fairness it must be said that this preference is occasionally expressed within the context of the denial of any particularly strong subject preferences. Alberto says: "I don't love...I do like all my classes. You know?" Arriving at a similar conclusion from quite a different direction, Anthony observes that he favours physics although "I don't know, I take them all the same. You know? I don't really look forward to any particular class." Some of the students also say that they like physics but that they have an even stronger preference for mathematics. This is the case for Manuel who argues that math is "the most relevant because it involves numbers and everything goes around math." Alberto also gives math first place "because it's right or it's wrong. Period. You know? I'm very straightforward. You know? If I have four bananas and there's five there, it's wrong. You know? It's right or it's wrong." There is an interesting division among these students in terms of the reasons which they give for preferring one science over another. Students like Alberto and Manuel speak about the intrinsic qualities of these preferred subjects. James echoes Alberto's sentiments as he describes his preference for physics over chemistry:

> ...in chemistry it's like bonding atoms as in it's abstract. It's not something you can actually...well, not always touch and feel and things like that...it's like...going back to the tinkering, it means using my hands or something or that I can see. Chemistry is not like that.

Although not all of these students would insist upon the priority of the concrete over the abstract, they all do share the view that they must find a subject intrinsically interesting, for whatever reason, in order to like it. Thus Alex, who in fact identifies chemistry as his favourite subject, says of physics "I've always been interested in physics, you know,...because it's, like, kind of like a puzzle where you have to piece it together kind of thing, you know. So, it's kind of interesting too. I like those kind of things." For

these students, as James says: "If you like what is being taught that's mainly where the interest lies. Not necessarily that you do well on the exam." In fact, Sharon continues at this point to sustain an interest in physics in spite of her disappointment with what is being taught in her course. "I just want to do more serious, completely different [physics]," she says, "what I want to do is quantum mechanics ...really, really flat poles at the end of the universe....It's really different."

For the other students in this group, understanding is the sine qua non of their liking for a subject. "I have to understand it to like it," says Joseph. "If I enter a subject and it's like Chinese to me I don't know what I'm learning and it's useless. I won't get anywhere...." On this basis, he tells us that he has come to prefer physics to chemistry this year. This sense of mastery, attributed to a better high school preparation, tips the scales in favour of chemistry for Anna. In the same way, Anthony says: "I don't really have a favourite. I guess physics will be there because I find it easier," and Mei Li, who agrees that physics is interesting, opts for math as her favourite "because it won't be hard work. We have regular work and it's more comfortable to see the material...." Nick, the student in this group who expresses the most negative attitudes toward physics, blames his problems in this subject on the teacher and says "I like chemistry a lot....I always did good in chemistry." At this stage, Susie seems to be the most atypical of these students. She says that she has no preferred science subject at the moment and in response to the question, she explores a range of interests which are unique in this group. "In grade nine, I liked biology," she tells us, "and now I'm taking psychology and I'm learning about the body. I like learning about how you think and how everything works in our body. It's interesting. In physics....I don't know about physics. My teacher tells us things about physics that I don't see what I'm going to need it for."

3. Experience

As the students talk about their actual experiences studying science at Cegep, one is struck by the highly instrumental approach which the vast majority of them take to their academic work. They speak about the need for efficiency, organization, and strategic pacing of their energies. A good deal of this talk takes place within the context of their concerns about what they perceive as an increased workload at Cegep: "It's getting a lot...all of a sudden," observes Alex. "[I]t goes much faster." James agrees. Although it is difficult to gauge how much work any student actually does, it is interesting to us that relatively few students in the group complain of over-work. In fact, for some of these students it would seem that any work at all represents a change in their experience of science education, and this is true of some of the very high achieving students as well as the weaker ones. Sharon says: "Well, I just never studied" and she is not atypical in this respect. Manuel describes a very similar experience: "...in high school, I didn't really have to do much studying for my science." Anthony also says: "In high school, I never like studied really, really for a test." As James explains, "...in my old school it was simple enough that I could understand it on the spot and I didn't have to worry about working at home. I could completely understand the theory behind it. It was grasping facts and I was able to use it again later on in exams." He points out that Cegep teaching differs primarily in terms of the speed at which material is covered in class. "Here, now, they throw the subject at you and teach it and they go on to the next....Now I'm trying to find a system. That's what I'm trying to work out." Although James laughs when he speaks about "a system", it is interesting that several of the students in this group speak about self-conscious efforts to develop strategies for dealing with these new workload demands most efficiently. "The main thing is, is to adapt," Manuel tells us. Alberto is particularly pleased with the new perspective offered him by a physics teacher:

> He said, 'You have to go home and practise, you can't just look at it,' and he used the example of hockey. He says, 'You can't be watching T.V., watching Wayne Gretsky skate and just by watching him you know that, Okay, tomorrow I'm going to go out and skate like that. You have to practise. It's the same thing in physics.' It's true, I never thought of it that way. It's very true.

As these students describe their current study habits, however, it is clear that the students who report doing little work in high school continue to see themselves as expending only moderate amounts of energy on their school work. One cannot help but feel that they have made self-conscious strategic decisions in this regard. Sharon finds that her old approach continues to work in this new environment. "If I listen and I pay attention I usually get it all in one shot....Homework....They don't usually assign really big things. You usually do it pretty fast. Like maybe doing it in lunch hour for five or ten minutes or during classes during review a little here and there." Anthony says: "There's a lot that do more work than me. Sometimes it just comes naturally to me like in physics. I don't really have to do a lot of the work." Alberto suggests that this is in the nature of subjects like mathematics. "...I don't find math something you can study for. Like in English you memorize something....Math is something that you either understand or you don't." Furthermore a student like Alberto sees himself as balancing his efforts, trying to maintain results which are "good enough" without sacrificing other activities which clearly have priority in his life. "I'm the type of guy that sometimes slacks off a bit on the work and goes to the soccer games," he confesses. Alex also talks about achieving this balance:

> Well, you know, I also have lots of time for myself to, like, I put aside time for myself to do things with my friends also. So, like, but you have to have some dedication to, like, stay in the sciences, you know, like and do all your work and, because especially in college, you know, like, if you don't want to do it, you don't do it, you know. It's all for yourself; if you want to do it, you do it; if you don't, you don't.

It is interesting that for a student like Alex the non-compulsory nature of work at Cegep is embraced as a relief from pressure. At this stage, only Nick and Manuel express concern that they may be unable to furnish an effort equal to the task. Manuel worries that his studying is interrupted by phone calls too frequently. Nick is more anguished in his concerns: "Like when there's a test I study for it a lot. The nights before I'll look at it but I have a hard time understanding it so like sometimes I just give up." He tries to assess the relationship between his efforts and his results: "I feel that I'm working enough to be passing," he says, "I don't know....Now, I'm going to try harder....I want to still try to pass but everything that I'm doing lately is not...."

The orientation of a student like Susie stands in sharp contrast to these others. "I work until 2:00 a.m. unlike most people I know. I guess I work too much," she tells us. "I'm a perfectionist," she offers by way of an explanation. "I want to do everything right." This is not to suggest that she is less instrumental in her approach. For example, she describes choosing her boyfriend as a lab partner in chemistry because she knows that "he's good" but she is very clear about her goals in this respect: "The faster we do it, the faster we can get out of class." Anna also tells us that she works constantly, evenings, nights, and weekends in order to keep up. Although Mei Li seems less oppressed by the amount of work, she too describes herself as a worker: "I like to work," she says. The only other student who seems to work at full capacity consistently in this group is Joseph. "I never, ever leave anything to the last second," he says. "...I do [the exercises] again and again and again....I just look at it and I know the answer after a certain point. I know that's too far but....Because I don't have any confidence in myself and I'm trying to build that up. But I don't find anything particularly difficult."

Indeed, whether or not students find the work difficult is not what serves to distinguish the "workers" from the "non-workers" in this group. It does seem important to note that three of the four women are among those students who describe themselves as disciplined, hard-workers. It is also interesting, but hardly surprising, that it is Susie, Anna, and Joseph who speak about the stress of their studies in the most general, pervasive terms. Most of the rest of the students experience anxieties which are much more closely associated with a specific event: running out of time during a quiz, dealing with error factors in labs, keeping up with a teacher who speaks particularly quickly. Only Sharon and Alex report worrying about nothing with respect to their studies: "I take it pretty casually," she says. On the other extreme, however, Nick is operating with an almost debilitating sense of being out of his depth. In the middle of his first interview, he says: "I don't know how to tell you this but I'm starting to get confused....You know? Like I thought I could do and I go into the quizzes and...."

Regardless of the amount of time that students spend on work at home, they conceive of this activity as essentially and necessarily private. Joseph's description of his orientation, while more extreme than some of the other students', is not fundamentally different. He says: "So I depend on myself. That's why if I have a question I either look for it in the book - I don't care if it takes three hours to find the answer - it's just that I have to do it and find it. But then I never forget it." As Alberto explains: "Basically you have to be very responsible. If you want it, you have to go get it, no one's going to bring it to you." They all count on classroom time for the basic understanding to take them through the problem solving which they see as the real test of their knowledge. Anna says: "Like somebody can explain it to me in two seconds and that's all I need but I need that person to explain it to me." Joseph describes what he's like in the classroom: "It's like me, the teacher, and the information he's giving. I just give it everything I've got and concentrate on it." There are only two students who ask for anything resembling a more active student involvement in the learning process: Mei Li says that she would prefer more homework assignments and Nick says that he would like to see more work done in the classroom.

All of the students say that there is competition in their science classes; however, they are quick to point out that it is not intense, often arguing that high school was more competitive. Only Anthony speaks about competition in entirely negative terms, describing the pressure as conducive to making mistakes. Most of the other students, in fact, depend on competition to assess their relative position in the course and to motivate themselves. Joseph is clearly the most serious competitor: "I don't like it when someone else beats me," he says. "I don't like it and I feel he's not better than me and I just have to work a little harder and so I do it and eventually I beat him." Most of the students, however, share Sharon's more balanced view: "I think it's good. It encourages you. But if you start to get down about it, you shouldn't do that." Some of the students speak now about having to readjust their sights, given their new surroundings. James, in an enriched science programme says: "Here I know that there are always people who are better than me, who are more knowledgable in the subject, so I have no interest in trying to force myself to be at the top" and Susie says "I used to feel smart but I'm not that bad now. I'm getting over it....I guess you realize that you're not as smart as you used to be. You're just equal with everyone else now." Nick talks about the difficulties of accepting the inferior position in a competitive world: "They're doing better than me. I feel that I could be doing better, a lot better than what I'm doing now. I know I could be doing a lot better than what I'm doing now but it's just not happening." Only Alex and Alberto see themselves as standing outside of the competitive framework at least in this arena. "If someone gets, like, a higher mark than me, it doesn't bother me because, you know, it's what I get that counts not what someone else gets," insists Alex.

With the exception of Nick, the problems which the students report encountering are more

in the nature of specific questions as opposed to large concepts or whole topics. They differ somewhat as to how they handle these. Most of them turn eventually to the teacher, with varying amounts of trepidation, related to the personality of the particular student but also to that of the particular teacher. Three of the students tell us of difficulties which they have in approaching teachers even after class. Mei Li says: "Sometimes they are many students with the teacher and it's hard to find a way to ask the question." Anna shares her own sense of the dilemma involved: "If I ask him a question it might sound stupid, you know. He might think that I don't know anything. I don't want him to think that and then he'll remember me because I went to his office and I don't know...." When Nick speaks about his reluctance to seek out his physics teacher, however, one hears the way in which such behaviour is also a measure of defeat. He describes what goes on in this class: "I sit there and I hear him talking and I don't understand a word he's saying." "Have you ever been to see him?" the interviewer asks. "No. What is he going to tell me?" comes the response.

"If I'm really, really stuck then I go ask the teacher," says Joseph. "It's mostly after class." Indeed, none of the students report feeling comfortable about asking questions in class and many turn at this stage to a friendly classroom neighbour. Alberto talks about his efforts to overcome his feelings of shyness.

> Even if I don't understand, I usually ask my partner which is no good. You know? But slowly, slowly I'm starting to raise my hand and ask the teacher. I'm the type of person that feels, okay, what if it's a dumb question. Everyone will laugh at me and this and that but I'm breaking out of that phase, I guess, slowly enough.

While many of the students report using friends as Alberto does, only Alex and Anna see friends as a positive resource to be preferred to the teacher. Alex says: "Like the teacher will tell me, I know my friend understands it, my friend will explain to me, like, in a different way, and then I'll understand it, you know...." Anna observes that the explanations of friends are frequently preferable because "they understand and they look at it in a different way...."

Nonetheless, all of the students see relationships with peers in the classroom as having immediate practical advantages and they work to identify people they already know or to make new friends. As Susie says: "If I transferred from somewhere and I didn't know my stuff I'd die. I'd have to really make friends quickly or acquaintances. Like give me some notes or explain or something." The social support system which develops in small programmes is one of the features most valued by the students in the enriched science programme and even a student like Joseph who is really a very independent and solitary worker says: "I have a bit of friends everywhere. I have to make friends because you might need something sometime and you have to have someone to call if you need help." In the first months at Cegep, friendship networks appear to be relatively small and the students talk about the difficulty of meeting people in some courses. "I know more people in my chemistry class than in math and physics," says Susie. "Because in math you can't talk with anyone. You're too busy copying down everything the teacher is saying and you don't have time to talk and converse." This is seen as a real disadvantage. As Anthony points out: "If you're all alone you're always second guessing like am I doing this right?" A student like Mei Li also works against language difficulties in constructing her relationships at this stage. Although all of the students are agreed that relationships with peers are important, four of the men give voice to the ways in which peer relationships have begun to work against them as students. Both Alberto and Alex find that their friendships, highly valued in and of themselves, draw their attentions away from their academic work. Alberto describes something of the process:

> ...now I'm starting to get more friendly and everybody is a little bit more talking in class and this and so you don't listen as much and so now its like the real college is kicking in and now I've stopped listening a bit. You know? A little bit talking here, a little bit of talking there....Once you get comfortable with the people around you....I guess your attention reduces a little bit to the teacher.

Alex talks about how his friends draw him away from homework on weekends and now increasingly during the week as well. Manuel's assessment of the balance between work with others and work on his own is particularly interesting; for, while he insists on the value of studying with others as a learning experience, "a lot of matters come up," he laments. "I like studying with people but I've tried that a lot this year and maybe that's why my grades are down." Perhaps we are here tapping into a problem related to the homogeneity which students tend to seek in their work partnerships. Hence, the most disciplined, least distractable students find each other in the class and weaker students are left to face the dilemma which Nick describes: "Well, like I have my friend that's in most of my classes but like he has the same trouble as me."

For these students, teachers really perform two roles. On the one hand, they are transmitters of information in the classroom and, according to the students, they therefore must be clear and consistent, focussd on the extent to which their transmissions are being received. Anna sums it up when she says: "[A good teacher is] someone who realizes that we don't know as much as they know." Again, the emphasis here is on maximum efficiency in "consuming" material. As Susie puts it: "If they explain it better then I have less work at home." Only Sharon suggests that good teaching involves the ability to inspire in any way: "If they have the enthusiasm I guess it kind of rubs off and you want to learn more about it." On the other hand, the students also rely upon teachers to deal with problems which they are facing on an individual basis. This latter function is perceived as being so important that all of the students mention qualities which they see as being associated with it. "Patience" offers Anthony without hesitation in describing the characteristics of a good teacher, "like they'll give up time." "They have to be accessible," says Susie and really everyone agrees. Alex goes even further and suggests that the teacher should invite requests for help: "Like if a student is having a problem with something, like, maybe he'll ask them if they need help or something." Alberto captures the general opinion: "A good teacher is one who is willing to make the time to make the student understand and not to just do their job and that's it. I did my job and now it's your turn." Interestingly enough, as the quotation from Alberto makes clear, the interventions which are rooted in a more personal relationship with the teacher are frequently viewed as teaching which is "above and beyond the call of duty". When they experience such attentions, the students talk about them with gratitude. Manuel tells us about his high school: "I'll tell you one thing, there were a lot of teachers interested in me and another student who was in the science course. And we got a lot of attention, I have to admit." Alex too remembers high school fondly: "And so, like, I knew [the physics teacher] for three years already, like, and he really liked me, you know, he liked my parents and they were like friends, you know, like, I was very friends with him kind of, you know, so, he helped me out a lot." Anthony tells us about his math teacher who has given the class her phone number and Joseph says of his teachers this year "I couldn't ask for any better teachers".

Toward the end of the interview, we ask students to reflect upon the ways in which they expect to be affected, perhaps even changed, by their science educations. They expect little in the way of transformation. Those who anticipate any impact at all see themselves as becoming more firmly the people they already are: more curious, more analytical, more organized. "Well, I was always curious," says Sharon. "But I guess more curious and wanting to go further. Yeah, wanting to know the

complete explanation." Anna predicts: "I'll be more logical" and Joseph says of a science education, "it makes a person want to search for solutions to problems."

C. INTERVIEW TWO

1. Motivation

When we return to interview these students at the end of their Cegep careers, we are impressed by the fact that, in the majority of cases, students' interests in the sciences in general and in the pure and applied sciences in particular have deepened. Seven of the eleven students say that they are continuing their educations in Pure and Applied Science with a heightened sense of having made the correct decision and most of these speak at some length about the ways in which they have found their studies intrinsically satisfying. "I can relate to it," says Joseph, "because a lot of things that happen can only be explained by sciences such as physics and those kind of sciences and so that's why....That's mainly why it interests me. It explains a lot". Anna has this to say: "It gives me a high...sometimes like I can....It takes a lot to start and I'm not going to kid you but once I get down to it I can stay on something for hours and just try to figure it out." Manuel, in fact, says, "Actually I have a greater interest [than at first]. Actually I have a very high interest" and he goes on to explore the connection between interest and studying which we have come to expect from many of these students. "I study because it interests me," he explains. "If I don't like it, I just don't get involved in it." Even Susie, who begins her Cegep career feeling very confused about where she is going and whether science is the area for her, now says, albeit cautiously: "I think I like the science programme." Of the students who report an increased level of commitment to the sciences, only Anthony expresses disappointment with his courses and more specifically with some of his teachers. He reflects upon the past two years: "It's been pretty good except a lot of teachers I really don't like here. It's like they're not understanding. You know?" Still, he reminds us: "I stayed in Pure and Applied all the way through .... I'm happy with that. Well, I mean I know where I want to go. I want to go into engineering. I was set."

Listening to these students, one senses that they do indeed "know where they want to go" and that this knowledge has played an important role in bringing them into the sciences and holding them there. James says:

> My interest is quite high. I've been interested for a long time in computers and just working with them and things like that and so my interest has been retained ....And nothing has been done really to demolish that. Nothing has been done in a negative perspective towards that.... I have a real keen interest.

Hence, they are very conscious of themselves as being "in process", that they have completed only one stage of a learning experience. As James explains:

> I mean sometimes it's a very small thing but just in general there's always this sensation that what you're learning now is by no means the end of that subject....So, yes there's definitely a sensation that there's more to it and if you continue in that direction you'll always still find more and whether there's an end I can't say because I'm not there yet. But, yeah, I would like to continue out of seeing where these things can go.

Not only do these students have concrete plans for continuing, (James, Joseph, Susie, have been accepted into engineering at McGill; Mei Li, Manuel, Anthony, Sharon, and Anna also have univer-

sity acceptances into engineering and are awaiting acceptances to their institutions of first choice) but also their visions of their lives include commitment to long term investments in education and training: Masters and even Ph.D.'s, further specialization in related fields such as computers. Manuel says: "I'll never stop learning, or I'll never put the books down because there are always new things to learn."

These are students whose lives are future focused, driven by very clear career goals. Many of them speak at length, with animation and a substantial degree of confidence about their chosen fields. Anna is a good example as she explains why she has chosen to be an engineer:

> I don't know it starts off with the interest in math and physics. Engineering is basically working.... I don't know, I guess engineering is such a broad area and you can go into absolutely anything and even though I graduate in electrical engineering I can go into medical engineering or something in medicine as well. You know, I think it would open a lot of doors. And aerospace....I want to be able to build things for space and I want to be in the middle of the building process. I want to be able to see how things work and I think that engineers basically do that. See how things work and break things down....

And Manuel analyses his interest in electrical engineering: "I can say that why I want to is because I'm very interested in physics, I'm very good with my hands and I'm very good at analyzing circuits or analyzing anything...." James, accepted in computer engineering, says of his chosen field:

> Programming is very creative because it's up to you to design the logic of how something will go on, it's up to you to decide what you want to create, what you want to programme, what you want to do, what you want it to look like, will other people like it if they see it....Things like that.

In keeping with the extent to which jobs and careers have been an important issue for these young men from the beginning, Anthony and Joseph choose their particular branches of engineering with careful attention to the job opportunities available in each. Anthony shares some of the thinking that brought him to computer engineering:

> Job opportunities, room for expansion....Like in airplanes the military is dying and commercial is going down. Basically, the only place to go is space.... There, it's a monopoly that NASA has, and it doesn't look good for NASA. So computers is more open and there's plenty of room for expansion and invention and some place to make your name.

Susie distinguishes herself from the other six students, in this respect. Although she has clearly had many positive experiences in the science programme and insists that this is where she wants to stay, she remains uncertain about what she wants to do, settling finally on electrical engineering "by the process of elimination". In her case, one cannot help but feel that the effort which she expends to succeed in the sciences operates to lock her into this domain, preventing her from exploring alternatives or even acknowledging the full weight of her doubts. For example, although she describes toying with the idea of pursuing careers which would allow her to tap her interests in mathematics, she concludes: "I continued with engineering....Because then I'm thinking why did I bother going through all of it? If I was to go into accounting I could have just taken commerce....I *went through* all of this and I am not going to go back now. ...I think I've suffered enough."

The other four students in this group emerge from the Cegep experience with a diminished interest in the sciences, although they continue to aspire to pursue studies in the area of pure and applied sciences at university. Alberto explains how he feels as he prepares to take up a soccer scholarship at an American Prep School.

> Naturally the first semester I came in thinking, okay, this is going to be good for me and it's going to open up all my doors but as it went along into second semester I felt that I should have....I want to become an architect...and I felt that I should have gotten streamed to a three year architectural tech programme because I see some of my friends that are in that programme come down...they come into the class and they have like their drawings of different plans and here I am doing derivatives and finding how to titrate something in chemistry and I find, what does that have to do with my future? I don't see the connection now. But I've got to stick with it.

Both Alex and Nick are carrying very low marks in their science subjects, struggling to amass sufficient credits to graduate. Nick faces an extra year at Cegep. "I thought I would do a lot better than what I'm doing, to be honest with you." Still, when he is asked how much confidence he feels about continuing, Nick responds:

> A lot. O.K. there's the difference between wanting to continue and having confidence. O.K. so, like of course I want to continue but confidence to say that I do it is not the same as like it used to be. I don't know if you understand that....Well, in computer science it's different, it's something that I want to do, something that I like to do. I would like ... so I hope that's going to be different for me. I'm hoping. So, I'll ... when I go into it I'll understand it, I'll be willing to put maybe a greater effort in.

Alex talks about the difficulty of sustaining interest in an area where he has begun to suspect he may have real difficulty holding his own. He begins his last interview by telling us: "When I started I liked science a lot more than I do now I think." He describes his particular conundrum at some length:

> Because I did really well in high school and I really enjoyed it. When I first started here I enjoyed it and now it's just getting more in depth and it's kind of scaring me because it's really hard and when I go to university I don't know how hard it's going to get. You know? And maybe my ambition isn't as much as I would like it to be. You know? To do as well as I possibly can. But science in general it's like if I had to choose something now I guess I'd still have to pick science because I'm not really sure what I enjoy now because I'm not really sure what I want to do with my life where I am right now.

At the time of this interview, Alex is awaiting word on his application to a university which is not his first choice. He has applied for acceptance as a chemistry student but psychology is listed as his second choice. He eliminates engineering as an option because of the impossibility of finding a programme where he would be accepted. As for his career plans, he observes: "I'm not sure....Anything can *happen*. I really can't say what's going to happen because I have no idea right now....I have no mind set of what I'm going to do in the future."

Because Sharon also expresses ambivalence about her future, we have included her in this sub-group of students. However, it is clear that her story differs, in important respects, from those of the

three young men. She has enjoyed her science education and feels positively about what she has learned and about herself as a learner. "I know I'm good in science," she says, "but I don't know if I really want to continue in it. I mean I will but I know there are other things and if I want to go into arts or - I could if I wanted to - but I'm just going to stay in science until I'm sure." Sharon expresses an ambivalence about her future which reminds us of the uncertainty Susie nurtures; however, she has a heightened sense of herself as someone in possession of a wide range of options which, in fact, distinguishes her from all the other students in this group. "I like a lot of things and I could spread out far from science," she admits. She is also the only student who verbalizes concern about the compatibility of career and family in the group. "I don't know if that's actually possible," she says contemplating her future. "In terms of what I'm doing for a job....I don't know." Nonetheless, at this stage she is applying to university in engineering and physics.

2. Attitude

There is a remarkable degree of consistency among all of these students when it comes to describing the characteristics which contribute to success in science studies. At the end of the Cegep years, the students still talk about the importance of interest, curiosity, and a certain innate capacity, as well as the desire to "know how it works and why it works". However, one is struck by the substantially greater emphasis which is placed on dedication, hard work, and various acts of will when the students discuss the ingredients making for success. Only James and Sharon downplay this aspect of the science experience. Anna covers most of the issues raised by the rest of the students when she enumerates what, for her, are the essential ingredients:

> Somebody who is dedicated....Someone who is interested. You have to be interested in it. Somebody who will apply themselves to learning or like to be open enough to learn....That would be a basis but I wouldn't stop there....I think you have to be capable .... You have to be hopeful. Not hopeful but I mean try not to get discouraged easily. ...Don't worry too much ....Take one step at a time. You have to be able to organize yourself....

Anna significantly cautions against self-doubt as a de-motivating factor. For most of the other students, it is sloth which is most to be feared: "slacking off" as Alberto calls it, "people that don't care", according to Anthony, students who "think it's magic" according to Susie. "Manage your time and don't be too cocky," warns Alberto, coming at the issue of motivation from quite a different perspective than Anna.

We are particularly interested to note the extent to which the students themselves feel that they can identify with the successful science student. It comes as not much of a surprise to discover that the three young men with the weakest academic records also report feeling most distanced from the persona they have come to see as a "science type". Alex says:

> They're very ambitious. Like if you go ahead and do well are the people who like put a lot into and this is their first priority and they don't think of anything else....You know? They'll skip lunch to like hit the library to go study for their quiz like for tomorrow or something .... Which isn't something I do normally. If I get hungry then I go eat....

Manuel too worries about not measuring up in terms of discipline. However, two of the young women in this group speak about their sense of not belonging in quite different terms. Mei Li, a high achieving student, focuses her attention on "the brilliant" science student.

> They're just like that. But sometimes I can do better than them in tests but I just can't be as successful as they were. ...They will command the other scientists and I will be that person who will do the work but they will be the one who thinks in advance and who finds out who finds out the new....I'm just the one who just does what they want me to do .... Something like that.

Susie, with much less regret, predicts a similar fate for herself: "I think it would be a big responsibility to make sure everything is working and if some things fizz out then you're responsible for it. I'd rather be the one doing the work and leaving it to that person up there." Whether or not one feels these women are making accurate predictions, whether or not one agrees that, under certain circumstances, it is, in fact, preferable to moderate ambition, one cannot help but be struck by the different consciousness reflected in James' view of his future: "I would say to continue on as a person who is successful would be someone who does have some sort of responsibility, creativity, and some sort of ingenuity to make something that will be different....I hope I could....I can't say yes I am that person ... but I hope that...."

The students in this group are the ones who have had the most direct experience of the under-representation of women in the pure and applied sciences. At this stage of their educations, the fact imposes itself with particular clarity upon those students who opt to take a more specialized physics course in their final semester. Anna, Mei Li, and Sharon live the experience from a woman's point of view. Here, Mei Li describes her first day in the lab. "[A] girl came in... she was my friend and she just told me, Wait, there's only two girls in the class. Oh, yeah?!! I turned around and it was all boys." The men notice this too. "Most of the girls stick to health science. I don't know why," observes Anthony. James, who has a brother in engineering, says: "I know when I get to engineering actually I'll find this quite a shock in the sense that almost all of the engineers are going to be male." A good deal of ambivalence and a mix of opinions surround the perception of the gender inequality here. Manuel insists that because of stereotypes "the boys have much more chance" when it comes to getting jobs in the field of engineering. Sharon is not so sure. She describes her feelings about the gender disproportion which she knows awaits her in engineering:

> It might worry me a bit but it's just....Maybe a bit ....I don't know why....Maybe it's just all guys looking at you or something because you're a girl but in terms of school I think it should be okay....Well, you know, that's the way it is and it's changing slowly but....You know? That's the way it is.

"If anything it would only encourage me to continue," says Anna as she describes her experience in this specialized physics course. "I'm very big on equality of men and women and I think women should have an equal chance in science as men do." Susie suggests that this helps to explain her experience of women students as the ones who "would actually do the work". "I think because they're already at a disadvantage that they're women anyways because when they go into the job market even if they have the higher mark or whatever their salary and I guess just being a woman .... I guess you have to prove yourself." Mei Li tells us that she didn't think about herself as a minority in this course until it was pointed out to her by the other woman. Then she says:

> When they talk about it I think, Ah, well, that makes me scared....Why it's scary....I don't know. Because they used to....Will they do better than we do?... When I talk about the students I find they are amazing. They all boys. I never find ... Yeah, right .... Up to now, I haven't found a woman that I find is amazing. Usually .... No, the girls can do well in science but ....

For the majority of students in this group, the past two years have been a time of consolidation. Little has changed in their ideas about what science is or about how it can be used in the world. The one notable exception here is Alberto whose own discomfort with the curricular demands of the programme seems to coincide with a growing appreciation of the complexity and perhaps even ambiguity of scientific knowledge. Thus the young man who enters Pure and Applied Science two years ago because he likes clear, certain solutions, now says of science:

> I don't know exactly what science is. Science is more like discovery. It's not something definite. It's like change. Change in the world let's say. Am I making sense? ...It's not like you're given something and bang that's it. It could be this and it could be that. You have to experiment with it.

A few minutes on in this same interview, he returns to this idea and wonders aloud: "Maybe that's why I'm having problems with science ...."

The vast majority of these students see themselves as "belonging to" the pure and applied area of science which they see as being different from other areas. For example, Anna approaches the issue of what science is:

> I'm in Pure and Applied so the focus is on physics and math ... the study of how things work....Yeah, it's how things get together and why things are ... why is a good question for science. It explains a lot of things. There is proof, evidence, right in front of you, and you have to learn how to get through the proof....

The focus remains understanding of the physical world, development and manipulation of technology. In spite of this sense of specialization, few students express a consciousness of working with a particular epistemological framework. Only Sharon, James, and Manuel speak about science as one perspective among others. James says: "Actually, it's quite different than the artistic approach which is just to look at everything as a whole and to understand it as it is right then and there." Only Sharon suggests that the approach may have its own limitations. "There are other things you can't understand," she observes. "It's just one way of looking at things." "I got that mostly in my humanities," she adds.

In more complex ways, the theme of consolidation also emerges from the story of these students' lives beyond the classroom. A few of them have, in fact, changed not at all in terms of their interests and occupations since the original interview. Mei Li, Anthony, Joseph, Alberto, and James tell us that they still have the same pastimes and, if anything, the attentions of some of the young men are now even more fully given to activities which they see as related to the areas of science they wish to pursue. Anthony is more deeply involved with computers, James has a summer job in an engineering firm "...so it will be good experience as a hands on knowledge". In the other students' lives there have been some changes. As the students describe their new involvements, volunteer work, part-time jobs, participation in a range of student associations, one cannot help but feel that their interests have become broader, more diverse. We note, almost parenthetically here, that it is only the women who report involvements in extra-curricular activities at the college. It seems to us that this is one important marker of the different attachment to the learning environment which manifests itself in a variety of ways and which seems to be gender related. The students see these other interests as positive and adaptive and, indeed they are, in the sense that they use such activities quite self-consciously as a way to renew themselves for more work. Time spent on these activities is controlled, carefully planned, viewed as a good investment. Anna explains that she has changed her approach to work since we last spoke. She says: "I want my days off [now] because I don't think it's very healthy to just work, work,

work. And so I try to go out on weekends and not to isolate myself from everyone." In the same way she has taken a part-time job close to home. "I can leave my house two minutes before work, go there for five hours work, and then come home and that's it...." Her reasoning is echoed by Sharon who takes a job on Saturday: "...just nine hours...one shot." Manuel describes his volunteer work as "just something to keep my head off it." James talks in the final interview at greater length about his drawing hobby. We are interested to note that for him his art, far from competing with his science interests, is seen as another expression of these interests. "I was considering actually taking sculpture to fit my schedule because that would also be interesting. To make things with my hands. I like using my hands just in general because of the electronic gadgetry and tinkering with things and making things."

For Alex, Alberto, and Nick, life beyond school absorbs energy and diverts attention. Alberto turns this to his advantage in pursuing a soccer scholarship but one suspects that Alex and Nick will not be as fortunate. At the time of the final interview, Nick is holding down two jobs. Although one of these jobs is in an engineering firm (a contact which he owes to his engineering father), the price of this form of apprenticeship, as contrasted to James' summer job, becomes clear when he describes his day: "But like there's a time where I could sit down and study, like for example if I didn't have a job I probably in the afternoons, I would sit down and study, probably understand things...but with work now, it's, it gets hard."

The attitudes of these students to their non-science subjects have also undergone some changes. Now only Anthony evaluates his experience in these courses as "pointless". When he describes his English course, his sense of a line separating science students like himself from non-science students becomes clear:

> English would have been better if we had done grammar to actually help us in maybe our other classes. But, you know, you're reading a book and you're analyzing the book and they read outside of class....I don't see myself reading in the future, you know....I don't know it's pointless.

While not many of the other students in this group would agree with Anthony's assessment of the value of studying English literature, it is interesting how many of them share his sense of a science identity. Manuel says of his English and humanities courses:

> I had fun ... yeah, overall, it was okay. I don't know for science students....It is important to know how to express yourself. I think that is the most important thing in the world. If you can't express yourself you just can't get ahead. But there's a lot of emphasis on papers and sometimes science students just don't have the amount of time to put into it.

Anna shares his concerns about workload and speaks in favour of "specific English and humanities courses ... like for science students ... that don't require too much." She talks about English and humanities courses which were really interesting, others which she found to be "boring"; however, of them all she says "it's a good distraction." Alberto describes his experience in a philosophy class: "...that was an interesting course ... a little weird....Sometimes these two points that he would bring up didn't even connect in some way. It was just thoughts flying around the room. You know? That's the thing. My mind is not like that and I can't think like that." Still he describes this course as having been interesting and, in fact, most of the students feel they have benefitted from at least one, and usually more, non-science subjects. As they describe these experiences, what comes across most clearly is that they see themselves as science students venturing into another world. Some do so with enthusi-

asm, some with a kind of good-natured indulgence. But only Anthony is absolutely negative about the trip. Sharon talks at length about the benefit which she feels she has derived from her non-science courses: "At the time I was like, oh, no .... But it was very interesting and very different. And now I'm glad I did." Speaking about a particularly happy experience which she had in her humanities course, she says: "Well, I know that [science] was one way to look at things, but from the humanities course, I got many other ways of looking at things." Susie, who was so negative about her writing in the first interview, now says: "I wouldn't want to write stories but I like writing personal thoughts like in a diary and the journal is interesting." Even Joseph, who begins his final interview with the announcement: "I didn't like so much the humanities-English part," says of his current humanities course: "it was amazing and it was lots of fun." Psychology emerges as a particularly popular discipline. Again, only Alex looks at it as a serious alternative to his science studies; the other students are content to appreciate the experience, integrate it into their lives, and move on. As Joseph says "...psychology....I enjoyed that. That was very useful. I learned more about myself. You know?"

The science subjects are the centre of these students' academic experiences in a way which goes well beyond the meaning of the term "concentration subject". More specifically, they see themselves as drawn to the physical sciences. Of the eleven students in this group, nine place physics among their preferred subjects by the end of Cegep. In three of the nine cases, it comes in as a close second to mathematics; in one case, as a second to chemistry. Furthermore, they see themselves as drawn to these sciences by interests which are embedded in their personality structures and over which they have little if any control. Joseph observes: "Maybe that's why I enjoy math and physics because you actually see the effect of the work. Like, if you have a theory, you research it and you apply it and you see what happens. You have the result in front of you. Maybe that's why I like it." James explains his attraction to math: "It's straightforward. You're not going to run into too much trouble. You know? It's there and there's just one way of doing it and that's it. It's not going to be too radical....It comes naturally." In keeping with this vision of the affinity between knower and knowledge, Joseph declares "I don't like biology and that's the way I am." Indeed, his assessment of the problem with biology is one which is shared by ten of the eleven students in this group:

> I find that biology is all memorizing. It's a name, it has a function, and you just have to know it. There's no why. It's just there and you have to know what it is. You have to memorize a lot....And so that's why I like the physical, mathematical subjects because it can be proven. There's a reason why this is like this. You don't just say, well, assume this is what happens. Sometimes but it's very rare. Biology, you just have to know it. Just memorize blindly.

Even Sharon, who is the only student in the group to say that she enjoys studying biology, reminds us that it is not "her" science: "I just like it because I found it interesting just for school, but I wouldn't go into it though."

It's interesting that a student like Anna worries about how deeply the affinity which she feels for physics runs. In spite of high achievement in the subject, she says: "I like [physics]. I still think that I'm....I don't know if I'm really cut out for it but I think it's been alright." Later she explains more fully: "I know people who can just take a problem, just break it down and just go ahead and do it. Obviously it's this and sometimes I can just not see it. You know?" She hopes that further training at university will "help my mind sort of deal with it" but, in fact, there is a note of hesitation, perhaps scepticism, in her voice. In the vision of these students, the power ascribed to teachers and curricula to alter the basic predisposition of the individual is limited.

This is not to say that teachers are irrelevant to these students' academic lives. On the contrary, they speak about teachers whom they have liked with obvious appreciation and respect, complain about those whom they have found demanding or inflexible or disorganized. Teachers tip the balance in favour of mathematics for Anthony. "They were just more open, friendly .... You know?" However, it is also true, as Joseph points out, that what counts above all else is "the material they cover". Joseph ponders the difference a good teacher might have made with respect to his attitude to biology: "Maybe if I would have gotten a better teacher maybe my views would have changed. I don't know. The material certainly wouldn't have. It's the same thing, it's there and you have to do it. But maybe I would have liked it a little more. I don't know." As Alex, whose future in the sciences is much more problematic, assesses his relationship to the different science subjects, one hears, once again, the theme of personal affinity. "I enjoyed biology," he says, "Like, to a certain extent some parts of it I enjoy. But like when, you know, when we hit like genetics and stuff, I enjoy doing. Like, the more, you know, mathematical kinds of things I enjoy doing. Things you know that are straight forward." Then he turns to compare his own attachment to biology with that of the students around him: "...like some of these students are really, really interested in this. You know what I mean? They own the book and they enjoy reading it because they're interested in it. When I read the book and after a page I'll be thinking about, you know, what I ate for supper or something." He retains his preference for chemistry: "I found it pretty interesting and I like doing labs and also I had good teachers." One can measure the impact of an outstanding teacher in Alex's story: "...my favourite course that I was taking was my physics waves. Although it wasn't even chemistry. But I had a great teacher for that..."; however, the fit between student and subject matter remains an essential pre-condition. Then, as Joseph observes "...if you already like it then you just end up loving it at the end."

We are interested to note that this sense of an affinity between the individual and the subject manifests itself even in the stories told by the academically weakest of the students, those most at risk for non-persistence in this area because of inadequate grades. Alex, whose careful assessments of his science preferences have already been mentioned, stands as a case in point, as does Nick: "My favourite? Well, ...even though I failed my Cal's, I guess Cal ... the thing is it's like ... you do it, you know how to do it. I mean either you know how to do it or you don't O.K." Nick tells us that Cal II, "I got it right away." Of course, the sense that one is "getting it", automatically, even magically, can also serve to relieve one of the obligation to work at it. Nick is one of the two students in this group who does not identify physics as among his preferred subjects. Alberto is the other and it is perhaps not coincidental that they are both very much at risk for non-persistence in the area of pure and applied sciences. It is also interesting that Alberto focuses increasingly on performance in evaluating his subject preferences. He is the only one of the students in this group to systematically and consistently conflate favourite subject with "best" subject and to identify the teacher as the most important criterion in determining this "best" subject. He says: "Chemistry. That is so far my best subject....But that has to do with the teacher, she's a very good teacher and I got lucky.... For physics on the other hand, I still have trouble understanding my teacher...."

3. Experience

From the students' descriptions of their actual experiences in their science courses, it becomes clear that adjusting to the rhythm of assignments and tests has been the central item on their agenda. What is most striking about the students in this group is how planful they have become, how successful for the most part at gauging the amount of effort they must invest in order to achieve what

they perceive as the desired results. In short, they seem to have perfected the instrumental approach with which they entered Cegep. Only Anna and Alberto talk about working so hard that they feel on the edge of control. Anna says of the enriched science programme which she is completing at the time of the interview: "I think there was a lot more [work] than I expected. Even my parents thought it was a lot more...." Alberto who is juggling a heavy commitment to soccer agrees:

> The workload is very demanding....I found it really hard to like manage ... my calculus teacher always tells me, if you would spend as much time on calculus as you spend on soccer you would be very good at calculus. She always tells me, practice makes perfect, practice makes perfect. It's the same with every subject....

However, with the exception of these students, who clearly feel some sense of struggle in the work (and with the exception of Nick), one is impressed by the extent to which they appear to feel in control of their academic lives. Even Manuel, who left the enriched programme after the first semester, sees his decision to leave as a positive response to a situation which he perceived as being unreasonably and unnecessarily stressful.

In fairness, it must be said that many of them work at sustaining this sense of control, largely by maintaining a disciplined, in some cases inflexible, routine. In this respect, Joseph's description of his own approach to work serves as a model of sorts although he is probably an extreme example. This is the same young man who talked about doing problems compulsively in the first interview. Now he says: "I organized my time better maybe. When I sit down to study I just do it, get rid of it, and ....Maybe that's it. But I don't spend that much time anymore." He is conscious of a range of skills and habits which serve him in good stead. He describes being extremely focused when he works, very attentive in class, very resistant to distraction.

> In school that's basically it because most of what I do here is study. Studying and homework. Like in the cafeteria I see these huge groups of people hang around talking and just wasting their time. I'm like, why? You know, a simple chat of five or ten minutes and maybe half an hour at the most and that's it. Playing cards is the ultimate waste of time. I mean it's unbelievable. I've had so many friends ask, Do you want to play cards? It's a waste of time....

Susie also says: "I didn't think it would be as easy as it is. ...Well, I do have to work though but it's not that bad .... I keep up with it and most of the students don't so then they fall behind and then they screw up after." This sense of being the "captain" of one's own ship comes across very strongly in our interview with Anthony. He, in fact, ascribes his success to his ability to accurately assess when he needs to do more work in an area and when he can coast. As he says: "I know if I have to work harder at something or if I can take it easy because I understand the stuff. Yeah, I'd say I have a good sense of where I'm at." It's interesting that even those students who are critical of their performance draw confidence from the belief that they can control their work patterns and that they could have worked harder. This is certainly the case for Sharon who observes: "I could have done better ... if I had tried harder .... I know when I try I get higher marks; that's for sure. I would have gotten, I'm pretty sure 90's." Even Alex whose achievement level has been low and who worries that he may not have his "priorities set straight" takes comfort in the fact that he has not worked and the belief that he could if he wanted to:

> I still feel confident because I'm pretty optimistic I think. I just sit down and I think, well, you know, all you have to do is this and this and this and then I can just make

> sure. ...Then, I'll be safe and whatever .... Like you know if all I have to do is pass this course with a 70 and pass this course with an 80 and I'll be alright. You know?

Although one suspects that he has been shaken by a string of low marks and some failures, there is little in what he says to bear this out.

The other students prepare to move on to university, and as they do so many of them draw confidence from their faith in their capacity to do "strategic planning". Joseph is a particularly striking example. He spoke at length about his lack of confidence in the first interview but now he says: "Yeah, I think I'm ready. I'm not saying it's going to be easy. I'm preparing myself. Like once I start university I'll have my guard up and I'll be ready for whatever comes. Hopefully from the skills I've learned here it should be okay...." James is also already engaged in planning the next "campaign". He describes his current system for studying and then he says: "...my marks are so far good. So it seems to be working at the moment whether it will hold in university, I doubt. That's because there's too much to understand and for last minute times it's not going to work." Among the high achieving students, those most sceptical about their capacities to "manage" the situation are two women, Susie and Anna. Susie captures the ambivalence, the sense of achievement and the sense of the fragility of that achievement, when she says: "I thought it would be more difficult in Cegep .... I do have to work though but it's not that bad. I'm having the same outlook on university now. I think I'm going to die there." Anna says: "You wonder whether you're cut out for it....There's always a doubt. I'm confident that I will continue but there's always that little question." Sharon also speaks about test-related anxiety for the first time, perhaps related to the fact that she has been in an enriched programme. However, unlike the other students, the bulk of her worrying is unrelated to the specific issues of tests, and homework, and grades. She explains: "You need to go to school and the way it is now, you have to go and get a Masters or something and then there's no guarantee of jobs and you only get a generation to do it. ...The feeling doesn't go away but you just kind of put it in the back of your mind."

Two of the men, James and Anthony, talk about how they benefit from a "gift" of sorts which allows them to get good marks with less work in subjects like physics and math. James is quite reflective about how it works:

> I would find that like for one subject like my physics I'd say I am .... I mean I'll be honest I'm not doing as much work as I find that most people are doing in it but I have the comprehension. ...I can see it in my mind. I can see, say, a spring bouncing up and down with a mass attached to it. I can see how it's going to go and if you're starting to push it how it's going to start moving up and down more rapidly or if you put it in water how it's going to slow down because of the friction and things like that. It's just, you know, the physical attributes of what's going on in a system or something like that.

Once again we are struck by how important classroom learning is for these students. Only Nick talks about the difficulty of maintaining concentration. All the other students describe how central what goes on in the classroom is to their experience. "Like I'm that kind of person who learns from class," says Manuel. "I get very involved and I'm very active in class and everything. When I don't understand something I want to do something about it right there and then." Although most of the other students report asking few questions in class, they see themselves as being highly involved in what is going on. "Yeah, I don't know," says Anthony, "the teacher says it in class and it just sticks and I know what to do." Joseph tells us: "I always sit in front because I don't get distracted in back because

people talk in back." "I like it to be quiet and I like the students to be paying attention," says Alex. "That's the first step for me to know something. If I can pay attention and listen in class...." In fact, however, Alex puts too much faith in the power of classroom learning as he himself realizes:

> All through high school I've had like a sort of study thing where I'd like listen in class and pay attention and I'd understand everything and then when the time comes for the exam maybe two days or the day before I'd study for it and put some effort into it and then I'd do all the exams. In high school it was like perfect ... and I was doing really well in high school. And when I got to college it doesn't seem to work as well anymore.

James also uses class time quite self-consciously to reduce the time he spends doing homework. He explains his system:

> I try to stay on top of the material as the teacher is teaching it and this way I understand as it comes in. Sometimes when they're doing an example on the blackboard I try to race a little bit ahead of them and see for myself if I understand what they're doing and things like that. So, then, if I can continue it and if I can reach a solution before he does after seeing the theory and after seeing maybe one or two examples before then at least I have the satisfaction of say, yes, okay, I do understand what's going on and I don't necessarily need to go home and punish myself by doing homework.

With one exception, all of the students mention a teacher and often teachers who have been particularly influential. A lucky few identify teachers who have actually been inspirational; most remember teachers who seemed to care about the students, who "really showed that they enjoyed [the subject]." "He's really special," says Mei Li. "He's nice first of all. He's always smiling and answers your questions very clearly." "She made it interesting," says Susie. "He explained. ...I understood what every formula meant." Without exception, the teachers who occupy positions of importance in their memories are science teachers. Anna can name no one. She seems to feel that she has been pushed and pulled through her enriched science courses. She says: "Teachers ... okay, they should go at the speed of the class." It is also true that almost every student has a negative experience to recount. In some cases, these negative experiences, bound into the students' own difficulties with a subject in ways that are too complex to assess properly here, affect the way in which they approach a subject for semesters and perhaps years. This is true for both of the low achieving young men in the group; however, Anthony also tells us that he has grown to like physics less as Cegep has worn on."The biggest problem was the teachers," he says with absolute certainty.

The "science" experience also conditions their relationships with peers in ways that are more powerful than we, at first, expected. Eight of the eleven students in the group tell us that most of their friends are in science, and in some cases they are even in pure science. For various reasons they all see this as a distinct advantage. Joseph explains: "Well, it sort of gives me a sense that I'm on the right path because most of the people want to go in a certain direction. Most probably because some of them are informed....So they sort of guide me and they give me suggestions. So it helps to be reassured." This same student, in fact, worries that friendships that extend beyond school are an unnecessary and potentially dangerous distraction, that "once you get into social relationships it will just throw you way off school." Indeed, Alex offers the pull of friends who are not in school as a reason for his sense of distance from college life, in general, and from his studies in the sciences, in particular.

For Nick, friends, even in the classroom, are to be avoided. He explains: "Sometimes when they're in your classes, you have friends there and you won't concentrate on the work sometimes. ...Like I've lost touch with like more than half of them," he tells us with relief. However, Nick and Alex stand alone in failing to see the academic potential of friendship networks. James, who is one of the few students in the group whose best friends are not in science, sees this as a problem to be remedied in university. "I mean chances are when I get into McGill I'll try to make study partners or things like that," he tells us. "[T]hen it will become a very important factor. In Cegep it's still not at the point where you need to actually go out and learn something yourself without the teacher teaching anything of it."

For the other students, considerably more affect is bound into the importance of relationships with peers. Anna says: "Basically, they understand what you're going through and it helps a lot to have something like that." Sharon agrees: "We have something in common." "I want there to be a lot of friendship," insists Manuel. "People to be friendly and a lot of interacting with them. A lot of support." Alberto, who describes himself as being "very sociable", advances a theory about the nature of science study which defies the stereotype and forces us to appreciate how important peer relationships are to these students. He interrupts himself to say:

> I just thought of something....It's interesting that in all my science classes the whole class knows each other and we can all talk to each other. When I look at my English, my philosophy, and my humanities there's no mixing whatsoever.... I guess the sciences not only makes your mind work individually but you have to be able to work with people. ...In a way that's good and that's why I'm probably doing better in the science subjects.

Those students who seem to rely on competition for motivation tend to see this competition as being integrated into supportive peer relations. "So it's not that we withold anything from each other. It's a competition we benefit from," explains Manuel. Sharon agrees as does Joseph who says: "...I like to compete with a lot of my friends and that's what keeps me going." However, these are the only three students in this group who see competition in other than negative terms at this stage. Although James and Mei Li recognize competition as a reality imposed by the university selection process, they agree with the other students in seeing it as the source of unnecessary and unproductive stress. Those students who are on the lower end of the achievement hierarchy seem resigned to their positions. For them, questions about competition are largely irrelevant. Alex seems to represent this group when he says: "I know there's always going to be someone out there who can. ... I know it's pretty pessimistic but there's always someone out there who can do better than me. You know?" In a way, it is Anna, a young woman in the enriched programme, accustomed to being a ranking competitor, who suffers most from the competition and speaks for the damage that it inflicts on "the losers". She reflects upon the experience of competition in her class and says: "I found personally that that's what discouraged me sometimes. Thinking that, well, I'm in the enriched class but I think I was the lowest of the class. I always felt that. You know? I always felt that they were the smart ones and I was the odd one."

All of the students see themselves as having been affected in some way by their science educations; however, they see these effects largely in terms of technique, that is, they have become more analytical, more disciplined, more logical. It is consistent with their highly instrumental approach to their own educations that so many of these students offer experience-based, concrete suggestions when they are asked to reflect upon ways in which science education might be improved. Three students focus on problems with the registration procedure, two complain about particular programme issues, two complain about workload, and three make a plea for greater specialization, "eliminate a

couple of courses that you don't really need". These students entered Cegep with fairly firm ideas about where they would be heading at this point and with the exception of Alberto, Nick, and Alex, their experiences have served to confirm their original resolve. Only Nick comes to question the value of a science education per se, his critique executed in the terms which he most values:

> To be honest with you, I ... no, because I think people might have passed school with flying colours and when it comes to getting a job, they won't be able to find a job .... Because there isn't a lot of jobs in engineering, I know that, and ... so there's a lot of people who want to finish to become engineers, but I don't know where these jobs are going to be found....

Although several of the students talk about the value of these past two years as a time to expand friendship networks and broaden one's horizons, only Anna and James see learning in terms which reflect the transformative potential of education. Anna, in fact, describes this as a self-conscious process:

> You start asking yourself questions like, Is it worth going through all this? Why are you going through all this? The reason why you're going through all this is because there's the interest and the dedication and you want to be somebody. ...It goes up and down, you know, your self-esteem. Really high or low. Just that fact alone can also help you see what type of person you are and how stable you are.

James is clearly more drawn to a cognitive dimension when he says: "So there's always this continuous broadening and I think that's the most important to keep it that way. To keep going in the sense that there is no limits. You know?" The vast majority of these students, however, emphasize the instrumental, the importance of Cegep as a transition to university. As Joseph says: "Cegep for me has been sort of a preparation for university. It's not high school, it's not university, it's somewhere in the middle. ...It just takes you deeper into your subject...."

III. STUDENTS WHO ENTER CEGEP IN PURE AND APPLIED SCIENCE AND PERSIST IN THE HEALTH AND BIOLOGICAL SCIENCES

A. SUMMARY

There are eight students in this group: seven women and one man. At the time of their last interview, all of these students expect to receive a DEC in science and they all anticipate continuing on to university for a further degree in the sciences. The one deviation from this pattern is a woman student who has left Cegep before receiving a DEC in order to take up a basketball scholarship. She is included in this group nonetheless because, like the other students in this group, her persistence in science has included a shift from pure and applied to the biological sciences. In fact, this shift away from pure and applied science and into the biological and health sciences has been central to the persistence of these students. The group includes the two extremes of the achievement range for students persisting in the sciences. At the top are two women with science averages above 95% (one of these women is ultimately accepted to medical school from Cegep). At the bottom are a young woman with an average in the low 70's and the young man who enters university with a science average in the mid-sixties and an incomplete DEC. Three of the students went to private high schools.

With the exception of one young woman, all of these students enter Cegep with an intrinsic interest in the sciences. However, only one of the students, the young man, traces this interest to experiences in his home which he sees as having inspired him to think about pursuing a career in genetic research. He is thus different from the others in the group not only because of the importance of career aspirations in forging his connection to the sciences but also because he is, from the beginning of his Cegep education, really committed to the biological sciences. The other students, all women, are drawn into pure and applied science by a range of motivations. They speak about "discovering" science at school where they have teachers and learning experiences which afford them the opportunity to discover something of the excitement of science. Most of these women also talk about a wide range of interests beyond the sciences: music, hobbies, part-time jobs. Within school, they emphasize the importance of a "well-rounded" education. Six of the seven women describe non-science subjects as being essential to their lives. However, they see few possibilities for integrating what they call "the rational" and "the intuitive" domains and content themselves with apportioning their time as well as possible between the two. For all of these women, their decision to continue education in science is conditioned in important measure by the fact that they perceive themselves to be "good" at it. The superior status of science as an area of study, and one suspects of Pure and Applied Science as a programme in particular, also clearly enters as a significant motivating factor for these students. None of the young women expresses clear career ambitions. In fact, on the contrary, they describe themselves as distinctly undecided with respect to careers and many see this as a positive thing. With few exceptions, they look to the education upon which they are embarking as something to be valued for its own sake, or as a potentially transformative experience "to prove that I could be something". Several of the women in this group identify these broad questions of achievement and self-esteem as gender issues and, in fact, in both interviews many of these students have interesting reflections upon gender.

Although some of the women recognize that the "logic" of science seems to come easily to them, all of the students insist that hard work is the key to success. Several of the women take pleasure

in this hard work in that they enjoy the challenge of their science subjects and they express few strong dislikes in this area. While math is an important point of connection for many of the women, the young man says that he hates it. Furthermore, he distinguishes himself from the other students in that he has a highly instrumental approach to his work: he plots strategies (not always successfully) for getting the most marks for the least effort. The women, less instrumental in their approach to their educations in general, are also less strategic about the work which they do. It seems likely that they experience science as being so demanding because, highly invested in their work, they do more. With the exception of one high achieving woman, they all report being very anxious. The man says that he feels no anxiety associated with his studies.

The classroom is the place where important learning takes place for these students. Without exception, they emphasize the importance of good relationships with peers for reasons both personal and academic, although the young man also describes being distracted by friends. Affective issues, such as the level of the teachers' concern, are of primary importance.

After two years of Cegep, all of these students opt to leave pure and applied for the health and biological sciences. For the man in the group, the shift is rather pro forma and he, in fact, feels that he is continuing on his original career path. The women, on the other hand, are conscious of having changed. Their discussion of this change, detailed and self-reflective, suggests that it is very much related to a growing consciousness about the importance of social responsibility and human connection in their lives. Although few of the women have clear career aspirations, they describe a shift in subject preferences which we characterize as a drift away from the physical sciences, particularly physics, and into biology. It is interesting that within this group of women persisters, where there is high achievement in and a good deal of comfort with the subject matter of science, there is also a considerable measure of ambivalence. Several of them express uncertainty about their ultimate persistence in this area and a range of doubts about the degree to which they are the "science type". On the other hand, the two students in this group with the lowest achievement levels, holding firmly to career aspirations, are the least bothered by anxiety and self-doubt.

Within the framework of these important changes, there is also substantial stability. Little in the study habits or approaches to learning of these students undergoes substantive change. The stories of these students, emphasizing the centrality of hard work to their experience of science, help us to understand how this very work serves to reinforce the commitment of many to persist in the area.

B. INTERVIEW ONE

1. Motivation

When we look at the motivations which these students express for entering a science programme at Cegep, it is interesting that only the young man articulates a clear and singular connection to the sciences, and this via his career aspirations: a genetic researcher. "Ever since I was a kid I loved clone movies," Henri says; "if I have a career I want it to be in science." The women in this group, on the other hand, describe interests in the sciences which are multiply-determined.

All but one of the students in this group (a woman named Christina) express an intrinsic interest in the subject matter of science. The locus of this interest for the young man is his home and his "private life": clone movies and Time magazines are his points of reference. The father of this young man is an engineer and he tells us that it is his father who has identified the area of genetic research as the field in which "all the advances and stuff are going to be". Two of the young women in the

group also come from homes where at least one parent is significantly involved in the sciences. We do not want to minimize the importance of parental involvement in the sciences. Clearly such involvement operates as incentive and support for some students and this in numerous ways, some of which are bound up with other class issues. Nonetheless, it is interesting that, in the stories told by the women, school experience occupies an important place in the narration. All of them speak about science as the science they learn in school and they reflect upon their relationship to this science. Several of these young women speak about "discovering" science at school and an encouraging or inspirational teacher figures frequently in the story. "I didn't know I wanted to do this when I was in junior high. I had no idea. But I was encouraged by my teachers...." Another woman says: "I used to kind of hate sciences actually....I remember how my teachers used to have us do like experiments in the classroom. I think that kind of got me into it." Another says: "for me it is [interesting] because there is always something to learn ...it's always the thing you least expect and so it's full of surprises." As though completing her thought, another student observes: "It could be how the teacher is pointing out something you take for granted everyday. You don't really notice it....He points out an aspect of it and it's, Oh yeah...."

For these young women, understanding the material which is presented to them in their science courses is, in various ways, an important part of their connection to science per se. One says: "I found it [science] logical and easy to understand;" another explains: "I go through periods where I don't like it. It's usually because I don't understand what's going on and if I'm not comfortable with it I may not like it for a few days and when I understand it again it gets a bit better." Understanding carries affective weight for these women and it does so regardless of actual achievement. "I like physics a lot. It's hard. I'm having trouble and I can't say why....One thing is that I'm not doing the homework like I should be. I'm having a lot of fun in physics... understanding it...." Perhaps it is because these students derive such a strong sense of satisfaction from understanding the material that one finds among them a student like Barbara quite comfortably ensconced in the sciences despite the fact that she maintains: "I don't think things like physics, chemistry, calculus, I don't think they have any relevance to people."

It is interesting that for the high achieving students, all of whom are women in this group, achievement is in and of itself offered as an important reason for continuing in sciences at the college level. "I mean I liked doing it and I'm pretty good at it and my marks are pretty good so I figured I should continue," explains Barbara. Another high achiever says: "I guess it's because my best marks always came from sciences and obviously I took more science courses and I didn't really find it that boring, it was pretty interesting and so I said, why not?" Achievement issues are very much bound up with the motivation to study sciences at the Cegep level for these students and this, in turn, is enmeshed in the status which science occupies in the hierarchy of disciplines. The prototype of this orientation is provided by Christina, a high achieving science student, who is the only student in this group who clearly experiences no attachment to the sciences per se. She says:

> Basically I picked science out of a process of elimination. Usually when you're in high school it's, okay, I'm going to go into science and it doesn't matter what science is. You just know you're going to go into it either because of your grades or because....Usually it's because of your grades and because there's nothing else better than science. Science is your best choice and since you have the grades for it go into it. If you don't like it, you'll change.

This attitude conditions the way in which she approaches her courses: "...most of the things I do I don't think are relevant to my life so I just ignore that fact....You can't think that way. You know you have to

learn it and it's no use complaining about it." She considers other possibilities: "[I didn't want] Social because I figured it's a lot of reading." Ironically, the superior status of science draws both students who, like Christina, experience a bankruptcy of options and those who, like Barbara, are "interested in almost everything". "Well I'm really kind of in science basically because I'm not exacty sure what I want to do yet. I like the sciences. I also like many other things but I figure that this way it would keep the doors open so when I decide I'll be able to do what I want to do."

All of the students in this group associate science with a broad and ill-defined measure of social success. With the exception of the young woman who describes herself as being interested in almost everything, they all see science as the "place" where there are jobs and careers and in this view they seem to find encouragement from teachers, parents, and friends. As Amy says "...my mom's really impressed. And she's like why don't you be an engineer when you grow up? You can make a lot of money and have a big house." Amy is at the time of the first interview, in fact, considering a career in engineering. However, like the other women in this group and unlike the young man, her career plans are only one of several reasons for pursuing her education in the sciences. Furthermore, these plans are best described as unfocused. She says: "I'm thinking about engineering. I'm not sure yet...There are so many parts of engineering." One other woman in this group, Penny, also expresses interest in a career which might be linked to the pure and applied sciences per se: "a kind of job involving computers, involving creativity in computers." Significantly, none of the other women in the group can identify a specific career goal at the time of the first interview, although one, Natalia, does say that she has considered both environmental engineering and dentistry. When pressed by the interviewer to consider career possibilities for themselves, the characteristic response is to resist such a narrowing of focus. Barbara says: "I can't picture doing one thing for the rest of my life" and Teresa reflects at some length:

> I don't know....I guess what I aim for is to be happy....So I think you should wait until you find out something like in class or whatever and someday you go, Wow, I really, really like this. It's not because I'm doing well in it, it's not because I understand it but I genuinely want to know more about it and that's when you know which field you'll go into....

The motivation to enter the sciences is also bound up with issues of gender for some of these young women and this in the sense that they look to the sciences as an arena in which they might prove themselves by defying the traditional sex role ideologies. Natalia says: "I know there are jobs there and I want to be successful and everything because I grew up in a home where my father thinks...women should stay at home...and I want to prove myself and to him that he's wrong and that I could be something." Penny and Amy also talk at some length about the fact that they see themselves as pioneers in the sciences. It seems to us that this orientation to science, in which more is at stake than simply career success, is also reflected in the greater tendency of some of the young women to look to education in the sciences as a personal testing ground of sorts, an experience from which one might well emerge transformed. This view is articulated most clearly by Teresa and Natalia in this group. Natalia says: "I feel like if I can do this then I can do anything. I feel really strong. You know? I don't know how to say it...I feel like I'm in control or something."

Students are also asked about their plans for marriage and/or families in the future. Only one of the eight students (a young woman) sees a future with no family responsibilities. Of the women who want children, only one sees the combination of family and career as entirely unproblematic. It is important to say that the dominant feeling is that such considerations are premature and can comfortably be postponed. Nevertheless, it should be noted that in spite of the strong resistance to traditional

gender ideologies with respect to occupations, two of these women anticipate withdrawing from paid work in order to raise families, at least under certain circumstances. Teresa is the student who has most clearly given the issue some thought and she says:

> It depends who you marry, where you're living, what you're doing, what city you're in and whether or not you have enough stability to have children because it's not fair if your kids are just going to be born and you're going to work from 9:00 to 5:00 and never see them it's not really fair. You have to decide about one or the other. If you have kids you have to devote a lot of time to them or it's not just have children and that's it.

We are struck by the range of interests which the students in this group report. In this respect, Evelyn and Henri are the exceptions. Neither of these students speaks about any particularly absorbing extra-curricular interests. Evelyn barely notices her non-science subjects and Henri brings the same approach to his courses in this area as he does to his science subjects. He explains that the non-science course which he is taking as a complementary was chosen because it seemed to relate to genetics and, of equal importance, it fit into his schedule. The other six women, however, speak about a wide range of interests, occupations and part-time jobs in addition to their formal studies. For example, Teresa says: "Actually, I play the piano and I really love music. I don't know I found that science is more something you want to do as a career rather than art and music which is more of a hobby. So in my spare time I would probably practice my piano or paint in my sketchbook...." It is clear that Teresa's sense that subjects like literature are different from science subjects ("English is harder than science because English has no answers") is a feeling that many of these students share. Nonetheless it is striking how many of the young women in this group see their non-science subjects as essential parts of their education. They all talk about the importance of being "well-rounded" and they take pleasure in their non-science courses. Natalia goes as far as to say:

> I think we need them [non-science subjects]. Not only rational stuff but you need something creative. If you think only in terms of the rational you'll never make it in this world. You need something to get away from it, to pick up imagery, something not only dealing with numbers and facts.

For these six women, other interests are important; however, it is clear that the women do not see these interests as drawing them away from the sciences. For them, the world is divided into two domains: the rational, scientific and the creative, intuitive; one apportions one's time between the two.

2. Attitude

It is not surprising that at this stage of their science "careers" these students are still in the process of staking out the territory called science. They have few solid definitions; however, they are agreed that science subjects are different from non-science subjects and this for a variety of reasons. Those which resonate with positive affect for these students have to do with logic and certainty.

For example, Penny says that science is about "dissecting and finding its parts and seeing how it works together as the solid thing". When she realizes that she approaches humanities and English in this way, she concludes that science is where she belongs. "You kind of see things as they are. I guess that's what science is," suggests Amy. "In science it's always one answer .... There's only one answer," observes Teresa. "And you just have to practise to get that right answer and so it's not just

sitting there, okay, I have to write a creative story and make it up on your own. At least science is already there and you have to practise." The man in this group is distinctly unreflective about these issues. In response to a question about the science curriculum, Henri says: "I don't give it much thought ever."

The majority of the women in this group identify math as their favourite subject. Penny opts for physics, Teresa for biology, and Henri chemistry. Although all of the students can identify a science subject about which she is more "wary" than the others, only Henri is adamant about his dislike: "I hate math," he says, "math is very boring." The rest of the students are more tentative about their preferences and Barbara can identify none; "sometimes this and sometimes that," she finally says. Regardless of the particular subject chosen, however, there is universal agreement among the women that understanding is a critical factor in making a subject interesting. Teresa explains: "It's more if you understand it and then you begin to like it because you want to go deeper. If you're lost you just feel like giving up." Christina explains her dislike of chemistry in terms of the difficulty of understanding theory and when Natalia explores her preferences one is given a further glimpse of the affective significance of these issues: "Math. I know what I'm doing. I go in there and I feel competent that I know what I'm ....I can sit down and I'll feel at ease. Physics, if I go in there I'll feel tense. And chemistry is in between."

The only exception here is Penny who dismisses biology on the grounds that it is about "treating people", something which she does not want to do. On the other hand, Penny also talks a good deal about the centrality of understanding and, in fact, it is Penny who makes it clear that the pleasure of understanding a subject is enhanced by the expenditure of some effort. She explains that a subject is enjoyable when it "is a challenge but not impossible so that when you get it you're proud that you got it." An appropriate level of challenge allows students to experience "the victories" which make their work pleasurable: "On the test you want a challenge, you want something, if it's a challenge you want to be able to know what the challenge is."

All of these students associate hard work with the sciences. Christina offers a fairly typical description of the science student when she says: "Mostly science students come to school to go to class and it's not a popularity thing and to look cool and whatever. More serious." For all of these students hard work is a cornerstone of the science experience. Even Barbara, who insists that there is no "typical kind of person in science" says: "Like in non-science courses ... I find it easier. You read the stuff and whatever material it is you're doing .... Well, for me it kind of sticks to my head and so I don't have to go over it and study it .... If I have to write something about it, I just write it but it's not like going back and checking this and that ...." Penny says: "[In science you have to think] whereas other things it's just plain memorization, just plain common knowledge, whereas this you have to work it out." This is not to say that all of these students work equally hard nor that they think they do. However, it is to say that their workload is one of the ways in which they distinguish themselves from students in other programmes. Henri makes this point most clearly: "...I could work harder but I work hard now.... My friend is in Communications ... he knows what he's doing and he almost never has any homework. He spends his time playing with the computer. It's a different life."

From the weakest to the strongest, the students see their success as contingent upon their own capacities for perseverance and they all minimize the importance of innate ability. Teresa observes:

> ...after a certain point you have to start working for your marks....For some people they have the ability already to think....Either they've done the subject before or they have an intuitive mind and they can prolong that not studying for a test for longer. But at some point they're going to have to start to work.

It's interesting that because of this emphasis on hard work, neither success nor failure speak clearly and unambiguously to the student's abilities. This has consequences for the way that students will evaluate their performance in the sciences. Already Henri explains his poor entry marks in math as being because he has not done enough work, a pattern which he says is continuing in his Topics course. In theory, at least, the most problematic position is that of the student who feels that he or she works hard but still fails to succeed. Interesting then that, in these early weeks, it is the academically weakest of the women who is the most despairing about the workload. "Hard work...too much work...always studying. I used to not work much. You know? Just do something and it was no big deal...and probably have high marks....But now if you don't work you don't even pass."

In a situation in which students might well lay claim to superior intelligence, these students use the importance of hard work as proof of the non-elitist nature of science programmes. As Amy says: "I think anyone can be in science if they really want to, if they put their mind to it" or as Natalia says: "Anyone could do it if they put their head to it, you know?...It's determination and a lot of work." Teresa says:

> ...they think that science students are really smart and have to work a lot. Which is true. You do work a lot. It's not really that science students are smarter. It's just that they're better in a different field. I mean you have to be smart to be studying history or studying psychology. You have to know what you're doing in those fields.

It is interesting that both Teresa and Amy go on to articulate a concern that even the emphasis on hard work may be exclusionary. Teresa says, "But science has a very negative image.... You know, science students always complain about their work and they always complain about having such a hard time and so you already have this idea that the subject is going to be hard and so you're not going to have a tendency to grasp it as quickly because you have this mental block, it's so hard, it's so hard and you're not thinking, I can do it, I can do it...." Amy points out: "There are, I guess, hard workers but a lot of them have lives. They go to parties and stuff." They see their own experiences in the sciences as standing in contrast to the perceptions of science students held by their peers. Teresa reflects: "I guess they think that all science students are really, really smart and really, really enjoy doing science which is not true." Although these students have a good deal to say about gender issues, in general, they report seeing few differences with respect to gender in their classes. Perceptions vary from none to fairly vague observations, in which women more frequently emerge as the more involved, if less recognized, gender.

3. Experience

As the students talk about their experiences studying the sciences to date, their study strategies and relationships to teachers and peers, Henri, the young man in the group, emerges as the clearly exceptional case. For Henri, science education is much more exclusively a form of training for career than it is for the other students. His basic approach is almost a caricature of the highly instrumental orientation to learning which we have seen used successfully by other students. He estimates the minimal amount of work required to pass each course and he does it. At this stage of his education, he has only met with mixed success using this approach. In physics, he assures us "show up in class, it's a rule of thumb, show up at every class and there's a good chance that you'll pass." On the other hand, in math "thinking I had done enough, I hadn't done enough."

All of the women, on the other hand, regardless of level of achievement, talk once again about the work demands of the science programme. It is interesting that for at least some of the high achieving young women adjustment to the workload has involved learning to accept that they will not be able to do every problem. At this point in the first semester, only two of the women talk about feeling overwhelmed by the pace they feel called upon to maintain. Both Evelyn and Christina complain that they are inadequately prepared for Cegep level science courses. Christina, struggling to keep up with an enriched science programme, complains that the work is "constant and I feel like I'm always behind and I feel like there are people who know a lot more than I do because of their prior schools." Christina is also the only woman in the group to be self-critical about the way in which she organizes her time: "I usually end up studying late and I stay up at night....I know I have to correct it, it's not very good." Evelyn feels much less in control of her life at this stage and she laments: "I don't do much in other things though. I study the most. There's so much studying." There is also remarkable consistency in the way all of the women describe the "business" of studying science: a solitary undertaking, involving movement from notes to text and back to notes, with an emphasis on trying as many problems as possible. Difficulties with the material are generally referred to a friend as a first order of recourse.

All of the students speak about the importance of social relations with their peers. In addition to the practical advantages of knowing someone in each class, they also talk about the extent to which these friendship networks make them feel more relaxed and more supported. As Teresa says: "You need to have people there when you do well to pat you on the back and when you don't do well too. You don't want to be in a class with strangers who don't really care about you." Here, too, the young man distinguishes himself from the rest of the group. Henri is distracted from his courses by the "social scene": "We're in the corner. This one corner is doing really well, troublemakers, ...we talk a lot." The other students, on the other hand, all see their relations with other students as contributing to and even enhancing their science learning. "[O]ther people have different ways of tackling science," Teresa explains. "And you can learn from them and they can learn from you." Although most of these students see competition as having positive aspects, they worry about the effects of this competition on these relations, relations which have important affective functions although they are seen as being different from more intimate friendships. Natalia expreses her own take on this difference when she says: "I mean you know each other but not to the point where you'll start talking about your personal life in class. So I feel comfortable. I'm not scared to walk into class and feel so alone and stuff." Penny is the student who feels most positively about competition which she understands in the terms of her involvement in sports.

It is only when peers are unable to provide help that most of these students turn to the teacher, and then only in those cases (the majority) where the teacher is perceived as being approachable. Only Henri expresses no hesitation about asking questions in class: "If I have a problem or something I'll raise my hand and bother the teacher until I understand." The women all speak about varying degrees of reluctance when it comes to asking questions in the classroom and it is absolutely clear that the teacher's behaviour affects the students' willingness to expose themselves.

On the basis of our interviews with these students, it seems fair to say that the women are involved in what goes on in the classroom in a way that Henri is clearly not. For the women students, the classroom is a place where important learning takes place, and they are committed to this learning in the interests of achieving higher marks if not for its own sake. Penny says "like I find if I sit in class and I listen I understand a lot better and I pick up things a lot faster than if I just read my book." They talk about concentrating during lectures and complain when the pace is so fast that they cannot

absorb the notes which they are copying off the board. It seems consistent with this sense of involvement that they all report enjoying lab work. Penny is the most effusive: "For me it makes the course." It must be said that lab work is also popular because the lab is seen as a block of time which is more amenable to control by the student than is the lecture. "They usually end early," Teresa points out. Henri, however, says he does not like labs too much because they entail writing lab reports.

Perhaps the high levels of anxiety which are reported by all of the students, except for Barbara and, once again, Henri, are also related to the intensity of the involvement. Most of the students talk at some length about the anxiety and stress associated with studies in the sciences and particularly taking tests in these subjects. Although each of these students clearly has her own stories to tell, Natalia's analysis of what makes her most anxious conveys something of the self-doubt associated with not "measuring up" in this domain. "So I guess that's what makes me feel tense. Because everybody is so smart and they know their stuff and I'm like, do I really deserve to be here?" They tell us about strategies to control the anxiety and about how the discourse of anxiety has been transformed by some into a self-protective ritual. Teresa describes the layers of denial involved in the process:

> I usually know how I've done but if I think I have done well I probably won't say it because I don't know I think there's a jinx in it or something. Or if I do worse than I thought I did you feel worse after, so it's always better after a test to go, oh, I did really badly than I did really well. If you say you do really well and then you do really badly it's, oh, oh.

As already mentioned, the students tend to conceive of science as a body of knowledge to be acquired. It is thus hardly surprising that students should see the teacher as a person who stands between them and this body of knowledge, whose job it is to facilitate the acquisition. What is striking is how many of the women identify the teachers' caring about them as a sine qua non of effective learning. Teresa summarizes the view of most of these women when she says: "It's not whether or not they know their material it's whether or not they care." This caring seems much less important for Henri. He identifies practical issues, that teachers should speak clearly and offer ample opportunities for students to improve their marks, as most important. Only Barbara identifies the teacher's ability to inspire interest in the material as being primary.

INTERVIEW TWO

1. Motivation

What particularly distinguishes this group of students is that, regardless of achievement level, they persist in the sciences, and they do so by abandoning pure sciences for the health and biological sciences. When we listen to these students talk about their experiences at Cegep and their plans for the future, it seems to us that several issues emerge as critical in helping us to understand the persistence of students in this group. On one hand, there are those students for whom NOT persisting in the sciences is inconceivable. For both Henri and Evelyn, the alternatives to science are completely unappealing. Neither finds their non-science courses particularly interesting, except insofar as they can be related to the much more central science interests. Evelyn says: "If you tell me to do something in history then don't bother. In humanities like I don't do much work. I just don't bother too much with it. I like science more." She cannot imagine working in an area where science is not involved in some

way: "I'm sure I can do science. I like it. I'm interested in it and so I'm sure." Henri, in fact, asks: "What else is there? Selling jeans maybe. No, no." Both of these students then opt to persist in the sciences, in spite of relatively low achievement levels by the end of Cegep. In fact, for Henri, there is little other than the relative absence of alternatives to recommend his choice. "I don't know ...like my friend says, It's just there. I don't love it...."

Henri switches to Health Science and enters university in biology as part of a strategy to pursue his original plans for a career in genetic research. Evelyn, however, has no such firm career plans when we first interview her. Now she is applying to Pharmacy, with Nursing as a second choice in the event that her marks are not high enough to win her a place in the former, although she says: "I know I want to be something more than nursing. You know?" Christina is another student who opts to continue in science because she can see no alternatives, although she has graduated from the enriched science programme. Her choice is also very much bound up with her continued preoccupation with science as the area which offers the "best" jobs. Although she does not actively dislike the non-science subjects which she studies at Cegep, she remains concerned about the fact that they do not seem "hard" enough. She explains: "I don't know even in high school when you all apply to college, you know, social was the lowest thing you could apply to and be sure to get in." She chooses to pursue biology in university by the "process of elimination. Somewhat. I never liked physics that much....I always liked math but there's nothing you can do with math but teach." Hence, she says: "I'm applying to biology so I assume [my favourite subject] is biology. Even here I'm not crazy about my biology course now. I just want to go to university. I hope it's different because it's not the best it could be yet." Her choice has the quality of a leap of faith: "Like I know I'm going into biology but I don't know how....I'm sure there's a lot of jobs out there and different kinds of jobs but I don't know what they are. Or, in any field. I don't think anybody really knows." Even she concedes that in the final analysis commerce might be a remote possibility.

It does not seem to us that the absence of alternatives operates with quite so much force in the lives of the rest of the students. They all talk to us about how much they like various non-science courses and it is clear that many of them have been deeply influenced by teachers and subject matters in these other areas. Even Amy who insists that the career "has got to be related [to science] somehow," emphasizes the impact that her Women's Studies courses have on her life and Natalia reaffirms her original sense of the importance of non-science subjects. "I love them," she says. In fact, Barbara, at one point in her final interview, laments: "I like too many things."

Many of these students find their non-science subjects to be relatively easier than their science subjects and this is viewed as "refreshing". As Natalia, who loves her non-science courses says: "The material is less. I have to say the content is less and I find myself relaxing and you're giving your mind something else to absorb rather than just physics, chemistry, and biology." This also figures into Teresa's enjoyment of subjects like humanities and English.

> Well, because like in English and humanities like for me I don't find them that hard. So, you know, once I get past the material I can start to enjoy whatever we're doing. But in sciences like it's just hard to get past, you know, all the material beacuse there's just so much to do and, you know, some of the concepts are very hard. And so like you're trying to grasp that and so you don't have any time to really enjoy what you're doing.

Natalia's view of the relationship between science and non-science curricula changes little over the Cegep years. "You're getting the practical view when you're in the sciences and then when you enter

these classes (non-science) you're getting more of an idealistic view and how to use your imagination and stuff like that. That's good and I think you need both of them...." This distinction is one held by Teresa as well but she points to a more difficult aspect of the creative dimension of non-science subjects. "But the thing in non-science subjects is that it's very subjective. Because in science like if you know it you'll get the right answer. But in non-sciences if the teacher doesn't really agree with you, you won't do as well so sometimes it's more frustrating...." The tension between science and non-science subjects, present in varying degrees for all of these students, finds its most extreme expression in Barbara's view. She says: "You mean connect between science and non-science? No, I don't think so. There aren't many things in common." Teresa, Natalia, Barbara, and Penny have all given some thought to turning to pursue careers which are not in the sciences. The alternative careers which they have contemplated are people focused and frequently involve a caring orientation, variations on social work and teaching, or they tap a talent such as music or writing. Teresa's description of her thinking in this area captures the extent to which career plans remain open and fluid for these women even in their final semester at Cegep:

> I don't know. Because if I end up becoming a teacher I might consider going into arts instead. Like teaching, you know, English or.... Just because .... I don't know, I find like science is a broad field but if you're teaching a science course it's always the same. But in English or in the arts you can vary what you teach more and there are different levels in the arts of looking at things.

Among these students, only Amy talks about her interest in the sciences as being unshakable: "I liked it. It was interesting and I just felt it was something that I wanted to do and something I want to pursue as a career. Basically I haven't changed. I felt like this in high school and I still feel like it now."

The breadth and variety of these students' interests also emerge when they discuss extra-curricular activities. All of them manage to sustain the activities about which they speak upon entering Cegep and several add involvement in various college organizations to their lists of credits. They speak about these involvements with commitment and energy. Penny, in fact, identifies being a well-rounded student, a valued athlete and an honour roll student as the achievement of which she is proudest. Only two students mention pastimes which they see as connected to their scientific pursuits: Penny is a dedicated internet user. Henri tells us that "the Discovery channel is on ten hours a day in my house." His only other occupation, however, is sports. Amy works hard at finding the relationship between what she describes as her scientific side and her artistic side. "Music has kind of like a sort of math," she says, "because of the time intervals and patterns. And, well, for like painting and stuff....Like the paints there's like the chemicals behind that and the materials."In the end, of course, the sciences win out, but none of the women in this group is single-mindedly attached to a specific career. In fact, many of the students complain about the absence of information about careers just as Christina does. Natalia says: "And I don't know really, what are the pre-requisites of environmental jobs .... I don't know what I have to know. And that goes for most of the programmes." Christina adds: "You don't have a sense of what's out there." When Teresa talks about her interests in medicine she says: "Well, that's just like one side. I don't really see myself in the future but I just want to do something that I like. Like, I don't think that it has to be medicine. You know medicine is just nice because, you know, it's science and it's also people and you get to help people. But you know it's not my whole world. Like I see myself doing a lot of travelling, going to plays, having a family ...." Penny also voices this sense that a job is only one part of her life, even as she underlines the importance of doing something which she *likes*: "With whatever life you have you can still do what you want. You still have 'x' amount of free time to do

something that you really like. But if you have the job that you like that 'x' amount of time is just going to be even better." Barbara probably expresses the largest amount of uncertainty as she talks about her application to biology at university: " For most people biology is like a stepping stone toward med school but I don't think that's where I'm going. I haven't decided for sure. I don't see myself as being a biologist either .... People want to know if you want to be a biologist but ... but I don't feel it's a very good choice." Many high achieving science students feel that they must define themselves vis a vis medicine. Christina talks about this and in the process betrays something of her own sense of being adrift in this world in which she nonetheless manages to be successful. "Actually, I read the application and you had to write an autobiography and in it they wanted you to include why you want to be a doctor and you had to convince them of why you really want to be a doctor. I didn't think I could do it. I couldn't even invent something." And a few sentences later she says: "I think I'm still trying to convince myself so that I won't have to be a doctor."

All of this uncertainty is reflected in their discussion of plans for further education. Only Teresa and Evelyn have opted for professional degrees at this point, medicine and nursing respectively, and they await decisions from elsewhere. The other students view their options in much the same way as Christina who describes the issues at some length:

> I don't know yet, but definitely more than a bachelor's degree. You hear all these things all the time and people say, well, in the future there's going to be a hierarchy and it's going to depend only on education....But I don't know what I'm going to do after. Maybe a Master's....I don't even know the difference between a master's and a Ph.D. If you do a Ph.D. well then you do independent study or you teach. I don't think I'd want to do that so I'll do a Master's....Ooh you have a Ph.D. It sounds so much better than a Master's.

Natalia expresses what is at stake for those students who hold to this view:

> I feel like I'm standing on top of the world. I feel like it takes so much to get that far. You know? It's all the....It's the status, also, you know.... It's like, oh, people are going to think I'm so intelligent and everything and it feels good inside. You know? It's not only all that. It's the fact that you've gotten that far and it means that you've been working hard and it means that you know something.

It seems to us that the connections which these women continue to feel with the sciences remain multiply determined. Certainly some of the appeal which they describe is familiar and hearkens back to the earlier interview. Amy reiterates her own sense of this appeal: "Because I'm able to understand it and not have that much trouble learning it compared to other people. Because I can grasp the ideas more easily. I guess the marks are also a factor." Penny too focuses on the continuities in her experience: "Well. [it's] been fun, it's challenging. Nothing much has happened, nothing much has changed. Everything is just going along pretty smoothly." These young women experience their non-science subjects as genuine, alternative learning experiences; however, many of them describe a particular affinity which science holds for them. Teresa says: "Like your thinking has to be more systematic and that's probably what attracted me to science in the first place" and Amy reflects: "I do [feel like a science person]. I've always been kind of a loner. Like I like to be on my own. But I also like to be with other people but like there's a time for that and there's also a time for me and my privacy." And Barbara reflects: "What I want to get out of it [science] maybe has changed. Like in astronomy I look for parts that I find more interesting, more personal." And she explains how much she has enjoyed an

astronomy course where the textbook uses a biographical approach. For Penny, science has come to represent a coming together of the traits which she sees as important in a chosen field: opportunity, the possibility of enjoyment, and "an application to everyday life".

On the other hand, we are struck by how much the interests of these young women in the sciences have changed. Their opting to continue their studies in the health and biological sciences at the next level of post-secondary education is an expression of this change. With the exception of Henri, all of the students in this group, that is, all of the women, talk about how their interest in science has come to accommodate what they perceive as a new consciousness of the importance of social responsibilty and human connection in their lives. This development is so striking in this group that we quote from each of the students.

Barbara says: "My interests in sciences have changed a bit I think .... I mean if I go into the sciences I'd like to have the combination of helping people and ideas." Natalia announces that she has switched out of Pure and Applied Science and then she explains:

> I know that in the sciences I can make a difference. If I become a doctor then I know that I'm saving people's lives or at least I'm trying to save a person's life. If I become an environmental engineer I'll be doing something that makes the situation better for the earth....I know that if I choose a profession in this I'm going to make a difference. I have to. I feel it inside, you know?

Finally, she says that she looks to teaching at the collegiate or university level as a way to integrate all of her interests. She describes how this would work:

> Because I'll be giving....Sure I'll be giving the facts and whatever but at the same time I want to try and make them realize what the purpose of it is and give them. like I say, real life experience. ...Like a student coming up to me and telling me about his or her problems or why they think they're not doing well .... You know? It's a whole different concept and I think that's why I'm so attracted to it.

Teresa explains her application to medicine: "Like, I want to have contact with like people all the time also and I want to apply science at the same time so..." and later in the interview she adds: "I think I want to work with children but I'm not sure yet. Something along that line....I just want to see people everyday. I think that's the most important thing for me. I don't see myself in research working in the lab." Teresa applies to Computer Engineering as a fall back option, in case medicine does not work out. However, she makes it clear that her sojourn in engineering would be temporary, a detour on the way to somewhere else, perhaps teaching.

Penny who begins her career at Vanier loving physics and hating biology is now headed for full-time study in the latter as part of an environmental studies programme. "I'd like to make a difference," she says "...and maybe even environmental law after I get my science done." As for her original interest in computers, she now plans to build awareness of ecological issues through the internet.

Even Christina and Evelyn, women whose orientation to the sciences is quite different in other respects, share this commitment to focusing on people. "You want to make a difference in the world," says Christina as part of her explanation of her choice of university programme. Amy reflects back upon her original aspirations to be an engineer and now says:

> It was just mechanical ... (she laughs). I think my first interview ... [I said] I am a woman and I want to go into engineering because there weren't enough women. Now, that's still part of my reason for going into science but I'm not going into

> engineering, I'm going into bio-chemistry and I'm doing that because I just wanted research stuff and find out new things and like new drugs to cure illnesses and, I don't know, the dynamics changed a little.

The women who first identify defying traditional gender roles as a reason for entering the sciences continue to talk about this aspect of their motivation and they are joined by at least one other. Natalia speaks about this at some length:

> I feel I have more of a motivation than a man does. You know? A man is like, okay, well, many men have been there but I'm doing this and saying to myself, well I'm going to try and change this. You know? I'm going to be one of those women that's going to be up there and do that job just like a man can. Like a man feels like he's expected to. There's nothing much to it when you see another man, you know? I see my friend and he has a different motivation which is totally personal. As far as a man from a woman, men have already done that, have already, so to speak, proven themselves. I'm trying to prove myself and I'm trying to prove it for the women as well.

All of the women speak about desires for children but their ideas in this area are even more vague than they were at the beginning of Cegep. No one now suggests abandoning career for home.

Some of the students talk about the role of a particular teacher or group of teachers in their decision to continue in the sciences. Barbara, for example, says: "Most of the teachers were quite good and they encouraged me also to continue on afterwards." Amy identifies a chemistry teacher as playing a central role in her decision to abandon her engineering aspirations and Henri too speaks about how valued he felt when a biology teacher loaned him a book. Interesting that when he is asked specifically about the role of teachers, the young man who expresses such minimal expectations of teachers says: "No, no, not really [important] No. I think it's just my friends...my good friend."

The relation between achievement and persistence in science, important from the very beginning of our work with these students, has undergone changes and is now more complex. It is true that achievement continues to occupy an important place in these students' lives. With few exceptions, they offer examples of receiving a particularly good mark on an exam or in a course as high points in their science educations at Vanier. Most of them see themselves as successful students, though often with qualifying descriptions which we discuss below. It is clear that the high achieving students see their continued success as having played a role in their decisions to persist. For example, Amy says: "Yes [I am good in science]. Because I'm able to understand it and not have that much trouble learning it compared to other people. Because I can grasp the ideas more easily. I guess the marks are also a factor." For Christina, who has few other points of connection to this domain, achievement in the form of marks carries particular weight. She says: "I don't know [if I'll continue in science]. I hope so but I don't think it's a sure thing...because it's hard. University is going to be hard. Cegep was hard and I did okay. Now my grades are starting to slip a little bit....I'm not really sure." She reasons that she is above the class average.

Henri and Evelyn are particularly interesting students in this respect because they have persisted in spite of more modest academic achievement, and in both cases this seems to be partially related to a capacity to create a situation in which one can conceive of oneself as being "good enough". For example, Henri evaluates his performance over his years at Vanier and says: "I did okay. The fact that I got out of here in two years....Like the odds are against us leaving this place in two years and that's not bad. It's okay." And Evelyn explains: "Like maybe the marks aren't that way but like

I mean now I know much more stuff than before. I understand even though I don't have great marks." Such self-evaluations, however, must surely be read within the context of their larger stories in which few alternatives to science figure.

2. Attitude

After two years of studying science, the students' views of what science is have undergone evolution, as opposed to change, and this in the direction of emphasizing the ways in which science is a way of thinking, one perspective among others. Amy begins: "Well, I see it as a way of thinking. It's a perspective of seeing the world and explaining things, I guess through cause and effect and all that" and Penny takes up the theme: "As opposed to working it out through languages....As opposed to just asking somebody, you go out there and you search it. You find logical reasons for....I think it's a big logic thing....Finding logical reasons instead of emotional reasons why this happens and why that happens." Only Natalia, herself so determined to find a place in the sciences, insists on the all-encompassing nature of scientific knowledge. "What does the word science mean to me? To me it's the future...everything is becoming science. The future is to know what the problem is in the world and you have to apply science. You know?"

We are impressed by the extent to which their definitions of science, constructed out of their own learning experiences, bear the mark of their own particular sense of attachment. Thus, Teresa insists that "the basis of science is creativity...and especially when you get into harder science courses you need a lot of creativity to kind of understand what you're learning;" Penny says: "Science is such a big, huge sort of field....I guess science to me anyway...science is like a very big quest. Like you're out there and it's a challenge. It's not so much....It's finding out answers to everyday problems in a more scientific way, in a more technical way." Evelyn offers this definition clearly shaped by her own desires: "It's something interesting. I don't know. It deals with people mostly. Like if you talk about biology and stuff it's about humans. Chemistry deals with how to make medicine. I like dealing with humans basically. In physics, like quarks and all that stuff....It's all science." Even Henri, who offers a textbook definition of science now adds: "I'd probably go kind of like this because I kind of agree."

In their reflections on this topic, one hears a developing sense of the connectedness of science subjects. Christina, for example, says that she still thinks about them as separate subjects but that "they used to be very separate and now they're coming more together. There are still divisions though. Some things apply to everything....You see that they all mix." Evelyn explains that biology connects to chemistry while physics connects to math. Only Barbara resists talking about science <u>per se</u>. "I see it as subjects" she says, "I guess, yeah, I see them as different subjects....I don't see just one science."

When they come to consider the type of person who might successfully practise science, a few of the students focus briefly upon the personal traits which they see as being most advantageous. Amy, who describes herself as a logical person and who defines scientific thinking in terms of its logic, quite reasonably says: "Well, I think the important thing is that they're interested in it and I guess if they can actually understand science....Well, logic. If they have a pattern of logic that I guess suits science then science would be the field for them." Barbara has the same difficulty identifying a science practioner that she does defining science: "For people who are in science like, I would say, medicine .... It's very different than say a physicist, engineers.... It seems like physicists and mathematicians are more like ....They have less to do with people. More like ideas...." On the other hand, both Natalia and Teresa are very clear about the personality best disposed to scientific work, and they are very clear about the ways in which they do not resemble this person. Natalia who tells us so much about the

anxiety and stress associated with her education says: "Their [the successful science student] personality is that they're very confident of themselves...not egotistic, confident. They are never worried because they know that they know their stuff. They know that they know the material. They're not people who get very stressed out quickly. You know? I find that, basically, that's it..." And then follows an interesting shift from confident to competent, for Natalia continues "...they're so competent. They're competent and they know the material and they can go in and do it without problems." Teresa, ultimately accepted to medicine, reflects: "And so someone who would be well, not only successful in science, but also they'll go through it with ease would be some one who can....You know, whose mind is very systematic and they can see things in their minds rather than having to see them like in real life." After a pause she says: "Well, I'm more practical. I have to see it in real life before I really understand it."

At bottom, however, hard work remains central to the definition of success in this domain for most of these students. Christina explains the theory (to which many of the students would subscribe): "There are two types of people who successfully go through science. There are the people who work really, really hard and there are the people who have just got it." Penny adds a third type, a hybrid, who combines ability and hard work. It's interesting how far this basic idea goes in terms of providing students with a rough and ready guide to their relative merit in this world. Christina confides: "I'm closer to the person who doesn't study and does well." However, in the absence of any particular interest in or attachment to her studies, she can derive small comfort from this fact. Natalia who really struggles with issues of achievement and who takes pride in her accomplishments, sees her own hard work as a mark of her outsider status. "I think I've done very well. I've done well but I wouldn't say it comes naturally to me. I have to work really hard for it...." This shapes her view of her future. On one hand, she says: "I see myself struggling a lot....I see myself going over a lot of bumps. You know? But getting there. Yes." She is echoed by Teresa who says: "Like I find science hard and the only reason I do well is because I work at it like really hard and so I know that in order for me to succeed in the future in sciences I'll have to work. Like it's not, you know, a natural gift or intelligence."

Barbara offers a very careful assessment of her relative position in this "work world". "Well," she says, "I do study more than other people do. I guess more than regular people...like average mark students. But like I don't stay up crazy hours because of studying....I guess I go over the material more. Once I go over it I think about it also. If I'm not studying it's still in my head somewhere." It's interesting that she is the only student to articulate the loneliness of being a student invested in academic work. Significantly, she associates this loneliness with her experience in non-science courses, courses which she otherwise enjoys a great deal. She explains: "I like when people around me are also interested in it. It seems like there are a lot of people in the class who are just there because they have to be there. It spoils it....Not so much in science courses but in humanities courses a lot. English. It's like everyone is there because they have to be."

Both Henri and Evelyn have lower marks than the other students. They locate themselves on the periphery of this work activity. Henri says: "I'm supposed to be saying that I study a lot but I don't study that much. Every now and then I study when I'm not in school but...." Evelyn describes a student who does particularly well in her class but in the course of her description it becomes clear that her success carries a heavy price:

> She has a 90% average and she is really good and smart but she never goes out and I think she's always home and studying and at the library. I think she's going to be a doctor or something. Okay. But I mean it's also nice to have a social life. It's too boring without nothing, with only sciences. It's your life. You're not going to be young all the time."

She evaluates her own performance: "Some people study until 2:00 o'clock but I can't. After 9:00 I get so tired and I can't so I have to sleep. Even though I try I can't."

Since the shift from pure and applied sciences to the biological sciences is what characterizes this group of students, we might expect to find that a clear, and perhaps even dramatic, preference for biology emerges among these students during the course of their studies. Indeed it is true that they all report enjoying their biology courses; however, it seems more accurate to describe the change in orientation as a gentle drift into biology, away from the other sciences, particularly physics. Barbara describes the course of this shift: "...I like biology better than physics. Some aspects of physics are alright but 301 which was waves and modern physics I found that interesting but especially electricity and magnetism it wasn't something that I could relate to and like I wasn't very interested." From Barbara's discussion of her physics courses, it becomes clear that she has indeed been fascinated by some aspects of the subject. "You know ....I'm very interested in the history of the universe....Trying to find out how old it is and the theories about how it began and things like that." It is also clear that she has "done fine" in all her courses but as she says: "I got tired of physics." At the same time, she discovers biology as an area which she finds intrinsically interesting and in which she finds a teacher who sustains this interest. "If the teacher gets your attention and interests you in the topic in whatever the subject matter is. For me, it's like biology and that's what I decided to go into."

Thus, the pattern which emerges in the attitudes of the women students in this group is of a drift toward the biological sciences within the context, however, of a general ambivalence about career and future. This orientation seems related to the open, receptive approach which many of these students bring to their learning. It helps us to understand the significance of the fact that many of them report no marked preferences among science subjects. Teresa, for example, identifies organic chemistry and calculus as her favourites, explaining that she "liked the ones that were easier. I didn't like physics that much. Like I liked the first physics because like when I finally got it I was like, wow! Like I understand it so .... But there wasn't a particular science that, you know, I really dreaded going to." Of biology she says: "I like biology. It takes a great deal of memorization though. It's not that bad...because biology is really broad. Like, you know, I'll find human biology interesting but I don't really care about what plants do so...." Penny's views are very similar. She says: "I don't think I really have too much of a least favourite subject. I like school so I guess that's a problem." Of her choice to pursue education in the biological sciences she says: "Okay. Well, I probably like biology better because there's less math....I feel that it's more related to topics to-day and the environment and environmental issues. I also like chemistry for the same reason that it applies very much to what you see around you in the environment ... and physics I'm on and off with." Amy, in fact, never identifies biology as a particular favourite. She expresses a preference for math but quickly adds "I like them all." This is also the theme to emerge from Evelyn's discussion. Although she is very clear about the fact that there are some topics which have failed to capture her interest, her basic liking for science subjects extends to physics as well. She is the only student in the group to feel this way about physics.

All of the students in this group, without exception, see the teacher as playing a significant role in shaping students' attitudes toward the subject. The role of the teacher emerges with particular clarity in the stories told by Christina and Natalia, two students who express the strongest aversions to physics. Christina narrates her experiences in the various physics courses and concludes "...now, I have physics again and the teacher and the teacher I have...it just doesn't do it for me...so, now, physics, eh,. I don't like it as much as I did. But the teacher has a lot to do with it...." In a final reflection upon her relationship with physics she observes: "I end up with good grades. But I don't feel like...like I never sit in class and get the feeling, oh, that's interesting. You know? Like that could happen to me in some

other classes but never in physics class." Natalia hardly hesitates when she identifies chemistry and biology as her favourites. Although she complains about the sheer volume of material to be absorbed in biology, she is scathing in her attack on physics: "I don't like physics. I find the teachers....I've had terrible teachers in physics. I don't think there's actually any one good teacher."

The student who seems to change the least over the two years is Henri. He begins his Cegep career with an interest in biology and he finds that he remains committed to this subject. He describes this commitment with characteristic understatement as being due to the fact that it is the subject which "I failed the least." He also sustains his aversion to math and his analysis of his feelings reveals an important dimension of his orientation to his studies in general. "Do you want to know why?" he asks with respect to his professed hatred of math. "Because the class sucked. They were all like cold people in the class. Usually I love classes and they're kind of like socialization periods and everyone gets more friendly and it makes a better study environment in class."

In the students' reflections upon gender in the classroom, they seem to be adjusting to a reality which contradicts the expectations which they have been given. Teresa says: "...I've read all these articles about girls not going into science but I went to a private girls' school and like half of my grade was in the sciences...." Christina reasons:

> I don't know when I was in high school I always thought girls were smarter than guys and then people started telling me, well, no, it's not that men are smarter it's just that they do much better in school or whatever. Even when I was looking at the math competition results and most of them were males that do well. This perplexed me because I always thought that girls generally do better just from what I could see, you know?

Henri observes that there are more "girls in biology than there are guys." He says that they really concentrate in class and take better notes. "I have crappy handwriting and so I always have to mooch off their notes." When asked whether the women have the same career plans as he does he responds: "Not really. Well, they all have their little scams and everything they can pull off like doing two years at Concordia and then going to McGill to have their bachelor's say McGill on it and stuff." In Henri's sarcasm, one can trace his own ambitions to attend the more prestigious university, his own realization that this is unlikely to happen. However, surely one also finds here, beneath the resentment about the measure of the space occupied by women, the mark of his own extremely instrumental orientation to education, in which achievement is understood as a successful "scam".

Only two students, both of them women, suggest that different genders may have different interests in the sciences. Evelyn observes that "it's mostly guys" who apply to engineeering. "Maybe they're more interested in that," she suggests. Barbara talks about this as well. "...my brother and others are sort of like obsessed with it and that's like all they do," she says. "I don't know if it has to do with me being a woman but I don't get so interested in doing things that are inanimate...."

Two of the women mention the gender of the teacher as an important factor in their learning. Natalia, so unhappy with her physics courses, complains about the fact that no women teach this subject and Amy recalls the importance of a woman as teacher when she describes an influential high school biology teacher: "I guess because she's a woman I looked up to her," she says.

The majority of the students in this group feel that as science students they have benefitted from their education. For Christina and Teresa, the benefits are to be measured largely in terms of more knowledge. "The only thing it's changed is my level of knowledge," says Teresa. Christina offers a similar assessment. Amy and Penny suggest that their thinking has been shaped by the experience

of a science education. "Methodical. More logical," says Penny. "Because you solve mathematical problems and it's like solving other problems like everyday problems," Amy offers. For Natalia, who has throughout seen her education in highly transformative terms, the effects touch more closely upon the issues which are more central to her psychology. She says:

> It's made me more independent, it's made me stronger, I would say....It's made me more ....Because I don't tend to give up so easily. You know? The sciences have made me like learn to deal with struggling and with the meaning of pressure....I'm really bringing this up a lot but it really has. I used to be a nervous wreck, I used to be a nervous wreck. And now I'm more calm and I'm learning to deal with the problems that arise from no matter what course you're learning or whatever.

There are really only two students in this group who do not share in the positive evaluation of the experience and this for very different reasons. Barbara insists that there is little in her development which "has to do with sciences"; Henri reckons that it is because he opts to study science at Cegep that he does not achieve the entrance requirements to attend the university which he considers to be more prestigious.

Throughout the interviews with these students, we have felt that they might have produced lists of the things about their science educations which they would have liked to see changed. It is significant that when confronted with this question directly, they produce few suggestions. Natalia, plagued by anxiety and disillusioned with her teachers, says: "I wouldn't have changed anything. You know, it was for the best". A few students, interestingly enough, talk at this point about the things which they would have changed in themselves: studying harder in organic chemistry for Henri, being more of an exrovert for Amy. Perhaps we are now also tapping into the strength of the ideology which the students have absorbed. They certainly give little indication that they see science education as amenable to change and they here turn discomfort into self-criticism. Thus, Christina, a student who has had so much difficulty keeping up with the workload demands of the enriched science programme, says: "I don't know. You hear about other countries and we don't work half as much as they do and so I don't think I could complain about the work. Like, say, less work because we're already so lazy. Like we hardly do anything....I can't complain, I guess." There are some suggestions for improvement. Evelyn does say: "Less workload. Or more time for the work we have to do. Maybe better teachers...." However, the students' suggestions are marked by their own sense of having little to contribute to the shaping of curriculum. We hear poorly developed, relatively inarticulate alternative visions: "Anything about here...ummmm....No, not really. Maybe less physics". Barbara's critique ends with her assuming private responsibility for the lack of diversity in course offerrings in the sciences:

> ...with science you have to take three science courses and choose one complimentary and so I was taking Russian because I really like it. Then you can take psychology....I really wanted to take a history course or something like that but I didn't end up doing it.... I guess for those if I have time just do it on my own....Find out about it.

3. Experience

Given all that has already been said about the importance of work, it is hardly surprising that it should emerge as central to the discussion of the experience of studying science for two years at Cegep. Teresa begins her final interview by saying: "Well, it was a lot of work. I don't know.... It was

a lot of work. That would be the main thing about science." For someone like Amy, the amount of work has been a surprise. "You have to spend more time actually studying instead of just being able to fluke it off." It is clear from some of their descriptions that there has been real anguish involved at moments. Teresa says "Like sometimes you're kind of wondering, Well, why am I putting myself through all of this?" From the vantage point of the end of the science programme, this hard work becomes a sort of rite of passage, an initiation which ensures one a place among the elect. Penny describes the experience as "regimented and sort of sacrificial in a way. A lot of giving up of this and that. But I mean it's worth it." Christina says: "I know I shouldn't [feel superior to other students] but sometimes you feel like .... I'm in college and I'm doing all this and you're in college and you're doing nothing....You can't help but feel like you know more than them." Natalia too talks about the hard work in terms that suggest that it has become a test of sorts: "There's so much to do. I'm up at 2:00 a.m. sometimes doing homework. Every night it's like that." Later in the interview she reminds us that this aspect of the experience can serve to cement commitment as she says: "I know that even though I would choose a career out of sciences I would still be good at it. But I choose not to go on that path. Because I say to myself, I just can't give up now, I've gone too far. You know?" Even Henri, a self-confessed not hard worker, says: "I didn't study all this much for nothing."

We are struck by how little, in fact, has changed with respect to each of the students' study habits or approach to classroom learning. Indeed Natalia says: "I knew what to expect. I knew that it would be a lot of pressure and I expected it and so I went in there knowing that I had to deal with it." Only three of the students, Henri, Evelyn, and Christina, report feeling that they had not worked as hard as one "should" in sciences; only the women express disappointment with themselves in this respect. As already mentioned, Evelyn talks at some length about her difficulties in sustaining a daily work routine and Christina, too, says that the discipline of daily work has become more difficult to manage. "...I get tired," she says. "I don't know if it's psychological or I don't know if I was more motivated then or less motivated now but I get tired and so I go to sleep. I try and wake up early in the morning and that doesn't work very well." Henri readily admits to weak study habits but he expresses few regrets. He explains:

> Most of my time I spent in the library. But I have a really big mouth and I talk a lot and so not too many people studied while they sat around me. I did study kind of. I studied before....I started learning some stuff while I was hanging around with my brother and by osmosis. Just from picking up stuff....I'd pull off tests with a 60 or 70%.

The other students describe learning how to organize themselves in order to cope with larger quantities of more difficult material. Teresa says: "I learned to be very organized, like very fast, so most of the time I knew I'd have a lot of work and I tried to get as much of it done as possible." All of these "hard-working" women talk about the necessity of keeping up. "You have to [do homework every night] or else you fall behind and then it's terrible," warns Natalia. They talk about learning to make good strategic choices about what assignments should be done in which order. Although there are different opinions about the pleasures associated with doing problems, ranging from Amy who compares problems to puzzles and says "I love puzzles" to Barbara who says "I like more the interesting reading", no one reports hating problems. Many of these students have evolved their own understandings with respect to the relationship between theory and problems. It is interesting that there seem to be a variety of successful approaches here. Teresa insists that she has "to do all the problems in the book"; Barbara is happy to try just a few. Natalia talks about struggling to find a balance:

> What you have to do is you have to limit yourself. You have to say. okay, I can't read this in the book so I might as well read the teacher's notes even though they're not that great. And then you have to focus just on doing problems and then you're not learning the theory. All you're doing is memorizing problems and it's not good. So I might get a good mark but it's not worth anything. You know? Because I might not understand it. That is terrible. In my opinion, it's terrible when you don't understand it.

Penny seems to offer good insight into the nature of this struggle, surely reflective of how invested many of these students are in their studies and in learning for its own sake, when she says:

> It's the time constraint versus high marks versus grades versus learning that is interesting. ...My basic strategy is to get the main understanding, understand as much as I can and then work out a few problems. It saves a lot of time. If you can just start ploughing into the problems you're going to waste a whole lot of time and that's a major part.

Once again the students in the group talk about their involvement in lectures, attentiveness to the teacher. It becomes clear that this is the fundamental way to absorb material for these students. Penny says: "Everything I hear I remember....I have to attend every class otherwise I'm going to be lost." Perhaps the importance of classroom learning can help us to understand some of the failures among the weakest students. For example, Evelyn explains her poor performance in one of her chemistry courses: "I didn't bother coming to class because it was too boring." Henri registers the same complaint about his ill-fated math course, a problem compounded by its Monday morning time slot. Reluctance to impose their problems on the class persists as a pattern for the women. Two of the students offer an interesting analysis for non-intervention. They point out that when one is lost it is difficult to formulate a question. As Christina says: "I can't raise my hand and ask a question when I don't know what to ask the question about...." Once again Henri is the exception here.

All of the students in this group tell us about the significance of relationships with other students. In a general sense, they all see meeting people, learning about people, and making friends as a significant value associated with the Cegep years. It seems to us, in fact, that for a student like Henri his personal relationships with other students now operate as an incentive to further education, not only in the sense that he takes pride in having developed note-taking contacts but also, and more fundamentally, in the sense that he takes pleasure in his education as a social experience. As he himself says: "Usually I love classes and they're kind of like socialization periods...." However, if his social relations have this immensely positive aspect for him, they also have a negative side which he cannot always manage: others absorb his attentions and distract him from his studies. The women in the group seem more adept at managing these distractions. Although they all insist on the importance of private study time, they also tell us about peer relationships which successfully integrate social contact and academic work. Teresa identifies working with others as a preferred mode in which to approach problems "because I find like by talking to someone else usually you'll come to a solution faster than working on your own just because the other person might like see the problem differently." Christina says, "I think a lot of the things I learned in class was from other people in class and not from the teachers themselves." In fact, she suggests that in this sense she is disruptive in class - and she likes to laugh. Natalia says: "I'm there to learn for myself and even for others....You know? Like, if I can help someone that makes me feel really good inside." This is not to say, however, that all the women favour group work. Penny prefers her own solutions, achieved by solitary effort. Amy emphasizes the impor-

tance of supportive friendships in the class but says of group work: "Most of the times I guess the results....I'm not satisfied with it because I know they can be better....Also sometimes I don't want to offend people because I think a certain way is different from theirs. They might feel, I don't know, maybe intimidated or put down or something."

It is interesting that the worry that others may feel "put down" in one's presence emerges once again when two of the high achieving women discuss their experience of competition in the sciences. Significantly these women are both very good students who are in the regular science programme. Natalia expresses her negative view of competition, not unrelated to the concerns expressed initially by the members of this group.

> To some extent, yes. When you have competition it instigates you to do more work....You want to be on the top of the class. You know? The top of the class. But it's not good to be like that all the time because it's not a desirable quality. Not many people are going to like being with you if you're always going to try and be better than them.

Barbara also explores this problem with great hesitation. "I don't know I end up doing better than other people so....It takes away from....I'm proud of it but..."

For the students with the lowest grades, competition has by the end of Cegep clearly become a non-issue. As Evelyn observes: "[It doesn't affect me] not me but some people it does. A lot." However, the students in the enriched science programme have a good deal more to say about the role of competition in their experiences. It too is negative. Christina says: "There was definitely competition. I don't think people talked about it. It's very bad if you never beat anybody else. If you're always at the bottom of the class you feel very badly." Amy observes: "But sometimes when you can't compete....Well, you want to but just can't because they're just way ahead of you then you feel I guess....I feel left behind." Only Teresa, who is really at the top of this class, insists that there is little competition here, at least "Like no one is super competitive in my class," she says and then she continues: "I prefer it that way because it's nicer...It's a lot healthier because it takes away a lot of the pressure. Because if there's a lot of pressure and you've been doing well like you feel a lot of pressure to keep it up." Thus, in the end, only Penny continues to feel positively about competition as she says: "...everything I do I'm competitive. Absolutely everything. So it's like a way or just a mode of life now."

Performance level also offers a meaningful way to enter the discussion of anxiety in this group. It seems to us that the students who report the least amount of anxiety are, in fact, the students with the lowest marks. Evelyn cannot think of a single anxious moment and Henri, after some thought, offers his first physics course with a particularly difficult teacher as an instance. The other students all talk about anxiety with some measure of familiarity, although here too there is a range of intensity from Barbara's moments of work overload to Natalia's descriptions of the emotion in which her life seems bathed. "The starting, the pressure, the exams, the exams...," she fairly wails. Indeed, most of the anxiety in the group is traced to worry about performance on exams. Interestingly enough, only Evelyn and Henri express concerns about their futures. Evelyn says: "It's scary going to university. Whoa! I don't know anybody and stuff." Henri's worries are associated with much more abstract issues, unusual for him in the context of the rest of his interview. He worries about whether or not he is ready to come up with new theories and then says: "I guess I might be able to do that later on but now it's a bit scary."

It is Christina who gives voice to the ritual advantages of anxiety this time. She explains:

> I just generally feel nervous before a test. Yeah. It seems to be effective. If I don't feel nervous I don't do well. This is my theory. Everybody tells me I'm wrong but I

> like it....Unless I'm really, really, nervous then I don't do well or if I'm not nervous I don't do well. That's my theory....But I can't pretend to be nervous. That doesn't work. Like I can't fool myself into thinking I'm nervous because I think I'll do well that way. It doesn't work. I'll still do badly.

Perhaps because anxiety is invested with these positive aspects there are, in fact, few strategies for dealing with anxiety to emerge from this group. Teresa tells of her efforts to keep anxiety under control and Natalia describes how she has been forced to learn how to deal with negative results:

> ...in high school I never failed anything and I didn't know what it was like to fail something. I came here and you can't make it all the time; there are some times you fall behind and there's that test or that quiz that you might not do well and I've learned to say to myself, okay, I can't let this get me down, there's much more coming up and I've got to be stronger, I've got to continue and so it's taught me that.

It is clear from the preceding discussion that teachers enter the fray in various ways at various levels. Some students do tell of particularly traumatising experiences with a single teacher: Henri in physics, Amy in linear algebra. Natalia tells of a bad experience with a chemistry teacher but its effects are mitigated by the fact that the whole class organized to complain. Over all, however, what is striking about this group is the extent to which they register satisfaction, even pleasure with the quality of instruction which they have received. Barbara, Henri, and Amy all talk about teachers who have made a difference in terms of their educations. It must be said, however, without detracting for a moment from the quality of the teaching which these students have received, that the demands of the students, at least those which they articulate, are remarkably modest. Only Amy suggests that good teachers should be inspiring. More typical of the responses is that of Teresa who says that the best teachers are "the ones who pay attention to the class. Like the ones who know all the individual members of the class. Those were the teachers, you know, that developed like a good student-teacher relationship and that was very important because then you feel encouraged, you know, to do well because you kind of like....You know it will make them happy and you know it will make you happy." In short, human values are most valued by the students in this group. As Christina says: "...so it's not like he's standing there talking to himself or talking to the blackboard he's actually talking to you. I think that's very effective." It is in human terms that Henri evaluates his connections to his teachers: "Well, there are teachers that I still come around Vanier to see and say hi and everything."

Of all the students in this group, Natalia probably represents the saddest case: highly motivated, committed to continuing in science, she has few happy experiences with teachers to recount. "They're just there to teach," she says, "You know? Not to get anyone to really like it or to be interested in it. They're just there to give you the facts....Deliver information and nothing more." She sees this as related to her whole experience in the sciences of which she says:

> It's hard to say for sure. I've been motivated by myself. I can't say any science teacher has motivated me....I've known students who have been motivated by their teachers....I've gone into their classes and I can say that they did motivate me but I couldn't go to their classes all the time. But none of the teachers I've had have personally motivated me and maybe it's just my luck. I don't know.

On the other hand, Natalia has a very strong sense of having much to value in her Cegep education. When she speaks of the impact of this education, she speaks in terms which epitomize its

power to transform. She talks about her new found ability to deal with pressure, about the way that she has come to value education and friendships made within an educational context. She describes the impact of role models in her life. Henri too talks about the importance of friendships made during the course of these years; however, he significantly turns to consider the instrumental value of his education: "It kind of prepared me to proceed to university vaguely," he says. It is its transformative potential which is the theme to emerge as most central to the women's evaluations. Amy says: "The past two years helped me to grow up ....Also because I've been able to find out...well, not entirely but...who I am and what I want to do and what I want to be. As a person." While not all of the women express these issues in such dramatic fashion, the vast majority of them make some reference to convince us of their centrality. Indeed, it is in terms of these issues that some of the women explore the limits of their science courses. As Teresa says: "Like, your aim is to do well in your courses but, you know, it's also to get a broader experience of whatever is out there." Barbara is even more specific: "I think I get more like out of humanities or classes where we actually discuss things. We get more out of something that will be of help in figuring out who you are and things like that. I get more out of that than I would a science course."

IV. PERSISTERS IN THE HEALTH AND BIOLOGICAL SCIENCES

A. SUMMARY

Thirteen of the young women of our sample who enrol in the Health Science Programme in 1993 persist throughout Cegep and intend to continue their studies in the medical or biological sciences in university. These students share many common features, and examining them as a group has given us insight into what helps women persist in this area, and where their difficulties lie.

All come to Cegep with positive experiences in science and math from high school, often very much encouraged by teachers and school board programmes that have given them exposure to hospitals and medical careers. Of all the women in our sample, these are the most career-oriented: many of them already sure they wish to be optometrists or pharmacists or physiotherapists, and some few wishing to be doctors and dentists. Those who are less sure of their futures talk about keeping their options open, but all of them seem to feel those options fall within the sciences because it is the sciences that have really captured their interest and challenged their minds. Nevertheless, they also bring with them an enormously broad range of outside interests in music, literature, dancing, photography, animals and nature, and so on. Many have been very active in their high schools in terms of clubs, student council positions and other extra curricular activities. They are almost all extremely sociable, and an important motivation for the future is a desire to work with people, to care for people - or in the case of two of them, to care for animals and the environment. They represent a wide range of achievement, from those offered places in the Science Plus programme to those who seem to have only barely made it into science. In terms of subject preferences, they speak most enthusiastically of high school biology; they have all felt comfortable with their math abilities; none are enthusiastic about chemistry; physics poses real problems for many who cannot see the point of taking it and admit they have a real mental block against it. They are quite hard working on the whole, some very hard working, and all are very serious about their responsibility as Cegep students to keep up with their work. They have high expectations of teachers, but only complain about real violations of student dignity or of teachers whom they cannot understand. They are very, very anxious about their work, and they do not, on the whole, like competition, though many of them measure themselves constantly against others. They do not have a high gender awareness, but they are willing to talk about the differences between men and women students, and many clearly have felt very comfortable with the few women science and math teachers they have had.

Their two years in Cegep have an enormous impact on these very open, educable young women. They have found their studies very, very hard, and many of them have suffered terrible periods of anxiety, depression and self-doubt as they struggle to master material, deal with academic and life situation set-backs, undertake the research and planning appropriate for making university applications, and so on. They have made some definite career-plan changes, all quite realistic, as they have discovered more about their tastes and abilities. They continue to believe that hard work is the secret of the science student's success and indeed, the student who is about to be accepted into McGill pre-Med is the hardest worker of all. It is clear, to us if not to them, however, that factors of educational background, family social class, and economic security have a great deal to do with the success patterns here: the woman who will be accepted into medicine comes from a family of doctors, has had private schooling, has been guided to do very interesting and appropriate extra curricular activities, and is helped to organize her work by her parents; the woman who does not quite make it comes from a working class family who think she is wonderful but have really not been able to offer her

anything more than that. Both these gifted women have shunned Science Plus as too competitive, despite the fact that the programme welcomed them: one refused ever to enter, and the other dropped out. A mature student and a racial minority woman have had to work to help support themselves, and their grades, their progress, and their confidence have suffered. It is notable how often all these young women mention their women teachers as inspiring, helpful, compassionate and knowledgeable: we note very obvious role modelling taking place here, especially in biology.

Despite their determination to continue in science, sometimes in the face of better success in other, non-science subjects, these students have gained a very broad education form the Cegep. They have enjoyed English, humanities and complementary courses. They have made friends that have supported them through bad times and good. They feel they have learned how to think, to learn, to wonder, to discipline themselves, and to view the world from a mature and well-informed perspective. They are, on the other hand, exhausted, fearful of the future, demanding of themselves. They are determined to have careers with real status, and those who have not done as well as they wished in college are most worried about whether they will get what they are after. There is a real conflict here, then, between the comfortable acknowledgement of skills, knowledge and attitudes gained and, on the other hand, whether all this is good enough to allow them to go on in science. The transformative possibilities of the Cegep education have been embraced and utilized, but the instrumental motivation to use this stage of education simply as a step to higher things tends to undermine the satisfaction of that transformation.

B. INTERVIEW ONE

1. Motivation

Women persisters in the health and biological sciences enter Cegep with some remarkably similar motivational profiles. Virtually all of them arrive at Cegep convinced that, whatever else happens, taking a science programme will keep more options open for them. When discussing their own motivation, they talk about this open-door access very matter-of-factly, without really saying science is better, or gives them access to the circles of the powerful or elite. They simply talk pre-requisites to university programmes. Equally, however, for none of them does this seem to be the single or even most important factor. When they talk of science, they certainly mean the science they have studied in school. Almost all of them speak of having found high school science courses "interesting"; Jane adds that she is "better at it than some of my other courses"; Judy says she has always been "science-oriented - I think everyone knows that;" Hannah says she is "comfortable in it....You know there are some courses where you don't feel comfortable and you're sceptical of what you're doing and everything....But [in science] I enjoyed myself and...I felt good about it." Few are able to explain this instinctive sense of belonging, and for many it may simply be attributed to the influential adults who have encouraged them - a most important factor common to this group (see below). However, Judy does try to explain: "I like things that you can write down and then it adds up. I like things that are down to earth and they're practical.... I like taking each step and.... I like seeing it shape up.... I don't like guessing." Others stress the pleasure of "understanding" things - some quickly saying they also like to be able to memorize, and some saying they want to understand and not memorize. But there seems to be a sense among these young women even as they begin in Cegep that science satisfies their need for answers, that science explains, as Jane says, "how things work and we can now understand how microbes work and circuits and stuff and you can apply it to everyday life."

Another important common factor among the members of this group is career motivation. All of these entering students are very future focused in one way or another. Almost all of them are certain they want to work with people and to have some kind of impact on the wellbeing of others. Stephanie's remarks are completely typical of this group:

> But, like, I want to, not only do I want to be, like, in the medical field, I wouldn't want to be like a chemist or something like always working with objects and with formulas. I'm like, more of a people person, like, I would like to be in that field. But, like, I love helping people, like I've worked with handicapped children and I've taken care of them and, like, I just, I feel so, like, good about myself knowing that I'm helping the other people, and that's what I'd like to do. I know it would make me happy.

Even Sara, whose career goal is to be a vet, talks about animals as sentient, contributing creatures of her world to which she wants to give something back, and Kay's lifelong attachment to animals is clear when she says wistfully: "I would love to study wild fowl." Almost all of the women refer to medicine as a possible career goal and one which they considered when they were younger, though many now have great hesitations about their ability to get the entrance marks "because of the competition," as Nora says. Some seem to have dismissed medicine for other, sometimes mysterious reasons. Jane talks about the lack of freedom of doctors who are so rule-bound by hospitals, as well as the fact that the profession is "overloaded": she seems to be searching for reasons not to focus on medicine as a possibility for herself, as if medicine were simply out of her league. Other strong career wishes include dentistry, optometry, physiotherapy, and pharmacy: none of these career goals seem as tainted as medicine with the forbidden fruit syndrome. It is notable that the career goals tend to be most specific in this group, and career goals that are quite correctly prepared for by health science programmes. In other words, these young women have given real thought to the possibilities of their lives, have done some careful planning, and have made future focused decisions as early as tenth grade.

High on the list of influential background factors seem to be the encouragement given these young women in their high schools. Many such as Gloria, Judy, Stephanie, Annie and Hannah were drawn into school-board-organized hospital volunteer programs in which they were allowed to observe many different medical procedures, treated with respect and dignity, and stirred to emulate the work of admired health-care professionals. Stephanie's remarks about her work with children are quoted above. Furthermore, as Judy says: "It was a good experience. It was nice walking around wearing a lab coat and you're feeling important." This remark sits interestingly with the many comments that such work makes them "feel good about themselves": certainly, they want to make a contribution, and caring for others is very important to them, but there is an element of status involved. For instance, when cross-questioned as to why she wants to be a vet and not an animal health technician, Sara says: "I wanted to be the one saving their lives or something....I didn't want to be the second person in their life." Kay has actually returned to college to complete a Dec in Health Science after finishing her Diploma in Natural Science. Her reasons? "Well, to be honest I don't want to be just a technician." Individual teachers have also had a great impact, particularly teachers of ninth grade biology who captured Nita's and Annie's interest in the body in unforgettable ways. When one considers that it is at the end of ninth grade that students must choose to pursue physics and chemistry, the significant role of the biology teacher is underlined. Jane, who comes to Cegep with marks in the 80's, talks about the long-lasting effects of her ninth grade math teacher: "At first I used to get 60's in math.... Then when I got in her class in grade 8 I started getting 90's. From there... I don't know what

she did but she really helped me a lot. She even put me in an enriched course after that grade 9 course...." Annie describes three women teachers whom she "loved" and how much they encouraged her even as a unilingual Greek-speaking immigrant in fifth grade. Most but not all of these beloved and influential teachers are women. Hannah says: "They're [the women teachers] good and they teach you something. Not that the men don't, but the women really made sure that you learned." Jane muses:"A male teacher will favour a male student, I think. Yeah, I don't know, they get along better." The role modelling effects of these women teachers cannot be ignored. However, Gloria does recall a man teacher of physics who pushed the girls especially hard, and "wanted the girls to do well." More general references to "good" high school teachers who "made the science courses interesting" or who "pushed us" or "really related the world to chemistry" or "who brought in stuff to really illustrate about physics" are often cited as instigators to continue in science. Sara, who attended a private girls' school, is so enthusiastic about her teachers there that she would willingly have spent the entire interview talking about them. High school teachers provide an almost indispensable source of general encouragement which these young women are quick to acknowledge.

Family influences work in complex ways as motivators. Since most of the students come from working class or lower middle class homes, the role of the parents is often to push their daughters to enter higher status, more secure types of career paths than they themselves have been able follow. Hannah says: "They really want to have a happy life for their kids because their life isn't easy either, you know, 'cause we're not well off...." Annie, Jane and Nora also speak with great understanding of their parents, and how grateful they are for the support they receive. Sara is particularly appreciative of her non-academic parents, who run a small store, but who understand her need to study and not be interrupted in her work: Sara is encouraged to "take over the dining room" during peak times in the semester. Only one of these persisters speaks of family discouragement: interestingly, it is Kay who does so, and it is Kay who has had to come back as a mature student to do her academic programme. She says:

> Both my parents are not well educated. So what. My father was the first and he was doing menial jobs, making money, getting out of the house sort of thing. He doesn't like.... Well it's not that he doesn't like me being in school but he prefers to see me, at this stage, especially now, working, getting married. He's Italian. Right? So he thinks the woman should marry and have a job... like a secretary job, he'd prefer seeing me having than something like this. He thinks it's useless, he doesn't understand it. Environment, why would you want to study the environment? For him, he doesn't understand things like that.

We quote her at length here because Kay is not atypical of post-secondary women students, many of whom have to deal with some lack of understanding on the home front. However, we underline the fact that she is atypical in this particular group, which seems to be so much supported by the home, and we note also that her persistence path has differed and will continue to differ from that of the others who have been more supported in their ambitions and efforts. Sometimes even these support factors can cause difficulties, however, as they do for Nita, who feels she is supposed to be a super-achiever for the family because her brother dropped out, or in Stephanie's case, where her parents are unable to understand the stress their daughter is under and try to persuade her to take an easier path. Interestingly, however, none of these persisters feels she has been forced to choose sciences against her will, though Annie describes friends who were, and who subsequently drop out. Wherever there is a family member who has taken a health care path, that relative has obviously become a role

model, whether male or female, and often the specific career choice can be traced back to an uncle, an aunt, or a cousin. Most of the students carefully explain how their mothers' career paths have been deflected by marriage and child-raising, from failing to finish the Ph.D. to abandoning the teaching or nursing job either temporarily or permanently. These mothers seem to be important figures in the motivational patterns of their daughters' lives, though the young women do not intend to follow this pattern (see below). The significant point here is how many of the mothers of this group have, in fact, gone beyond high school themselves, and are especially encouraging of their daughters' ambition - more encouraging, for instance, for Sara and Stephanie, than their fathers. Clearly, the need to join the middle class is deeply implanted in these young women: even when citing their secondary, non-science career goals, they say things such as Nita does: "I would like to be a career woman with a nice looking suit and a nice vest in an office building. I've always liked that. But I don't want ....I want my own office....I want to be a supervisor...." In the two instances where fathers are clearly professionals, the influence on motivation at this stage is not particularly marked. Judy, whose father and sisters are all doctors, is simply ruminating about the possibility of doing medicine, and Celia, whose father is a university professor, is clearly not interested in her father's subject area (business and management).

One of the remarkable features of the group, especially given their unequivocal choice for health science and their persistence in it, is the range of interests they bring with them to Cegep. In spite of their enthusiasm for their hospital volunteer work, none of them cite only science and\or health interests. Two of them talk of childhood interests in science, inasmuch as Jane asked to be given a microscope as a gift when she was in elementary school, and Nora liked to dissect the poultry organs when her mother was cooking. Many - indeed, most - have pets, and Sara has a rock collection. However, their interests clearly go beyond anything remotely related to science. They appear to have been very active in the extra-curricular life of their high schools, many of them holding executive positions on student councils. They take music lessons, study dancing, do photography, are avid readers, write and publish their poetry, fiction and articles, and engage in individual sports activities of various kinds. Many of them talk of enjoying other subjects besides science, such as English, humanities, the fine arts, languages and social science. Candy sums it up this way:

> And, but you can't depend on only science, you know. In order to be, I want to try I try to be a well-rounded person; I want to be in all activities, I try to be. I want to, you know, be friends with everyone and to be knowledgeable about everything. Not perfectly knowledgeable but to have some knowledge, to some extent, to be able to speak about everything and not to be ignorant. I don't want to be ignorant.

Other students seem less self-conscious about their pursuit of other interests, seem, indeed, simply to be doing what they want, to satisfy their "artistic side", as Hannah says, or to "relax a bit, you know, lighten up," according to Gloria.

Past achievement has certainly been a factor in bringing these students to health science. For one thing, they are not accepted into the programme with marks much below 75%. In these initial interviews, most of the students are already in a position to compare their high school achievement with their early test results at Cegep, and that is what they want to talk about. It seems clear that the group comprises a range of achievers, from students who have only narrowly been accepted at Vanier to those, like Nora and Judy, who have been offered places in Science Plus, though only Nora has accepted. Their attitudes to these marks are very homogeneous, however: none of them "likes" or "is happy with" a mark in the 70's in any science subject. A small number, like Jane and Hannah, who

have come in with low 80's, are thrilled to be getting high 80's and 90's on their first Cegep tests. Most, however, are feeling shell-shocked by lower marks, some, like Nora, even experiencing failure for the first time in their lives. There appears to be a broad range of reactions to this drop, but on the whole, they feel puzzled and displeased: Nita says she is not "used to this", and she does not understand why the marks are so low. Nita, Stephanie and Nora are already talking about not being well-prepared by their high schools. They talk about the inequity of such differential preparation, and how some students are so unfairly disadvantaged by schools that offer minimal science programmes. The students who have come from private schools (Judy, Sara, Candy) speak about good preparation, but even among these we hear Sara experiencing a genuine workload and achievement shock. The importance of the marks is a common feature, as is the extent to which the mark achievement determines how they feel about the experience, whether of high school or the first month of Cegep. These young women only feel "good about themselves" as students when they get good marks.

2. Attitude

Another striking feature about this cohort is their very decided set of opinions about which sciences they prefer. Every student says she loves biology, and looks forward to taking it in Cegep. They also find it easy to explain this preference: as Celia says: "it teaches so much about the human body and our environment." All the students say they like mathematics, too, though a few are beginning to find Calculus difficult, and Kay has not studied math for so long she has forgotten her functions. But most say math is "very straightforward" or, as Celia says, "all logic. You either understand it or you don't and if you don't there's a way of understanding it. It's pure numbers and no concepts." Annie says she finds repeated calculations "boring" but all the rest seem to have found math quite satisfying, something they could do well in: "I'm good in math," says Nita; "I like math," says Hannah. This particular gateway subject has let these particular women students past. Physics, however, is another story: seven out of the thirteen are very clear that they dislike it, have trouble understanding it and are irritated by the need to pursue it in Cegep. A common way of dismissing physics is "I just can't relate to it," but clearly these students work at it, and some get good marks in it as well. Even that achievement is not enough to satisfy these students, however. Those who like physics at this stage seem to like it as they like math, "because there's a reason for everything," as Hannah says. These physics-enjoying students find that chemistry is more difficult because it is harder to visualize (as so many of our students have told us, "I've never seen an atom") and does not, in their opinion, lend itself to rational procedure and exact calculation as do their introductory math and physics. Students who prefer chemistry, however, use some of the same language to explain their preference: "Yes, I'm amazed in the chem lab..... I guess because I have it in my hands. I mean I don't have to picture it in my mind. I can do it in front of my hands, you know, with measuring and mixing and heating things up." Annie says:

> I don't like the physical things that happen all around you....Force, tension, etc., but I like the thing that you're creating. You're creating a chemical even if you're not the first one to create it....Like you're making it....I was so proud I made it [a solution]. But then in physics you're not really creating you're just finding out how to do it but you're not really building anything. I don't know....You know what I'm saying?

Being able to visualize is stressed as an essential ingredient for success in science, as is the sense of mastery over the mystery of scientific process and principle. It gives these young women pleasure to

experience both, and they enjoy subjects which afford them this pleasure. They also want their learning to be "connected to life", and again, depending on their experience with the subject, they gravitate toward chemistry or physics, but always maintaining biology as the favourite. They admit that math is not related to life, but they "can do it, so you just do it."

These students enter health science knowing it will be "hard" and "challenging", with a very heavy workload compared to that of other programmes. They are very aware that this is the image of science which others have as well: as Sara says: "they put it on a pedestal so much as a high achievement." Kay, who probably has the most conscious elitist attitudes to science of the group, says: "Well, we assume they're not as smart because they can only get in Social Science. We make jokes like that." Gloria says: "they look up to science, it's like, 'Wow, science, you do work.'" Many simply accept this workload, but even some of these persisters are beginning, in the initial interview, to feel overwhelmed with the work and almost resentful about the way in which hard work does not always translate into desired success. "I work so hard. I work so hard," says Sara. "I'm not saying I'm failing or anything but I find I'm working really hard and I don't know...." Most of the students do believe, however, that hard work will bring them success. Judy even asserts that anyone can have excellent grades, provided he or she works hard enough. Hannah adds to the hard work the necessity of knowing what one wants and knowing what is required to get it. A really in-built self-discipline is also stressed by Annie, and she explains this discipline as a feature of both cultural and family background. Nora observes that the students doing best in her Science Plus class have professional parents, most of whom are in science-related fields. Some distrust the popular notion that "science students are so smart", while others admit they do know students who seem to have such a natural aptitude that they "get it" right away without all the extra work. Some actually see two types of successful science students: the hard workers and the gifted. In general, these attitudes do seem to bear some relation to the achievement pattern of the student, inasmuch as high achieving students like Judy seem to be more likely to say anyone can do it, and struggling students like Sara marginally more likely to believe that others are more gifted than they. There is some criticism of the arrogant science student, especially in Science Plus, who thinks he knows more than the teacher.

The vision of science which the students bring to Cegep appears to be that of a set of carefully differentiated, sequentially ordered subject matters which they must get past in order to continue. Many of them say they have no idea why they have to study physics, for instance, or calculus, repeating over and over again that they feel they may "never need them". Judy longs to see a connectedness among these subjects or a reason for taking one or another: "But I think it's got to be there for a reason. I know you need Cal I for Cal II but I don't know what you need Cal II for. I guess we'll see, it's got to lead up to something." Their view of their Cegep education is thus remarkably docile and accepting, despite their occasional doubts. Even when asked how they would improve science, they are unable to imagine a critical stance: their view seems to be that science is what it is and "you've just got to like it, that's all." The few suggestions made by this group of persisters, especially by Stephanie and Nora, have to do with the need for good teaching of science, or easing the transition between high school and Cegep, almost never with actual curricular matters. Jane, however, does speak at length about the competitive profile of science programmes, and how this makes students feel they aren't good enough: "Like you have to be extraordinary to do it. I think they should kind of stop doing that. I don't know. The whole attitude has to change."

These young women have quite a number of observations to make about gender issues in this first interview, though they show varying degrees of insight into the significance of what they are seeing and saying. Candy and Sara have come from an all-girls' school which they both loved and

about which they have much that is positive to say. They particularly comment upon the ways in which this single-sex environment has allowed them to feel comfortable about themselves and to be serious about their studies. In terms of the transition to a co-ed college, Candy says: "It's no big deal," and continues, in this first semester, to "ask a lot of questions" in class, whereas Sara feels overwhelmed, suddenly feeling that, for instance, physics "just comes so much easier to guys, you know", and that when it comes to answering questions it's "mostly boys." Of those who have come from co-ed high schools, Judy, Jane and Nora, talk about overt, discouraging and harassing sexism from teachers in these schools. Nita, who does not talk about sexism, does say, with respect to going on in science: "It was accepted for a woman and expected for a man." Many comment that more of their teachers both in high school and Cegep are male, but most attribute this to career attitudes of an older generation and do not interpret the phenomenon in a discouraging fashion.

About half of these women have observed very different behaviours between men and women students. A few comment simplistically that "boys ask more questions" and "boys talk more in general." Others have a much more complex analysis, including Nora's observations on men's tendency to challenge teachers while women openly ask about what they do not understand, Judy's, Annie's and Nita's view that women are basically more compliant and therefore are able to follow instructions and do the work required to succeed, Judy's insight that men are more able to think positively about their chances for success and therefore suffer less anxiety, Annie's view that men fool themselves about how they are doing, Stephanie's observation that men's bad behaviour in class penalizes them, and Hannah's feeling that men are so much more competitive than women, sometimes negatively affecting women's educational experiences in this way.

Gender-awareness is only minimally reflected in their discussion about their own futures as women. All of them speak about wanting university degrees and most of them want to have children: very few have thought through the problems that might arise for them as working professionals. One or two talk about part-time leaves or working from the home, but most seemed not to have problematised the situation in realistic ways. On the other hand, it is clear that they do not see being married with children as an either/or with a career. Stephanie, whose mother has always worked, uses this as backup for her belief that she too "could do it". Annie appears to speak for the group when she says: "I don't want to be one-sided like only my career or only marriage. Like I've seen a lot of people around me, like older, like my family that wanted to do so many things and never got to do them because they had kids when they were 19 or 18. Like I have everything planned sort of. I want to finish when I'm 25 and then I'll get married. Well, not right away. But I want to enjoy my life. I want to travel - husband or not - you know, I want to go travel and all that...."

3. Experience

The work patterns which these students are experiencing vary slightly, but not a great deal. Gloria and Celia confess that they only do homework when it is assigned and checked, and rely very much on in-class learning. Their big push comes only for tests. This stance is certainly not that of the majority, however. Most have disciplined themselves to work between two to five hours every day of the week, and most work much of the weekend as well. They appear to need this amount of time to do their daily work so that they are not overwhelmed when tests come along. Practising with problems seems to be the number one pre-occupation. Most of these industrious students also read their texts, highlight them or make notes from them, and make great efforts to understand what they are reading. Some talk about the need to visualize, to draw a picture to make things clear. Only Stephanie, Candy and Annie ask questions in class. A few others consult the teacher after class or go to the office for

help. Many, however, appear to be determined to "get it on their own" and to feel this is the more appropriate route. On the whole, their study behaviour seems to be consistent with their belief that science is hard and you have to work at it to succeed. Many even add that the effect of science education is to "make you a harder worker".

They also all believe that, as Annie says, "a lot depends upon the teacher". They all feel very dependent upon the ability of the teacher to explain concepts clearly and to go over examples slowly enough so that they can master the procedure. They see this dependence as particular to science subjects. As Judy says:

> In humanities, you're not going to find somebody who teaches and a student who says Sir I just don't understand what you just did up on the board. You're not going to find someone saying, I'm just not getting it. Maybe they'll say I don't agree with you on that sir and he will have no choice but to say, Well, that's your opinion but this is what I'm teaching or something like that.... I think it's something you won't agree with rather than you want to understand. There's two ways to any opinion but there's only one way to do chemistry.

Behind this remark one senses the belief that science subjects confront students with new knowledge or at least new procedures, while non-science subjects merely involve opinion on ideas which people already know: while this quotation perhaps represents an extreme example of this attitude, the student is not alone. Most of these students would agree that one of the effects of a science education is becoming more knowledgeable in ways which other paths of education do not seem to offer. Certainly such an attitude contributes greatly to the felt need for teachers who are patient, who are receptive to and often even anticipate student questions, who do not mind going back over what they have taught and who make time for students outside of class. A few students like Gloria and Annie also hope that teachers will "make it interesting" or "liven it up with humour", but on the whole what they are asking for is whatever it takes to help them "get it", and the requests for "some joking around now and then" are really made in the context of the great tension in the classroom about whether they are going to be able to understand the concepts and do the problems or not. When students are confronted with teachers whom they do not understand, who are impatient, who will engage only the top students in the class, who call their questions stupid or who tell them they should know their material better, they are not only hurt and insulted but often outraged. Nita, Kay and Stephanie spend considerable time describing some rather harrowing classroom experiences they have already experienced in their science courses. While there appears to be great respect for the intelligence and high level of education of teachers in general, as they often call those whom they do not understand "geniuses", these students are quick to point out that, as Nora and Annie say, "having a Ph.D. doesn't mean you can teach." Though Sara comments on differences between her high school and Cegep teachers, it is remarkable how rarely the stereotype of the impersonal college teacher is referred to: these students do not seem either to expect or to accept the notion that science teachers will not help them.

According to these students, the experience of science education is very stressful and competitive. Jane tells us:

> Because in the end you are competing because when you get into programmes there are certain things that you want and people who are the best are being picked and that's why you want to make sure that you're up there if you are. If it wasn't such a big issue in you know who's the smartest and stuff it wouldn't be so competitive.

This shared view of the state of things affects students in various ways. Many refer to high school as the time when competition was most overt, when "What did you get? What did you get?" was the question on everyone's lips after every test. Many explain the fact that this phenomenon is not so visible at Cegep by the fact that where student numbers are so much greater and so many are strangers to one another, students cannot really get a sense of how they measure up to one another. Most of the young women say they do not like competition and they prefer the Cegep atmosphere for this reason. Judy says: "I think I have enough pressure on myself. There's enough pressure in my family and within myself.I mean I always wanted to do well." Rita talks about actually experiencing social losses by winning academic awards in high school: "That day of the year, when they hand out awards, I was awarded third place for academics in high school, so, I lost, well, not lost, but like some friends, they got, like, they got upset." Nora says that it is the competitive atmosphere of the Science Plus class that most distresses her. Some students make brief asides to the fact that "some competition is good" especially if it "pushes you to do better" and is "competition with yourself", but they do not really expand upon this view: they are most concerned that students feel co-operative rather than competitive with one another. One of the most destructive aspects of competition, according to these young women, is how it tends to attack their self-confidence. Jane explains: "Because if you think people are doing better and you're not doing well so you feel lower yourself and you think well, What's wrong with me? Why am I not doing as well as anyone." Hannah answers the question of whether science is competitive by saying: "I try not to see it like that.... I try not to. Because then I would panic even worse than I do already.....I don't know. Maybe because I'm scared they'll have better opportunities." Sara, who is already in her first month of Cegep experiencing real academic difficulty, says: "I found that's when my competition sort of stopped. When I was having difficulties. I knew that I couldn't compete any more with others. I wasn't able to because they were better than me. I just couldn't compete." Here competing clearly means achieving, and the tone of the last sentence is depressed.

Every single student in this group of persisters describes intense anxiety about her science studies. Even Nora, who says of herself "I'm not a person who gets nervous," says that she has just been through a patch where she has felt "really tense...and I've never felt that way before." Kay comments that she is much more anxious about her health science studies than she was in Natural Science. Others say they have always been nervous, anxious students; Judy is even taking a stress management course to try to deal with what she sees as her own problem. Some get anxious as soon as they encounter difficult concepts or problems; some are anxious mainly just before tests; some are most anxious after tests, concerned about the results they may or may not have achieved; some experience their academic anxiety as situations in which they become needy and childlike at home and then become even more anxious about their own behaviour within the family. Stephanie and Sara talk about how comforting they find their mothers in these situations, but they worry about how dependent they have become. In the midst of their panic about not understanding their teachers, they also suffer anxiety about asking questions, allow their fear of ridicule to prevent them from doing so, and, as Jane and Hannah describe, suffer even more as a consequence. Hannah sometimes thinks that her panic makes her work harder, but most of the students are critical of their sensitivity to the pressures of college, and feel that what they would to be able to do with their anxiety is "block it out." Sara says: "Like, I have to say to myself if I can't get one problem, it's not the end of the world. I've got to go on to the next one. I've got to move on, you know, and I just can't stop now. I've got to keep going on." In spite of this repeated advice to herself, this young woman is already suffering from acute stress and almost paralysing self-doubt.

At this point in their studies, except for Kay, these students do not seem to have strong feelings about having friends in the same programmes as they are. Kay, with her memories of the close, collaborative study relationships she had in Natural Science, feels especially lost in science classes where she not only has no one to work with but feels much older and very different from the other students. The other students really do not share these views. It is clear that friendships are essential to them, and that many of their leisure activities depend on these relationships. They also stress the need to have someone they can trust as a lab partner, and many have not had such good experiences. Some have found the lab partner lazy or irresponsible; some have found him or her bossy or undermining. These bad partnerships seem to arise often in high school and in their first months of Cegep for this particular cohort: no student complains of both chemistry and physics partnerships, but many complain of one. All of the bad partnerships are with strangers: no one complains about someone she knew before the partnership began. Nita and Gloria have been able to find old friends to work with, and they are almost ecstatic. Nevertheless there are only a few students who speak of their wish or need for a study group or for peer support. Most talk about their preference for studying alone, about being independent, about fearing they will "fool around" if they get together with friends to study. They appear to believe that many hours of solitary study is a reliable route to success.

C. INTERVIEW TWO

1. Motivation

This cohort of persisters approaches the conclusion of Cegep education with less homogeneity than they began, but there are still some common features to their reasons for continuing in the health and biological sciences. Most say that, overall, they have "liked" their science program and all describe it as enormously hard work. Candy describes these two years of study as having given her both satisfaction and direction: "Challenging....Interesting....Worth it...." Nita communicates much the same feelings when she says: "It was a challenge.... It was interesting. I'm happy I did it because I think it was a more challenging program. I know now where my interests pretty much lie." Jane and Nita reflect that while they entered science because they had done well in high school and to keep their options open, they are now going on with it for its own sake. Kay says: "Actually, I love sciences....For me it's great; I love it. I love learning it and....Yeah, I love it....There's so much to learn. There's so much. And I want to learn it....To know it." They are a bit clearer about what the pleasure of science study is for them, too. Gloria and Judy immediately relate their enjoyment directly to the study of human biology, to the discovery of how the body works and why. Candy and Hannah talk the intense pleasure of solving problems. Candy says: "I guess because it's one right answer and that's it. You can't have anything else." Hannah explains:

> Actually I enjoy it because whenever.... Well, what usually happens is that I'm faced with a problem and I try it by myself. By myself I try and find the answers and when I find it is like party time. I'm so happy. I've found it. Alright, I won. So it's like.... I don't know, I enjoy it. I don't see it as a .... I can't see it as a chore anyway because if I did....There's so much studying that I do and if I could see it as negative....If I would see it negatively then I would see it as negative....If I would see it negatively then I would never do it. So....

This attitude to the work of science seems to be important. Rita says: "I like studying a lot. I don't dread the day I have a test....I don't mind it." On the other hand, Judy, the highest achiever and quite possibly the hardest worker, says: "no one is dying to work on science in whatever subject all day and all night. I mean no one is dying for that. Not at this point of our lives anyway." Still, most seem to feel the hard work of science is giving them something specific. Celia says:

> I think it gives me the feeling that I know how to do it....I don't know....Because I'm doing alright in my humanities and my complementaries. Like sciences are the only courses in which I have to try a little harder. You know, if I was, I don't know, in Social or something, I don't think I'd be working....

It is as if by successfully completing their courses in science they have proved their right to be there in the first place. However tentative this may seem as a reason for self-congratulation, it appears to be something they all share.

Both consistency and shifts in career plans over the two years seem related to careful reality checks, particularly in relation to their marks and averages, as well as to continuing background influences. The predominant motivation for career choice continues to be the caring motivation: one after another, these young women describe again their need to "make a difference", for "helping humans", to enter the "care giving professions". Judy and Nora who were considering medicine as a real option in their first semester are still doing so in their fourth because they have marks in the 90's; both have applied to McGill. Judy, who has the highest marks and the family background in medicine seems to feel, having been called for an interview, that she is likely to be accepted. In fact, she says: "if I don't get into medicine to be honest it's going to be the first time that I've applied to something that I haven't gotten." Nora, who has working class parents and marks not quite as high is not so sure. Jane, who gave us the very complex rationalizations for not wanting to be a doctor, continues to play with the notion in the same way, but now is more outspoken about being nervous about being the first in her family to go to university, and about fearing she will not fit in. Jane is only one of many who have as yet unclear career plans but are decided persisters in the health and biological sciences. Gloria, who in her first semester was sure she would go on in physiotherapy, has changed her plans to dietetics on the grounds that working with physically disadvantaged patients has depressed her. Rita and Candy, who gave optometry and pharmacy as their respective goals in the first interview, partly because they have relatives in the field, still wish to continue in these areas. On the other hand, Sara and Hannah who wanted to be a vet and a dentist, respectively, have each chosen, because of lower grades than they hoped, different career paths, temporarily at least: Sara is going on to nursing at McGill because her mother and sister have studied nursing, and Hannah to further studies in biology with a possible view to teaching since her mother has been a teacher. Kay still wants to do environmental microbiology, but she has had to take full-time work and now only attends night classes: she is not ready to apply to university yet. Choosing both university programmes and career paths seems to have created great anxiety for these young women. Jane and Stephanie talk extensively about their fear that, after all the work they have done, they may not be accepted in to the programme of their choice and may therefore have "killed themselves for nothing". Some are still worried about whether they have made the right choices: Candy indicates that the decision-making process has been a tormented one, during which she has made extensive and difficult consultations with adults already in the field. Few are able to imagine themselves in any other field besides science, though Annie and Sara continue to toy with the idea of business, given their interest in people and ability to do math.

These students definitely give the impression that they spend less time on their outside interests than they once did, but they have not set them entirely aside. Many of them say they "used to do a lot more", or they wished they "still had time for tennis/weight training/dancing/reading/". When speaking about her necessary cessation of piano lessons, Hannah says wistfully: "I still play whatever I learned....It's so relaxing and it's so beautiful. It reminds me of the good old days....In high school." Celia says: "I don't think I'd be able to go through the sciences without the piano. It's like a deviation from the sciences." And clearly, some still persevere with their outside reading, writing of poetry, sports activities, and so on. Some make a specific point of saying how important it has been for them to make themselves take some "time off, just relaxing with friends"; it is clear that this almost enforced leisure is seen as a must for continuing their path toward achievement. However, the outside interests have, for many of them become very focused upon programme specific volunteer work, in research centres, soup kitchens, homes for unwed mothers, AIDS Centres, hospitals, and so on. The descriptions of this work are lyrical and almost ecstatic, as if those few hours of "real stuff" give them far more than any of their courses. Sara, who has not been very happy at Cegep, changes her whole demeanour when talking about working with teenaged mothers and their babies: "It's a good feeling." Judy says of her work at a research institute "it was the most fantastic experience," but equally of working at a home for unwed mothers "I love it. I just love it." On the whole, it seems that this volunteer work is undertaken to make their CVs more attractive to universities, but they are personally captivated by the work once they are in it. Gloria has actually discovered through her volunteer work that she should change her career aspirations, as mentioned above. Only Jane and Kay have salaried jobs during the semester, and only because they must. Jane talks of the difficulty in finding both time to study and appropriate working hours, but she has to work because she had to earn her own bus pass and book money. Kay, as noted above, is now working a 40-hour week, and finds she has time for little else but her job and two evening science courses, and she finds it much harder to study than when she was a full-time student with part-time work. Others say they have tried salaried jobs and given them up because they cannot handle them together with their studies. Clearly, their vision is that science study is a full time job, and most have not been forced by their economic circumstances to work for their own support. Given the difficulties which Kay and Jane describe, students who do not have to work have a decided advantage. Outside interests, on the other hand, whether purely leisured or science-related, are seen as essential for their continued success as science students.

These students, as a whole, have done very well in their non-science courses and have enjoyed them too. Everyone who has taken psychology, for instance, has enjoyed it immensely. Nora has a few complaints about the heavy workload of an interesting course which, for her, is a complementary, but in the eyes of the teacher is a concentration for a particular set of students. Stephanie and Judy also complain that English and humanities can take up too much time, though they clearly like these courses very much. On the whole, however, these students express unmitigated pleasure over their non-science courses, talking about how they feel they are gaining knowledge that science does not give them and that they feel educated persons ought to know. Kay seems to have developed a much greater enjoyment of non-science courses than she showed in the first interview, and talks about the pleasure of learning languages as well as studying English. Annie, Hannah and Sara even say they prefer their English and humanities to their sciences courses, saying they "never skip them" because they are "so interesting and you can really get into it with the teacher", and revealing that their marks in these subjects are much superior to their science marks. It does not seem to occur to them that this enjoyment and success might be indications that they might change their study plans, however. Science remains at the centre of their post-secondary educational agenda.

It is hard to judge the exact degree of importance that can be attributed to science marks in the shaping of their decision to persist. Since their success profile as a group ranges from averages in the 90's to averages in the high 60's, it appears that very high achievement is not an essential motivational ingredient for all of them. In general, the students with low marks feel badly about them. The following comment from Hannah is a fairly typical reflection of those whose achievement has disappointed them:

> I like 80's. In high school I was like in the 80's and I've never been under that. So when I started getting 70's I was like, Oh, what is this? ... I mean for my sciences I wish it were higher. Like for my organic....Last semester I got 68% and I don't like that....I 'm sorry. So, I don't know. Everything else has been in the 70's. Other than organic, last semester I was in the mid to high 70's. I wasn't that bad. Well, comparing to a 68%....But I wanted to do better than this.

Almost all these persisters would agree with this student that Cegep science is much harder than high school, and that it has been very hard to adjust to the hard work and the pressure, particularly if one wishes to keep one's high marks. The student quoted above, like many others, is not however deterred from continuing, but simply changes her programme plans from dentistry to the biological sciences. Sara says: "I got a 65% on my first test and 66% on my second and I'm like it's impossible because I know people that don't even study and they're getting 80's. You know. I don't know what I'm doing wrong. " As noted above, she too has changed career plans, but still sees nursing, her choice, as science. It is the suffering and loss of self-esteem we notice in these cases, rather than any decision to abandon science-based studies.

Not all the students are quite so daunted by low marks: Gloria says: "I know I could do better if I really wanted"; Annie replies affirmatively to the question as to whether she is disappointed, but then goes on to say: "But I'm not the type of person to sit there and say, Oh My God....I looked at them and said, Okay, let's see what we can do....I don't want to be a pessimist...." Both these women show that they have, indeed, opted not to study "flat out" all the time and both choose to apply to dietetics, though Annie really does not quite have the average McGill requires. Certainly, these persisters all pay attention to their marks, take responsibility for them, and are fairly though not entirely realistic about university entrance requirements. Looked at as a group, they are certainly not "students-at risk" in any sense, since they tend, throughout Cegep, to pass almost all of their courses, and to greet the occasional failure with both shock and dismay. Jane describes her one failure in physics, the subject these students seem to have most difficulty with, as follows: "I mean I even failed a course which I've never done in my life." At the other end of the scale, several describe as their "best moment at Cegep" the achievement of a very high mark in one of their science subjects. Some report surprise that their highest marks are in subjects they do not enjoy, and, in some senses, do not even feel they understand that well; Judy says: "In a way I'm laughing because I don't know it that well that I should get a 100 type of thing." Others indicate they do best in the subjects they like best. Sara, Gloria, Kay and Jane describe life situations (death in the family, trouble with boyfriends, a protracted illness) as very much affecting their achievement, and a glance at their transcripts certainly corroborates their story. Whatever its effect in determining their future plans, their achievement status in Cegep science has been absolutely central to their general sense of well-being. As Sara says, "When I was doing well I felt best....I felt things were settled in my life...."

2. Attitude

Subject preferences have remained fairly stable throughout Cegep for these persisters in Health Science. All but Sara, who is just finding it and almost everything else "too hard," say that they have enjoyed Cegep biology even better than they expected. Hannah explains:

> Because it touches so many things, I find. ... Well, you go outside in nature and you see so much biology. I mean, like, when I go out to the country with my family or whenever we pass by I see it. Or if we look at plants with my parents....I can tell them. Well, this is some kind of plant because we learned it in biology and the leaves are....

Most are especially keen on human biology. Nora says:"I mean it's the digestive system or something and it's very close to you. I mean you go through it very day."

This enjoyment of biology does not seem to necessarily include getting their best marks in it: many comment on there being a lot to learn, and that some teachers have very high standards and hard tests. In fact, most of these students comment that math has, at least once or twice in their time at Cegep, come easiest to them and had given them their highest marks. Stephanie and Nita pause to wonder why they have not allowed these achievements to direct them to choose math in university. Many say math "is easy" or "numbers tend to click with me", but most seem to feel, as Nita says, "it really was just out of a book and you learn it and you put it back on paper."

They often explain their preference for biology and their trouble with another science subject in the same breath. As Jane says:

> Biology...I don't know... I guess I could apply what I was learning to things you hear outside of class. Like, you know, on TV or something. If something was happening, and you could understand it. For chemistry or physics, you don't hear that. You can't apply the amount that you're learning to what's going on round you so much.

Worth noting, also, are the comments of Celia, Annie and Nita, respectively:

> Oh I like biology a lot. yeah. I think because it deals with nature. I mean I can relate to it more. Like physics is much more... it's less concrete, more logic, and working out with numbers and stuff. Biology you can see where it applies, like what the application can be....

> It's so interesting to me because it's in effect me...doing rats and bio...It's still the same function whether it's the spleen or a heart of whatever.... Chemistry could be anything... like it's very abstract... a chemical you don't even know or....You care more about biology because it's more about you I guess.

> Well, I preferred those, for example, biology, because it's more tangible. I can see it more as opposed to chemistry where I can't understand the concept of the atom. There are tons of subjects in chemistry and we're studying something that we'll never see. An atom. I can't picture oxygen and hydrogen and the atom.

Though chemistry is much less liked than biology, different students have different attitudes to it, usually depending on how well they are doing, and often on how well they like the teacher. No other subject preference seems to be so externally determined. For none of them has chemistry been

the best loved or most disliked subject. Physics, on the other hand, is almost universally disliked, even "detested". Many confess that they came to Cegep with their minds set against physics, as was observed in the analysis of the first interviews. Others, however, who liked physics in high school, are surprised to find their interest level falling off, almost always because they "couldn't relate to it." Nita tells us: "I didn't see the point of finding out why a ball rolls at a certain speed and why it should hit this thing. It doesn't make sense to me....There's no purpose in it for me." Some indicate that teachers who have not been able to communicate the material in ways that make it either clear or meaningful (see below) have had some role in this distaste, but no one blames teachers entirely. The subject matter, as constructed in the Cegep curriculum, fails to attract these young women.

The students in the group who emphasize that science is the hardest programme are fewer in numbers this time around, but just as adamant. Judy and Stephanie are very clear about this matter. Again, elitism does not figure largely in their talk, though Gloria says that she has gained confidence in herself just through the admiration of her success in science by non-science students. They seem more interested, however, in talking about science as a field of study rather than as a Cegep programme (see below). They also have much clearer and somewhat more uniform notions of what the successful science student is like. Almost everyone describes some characteristic that singles the person out as "right" for science, whether it is just a liking for it, a life-goal that keeps them focused, self-confidence, a love of learning, or, in the opinion of four students who are not feeling like very high achievers at the time of the interview, an "ability to think science-wise" or a "gift from God". Kay, who is struggling very much alone with her courses talks about privileged background:

> A lucky one. No. Well, I don't know. You need some luck but it's only a part of it....Dedication....Maybe someone to push them like successful parents. Let's say their parents are well educated. Obviously they want their child to be even better than them. They have that going for them.

Every student stresses the hard work, good study habits and self-discipline involved in high achievement in the sciences. They almost all predict good fortune and happy lives for successful students: Judy spends considerable time describing the "charmed" life of her sister who is a successful doctor; Sara simply says: "They have the marks and they can go into whatever they want to do and they'll be happy." There is some concern that "some people go crazy because they try so hard", and Annie feels that physics tends to make people unfriendly and alienated from others. This group is remarkably realistic in the extent to which they identify with these top students: the young women who are getting 90's show a fair degree of identification, and almost everyone else describes herself as lacking one or more of the characteristics required. Of the two who are getting the lowest marks, Sara is wistful, saying "I wish I could be like that", Annie a bit critical, saying of some of the top students, "Don't even go near them and they're like.... They look at you, What do you want? Very closed. Into themselves." This last comment is atypical in this group, since in general they admire the high achiever in science.

When asked how they would like to see the science improved, Stephanie suggests fewer courses per semester and Jane less material and therefore less stress. Others, however, still argue that no change is possible. Annie says: "I guess the course load looks heavy because it has to be. I don't think you can change that....I mean if it's easier now, it's going to be harder then and it really doesn't matter." Some wish for less of certain subjects, like physics, while others argue the need to be introduced to them. Annie says: "Like you need to know like.... Like, you know, physics....If you like physics you'll most likely like engineering....You know? It's good to know that." Many, however, talk about the teaching they have received, and how it could have been improved. These criticisms are elaborated

upon below, but are mentioned here to stress again that though much better informed about what science involves (see below), they remain largely uncritical of the curriculum. Nita says: "Change the programme? No, not really."

Whereas in the first interview, these students all talked about science almost exclusively as a programme to choose and defined it in terms of its difficulty and prestigious image, this group now talks quite comfortably about science as a field of study rather than just a collection of disparate subjects. They say things like the following: "It's basically a study of everything that makes up where we live, how we live, what influences our motion" or "Learning mostly how stuff works... why things happen and what happens when they do" or "I guess discovering things that have already been discovered but you're discovering them for yourself" or "Like analytical and very precise....It's very factual and straightforward and it has a lot of guidelines " or "Science is helping humans." A longer quotation from Candy helps illustrate how these various attitudes are, at root, united, and why these students are still committed to science:

> It's a way of explaining life - how everything works and I guess that's why I like it. Do you want an explanation for everything? It's sort of like a puzzle. You put everything together and there you go. You get to understand why this and this happens and why birds fly and things like that."

When asked about the importance of science, Gloria talks about how basic knowledge of something like biology can help everyone cope better with health problems. Nora remarks on how "open" a field science is: "Like a very diverse field. You can do just about anything in science." Some have even begun to see connections between subject matters taught in Cegep, whether on a small scale such as how math helped them do their physics, or on a larger scale such as Gloria:

> She was doing like the digestive system and it's just like I was able to apply it and relate to it....It clicked, I don't know, everything just went together. Like what we learned in physics, what we learned in chemistry....It all just went together...as soon as you see it all like come together that felt good.

Annie describes how the study of science has made her feel so much more knowledgeable about everything:

> I think I know more now. I think it has changed you even if you say it's useless in some of the things you take. You keep changing, you know more. If you're having a conversation with some people you could actually butt in and say something that's challenging to them.

Jane describes the effect in these terms:

> I don't know, I think you get a connected approach to your own life in a very analytical fashion. Like you're taking away your emotions and just looking at it. You know. It hasn't happened yet (to me). It's only been two years but I can see it happening later on. Maybe it has started a little bit. You just have something more. I'm not saying emotional because that's not the word for it but....Just sometimes you'll just step back and you'll like break it all down.

Kay also speaks about the positive effects of science education:

> I think it helps them....I don't know if this makes sense but it kind of helps them to think. They can work things out in their minds better. Problems. Do you know what I mean? If something happens or just any kind of problem arises they can think clearly like in an orderly fashion and work things out. Not that it works for everyone but it helps me. Also, how do you say it.... Like,... or awareness of things....

If anything, there is less gender awareness in this group at this stage than there was in the initial interview. All but one say they do not see how, in any way, being women has affected their study of science, nor would it in the future. Jane seems more aware of wage and hierarchical differences in women's employment and says she is sure she will have to face discrimination at some point. Interestingly, Jane is the one visible minority woman in the group as well. Of her possible future problems, she says: "Well, I hope it will bring out a fighting spirit." Others seem to have the impression that their chances at success in science are, if anything, better than men's. Nora's remark is typical: "There are so many programmes opening up for women". Possible discrimination is such a non-issue for most that it is not a topic that generates much response at all. Annie and Sara re-iterate their sense that "Physics is really 'guy-ish'" and Annie suggests she has begun to feel the same about Computer Science. Stephanie comments at some length at how irritated she has been by the men in her class who insist on challenging the teacher and monopolizing his attention. With respect to their future lives as women, they are of one mind that the more education they get, the better. Marriage and motherhood seem to be pretty much regarded as optional, and a few see themselves as never having children. Some, however, are already hearing the biological clock ticking, and Gloria says "I don't want to be in school forever;" Nita says: "Like me, I want to marry, I don't want to stay in school till I'm 26;" and Jane says: "As I get older, I find more that it is definitely what I want to do is have children - more and more." Some see themselves as working mothers; some see themselves as taking a few years off from their career. All would agree with Annie who says: "I'm not going to university to stay home in the end."

3. Experience

Seven out of the thirteen young women in this group seem to experience almost all their time studying. They spend their breaks in the library, make study time tables for themselves, study particularly hard on the weekends, and only very occasionally, when they are exhausted, spend a week night without two to three hours of work. Judy and Hannah are willing to spend all night with their books whereas Nora says regretfully that she needs her sleep. Judy wonders about her future studies in medicine: "I mean everyone says, we're working this hard now, what's going to happen next year?" When asked what exactly they are doing at their desks, they agree on many issues. All agree that problems must be answered, and answered repeatedly. The importance of keeping up to date is stressed by Stephanie: "If you do badly on one test you can't do very well on the next one unless you study again the first stuff to help you with the next stuff. It's like a chain." Some of them talk about learning, over the two years of Cegep, better and better approaches to study and use of their time: how to discipline themselves and to work more steadily; how to use the text book to supplement the teacher's notes; how to make notes from the text so that they have at least two sets of notes as well the book; how to find and use additional study guides; how to be less "perfectionistic" and more realistic in selecting what to study when there simply is not enough time. Candy and Hannah seem to be spending a lot of time recopying notes. Jane uses all her spare time for study, but has to work 20 hours a week, and Kay studies on her days off. The students who appear to be working less hard do

some of the same things, but not for as long or as regularly; they talk about taking most of the weekend off, and now and then letting a week or two go by without doing anything. Celia and Gloria actually fault themselves for being "lazy"; Annie and Nita say they work as much as they can make themselves and that's it. No generalization can be made about this sub-group of four in terms of achievement: two are doing rather well, with low 80's, and the others tend to have lower grades. Some of the hardest workers, however, like Hannah, who gets low 70's, are also in the lower grade category, and Sara, who is doing badly, seems to work all the time.

One of the issues much discussed by these students is asking questions of the teacher. Only Kay, the mature student, is comfortable doing so, and she has only discovered this ability recently. Of the others, even Judy the top student says:

> I'm much less likely to ask questions and even if I don't understand, I'll ask my friends after class or I'll go home and look it up in a book but I don't like to ask in class...I think I don't really want to put anyone out. They're teaching and if everyone else is getting it then all I have to do is go home and read it. You know?

Others say things like "I'm mostly a listener" or "If I know the things, I like to talk. But if I don't and I'm not sure I really don't like to take risks" or "I've seen also that a few teachers don't like being stopped in the middle of a class. So unless I'm sure that my question is not completely out of...." Candy, one of the students from the all-girls' high school who, in her first interview, said cheerfully that she always asked questions, now says that she has found some of her teachers "intimidating" and has become much more of a listener in class; she too talks about the need to sound knowledgeable in class: "how can you ask a question if you don't know what to ask?" Rita, the shyest student, talks about not even being able to answer questions, and how disadvantaged this fear makes her feel:

> I'm usually quiet.... I've always been quiet.... I hope I change a little bit. Well, I'm quiet. You know? I'm very shy and I don't know, like if my teacher asks questions or she asks for a volunteer I never go.... Well, I find, the more you participate in the classroom the more the teacher recognizes you as wanting to learn more. That's my feeling. If you don't talk much she thinks you're just there because you have to be there. She doesn't like it. I guess if you sort of answer questions and she knows that you're really paying attention then....Maybe because if you do a test and then like something happens on a test and you blank out or something she knows you tried really hard on the test and it wasn't because you didn't study. She knows like you've been paying attention also.

This sense that they must persuade their teachers they are good students puts enormous pressure on these young women who cannot seem to make themselves enter the fray.

Teachers, therefore, continue to be seen as key to their success in science. Hearing them talk about their Cegep science teachers, one is struck by how undemanding they are: they want to be able to ask questions, to feel that the teacher likes the subject and likes teaching them, to understand what the teacher is saying, and to be able to experience a classroom atmosphere that is neither overly tense and intimidating nor chaotic. Annie says: "I like it when they look at you and talk like you're there. You know? They don't just go up there and teach and ramble on....You know? And you're allowed to ask questions and they don't mind you asking questions." They are remarkably open to different pedagogical approaches, as long as they understand what the teacher's intentions are. Judy tells us:

> You either like the friendly type and everybody helps each other, the teacher is really walking around the class and making sure you understand or I like the really structured, today, we're going to do this and we're going to lay out the points and we're going to....I don't like it when the teacher mixes them and gives you material and then jokes with you and then you don't know if he's serious about the material or he isn't.

Some of their worst experiences seem to be with teachers they cannot understand, but even then, their analysis of the problem is quite indulgent of the teacher. Gloria says:

> Well, sometimes, I found the teachers knew too much that I just sat there and it's like, What are they saying? I was totally confused. Because I mean they knew what they were talking about so what they thought was like so easy to understand was a mystery to me. You know? And I had to work at it and try and figure out what they were saying.

When they have teachers whom they describe as "horrible", they often fear they will fail: clearly, "horrible" for them is somehow failing to reach them. Nita, Judy and Candy, when asked how science could be improved, say that the teachers' attitudes to students really did need improvement. They seem to be talking about the teacher's awareness of and concern for what students may find difficult.

Their favourite teachers are those who either help them out of particular difficulties or inspire them in some way. Hannah talks abut a very low point in her first semester when a math teacher said exactly the right thing to save her: "I remember him saying just generally to the class not necessarily to me and he was just saying to everybody, Well, don't give up, it's not the end.... He was like very encouraging and ...it just made me...." This small gesture from the teacher has remained the highlight of her time at Cegep. Sara remembers the teachers who tried to identify her difficulties, and redirect her approach to the material. Many of these students comment in glowing terms on the same teacher. Jane says of her favourite biology teacher:

> She's very organized. She has all her things together and stuff and, to me, I can understand her a lot. Like the way she teaches really clicks with me. She's very demanding and I like that....It's like they expect something from you and it gives you a challenge but still I can do this....You know? Like she'll higher maybe your own standards. I like that teacher.

Judy says of the same teacher:

> I really like the way she teaches because she's very nice and she stops always in the middle of the class and tells us stories, oh something about MSG and she cooks and all kinds of stuff and about her son and this and that. And she tells us, you know, all kinds of stories about who discovered this and it makes it interesting - he discovered this, memorize it. I like that also and she'll talk of films and take a lot of class time to explain the stuff that a lot of other teachers don't.

It is true that Candy and Annie have found this teacher overly demanding, and feel they are not doing as well as they should, but in general, she is the favourite. There is obviously some role modelling going on here. Celia says:

> Like, you can tell that she really feels different about people who have higher grades or whatever. I don't know, I guess that kind of triggered me to... to be one

> of those...I think because I admire her as a person and so in return I wouldn't mind being admired a little by her. It's kind of a recognition kind of thing. I think I admire her knowledge of the subject first, and also just the way she's so into teaching it and like she really goes with it. It's kind of like a respect toward the students....You know?

Four of these students have a great deal to say about women teachers in general. Celia thinks that her women teachers "know their stuff better" than the men or "know how to teach it better." Sara says: "They tend to care. Yeah. I think they....I don't want to generalize but from what teaching I've had they know your name....Most of my female teachers told me, So, next time you'll do better....You know, things like that." Annie says: "I find that many of the women teachers seem to be more compassionate, I guess. If you have a problem they're more understanding and they don't shrug you off or tell you that's a stupid question as much or as often." And Gloria: "I don't know, I find I could approach my female teachers more. Not that I felt intimidated by the men but like, I don't like, I'm more able to say exactly what I'm thinking whereas with the men, I don't know...." The rest of the group have no preferences, in general, for either men or women, but these characteristics - the compassion, the accessability, the knowledge and the ability to communicate it are definitely the important things they look for in their science teachers.

These students continue to experience extreme anxiety with respect to their place within the field of science, now and in the future. Every one of these students talks about at least one terrible period in her two years. Nita tells us:

> Well, I just didn't come for a while. You know? I tried to understand what happened and why I got a bad mark and I guess I was sad. I didn't...but then...and you try to get back on the right track....Only two days. It wasn't a major....You feel rotten and worth nothing and I can't do this....It's not often. Just when something really bad....Everything is just piling up on you and you can't take it any more and you're about to have a nervous breakdown and you just want to give up.

Sometimes the bad times coincide with other life difficulties, especially those involving family and relationships, but even then the anxiety is about success in science studies. Again, they talk about differing pressure points - before, during and after "the test", depending on their personalities as well as upon their sense of whether they are prepared or not (when they are not prepared because they couldn't finish the work, they are always nervous beforehand). Many of them experience the anxiety in very physical ways. Judy says: "I get sick, literally sick to my stomach, before an exam...." Nita talks about the same experience. Annie speculates that her insistence that "I failed, I failed" is often a self-protective device:

> In a way I'm underestimating what I can do....Like in the lab exam, I'm saying Oh no, I did bad because I know I failed the other one....And also it's for disappointment. I don't want to say I did well and then fail. That's going to feel worse. But if you tell yourself I failed and you fail, then, okay, I know it. You know. So you didn't tell yourself you did good and then you failed and then you feel bad.

Anxiety about their future in science is an increasing problem for these students, as they make their applications for university and approach their final Cegep tests and exams. They worry about whether they will be accepted in their programmes, but they also worry generally about whether, as Candy puts it, they are "good enough" to go on or whether, as Jane sees it, because they come from working

class backgrounds, they will "fit in" at university. Good feelings about themselves are inextricably bound up with doing well in science. Sara who is doing rather poorly in her studies by fourth semester says: " I used to have so many interests in so many things. Like, I've lost them and I find that so disappointing....I don't feel confident about anything about myself any more....I feel like I'm all drained out." Jane, who has done reasonably well, says:

> In general, I find I'm confident because I have done well. And I know if I don't do well I consider the reasons why. So I usually know that if I would stop procrastinating or whatever I would do better or, if I wasn't sick or whatever....(I've lost my train of thought....) Yeah, I think I do have self-confidence. I think I would lose it though if it gets too hard or if I'm not doing as well as I used to then it's very easy to lose it and think, well, I've lost it. Lost the edge I used to have.

This young woman's comments seem at first to be corroborating the research findings that the confident person can explain difficulties in terms of external factors, such as health or work done. But she loses her train of thought at precisely the point where she is explaining this: she is not very confident about her confidence. She knows her confident stance is also dependent on the marks, and that if the marks fall enough, she will lose her sense of self-worth and not be able to deal with her work at all. Several of the students say they think they have high confidence, but nevertheless rush on to describe their intense anxiety, and the sense that we get is of very conflicted feelings: "I know I can do it" is said by Nita one moment after she has described her feeling that she was going to have a "nervous breakdown" when she failed a test. It is almost as if saying one has confidence is good for one, and helps make it true. Certainly they believe that confidence helps one do better, and lack of it interferes with performance. They want very much to be able to explain difficulties in terms of controllable factors. Nora says: "I won't say I'm stupid because either I didn't work hard enough or there's some other reason. But I won't say it's my fault because I'm stupid. I won't say that." Jane and Stephanie refer to feelings of intense anxiety as feeling "out of control", sometimes bringing unfair pressure on the family. Hannah talks at length about her sense that she needs to learn how to deal with all of these feelings better:

> I think that's one thing that I would like to control....I get overly hyped up....It's like I lose control over my emotions. Like when I get depressed over a mark or when I get really excited about something I just like overdo it completely. If anything, I'd like to have a bit more discipline.... I try to but I find it very hard still. I don't know if that is associated with maturity; it probably is so I guess it needs more maturity.

It would be interesting to know whose voice in particular this young woman has internalized, but she certainly believes that her emotional involvement in her success and failure is wrong and has nothing to say to her except that she is immature.

This same sense that they ought to master their feelings surfaces again in discussions about competition. Hannah says:

> Like, I see my friends do extremely well and I feel like, Oh, God...but I guess, I don't know, especially that second semester, I had to...I don't like the word "find myself" - that expression - but I just had to take time and like really realize that hey, well, forget what everyone is telling you and what everybody is doing and work at your own pace and do whatever you can do....I got out of the mode of thinking, well, who did better in this test and who did better in that test and

> thinking of, well, Hannah, study like this, study better so you can do better next time instead of thinking like I did badly, or I did that, or I did...I got out of that mode of thinking.

The self-mastery here is, again, mostly in the service of doing well in the tests. However, one of the ways in which they decide whether they are doing well is comparing their results with the class average. It is for this reason that the two highest achieving students have avoided Science Plus. Judy refused from the first to enter the Science Plus programme; Nora entered and then dropped at the end of her first semester because she did not like the atmosphere. Judy says: "In Science Plus you really take a chance when you compete with people that are as smart or smarter than you are and there's that reality." If they are doing well, feeling competitive seems to be an experience they do not fight. They admit they want to be at the top. If their grades fall off, the experience can very occasionally even liberate them from the stress of competition. Celia tells us: "I think that it happened when my grades lowered. You know, I felt as if I wasn't part of that high group any more and so it didn't bother me any more." When asked if she regretted this sense of not being in the running for top place any longer, this young woman says no, and then goes on: "Maybe because it had too many side effects....Like being anxious itself is not a pleasant feeling." But even the students who are clearly intensely competitive in terms of their marks and futures might say things like Judy does: "I was never one for competition. I never liked to play games where you could lose....I don't think I'm very good with failure. I think it's a big weakness of mine...." A continuing pre-occupation in this respect is inter-personal relationships: Hannah protests she does not "hate" her friends who are doing better; Jane stresses the importance of "a helping hand" and how disgusted she is by students who erase solutions so that others can't get them; and Gloria, concerned with other students' feelings, says: "you can be confident as long as you aren't conceited."

There are noticeable changes in the attitudes of these students toward working with their peers. One after another they report on how good it has been to have friends in the science programme. Nita and Jane say : "It's helpful if there's someone there that you know is going through the same things." More than half of them describe actual study groups such as Hannah's: "We help each other out....As a group. A bunch of science students just together...In the library....Like if I didn't understand something and I asked they'd help and if they don't understand ....It's that kind of mutual thing." Others work together in class; Judy tells us: "we'll literally pass our notebooks around. We'll sit in chairs next to each other and make sure we haven't missed anything and go back and forth and write things down in each other's notebooks." Many clearly still do their serious studying alone but enjoy group efforts of all kinds and feel they have benefitted from informal get-togethers with peers to talk through their work. On the whole, their lab partnerships seem to have gone well, but their great emphasis is that they must know the partner. Some, like Sara, Candy and Nora, seem to have gone to great lengths to register for courses with their friends and to therefore have "best friends" as lab partners; others, like Gloria have made friends with their lab partners and remained friends afterwards. There is still some wariness about getting the wrong partner who would not do the work or take it seriously but not nearly as much as in the initial interview. They seem to feel more in control. Celia says: "I kind of try and judge the person." Work and friendship seemed to have become more interconnected for them, perhaps because they have spent so much of their time working. Only Sara and Candy seem still to worry about fooling around with friends and therefore being distracted. When asked about the overall value of their Cegep experience, these students provide a wide range of answers. They talk about being well prepared for the next step in their education, about finding career paths through exposure to so many different courses in and approaches to science, about learning how to work very

hard and efficiently, about developing maturity, self-discipline and strength of character, about the friends they have made, about gaining awareness of other fields of knowledge than science. Of these Cegep years, Hannah says: "Obviously, I value them a lot. I think that I learned a lot not only in sciences but also about myself and everything that I'm able, that I'm capable of doing." Candy concludes as follows: "Well, I guess my education is very important to me and I've heard the saying before that once you have a diploma it's like a weapon. No one can take it away from you." Kay, on the other hand, looks at her personal growth and makes the following remarks:

> I feel like I'm a better person and I've learned a lot. I don't just think one way. I try and look at a picture in a broad sense. I find that.... I don't find myself so limited. Like you talk to a lot of people who are not so educated.... Well, not necessarily educated but who only think in one kind of pattern.... I feel sorry for them because there's so much more out there to learn and to know and they're just stuck in that one way and it's scary.

The tone of these remarks, usually in the final moments of the interview, are already a little nostalgic, as if, for all the anxiety and frustration they have been through, the experience at Cegep has been an important and deeply meaningful time for them, for many, many reasons.

V. HEALTH SCIENCE STUDENTS DEALING WITH INELLIGIBILITY FOR MEDICAL CAREERS: HOW THEY PERSIST

A. SUMMARY

Although the persistence decisions made by these five young men differ slightly from one another, we have looked at them as a group because they all begin in Health and share so many of the same motivations and attitudes. What they decide to do may be different, but the way they make these decisions and the experiences they share are markedly similar. They arrive at Cegep with grades higher than the average, and they see themselves as good students, in some cases as excellent students. They have no hesitation about identifying themselves with the top science achievers. They have high ambitions: every one of them is considering medicine, a common reason for enroling in Health. They have been much motivated by families which already contain parents, uncles and/or siblings in the sciences. All the fathers would clearly like to see their sons become doctors. These young men do not talk effusively about their interest in science, though some like the challenge, and all are very much aware of both practical and prestige advantages of following science studies at Cegep.

We notice, however, even in the first interview with these students, that four out of the five do not much like physics, and they are not very keen on math: they do not seem to have any very close or personal attachment to scientific pursuits. Their interests are mainly in sports, and they are already very involved in college teams where they compete with great energy and commitment. Though they tell us science is a hard programme, they are not studying hard at all, and they do not seem to fault themselves for this fact. They go to classes faithfully and rather expect the teacher to make the subjects clear to them in that context: they are very critical of teachers who are unclear or who intimidate students so that they cannot ask for clarification. They expect the learning to take place in the classroom. They can be anxious before tests, but they do not talk much about these experiences, except to say how important it is to stay calm and controlled and to have the right attitude. With respect to competition in school, they offer somewhat conflicting views: they would all clearly like to be "top" but none of them really is. This fact bothers all of them, but in varying degrees, and the very few incidents of lack of success which they are willing to discuss they blame on teachers. They argue that competition is not a good thing, but they are all shaped by an individualistic and competitive attitude to learning. They do not like to work with other students, and their relationships, which are very important to them, are entirely social ones.

When we come to interview them again, we find them not transformed by their education but more deeply dyed in the same colours they showed to us at first. They are, if anything, even less interested in science than they were, but even more focused upon their career paths. None has been successful in gaining the marks for entrance to medicine, and we cannot help but feel much of the persistence pattern in this group is shaped by this fact. Two of them have applied and been accepted into engineering: one of these students has come to feel he is unsuited for the close, people-concerned relationships of a medical profession, but the other is just switching to another reasonably prestigious career path that will accept him. The other three have chosen to do a Bachelor of Science (two in psychology, one in physiology) at McGill and to apply to medicine when they graduate. They do not talk much about their achievement, although they are a little more realistic than they once were, but even those with low 70 averages do not seem to consider that their entrance to medicine may be forever impossible. They are so career-focused that they do not even consider the messages offered them by their great enjoyment of and higher achievement in subjects other than science. They

are still fighting off anxiety and sometimes depression with anger, teacher-blame and bouts of intensely competitive feelings. They work much harder now than they once did, but they by no means spend the hours of study that top achievers do.

Though their attitudes to science, to gender issues and to the general purposes of education have not changed, we note certain interesting features of their development. They have very much enjoyed their non-science courses, and they have done well in them. This fact, though it is not operative in their future choices, is certainly worth recording as an important feature of Cegep education for these particular men. We also note that they have learned to work with others with a slightly greater degree of comfort, though they make very clear distinctions between instrumental relationships in college and personal friendships outside. When they are asked to evaluate their lives at Cegep, they talk about general growth, broadening of interests, and the making of friends, as well as the mastering of basic science. It would be interesting to know for certain why these changes are so little integrated with what they intend to do with their lives and how they evaluate success. It does seem, however, that they are very much driven by some sense that only science education will provide for them the futures which they ought to want and to have.

B. INTERVIEW ONE

1. Motivation

The five men persisters who begin in Health Science have a range of reasons for choosing the programme. Ron talks at length of his rather romantic curiosity about nature, human nature, the world and why things happen. Pierre and Subash talk about the "challenge" of "problem solving" and the satisfaction of "getting it right". As they speak of science as "the most demanding programme", the "hardest to pass", "the top of the line", we get a sense that their choice is related to this notion, since all of them see themselves as high achievers, whatever their actual marks (see below). Andrei is very outspoken about his choice of science being obvious since he is so good at it: he talks at length about all the olympiads in chemistry and math that he has won, both here and in the country from which he has recently emigrated. He alone, however, connects the fact that he "loves" chemistry with his programme choice. The others speak in more practical terms, of which keeping options open is sometimes mentioned and frequently implied.

A subject on which these young men are much more willing to talk is the whole matter of career path. Every one of them has a vision of how the programme serves as a entrance to the desired career. Ron wants to be a doctor. His motivation is powerfully rooted not only in his interest in biology but in his sense that he is "good with people". He also attributes this caring motivation to his religious beliefs. Andrei says he would rather be a chemist than a doctor, but that his work as life guard is beginning to bring him closer to considering medicine. Pierre and Subash are considering both medicine and engineering. Subash still seems uncertain which he will choose. Pierre, however, whom we have met in his third Cegep semester rather than his first, since he is a transfer student from a French Cegep, brought to Vanier to play football, is already beginning to move away from medicine. He gives very complex reasons for this change of heart:

> Well, I once was interested in being a doctor in high school, but I've lost interest....Maybe because....I don't know. It's different....Maybe because I think I don't have the grades good enough. Maybe that. Well, it's not.... Well, I like problem solving. Well, a doctor....You don't solve as many problems and it's with hu-

> mans. I'm not too good with human relations. Maybe I'd be....Sometimes I'd like to be.... Doctors have lots of pressure. Like lives of others depend on you. I don't know if I'm ready to deal with that kind of pressure....Well, in high school I was looking at the bright side of it. Like helping people to heal and all that. I was looking at it, okay it's fine like he was saved and now he's healthy....But I didn't think about feeling he was sick and now he's dead!

To what degree the grades issue leads to the rationalization (or realization?) that he is not prepared to deal with uncertainties like human suffering is impossible to tell, but the order in which he introduces the points is interesting. Perhaps both are important factors. We sense a distancing mechanism taking place here, a fear of taking on affective responsibilities, long before the student has to make up his mind about the future. Housein is also rather practical about entrance averages and therefore less willing to set his sights on medicine than on dentistry. And he too wonders whether he can deal with the human demands of medicine:

> Or if he tells me he has, like cancer, he's dying, I'm going to get too involved. And, like, in that field, you're not supposed to get too involved, so I won't be too well in medicine. But dentistry, you can't get too involved because it's like, you come, he opens his mouth, you clean, and that's it.

For none of these young men is the caring motivation really connected to self: even the religious student uses the vocabulary of obligation and talent-use rather than a felt need to connect with others.

The most significant influential background figures for these young men come from family, not school. It is true that Ron does speak of a very "motherly" high school math teacher whom he felt very close to, but this teacher did not seem to have influenced him unduly. Andrei talks about wonderful math and chemistry teachers both in Quebec and in his country of origin, and certainly these teachers encouraged him, made him feel good about himself, and helped him win prizes. But his love for chemistry really originates in the family, with a mother and a father who are both chemists. As he says:

> My parents were both chemists and so when I was studying chemistry I knew that my parents are chemists and so it should be something special for me....And so I started and from the beginning I tried to study hard because I knew that my parents are chemists and so I had better study hard.

His secondary plan, to become a doctor, also originates in the family, with a male relative who is a doctor, and a mother who believes that his chances are better in this country as a doctor than as a chemist. Ron is part of a religious family who very much approve of his choice of medicine but have not pushed him at all. His uncle, however, is a surgeon. The family is middle class professional, with father a lawyer and mother a family life educator, recently retrained. Pierre has a brother in engineering, a fact which he thinks may be influencing him to move in that direction, but his mother is a nurse, father a high school principal. Subash looks up to his brother who is at McGill and hoping to enter medicine, as well as being rather resentfully influenced by his father, an engineer who would prefer his sons to be doctors. Housein, in considering dentistry, does so very much in obedience to his family's wishes: his immigrant parents are not well educated, but most of the children have post-secondary education: one sister an architect, another a microbiologist, brothers with business degrees. He himself would rather go into politics, he says, but there have been political assassinations in the family and his mother has exacted a promise that he will not go that route. Thus, though two of these young men

speak forcefully about their independence, that "I don't want anybody to tell me what to do" and "I don't want him to think that, like, the reason I'm doing something is because of him," they nevertheless appear to be doing their career planning very much in accordance with family trends and profiles. Mothers are not totally invisible in this sphere of influence, but fathers, brothers and uncles - male figures, in fact - appear to be more influential.

The range of interests described by these young men is not very wide but very enthusiastic. All of these young men talk about sports. Pierre takes his role on the college football team very seriously and spends all his spare time on football and keeping in shape. Subash talks about playing hockey and soccer, Housein about football and wrestling, Andrei about swimming and life guarding. Ron says he likes to feel "more rounded", and includes writing poetry in his list of interests. Housein talks a good deal about politics, which he would like to enter, and has been very active in his high school: he seems a bit cautious about getting involved at college, and does not seem to want to take courses connected with this interest. Housein and Subash say they have very secondary interests in business and law but have not been interested enough to take any courses. Andrei mentions English as an important subject; Housein talks about doing well in humanities because he "knows a lot", but it is not clear how deep his interest goes.

These students appear to have entered the programme with good grades and expectations that these grades will continue to be in the 80's at least. Andrei, who has won many national prizes and is used to getting 100's in science and math, is quite scathing about his drop to the mid-eighties at Vanier: he blames the marks on the fact that he knows everything already, that teachers are not taking any special interest in him, and that he is not interested in his courses. Despite the fact that his marks are only about average in the Science Plus class, he says "I know even in my mind I know that I'm better than them." Housein, who will only say of his performance at Vanier "Yes, I'm doing well," describes at some length how well he did in his country of origin and how he has done very well in Quebec high schools. He sees himself as a mid-eighties student. Pierre, who is feeling his marks may not be high enough for medicine, is achieving mid-eighties. Subash is very angered by a test mark in the 60's and pleased that the next test in the same subject is in the 80's. Ron implies that he not only has excellent grades from high school (he cannot understand why he has not been accepted into Science Plus), but that he still sees himself as a high achiever at Vanier: "I do very well." It emerges, however, that, even as he talks to us, he has just failed a physics test. Why he has not integrated that experience into his concept of how he "does" is unclear, but he clearly has not. Self image for these young men is very much bound up in marks, but marks lower than those expected tend to be explained away or not dealt with.

2. Attitudes

Subject preferences are not as clearly defined as one might have expected from a group of students electing the Health rather than the Pure and Applied Science Programme. Discussion about their favourite subjects reinforces the impression given earlier that Health is elected mostly to allow for application to medicine rather than for any particular set of interests to begin with. The chemistry lover, for instance, is not interested in what he calls "applied chemistry", but in what he distinguishes as "pure chemistry, with a lot of calculations." He is not enjoying his Vanier chemistry because his teacher is not, he says, a good pure chemist. He says he has never particularly liked biology, neither understanding it well nor achieving high marks in it. Pierre and Subash say they have not been that fond of biology either, since it requires so much memorization. Pierre makes an interesting clarification

about the difference between memorizing and doing problems: "I don't hate memorizing but it's not the most fun. I don't really like to be passive in front of a book. I like to write and do some calculations and...." Ron and Housein really do seem to prefer the health sciences, however, especially biology. Ron talks at length about how fascinated he has become in the human body, its digestive system, immune systems, and so on. Both these students also like chemistry, especially as it connects with the natural world. There is a tendency to prefer well contextualized learning for most of these young men. Pierre is beginning to enjoy physics the most, partly because of the problems which he is enjoying solving and partly because he can see the point of it, as connected to cars and other recognizable objects in his world. Ron and Subash agree with him, saying physics is not necessarily a favourite but is alright because it employs "common sense" as applied to the world around them. This world clearly includes vehicles and sports examples. By none of these young men is mathematics either favoured or intensely disliked; Housein is experiencing some difficulty with calculus; Subash is doing much better than he expected; all find they have to apply themselves, but no one is particularly concerned about math, one way or another. Their math ability and achievement does not seem, for them, to be central to their view of themselves as science students.

As mentioned earlier, these students see science as a demanding field of study with a certain amount of prestige attached to the student enroled in a science programme. "You're, like, part of the image, you know...you could show off a bit, you know...." None of them is ready to deny that he is the "smart guy", as everyone identifies them as soon as it is known they are in Science. As they describe the good student of science, we have a strong sense that they are describing themselves. They agree that science students have to enjoy science and really make an effort to understand what they are learning. "So, someone who does well in, like, physics or something, is someone who, like, who understands the stuff, and, like, he gets, there's a gratification in understanding it and doing well, so...." They also agree that science takes hard work: most feel it takes more work than other programmes at Cegep. The prestige of science has something to do with the fact that it has specific pre-requisites that other programs do not and that it requires particular aptitudes. Andrei says: "You know Social Science....Maybe I'm wrong but I think everyone can do it....I think that science is more with intelligence....It's not just talking like in Social Science." There is not much discussion of superior giftedness: Housein says that high achievement without work would mean someone was a genius. Pierre and Subash say that the high achieving Cegep science student has to have a good background in science. Ron stresses attitude:

> Someone who has an attitude that they want to go out and they want to learn. They want, like, they're prepared to look at the material as a challenge instead of a threat, because if you take it as a threat - and you, people start looking at it as if it's above their heads, then you're finished.

There is a strong suggestion that calm and confidence are required for success, a point discussed at greater length below. It is significant, however, how closely attitude and outlook has been, in their minds, connected with achievement possibilities in the sciences. Housein tells us:

> Math, I really, I don't like it a lot. That's my problem, though....Well, for me psychologically, my only, like, when I get in the calculus class, I'm like Oh boy!, you know. But then when I get in the other classes, I'm like, Okay, we're going to be doing something new today. It might be fun, it might not, you know. But that's the risk you take.

Some of the students question the science curriculum and some do not. Those who do not say things like the following:

> I guess my assumption is that these, I mean, those courses are basically are the basics for the whole general field of science and, because I mean, let's say if you go into, you know, biology, you're going to be you know, you're going to be into the different things like chemistry, biology itself, and I'm not exactly, myself, I'm not sure exactly where math and physics come in, but I'm sure they do come in somewhere, and so same for, you know, for certain types of doctor. So, I just, I mean, I accept and I don't, I don't really feel like I'm wasting my time because I'm learning something you know....

On the other hand, one encounters statements such as the following:

> Oh, I always ask myself this question. Like, if I wanted to go into the medical, what am I doing English, or, like, physics and chemistry which really I do not like? Like, why am I doing calculus? I don't need calculus if I'm going into dentistry....what am I doing with English and French, which I took as an option, or gym or, you know, like, humanities?...Even though I am enjoying it but I really do not, I do not need, like, all I need is, like, scrape the surface of it, and calculus. I don't need, like, to get deep into it, so....Oh, I'm a very practical person.

Subash says that he used to question the curriculum a great deal more in high school than he now does. "Everyone does that, like, especially if everyone's against the teacher, you know, like, and they don't understand a thing. Then obviously they're going to question it, `Sir, why are we doing this?' you know...." As to why he no longer does this, he says "because I know the stuff, why should I complain." There seems to be very little vision of science as an integrated field of study. Housein and Ron are almost able to articulate this lack of vision as a lacunae in the curriculum itself, inasmuch as they appreciate whatever teaching they receive that connects their studies to the world around them, and they long to be able to see these connections more frequently. Neither actually talks about subjects connecting with other subjects, however. When asked how science could be improved, they tend to say: "Well, like the material is the same, you can't change the material." Andrei and Housein refer to the need for teachers to be more sensitive to student needs (see more below). And Ron talks at length about the heavy burden of study, and the intense stress that the serious science student can suffer (see more below).

When asked questions about gender issues, these young men try very hard to find something to say, but it is clear that the subject has not much captured their attention. Subash says, much more frankly than the others: "It's like, I don't want to, like, worry about it...." Most are aware that their teachers have been mainly men, but "like, who cares, you know." Only Andrei speculates that this might be due to nature, not nurture; Ron and Housein speak about socialized sexism which they deplore but see as a disappearing phenomenon. Subash talks about women being sexist because they notice issues of gender in English classes. Ron and Housein speak at some length about the different styles of men and women science students, how women do just as well as the men but make a lot less noise about it. Pierre says that women students are a lot more careful, work harder, and take better notes. He concludes: "all women do good so we don't want to fool around." Ron and Housein say that women teachers are more open with their feelings than the men, but they do not indicate which style they prefer. Looking ahead at their own futures, they see no obstacles to their persistence in post-second-

ary education. When asked about marriage and family, they answer a rather unenthusiastic "Yeah," and look quite blank when asked if this desire interferes with or affects in any way at all their career plans.

3. Experience

For a group that stresses the importance of seriousness and hard work, they are surprisingly unforthcoming about study habits. Pierre and Subash talk about doing the homework, especially problem solving, and reading their texts. Clearly, they do some studying, but it is difficult, at this point, to get them to focus upon what they do, or how much of it. They much prefer to talk about teachers, and how important it is for teachers to be clear, interesting, patient, and willing to contextualize their material. In fact, they talk so much about teachers and so little about their own habits that it is difficult not to draw the conclusion that they expect most of their learning to take place in the classroom. Only Pierre seems to be relatively uncritical of his teachers: so long as a teacher can answer his questions, he is satisfied. "For me, when I'm bored it's because the subject is boring," he says. He also says: "I never had a close association with a teacher." The others have a distinctly different point of view. Subash is just beginning to like physics for the first time, and to understand it: he accounts for this in terms of a teacher who is of the same ethnic background as himself, and with whom he has begun to feel some kind of bond. Other students talk about developing new subject preferences because of Vanier teachers they like a lot. Real difficulty with subject areas is also being laid at the feet of "bad" teachers, who are hard to understand, teach the material "on too high a level", or behave in cruel and condescending ways which are discouraging to the class. They are full of praise for the teacher who manages to make them feel they can ask a question even when no one else is asking. Despite the almost arrogant way in which these young men tend to talk about their abilities, they can easily be intimidated in class, and suffer much as a consequence. Only Andrei criticizes his teachers for not knowing enough, for making mistakes on the board, and for making errors while correcting papers. Even this criticism, however, seems at least partially related to the hurt feelings of this young man who is used to being singled out as a top chemistry student and teacher's favourite and who is, in the Science Plus class, suffering from being surrounded by other equally clever and perhaps more mature high achievers. From one point of view, considering the sheer amount of talk about teachers, we might describe them as both teacher-dependent and very demanding students. However, their definition of a good teacher being as reasonable as it is, it is difficult to say that they ask too much. This group seems to have arrived from high school with certain expectations of science teachers, and to be finding, as they did in school, that some teachers live up to their expectations and some do not. No one says that Cegep teachers differ substantially from the teachers they have been used to, and Ron is quite critical of the notion, often bruited around in the schools, that Cegep teachers don't care: "I think the teachers are very supportive, actually...."

Ron is very critical of science studies for causing undue stress for students. The other students do not talk critically about the demands of their programme in this way. They all talk about nervousness before and sometimes during tests, especially hard tests, or tests for which they are not properly prepared. But they seem to feel that "everyone gets nervous in tests" and that their task is somehow to control the nervousness so that it does not undermine their performance. Their talk is full of such phrases as "I try to think it is not obligatory what I'm doing, it's fun" or "I think if I keep it, if I keep it, that attitude as a challenge" or "I start reading verses from the Koran to calm down, which is...I, very, it makes, which renders me very calm". This latter student adds "See, I don't know, there's, like, some

people that do very well, like, some people take it easy and do well, some people get excited and do well. I think I'm one of the people that get very, very excited...." The need to control this "excitement" is clear, however. They talk about being confident when they "know their stuff", and that when they study, they usually "know their stuff".

For these science students, anxiety about the overall average is perhaps more acute than anxiety about science results:

> Yeah, and especially if you're going into a competitive field. Not only about science, but if you excel in science and you tend to ignore about your other studies, which you consider less than important, and then you do bad, poorly in those, your average is going to drop, and then you're going, you're really going to get screwed up.

Probably all these young men would agree with Housein both here and where he goes on to say: "I'm not afraid of competition and I love being Number One but if I can't, I'm, like, I'm not going to kill myself, you know." In general, they are a bit negative about academic competition, and they seem to feel that competition belongs on the playing field rather than in the educational arena: "Because, in sports, the objective is competition....In studies, that's not the objective. It's to learn." "There shouldn't be competition, there shouldn't be. But there is." Most of them keep their eyes on the class average, and feel gratified when they are well above it. Subash tells us he refrained from going on to Marianopolis to avoid intense competition, after experiencing quite heavy competition in a private high school. Andrei speaks most critically about competition in the classroom, yet it is clear from his talk that he is the most competitive of all these students. He gives himself away on many occasions, such as in the following statement: "Me, personally, I don't like competition....Because I know that I know better than them. Everybody thinks that he is a genius. But in....I know that I know five times better than them..... " None of these students is able to explore this distrust of competition sufficiently to identify his fear of losing.

It is striking to hear how isolating the initiation to Vanier has been for these young men, many of whom arrived here without any friends at all. Most have managed quite well by the time of the interviews, and most are very happy with the social connections they had made. Clearly, these new friendships are very important to them. Ron and Housein are almost ecstatic about the pleasure of having found themselves comfortable at a large institution, having come from small high schools. The delight at finding that all ethnic groups can interact so comfortably and the pleasure in finding classroom situations where one can be oneself are made very clear. It is very difficult, however, to get them to talk about the relationship between friendships and learning partnerships, or lab partnerships, or situations where personal interactions are of some academic meaning. Many simply shrug off the issue: you have to have a lab partner, so what's the big deal? Subash, who clearly loves people and enjoys everyone, nevertheless talks extremely manipulatively about work partnerships: "....my objective in, like, labs, is that to find someone who is, like, who knows more than me...." He goes on to say:

> I like people in general....I think it's better to work alone because that way you won't run into any conflicts. It's like, because, like, that's how friendships, like, get ruined. Because, like, there's a conflict, 'Yeah, why don't you do this work?' you know....

Andrei, the Science Plus student, is saying somewhat the same thing when he remarks: "I like to work in a partnership with somebody like a teacher who gives me something and not a student whom I try

to drag with me." All these students say they study alone. The overall effect of these somewhat contradictory signals is of a group of students having great difficulty integrating their affective relationships with their academic lives. Clearly, they all have friends - but the friends are, at this point, totally separate from their very individualistic ambitions as science students.

C. INTERVIEW TWO

1. Motivation

The differences among these young men has certainly deepened and widened over the two year period. One similarity among them, however, is that four out of five show less interest in science than they did at the outset. Only Pierre says immediately that it has been "a challenge...getting prepared for university and I feel that's the programme where you get the most work done and the biggest challenge." He adds: "I think I'm curious." This student also talks about the pleasure of the actual work of science:

> I like trying to understand what I don't understand. If the teacher gives me twenty numbers in the math book I won't like it to do them....No. It's just making me that I understand....Well, sometimes if I really work hard on a problem then I'll forget what time it is and how long it took to do it. Yeah, I lose a notion of time a bit....When I'm doing the problems I completely forget what's around me I'm in another part of the world when I'm doing my problems.

Subash does say that "it's fulfilling when you're doing it right. Like if you work on a problem and you understand it and you're getting everything right then, in general, that will give you a good feeling because you understand it and you feel good about yourself." He says, however, that he has not felt very motivated:

> Because I think if I go into university I'll be more motivated because I'm in my concentrated field. You know what I mean? This way it's understandable not to be like that motivated. Like, the only motivation is to do well. Not to like learn more....You know what I mean? Because in university you're going to do something that's supposed to be of your interest and that's what should motivate you. And to do well.

This sense of their involvement in science as being a forced and unnatural one emerges elsewhere in their discussion. Ron tries to explain as follows:

> Another thing I realized is that when it comes to the sciences you have to develop the ability to step outside of what you're learning and look at it and appreciate it. Because otherwise it hounds on you, and you don't appreciate it any more.... Basically what I'm implying is that, for example, if you're looking at biology or you're looking at physics, let's say, you're looking at a problem, it gets so technical and you have to remember all those little formulas and how to use them and when to use them and why to use them....Or, biology, you have to know which chemicals react and how they react and that's where you're knowledge of chemistry has to come in and you're not really used to it or not prepared for it, it just gets very tedious. You know? It's very technical. When it gets too technical for me, at least, I can't appreciate it. I could appreciate it, but I have to remember to do that [stand back].

Housein seems to speak for most of the group when he says: "It's rare to find someone who really enjoys it....Because it's hard work." Except for Pierre, as quoted above, and even he has to almost contradict himself when he talks about getting caught up in the problem solving, there is not a sense among these students that the hard work has been invigorating or deeply satisfying. Housein says: "Frankly, I'm not really, really interested in science but since I consider my decision to be a smart one, I decided to go into science because, frankly, with a science degree, it opens the doors as wide as it can." Even Andrei, who entered science because of his love of chemistry, gives very instrumental answers this time about his interests: "And I'm in Science Plus and I'm not doing that bad so it shows that I have some potential and so it would be not smart for me just to go into arts and not science."

As before, all these young men seem to be much more caught up in career plans than in their interests, and their career planning is often intensely practical. Some are still recognizing, appreciating and/or resisting family influences, whether of specific advice or general desire by the family to see the young person achieve. Housein has decided against dentistry ("you were like in someone's face and all the things flying and I didn't really like that aspect"), has applied to medicine ("at McGill and they're processing my file and hopefully we'll see...), and has also applied to engineering at Concordia ("I got accepted in engineering, civil engineering, and I'm planning to go"). There is a strange paradox to the fact that he prefaces all these remarks with the confession that he is not much interested in science. But, as he says: "If I don't like it suppose the first semester I'll transfer to business. That way I'll have my math. And, I can transfer to any field I want." He is also considering a return to work as an engineer in the middle east where he sees greater chance of prosperity than in Quebec. This strategizing is more extreme than that of the other students, but it is, in many ways, typical. Here is what Andrei says:

> I saw it - chemistry - was getting too much hard while biology was for instance somehow seemed...and so I was trying to become more interested in biology. At least, after talking to my friends....I'm going into medicine, I'm trying to get into medicine and it was also a factor.... When I thought about getting into marine chemistry there really wasn't much to do there. For example, people told me that if you become a doctor it's very hard not to find a job. A job is almost guaranteed.

His motivation does include some human orientation:

> I definitely don't want to be a closed-in scientist....Because being a chemist is staying in a room and working with chemicals and slides and papers, while being a doctor is talking to people....You know? It's much more interesting.

Ron, who, in his initial interview, said he was good with people, re-iterates his sense that he is a "people person. I know definitely in my career I'd rather interact with people than to be behind in a lab so to speak. " These two expressions of social interests do not seem to include social conscience or fully actualized caring motivations, though it is difficult to be sure of this. Ron and Subash have not applied for medicine, but for psychology. Both have carefully worked out a plan to take the bachelor's degree and then apply to medicine. Ron is considering sports medicine, Subash psychiatry. Ron sees his choice as still a means to keeping his options open: "I mean if I'd give toward psychology at this stage, I mean who's to say if maybe my last year of the undergraduate, it's like I might go more toward Social." Neither of these two students articulates his reasons for not applying to medicine now (see discussion of Marks, below). Only Pierre has simple answers to questions about career plans: "I'm going into Mechanical Engineering." His reasons? "Problem solving." Why has he abandoned medicine? "I wouldn't like seeing an old man die or sick children."

This very careful career planning seems to be something they feel they must do, and much thinking and research goes into it. But the language used to describe this process suggests how pressured he feels, and how this pressure is experienced as an obligation:

> Because I think by now I should have a plan of what I want to do and stick to it. I have to be confident in my choice. Because now if I'm thinking of other things then it's going to affect....You know? I've got to be sure what I want to do so I can do it well. Do you know what I mean?

These students are not really able to pinpoint the forces that are pushing them at this point. Andrei admits that "for my whole life I was just a child so I can't say if I'm changing because I never did anything else but science." This rather charming if not very articulate remark perhaps says more than is first apparent: these directions and decisions are, on some level, unexamined, however complex the surface-level planning of these young men appears to be. There is a driven-ness here which none has been able to either resist or explore.

The outside interests in sports have continued and if anything intensified for these young men. Four out of the five have become involved in Vanier or community teams - football, swimming, soccer, wrestling, volleyball, hockey. They see these activities as extremely important, but in no way related to their studies. It is clear they all take time for what they also call their social life, going "out" with friends. Subash talks about liking reading marginally better than he used to and Ron, who described an interest in writing poetry and church young peoples' groups in the first interview, still does these things, though to a lesser extent. Housein has begun to take a very important role in running the family business: "It's recent because my brother left and I have to take care of it. I think from now on it's going to be a daily thing....Yeah, I love doing it. That's the fun, it's being responsible." He agrees it is time consuming:

> But no, I try to find time to do my studies and take care of my family and not have my family be offended by me going out or you're not paying attention to us, you're always with your friends....I try to fit everything together and I think I'm doing a pretty good job.

Interestingly enough, none of these students complains about not having time to keep up his interests. Ron, the only one who does not talk about team sports, has begun to do weights and talks about the process as follows:

> At the beginning of last year, I started to go to the gym more and I started to really enjoy the benefits. The benefits I found were, on the minimal scale, were the physical benefits, but I guess on the more important optimal scale was more the psychological benefits. Things like increased self-esteem, motivation, a lot of discipline. You know, with the discipline that I've learned from that I've been able to really, you know, try to keep healthy nutritional habits....It's helped me motivate myself for school and I just basically enjoy the benefits that I got and that's where the interest and curiosity of not only keeping it as a hobby but potentially checking into seeing what careers are out there connected with it.

He is the only student who really connects his interests to his life-plans, as he considers the possibility of sports medicine. He is now, however,at this end point of his Cegep studies, more like the other young men than he used to be, in connecting physical activity with his general sense of well-being and in making certain that his schedule allows time for it.

A striking change has taken place over the two years in these young men's attitudes to their non-science subjects. They all talk about enjoying English and humanities courses of various kinds. Sometimes the interest seems to reflect a scientific or technical course focus, such as the mention of a humanities course in logic and an English teacher that, in two different courses, has really shown the student what he considers a fool-proof method of writing an essay. Often, however, the interest in these required, non-science courses seems to be intrinsic: "Sciences have, let's say, helped myself to appreciate, you know, the physical world. But the humanities, English and psychology have helped me to appreciate and understand myself as well as the more social aspect of the world." Occasionally we get a sense that these subjects and complementary courses have been easier than science courses for them ("Social science is something that any person can like analyze because....It doesn't take as much probably starting or something. It's just understanding and you don't have to know....You don't have to have this background to understand social science...."), that classes have been less formal, and that they have felt superior to many of the other students ("I really know a lot more than the students do and that's why I feel comfortable in the class"). Of all the so-called non-science courses, however, their overall favourite is psychology, which most have taken and which they feel is the most scientific. Their marks in these non-science courses are generally good, often higher than their science marks. This fact does not seem to have suggested reconsidering their future plans, however.

All of these students say they are "quite satisfied" with their marks. When questioned more specifically, they do acknowledge some quite low and even borderline grades, revelations they quickly follow with comments such as the following: "Had I not done so poorly in third semester, I don't think would have ....Like maybe like in university I would have realized. But, then, I think it would affect me more. Like it would be more negative." Ron, having admitted with great difficulty that he got two marks of 60, says:

> But I'm not....At the same time, I'm not entirely disappointed in them. I mean the way I look at them really is just indicators. I try not to put too much hope or....I try not to put too much into marks per se. You know? If I get a 75 then I'm happy. As long as it in some way tells me what I like.

Pierre says: "Like some marks might not show how well....Well, obviously if you have a 90 it's because you understood, but sometimes a 75...." In some ways, these are improved attitudes to marks. A certain amount of self-acceptance has taken place in the two years. As Ron says:" I was in a small high school, and you know, I felt as though I was one of the top students in high school. Then coming here it was kind of a change because in a sense I had to adjust to the fact that I couldn't be the only one 'on top' so to speak." Andrei, whose initial discussions about marks and abilities were quite arrogant and who was furious with Vanier teachers for not giving him 90's and 100's, has this to say now:

> Especially two weeks ago when I got back my biology exam....Because it was a lab exam and in my first semester I got 60 in my first lab exam and I failed my second lab exam...but I wasn't really good in that. You know? So when I studied for the exam and I got a 90 it feels good. So I can do my physiology and stuff like that. I didn't really get upset with the marks, it doesn't matter. Even if I get a 70 and the teacher says It's very good that you know this. You know? It feels really good to me. Just the fact that I improved a lot.

This student seems to realize that he hasn't much chance of being accepted by McGill Medical School with his 82 Cegep average. The other students, however, seem not to be confronting the discrepancy between their academic achievement and their career goals. Housein, the other appli-

cant to medicine actually has an average in the low 70's in his science subjects, yet speaks hopefully about McGill "reviewing my file." The two who have not applied to medicine, but are intending to apply from university, also have science averages in the low 70's: they do not say that marks have deterred these applications, nor do they acknowledge that the low marks may be indicators that medicine might never be a real possibility. It appears, therefore, that they still have a distance to go in self-awareness and realism about their behaviour and/or abilities. It does not occur to them that their higher marks in non-science subjects (aside from psychology) might be indicators that they might alter their future study plans.

2. Attitude

Subject preferences have changed a certain amount since the first interview, and, in general, seem to reflect and/or direct the university programmes they are choosing. Only Pierre says he likes physics: his choice of engineering is partially dictated by this enjoyment. All the rest have found physics hard, "inanimate", "too theoretical", "dead", "too technical", and so on. Three blame their teachers; the fourth says his dislike is just for the subject. Housein says:

> It's not something you can touch, you can't see and that aspect of it I don't like. But physics, the subject, is interesting...that is...the laws....But ...we've been studying like electric waves and magnetic waves and you can't see that and you can't really understand what it is. Whereas in biology like you have what you're studying and in chemistry, you mix these two things and you come up with what you're looking for. But in physics, it's not exactly the same. You only get the results and from what you've learned you assess that it's right.

Ron says that he has to see how a subject connects to him, how it affects him, before it comes alive for him, and that rarely happens for him with physics. A great enjoyment of biology is now in evidence in all those who dislike physics. Subash tells us:

> Just the other day I was reading and I was amazed. You know? Some of the stuff. Like if I had my bio textbook with me, I'd show you this picture; it totally freaked me out. Like I was on the metro reading and I saw some woman and I just had to show her. You know? Because it was incredible. Like it's stuff that's amazing. You know?

Ron sums up his feelings this way:

> In 401 a lot of it has to do with humans and now I'm raving about it because for me this is what makes it interesting. When it applies to humans, let's say, that's where it catches my interest and that's part of the reason why I feel comfortable with psychology.

Andrei has clearly redirected his interests to suit his career path: "Like, I want to choose a career in medicine and that's why now I'm more interested in biology." Of other science subjects he says: "So when I concentrated on becoming a doctor all of this is uninteresting." Most of them have rather liked their mathematics courses; several have been surprised, since they did not expect to do so. They do not talk about getting higher marks in math, but they seem to have found it easier than physics. Subash is very clear: "To tell you the truth the only favourite subjects were the ones I actually did well in" and "It's also because I found it (math) easy and that's why I liked it." These statements are later contra-

dicted by his enthusiastic outbursts about biology, in which he is not getting very high marks, but his rather flippant statements about preferences and easy marks are not entirely uncharacteristic of this group of students who do not, on the whole, really enjoy hard work.

These young men continue to feel that the science programme is the hardest, the most complicated, the most demanding, the most serious, and the most prestigious of the choices at Cegep. If anything, they are more certain of this now than at the beginning. "Science is not supposed to be fun," says Housein. As to what it takes to succeed, they are equally clear about the time, interest, commitment, curiosity, ambition, initiative, independence, organization, determination, maturity and good study habits that genuine success in science demands. When asked to compare himself with his non-science friends on the football team, Pierre simply says: "I think it's their background. I think when they were younger they weren't taking school seriously and...." This and other comments suggest a sense in which good science students come to Cegep with certain advantages, certainly in terms of attitudes. Housein talks about good science students as follows:

> From what I know of the students, the North American student, they're considered as nerds. But where I come from, and, which is the logical perspective, I have great respect for these people because they're very disciplined, I find. They go home, they do their homework on a daily basis, they're always up to date with the teacher and they participate in class. They know what's happening. See, once you don't know what's happening....Like you try hard and you want the teacher to see you and ask you a question....Whereas, no, they're involved, and they know what's happening. It's true that you might have to make a couple of sacrifices, which are not really important - like going out or watching TV - but in this society, I find that if you don't do that, you're a caveman or something. But for me I have great respect for these people. It's hard. It's hard to maintain and like keep up your work on a three-month basis. Even like over the holidays, they study to keep up. I have great respect for them.

There is much to be noted in this remark. This student, who is from the middle east, may be reflecting the overt attitude of non-science students to science students when he says good students are seen as nerds, but he is not reflecting the attitudes of his peers in this group. They too respect the good student. Ron and Andrei do, however, comment that it is important not to become too narrowly focused on science to the exclusion of life. Perhaps that is at least a part of what Housein has noticed, the wariness with which intense focus upon studies is viewed. But all these students say they wish they have been studying harder and more consistently, even Housein himself, and none of them can really explain why they have not done so.

An overall vision of science as a field of study is not very much discussed, but some of these students do seem to have gained some perspective on this matter. As Subash says: "I'd say as I progressed the material integrated more. But it still seemed separate. Like not as an entire unit." He has his own vision of what is scientific:

> I'd view something like biology as more of a science. You know what I mean? ... I see more of the scientific aspect of it....Whereas....Like physics and chemistry is just....Actually organic is also more of a science....Because it's conceptual. That's why. So it makes you think. Versus physics which is more practical. Like you're working on problems and it's still scientific but....Because when you have to understand the concepts, like, the conceptual, it's more scientific because....Well, that's the way I see it.

It is difficult to imagine why this student thinks biology is more conceptual, but it is possible that he has not been able to deal with physics concepts, and can only see that particular branch of science as problem-solving. Ron makes a somewhat wider definition of the scientific:

> I'd say it's the in-depth type of I guess analysis of looking at different things in nature both with organisms themselves and well - living things and non-living things - in form of how chemicals react and how they all work. And the physical plan about, you know....and mechanics and things and electricity. Science encompasses everything about the world itself and what it means.

Andrei says: "It is mainly the study of those scientific fields, the ones that want to explain life or try to solve the problems around us, that are involved in the scientific field most specific." Pierre defines science as "Progress. Pushing further the limits of everything like in medicine or finding new treatment or engineering....It's pushing the limits." About the study of science, he says: "It's preparing you. It's pushing your own limits." Aside from feeling that perhaps too intense an involvement in science might make them narrow (see above), these students are completely without a critique of the field or discipline. They criticize teachers and they criticize themselves (see below for discussion of both these items), but they seem to view the field and the programme as so utterly sacrosanct that they do not even begin to deconstruct it. When they talk about its difficulty, they can only talk about how one has to learn to deal with that difficulty; never do they say it is "too" hard, or that it ought to be changed.

Gender issues are still not of much interest to these students. Three speak of recognizing that science has been male dominated and that they themselves have been advantaged by this fact. Subash jokes about affirmative action as possibly disadvantaging him and then says he hardy ever thinks about it. Pierre notices how so many women students have turned to Health Science, while he has turned to Pure and Applied. "I don't know if they're more.... I don't know if they tend to learn by heart most of them or they're not into problem solving....Or they tend to like working with people more than I do." None talk about sexism at Vanier: indeed, Housein speaks glowingly about the anti-sexist, anti-racist teachers whom he has so much admired at Vanier. Again, all say they see themselves married with families in the future, but the question itself is a conversation-stopper: it does not interest them at all.

3. Experience

They are, however, much more willing to discuss their study habits than they were the first time around. There is now a range of attitudes on whether it is important to do homework that is not to be "handed in". Most feel this may be a route to greater success, but they cannot really make themselves do it. Two explain this lack of regular disciplined not-demanded-by-teacher work as laziness; Subash says he sees no point in doing work too far away from tests, for fear he will forget the material. Indeed, all but Pierre, who does appear to do work on a very regular basis, whether required to by teachers or not, all but he say they organize their time around preparing for tests and doing formal assignments. Even this orientation seems to keep most of them quite busy: all but Andrei (who says he often does nothing even for tests and sometimes still gets 90's in certain subjects) seem to work on something just about every night and certainly for part of the weekend. They describe doing many problems sometimes many times over, reading their texts, going over notes, memorizing biology, and preparing written assignments for English and humanities. Subash, who talks about being "much more focused" than he used to be, and about having learned to "organize my time," is staying up very late at night - not because he can't get the work done in the normal work day and evening, but

because he is also determined to do what he "wants to do" (clearly not studying), as well. He doesn't seem to feel there is anything wrong with this pattern, which he appears to have picked up from his brother who is in university. All of them, even and perhaps especially Andrei who still sometimes does nothing, say they are working three and four times as hard now as they did when they entered Cegep. When asked about their classroom learning, it appears that none of these students takes a very active role in the science classroom. More than one of them say things such as this: "I'm not one of those guys that's going to go, I have the answer and I want to show...." It is clear that they participate in their non-science subject classes, but less in science. Some of this lack of participation is explained by a feeling that discussion is inappropriate in science subjects whereas other subjects are not real knowledge but more a matter of opinion, but Subash may be speaking for more than himself when he explains his silence by his habit of working only for tests. When asked what kind of a learner, active or passive, he is in the classroom, he says:

> I don't even know if I'm a learner. It depends. Most of the time if I'm behind....Like, if I don't do the work, because I know I can handle it, I'm just there copying notes, doing it properly, taking notes on what he's saying so that when I'm actually going to do the work, I'll have it all there. ... I'm not afraid to ask. But if I don't have any questions or if I can't follow because I haven't done the work then I won't.

Given these study behaviours, it is easy to see why these young men continue to be very dependent upon the clarity and contextualizing ability of the teacher. As Housein says: "I really, frankly, think that it is the teacher that makes the subject and not the subject that makes the teacher....I wait for the teacher to teach me and I depend on what he's teaching to learn." They do not talk as much about being intimidated or hurt by their teachers as they did in the first interview, but they are quick to point out that far too many of the teachers teach "way above the level of the class" and others "just follow the book" and do not offer anything helpful to the student who is trying to understand. About tough teachers, they talk rather appreciatively: "But her notes are great and I follow and I understand" and "What I really appreciate from her is that I know she's going to prepare....Help to prepare me for university." Housein, however, points out the unfairness of having teachers of the same subject with different standards: "It's like 100% dependent on the teacher itself and so if you're lucky enough to have an easy teacher then good for you, you have the high marks. But if you have a hard teacher then you're going to be like having difficulty. " When asked about their favourite Cegep teachers, some cannot, at least at first, think of any, and are still talking about their high school teachers in nostalgic ways. Subash, however, does single out two teachers he liked especially: one humanities teacher of his own ethnic origin who took a particular interest in him and a math teacher who was friendly outside the classroom. In general, however, there does not seem to have been much bonding or role-modelling in these teacher-student relationships. These students want to do as well as they can, without undue stress or discomfort: they therefore appreciate good teachers who are generally pleasant and fair to them.

All these students seem to have suffered some anxiety about their studies and points of self-recrimination about low achievements. What is most interesting, however, is the language they used to describe these experiences and the way they have dealt with them. Subash goes on at length about his astonishment when he discovered in third semester that he was so nervous about passing a physics final that he was "literally shaking."

> I was nervous. Like I've never been nervous....Like I hear people talk about it all the time. 'Yeah, I need a 70 to pass.' I used to hear people saying that and like I'd laugh....But last semester I found myself almost like one of those people.

About the current semester, however, when the pressure has been less, he says of himself "I just take things nonchalantly." Housein explains academic nerves as a general nervousness that "kind of runs in the family....Whenever there's a big occasion I'm nervous. That's just how I am. Like, I think, that I take news, good and bad, in a good way, but the few instants before I'm like sweating and...That's just my personality." Yet he does not seem to mind this feeling. He says: "I find it exhilarating because I take it as a challenge and there's no one that's going to make me fail - not this class and not for this teacher - and so I'll do better. Like I need a motive to pump myself." Andrei says of a period when he was not doing well: "I was saying Why can't I do so good? You know? I was furious. I said, probably something is wrong, I don't know. I just let it go and don't worry." One of the interesting points that emerges from these remarks is how hard these young men fight to keep their composure and to control their negative feelings. They think of past achievements, often those of high school,and they say over and over to themselves and others things like: "I know I can do it" or "I know what I'm able to do" or " I never give up, I never give up." When bad results come, they may react momentarily with "maybe I'm stupid" but they rush on to say "But no, I still blame myself for it because I know I could have studied more" or "I know I could get straight 90's. I know how to do it." Confidence goes up and down with their results, but they work on their confidence almost like body building -and they all find ways to cope, even Ron who confesses, a little shamefacedly, that sometimes he catches himself playing the "dummy" to help neutralize and distance feelings of disappointment about his achievement.

About competition, too, most would agree with Ron who says: "I myself have tried to separate myself from it and not get myself all cooped up with 'Oh, I've got to be the best.'" It is the word "separate" here that gives the student away: if he could be the top, it is clear from his discourse, that he would not have to "separate" from feelings of competition. As he says, after being a top student in high school, in Cegep, where he is not, "I had to adapt." And so he "tells" himself it "isn't that important". Students whose achievements have been greater than this student's have tried to be "among the top", or "within the average" but it is notable that none of them now talks about being "at the top": they seem to have adjusted their sights to suit the reality of their performance. To strive for more is to feel "cooped up": involved in painful feelings which they seem to work very hard to avoid. The mechanism has its weaknesses, however, as one hears in remarks such as "Hey, I mean I don't need to be top in, you know, anything but what I want to become. So for me what I've discovered is that I like certain things more than other things...." One can see why the word "separate myself" expresses so eloquently the experience this student has to force himself to go through: on the one hand, competitive individualism seems to be almost inscribed in the bodies of these young men; on the other hand, avoiding the painful feelings associated with both the possibility and the reality of failure to reach the desired goals seems to be an absolute requirement, perhaps more important than reaching those goals themselves. Overt discussion of competition with these students goes around in circles: "I grew up with competition but I don't like to be competitive" and "I don't know, maybe more and more in life and the career becomes important, probably, you will become more encouraged to be like competitive" and "The purpose in science shouldn't be competitive it should be....Like... everybody should be interacting" and "In academics, competition shouldn't be there. It's there but if you want an ideal situation it shouldn't" but "Yeah, it gives a challenge."

These students are much more likely to talk in this closing interview about the ways in which relationships with other students have helped them with their work. Only Housein still talks at length about how distracting he finds it to work with others, but even he makes it clear that he has *loved* doing labs, "the fun aspect of science" and that he has found all his partners "very nice, decent people, who were willing to do the work and who are willing to take the time...." Most would agree

with this student that serious study is best done alone, but most do talk about checking things out with other students, feeling very comforted by knowing others are in the same boat, and passing on some hard won insight to another struggling student. There is some real measure of feeling attached to these experiences; they are instrumental, but they are at least partially 'felt'. They seem much less guarded than they were before. Subash actually says: "I love helping people" this time, whereas in his first interview he was just looking for someone who knew more than he. All of them have enjoyed their lab partnerships: there are no complaints at all. However, it is when we examine their ruminations that these experiences seem to carry with them some of the old separation of friendship and competitive individualism. Ron and Subash consider why it is they have liked having friends in the science programme. Ron seems to be saying it is better to associate with people who have interests and goals in common with one's own, but he does not say why. Subash ranges over a much broader territory:

> But I've given some thought and I like wondered. Because if it were a girlfriend or something, it would matter if she was in science or not. ...Because I think your interests would be totally different. That's what I think. That's what I find. I've given it a lot of thought. I think it's like if she were in science then it would be different. Yeah, because her focus would be different...See, I'm still thinking....I think it's more of being focused....Because I think they really know what they want to do....Like, I'm thinking. Isn't that important to everyone? You know? Because how can you be with someone or be friends with someone or like with someone who is unmotivated, unfocused, who has no....Who doesn't want to be anything or anyone? You know what I mean? Like, I'm thinking, 'Don't you want to do something with your life' You know? Isn't that natural for everyone? Like, if you know someone who's like that then that changes your own attitude and has an effect on you. So that's why.

There are so many things going on here: a wish to share interests, a wish to share seriousness, a need to be supported, a fear of being undermined, and so on. This is a far cry from the absolute separation of study and relationships about which these students first talked, but there is still some difficulty in working out how instrumental and affective needs can be satisfied in a relationship. This is a complex matter, and this student,in trying to deal with it, shows some real intellectual courage and a good deal of worry as well. Why the young men of our sample have such difficulty sorting through individualistic needs, work relationships, and affective relationships is still something of a mystery to us as well.

Pierre concludes by saying that he wishes he had not had to go to Cegep, but gone direct to university. Since this is a student who has made profound realizations about himself and the inappropriateness of medical studies for him, personally, it is hard to imagine what his first years of university would have been like without the Cegep interlude. All the others acknowledge the importance of what they have experienced, in terms of their science learning, their developing independence, the discovery of their areas of interest, the friends they have made, and the expanded horizons they have gained by studying subjects other than science. The following remark captures some of the overt and covert attitudes of these young men at the conclusion of their studies:

> Cegep in general - a good experience. I made a lot of friends, a lot of friends which is what counts. I'm more focused in knowing what I have to do and what I should expect at about the end of university. So I'm prepared. I know it's not going to be easy and I know what I have to do and I know there's a lot of work to do. I know I have to be organized and I better not get behind and I'm not going to let myself. And, also, I have to have fun at the same time. Otherwise it's useless. What's the use of doing anything, right?

VI. STUDENTS IN SCIENCE ACCESS: TWO SWITCHES, TWO PUTATIVE PERSISTERS

A. SUMMARY

This group is looked at as a unit despite the fact that two quite different persistence patterns emerge: two students who change to another programme in second semester and two who move through the Science Access remedial entry programme into Health Science and finish their DECs in science. As a group, however, they afford us an opportunity to follow the Cegep lives of four rather low achieving students, and in that respect they show us how different are the experiences and attitudes of poor students when compared to some of the excellent students in our sample.

These students have various degrees of interest in science, but no clear career goals and almost no positive school experiences in studying science. Their chief motivation seems to come from an ambition to gain university entrance in something fairly broadly acceptable for a number of different university fields. They have all been encouraged, three even pushed by families who have very modest educational backgrounds. They talk about rather low science marks, poor study habits, and very bad experiences with teachers: we have a strong sense of students who persist in school despite the low degree of satisfaction it affords them. It is notable also that this group does not identify math ability as the key to their choice of science: in fact, they talk rather critically about their math competence, and identify difficulties with other subjects so as to suggest that abstract thought is much beyond them. It is also notable that all this negative material seems to be totally disconnected from their rather ambitious plans for future studies. They all have a wide range of outside interests, however, as well as quite an informed view of what science is about, and some gender awareness. Anxiety has been felt by the women and not the men, and competition has been left behind in high school. The women seem to enjoy friendships connected with study, whereas the men just talk about good social life.

The second interviews show us two very different reactions to poor achievement: the students who switch out are following their sense of what they can do better and where they are happier. They prefer not only the content of Social Science and Commerce courses but the pace, the teacher willingness to repeat explanations and the reduced emphasis on exams. They do not say they dislike science, but they do not talk about positive experiences with achievement, teachers or subject matter. Study habits do not seem much changed among these students who have switched, but they are doing better in their new programme courses. They continue to have high aspirations for the future, still a bit unrealistic, given the mediocre marks they have. One student has continued to develop in gender awareness, whereas the other has not developed any at all. Attitudes to peers have not changed.

The students who have chosen to continue in science are both from families who have pressured them to do so. For the man, family pressure is paramount: he would really rather be following his interest in cartooning, but the family does not approve. The woman still has grandiose plans for the future, very much motivated by parents who both fault themselves for being "only nurses". The wide range of interests is still there, as well as enthusiasm for non-science subjects taken at Cegep. Their experiences in the sciences have not been very good, however: they have not done well, failing a number of subjects, sometimes more than once, and obtaining averages in the sixties or below. They are not happy with their grades, and the woman in particular is very distressed and puzzled by her

lack of achievement. The male student really does not do much work, though he is inclined to think he does. In their behaviour, they both try to emulate what they see as admirable: the woman student works all the time, and the male student tries to dabble in extra-curricular science reading and a wide range of activities. The woman student suffers from acute anxiety, sometimes despair; the man works by denial. We find these students very locked into stereotypes and models, perhaps because their persistence is so motivated by external factors. When assessing the value of their life at Cegep, they both single out experiences which have nothing to do with science. It is almost shocking to see them persist, since their behaviour seems to deny experiential and intrinsic knowledge that they are really better and happier in other subject areas. Perhaps of any of the students, then, they are the most obvious victims of the elitism of science, and the pressure to prove oneself worthy of a science education. And since they have never done very well in school, they do not know how to use achievement factors to help guide their future choices.

B. INTERVIEW ONE

1. Motivation

These students cite the practical reasons for entering science, the keeping the doors open philosophy that is common among many other students. Three of the four do, however, describe a real interest in various parts of the field: Gord describes taking apart electronic devices at 13 months; and Carmen recalls asking for chemistry sets as gifts - "Just mixing following instruction or sometimes I wouldn't follow instructions. I just liked mixing stuff. I'd be in the tub and just water would set me into that"; Sam says: "I took science because it explained why things are the way they are" and watches science programs on TV. Oddly enough, this last student tempers these remarks with a real lack of enthusiasm about studying science at this stage: "Once you get into university it starts getting very interesting. I think I'll stick with it. It's not really a problem." Stephana gives as her reasons that she has been in "high math" and liked the science labs. Since all these students talk often about their wish to go to university, it seems that they have quite ambitious educational goals, despite rather low entrance grades which caused the science programme directors to feel they required some remedial work. Most do not complain about being placed in Science Access rather than in the regular program (Stephana is least happy, saying "I felt like killing my math teacher"), but neither have they in any way adjusted their attitudes and expectations to this potentially discouraging placement.

Remarkable among them, however, and setting them apart from other science students, is a vagueness bordering on ignorance regarding possible careers. They say, as have many others in both science streams, that science is the best place to be if you have no idea what you want to do, but their discussion of this indecision is different from that of other students: it is not a matter of being torn by different interests, but lack of focus. Carmen says: "I do have some idea of what I want to do....Architecture, engineering, bio-chemistry or medicine." If she does not go on in science, she will do marketing, administration or accounting. Her remarks sound to us like a lesson plan picked up from a high school careers counsellor, lists of options that so far mean little to her. Sam says that if he doesn't go on in science he will go on in art or architecture, as if he does not know that architecture is actually applied science. Stephana says what she really wants to do is law, but that she fears she might never get a job. Gord, who first seems to have described natural engineering interests in how things are put together, is very tentative about becoming an engineer. None of this vagueness seems to bother them: Sam thinks of seeing a counsellor, but hasn't got around to it.

It is not surprising that these relatively low achieving students have not been encouraged to continue in science by their school experiences, but by their families. Stephana does talk about programmes in her high school to encourage women to enter science, but she thinks they often came too late for the students who might profit from them (Secondary IV, Secondary V): she does not say whether they influenced her, and it is impossible to tell whether they have, since she refers to them so casually and critically. None of the parents of these students is involved in the sciences. Two of the fathers are small business men, one is a public school teacher, and one is a nurse. All but the teacher seem to be actively encouraging the pursuit of science as a route to success, and none of the students complains of these parental attitudes. The strongest family persuasion seems to exist for Carmen and Sam. Carmen says: "I told him I might be changing programmes and he's like, What!! He's set on science and if I don't take science —ooooh... he's going to be on my back." She also says: "I think my Dad sort of regrets that he didn't make it into medicine. He's just in nursing so he's trying to pressure me to do better than him." Of her mother she says "She's also a nurse. So the two of them think I ought to. But my mother pushed more...." Sam cites all his uncles and brothers who have gone into science and says that his grandparents, with whom he lives in Canada, are actively interested in his success in science. Stephana says of her immigrant father: "My father was happy when he found out....At first he didn't know what it was. Then I told him and he goes, Ah, yeah, good." The family is particularly pleased with her plans since her brother has not done well in school. Gord does not feel at all pressured by parents, nor particularly influenced by them. Interestingly, however, he does say that if he did not go on in engineering he would take geography: his father is a geography teacher. He also says, in relation to a discussion of an Electrotech programme which seems, on the one hand, to offer the hands-on experiences he loves, that he wants "a little bit more, so, in a way of academic background" because "I plan on going to university."

All of these students have a wide range of interests and pursue hobbies outside of school. Two like to draw; one writes short stories; two enjoy "hacking around" with computers; one does drama, both performance and production; one loves to cook and finds it relaxing; one likes to "fool around with maps and things"; three are or have been actively involved in studying and playing music. Sports are mentioned by only Carmen, at this point. None of them is able to articulate any formal connection between these interests and academic life, and most hint that it is already hard to keep the interests up, given the demands of Cegep. Carmen and Gord even seem to suggest that the interests in themselves are demanding, especially music, and that they are not able to give the time. We are given a sense of somewhat scattered rather than richly layered lives, but they speak of these interests with genuine enjoyment. Only the interest in maps and drawing seems to be even remotely connected to what the individual student (Gord) cites as possible career.

All these students are fairly open about discussing their marks, how they did in high school, and how things are going in Cegep. In spite of their rather high career ambitions and determination to go to university, they talk quite calmly about high school marks in the 70's, about barely passing some particular subject in provincial exams, and so on. Their marks in Cegep appear to be very much on a par with their high school achievement: many have done very well on first tests, but drop to 60's or failures for second tests, and now have averages in the 70's. Their low marks tend to be very much attributed to bad learning situations or lack of work: they have never yet really come to doubt their own abilities: "Because my teacher last year. We didn't get along very well" ; "I feel like I didn't put enough effort in them because I think I could get 100 in most of them"; "Maybe it's the teacher. I find it.... Mmmm.... It's sort of very vague and...."; "So they slammed us, last year, into putting chemistry and physics, in both the same year...."; "Our whole grade sort of got killed by the provincial math exam,

grade 10." They are not pleased by their results ("Well, I'm just not happy with what I'm doing"), but they do not talk about what messages these results might be sending them, except perhaps that more effort might in some vague way be required of them.

2. Attitude

It is not surprising to find that this group of students has no particular profile with respect to subject preference: Science Access is for all Science students, whether they see themselves as Science Pure and Applied or Health Science. Despite the lack of coherent pattern, however, the students have strong statements about subject preferences: three love biology; two like physics and chemistry; some feel their subject preferences changing as they enter Cegep, usually because they now like and understand a subject teacher or do not. Interest seems very much related to what they can understand and relate to: in general, they tend to like labs rather than theory, and they are none of them overly enthusiastic about math. Gord is already feeling overwhelmed by it.

These students accept the notion that science is hard, that not all people can get 95, that students have to work and make sacrifices in order to get even reasonable marks. Their discussion, however, does not suggest that this extra effort makes the study of science more prestigious. They talk in very realistic terms about the workload: "You don't have all the time you used to have. You're scheduling everything. You do this, you want to do that, you don't get to do that"; "Sometimes I think they [non-science students] think I study a bit too much. They'll be free around the lockers and I'll have my head in a book..."; "The people who didn't get into sciences were because they just found it too much work". All agree that the top students do more work than anyone else. These students do not appear to believe that science students are more intelligent, though they are aware of that popular view: they seem to think that science requires a particular mind-set: "It's just `This is the example, follow the example.' If you can do that, you're half way to do all the problems or whatever." It is interesting that, among all the students interviewed, they are, as a group, the least forthcoming about the elitism that attaches to the study of science.

Interestingly, some of these students have a more philosophical "take" on science and a greater ability to critique it than many better achieving students. Most agree that, at times, "it's like `What does this have to do with anything?'" Their critique is not centred on changing the courses or giving more choice (Stephana mentions this in passing, but then says choice is not possible in science), but rather of teachers and courses showing why the knowledge is important, how it functions in their world, and in what ways it connects with other knowledge they are learning. The students who are happiest in science say things like "I guess I just take anything.... I like learning, basically. Just like....At this moment I feel like assimilating a lot of information, you know? Anything that interests me. It's not only in science." Students who are less enthusiastic say that the courses should not "squish everything together so fast" and also explain that science is "not very creative, it's sort of very pragmatic, it's sort of very straight. `If this is the way it's done' and `this is the way to do it' and that's how you do it, you know. ...It's not very, there's not very much, sort of, extra though involved in it." Gord goes on to say that in geography, his other choice, "you have to interpret things... it involves a bit more thought...." They all see the study of science as the accumulation of knowledge which may give them more control over the world. Stephana explains that not many people know what science is, and that more effort should be made to acquaint people with the possibility of studying science. There are not a great many suggestions for improving science, other than perhaps making it a little less hard, but most feel that "If you don't like it, you don't like it. Science is science - chemistry, physics, and math."

With respect to gender issues, this group has somewhat mixed and not entirely predictable attitudes. Carmen seems to prefer women teachers ("I feel women teachers have more patience") but she spends a great deal of time saying this is not universally true. Gord has virtually nothing to say on the matter. Sam has a story about reverse sexism, where a teacher favoured a girl with better and more careful explanations about scientific matters; he also talks about having watched a TV program about women in science and he seems to have understood some of the discussion about "thinking like a man" and so on. Stephana has a very high level of gender awareness. She talks about her uncle's expectations of her to be a traditional woman, and her relief that her father understands that she is "different". She is also "standing in" for a brother who has been a failure academically. She talks about some sexism in her school, and she describes how she dealt with it - extremely forthrightly and effectively. But she says that today women have to try harder, work harder and do better in order to get somewhere. This is how she explains the fact that her fellow women students are more serious than and "do better than the guys", though they (the women) were vastly outnumbered in science classes at her school. She is the only student who really looks at the issue of marriage and family: she says she would like to have three children plus a career. All the other students have the vaguest possible answers to this question, as if they really cannot bring themselves to look that far ahead.

3. Experience

This group is very vague about study habits, despite their acknowledgement that study is important. Those who talk about doing a lot of work seem to be putting in perhaps two hours a night and further time on the weekend. What they are actually doing does not always seem to be as focused as it might be: Carmen and Stephana talk a lot about revising their notes, and Sam about getting books from the library and getting together with friends. Sam's approach to learning is worth examining in detail, especially in the context of a not very successful academic achievement profile:

> Basically, what I do is I usually go in class but I don't like really follow the teacher to the letter. I just like day dream a little bit and come back. But the thing about me is that I don't truly need a teacher to study. I can use books and figure a few things out myself to study. Like, some of my friends, they really need a teacher or they're lost, right. It's not that they're stupid, they're very intelligent. I guess it's just the type of person you are.

This student has the behaviour of a high achieving maverick, but he really does not do very well. For some reason, he cannot modify his behaviour to suit what is really required to get the results he wants. It is impossible to get him to specify how much time he spends on homework or study, but the impression is that it is not very much. The others talk much more humbly about trying to understand their teachers and sometimes feeling rather lost. In general, they tend to keep a low profile in class, preferring to ask the teacher for help in person. Their need to visualize is stressed, as is their preference for lab work. The abstractions seem to be a bit of a problem. Perhaps Gord says it all, for all of them: "I'm not sort of a very workaholic sort of person."

These students are particularly ready to tell horror stories of science classes in high school where "the teacher knew his stuff but didn't know how to teach."

> He was slightly a scatter brain; where he'd write something on the board, then stop, say, 'Oh by the way, this goes with this' and then go back to it or what ever. Then he'd write a little bit more, and then turn around to the class and say, 'Oh by the way, you don't need to know this, but....'

> He wasn't sort of completely , altogether there. But our class was, our class was, I guess, it was a below-average class. He had a sort of, it was a rebellious class. But he, sort of, but when he started doing that to the class, then he started losing control of the class, and it got progressively worse over the rest of the year.
>
> Because there was only one class of functions in the whole school. We're all crammed in there and everyone was talking and there was a big mess, things flying around, and then he turns around and he starts going bonkers and he swears at you like, get out of my face, go outside. You get turned off by that. It's like who cares.
>
> The first year teacher was just out of university and it was hard....He couldn't really explain why. He knew himself but he couldn't put it into words. He'd write down exactly how to do it on the blackboard but if we didn't understand and asked him why he couldn't really say why....

A number of things come to mind as one studies these remarks. Many other students bring stories of bad teaching, but in no other group is there such a preponderance of teacher-trouble. Even in Cegep, where they are certainly prepared to say that teachers are "pretty good", they complain of teachers going too fast, writing too much on the board, not controlling the class. Some of what is happening here is the frustration of the poor achieving student who has to blame something for the troubles faced, and the teacher is a safer target than the self. In the high school experiences, however, it seems clear that sometimes these students were streamed with others in trouble, and were perhaps not given as carefully orchestrated a learning experience as some better students might have had. Perhaps even in Cegep, since they are grouped together, they continue to respond badly to teachers and perhaps even create classroom learning difficulties for each other. In any case, it is notable that as they discuss the role of the teacher, many can only enumerate wrongs done and remembered, rather than the good qualities they expect. Inferentially, one can see that they ask exactly what others ask for: patience, caring, clarity, good nature, accessibility, and willingness to provide context. Is it the failure of these students' minds that they find it so hard to articulate these positive qualities? Or is all this negativism indeed the history of low achieving students grouped together with teachers who have trouble coping with them? Whatever the answer, there is a story of educational failure here that does not bode well for these students' futures.

With these four students, it is remarkable how gender-defined are the patterns of anxiety, and how achievement-connected are the attitudes to competition. The men say they are not anxious, even before tests. Sam does weaken and say, "Well, I guess I try not to be." He does say that anxiety is more likely to strike when "you don't know where you are. Like you're completely lost." However, he quickly lists his strategies for dealing with the feeling: mainly, getting down to work. Gord just says: "No, sort of if it goes, if it goes my way, so much the better, if it doesn't, well, better next time." The women students talk a lot about anxiety, how they suffer before tests, during tests, after tests.... Again, the best strategy seems to be to try to master the subject. In terms of competition, the two who will ultimately persist say there is some merit in academic competition in that it keeps "high goals". They both say they felt more competition in high school, and very little in Cegep. The other two students say competition means nothing to them at all. Sam's remarks have some extra meaning here, as he talks about competition in sports in which he is good and in those in which he is a beginner. "When you know you're quite good at it and you know you can contribute to it that's when competition comes in. You know you want to win because you could win and you work at it." Here we see the familiar refrain

of students who experience the competitive edge only when they feel they are "in the running" so to speak; when they are "only a beginner" they do not really experience the competitive thrust. These Science Access students do not feel competitive with one another or with other science students because they really know they are not "quite good".

About friendship and study patterns, these students are very conflicted, but it can still be noted that the two women speak much more about the support they get from their friends than do the men. The men talk about other guys being "fun to be around" but "like you never get a 90 with this guy". There is a great lack of trust in working partnerships expressed by the men; though they see the importance of working together in the lab, they speak most about the disadvantages. The women, too, say that in the long run you have to work alone: "I was taught in science that even though you're doing a lab and doing team work always check your calculations yourself and never trust the other person because if you have it wrong your mark goes down too." Still, the women talk about needing their friends to help them feel comfortable in class ("I'll go to class because I know my friend is going to be there and.... that will make me go to class. But if I don't know anybody in the class and I really don't feel like going I tend not to because I don't feel like it.") Friends also help them stay up to study and help them get through tense situations. All four seem to appreciate the advantages of helping and being helped by others, that this reciprocal arrangement can benefit both learner and teacher. They do not seem as rivetted by individualistic behaviour as some other students, though they know that science requires them to do their work "alone."

B. INTERVIEW TWO

1. Motivation

The final interviews with these students are among both the first and last of the project: since two of the students, Stephana and Gord, decide not to proceed into science after their initial term in Science Access, they are interviewed as part of the programme switch group only one year after the first interview. Carmen and Sam, who not only go on to finish the science DEC but intend to continue in science in university, take an extra semester to complete their DEC's and are therefore interviewed two years after their first interview. This time discrepancy seems worth noting, given possible maturation factors, though no notable differences have emerged in this preliminary analysis.

When asked about their interest in science, all of these students have some positive and some negative things to say. All refer to the advantage of having many options open to science students after Cegep. All of them say, at one point or another in the interview, "I like science." Even those who are switching tell about keeping up their math ("You pretty much need math") and about having enjoyed the other courses to a certain degree: "They have their appeal" and "I enjoyed the physics and working in the labs." Stephana, whose programme switch is her own choice and directed largely by a change in career plan (see below), says that there is a repetitiveness to science, learning formulas and working them out, and that she wants more variety. Gord does not choose to switch but is refused entry to science, and he does seem to wish he were continuing in science. Carmen and Sam talk about the pleasure of getting "the extra knowledge into my head" and "It's like you want to know how it works and why it's like that." Carmen says that she really likes "to read about it and know how it's done and what is what but I don't like the part of calculating things and trying to figure out problems. I more or less like the theory part." Sam makes the following comments which seem relevant here: "It actually feels like you're getting somewhere." "I find that it was studying the hardest....it's one of the hardest programmes...." "It was challenging." "Like, I mean I have a brain, right, and so like I

mean why waste it. I just don't like to waste my time on something that...I mean like something else, you know?" These separate comments, brought together like this, suggest someone whose motivation is very much affected by the elite status of science and the need to prove that he is good enough to do it. The two who stay in science talk much more about its being hard than those who leave: its difficulty does not seem to have been the deciding factor for the students who switch.

Discussion of career goals is more focused than it was in the initial interview but the group still distinguishes itself by its uncertainty and certain undercurrents of what we may call self-deception about what might be possible, given their achievement level. Stephana, who switches to Social Science, says that she has decided she wants to do Law. This is not a new idea: she mentioned Law the year before but said then that she felt there were too many lawyers-in-training to make it a good employment prospect. She does not mention this drawback in the second interview, only that she really wants to become a lawyer, that she is taking many courses that seem to be related to that field, such as business law, and that she now plans to do a degree in psychology and then proceed to Law School. She even talks about writing her LSATs, and being encouraged to do so by her mother (see below). She is determined to get her DEC in the two years, despite the programme switch, and takes nine courses in her third semester with that idea (spring graduation) in mind. Why Law? "I like the public" is all that she says, but it seems to have been another route toward being somebody (it is worth noting that this student never says she wants to "be somebody": we infer it from her choices, her references to her uneducated immigrant parents, and her repeated remarks about the family looking to her to be successful since they themselves have struggled to survive and the brother has not done much.) Gord, whose low achievement seems to be at the basis of his refused entry to science, has switched to Commerce, is taking math courses with renewed interest, and is also taking geography, as he mentioned earlier that he might. The interest in Commerce seems to have arisen out of a summer in Ireland where he worked with an uncle doing some accounting work. The two science persisters are turning very different ways. Sam, who earlier opted for Health Science because he was not so sure about physics, is now applying to Mechanical Engineering, Computer Science and Management Systems Technology. He is very unsure about what he wants to do in science, and still feels pushed ahead by family values that say he should hurry on into a profession: "Like I was cultured like they believe children should go faster...out of school and get out of school quick and that means that they're smart. You know? I don't really find that's anything to do with it because.... Like I mean I'm stuck in the mould. Right?" He has a secret wish to become a cartoonist, which will be discussed more below. Carmen is planning to go on in biochemistry and molecular biology, take a degree, and then try to get into medicine. She says: "I like the fact that as a doctor you get to at least try to save lives and help people out." She is thinking of perhaps working in a third world country. She also mentions that she is quite "materialistic" and "I need something that earns a lot of money," but she makes a big point of saying this is a secondary consideration. She applied to Nutrition at MacDonald because, as she says, she knows in Nutrition she will not have to study physics which "is just not for me", but she has been refused because of her grades. This experience, though very troubling to her (see below), has not spoken to her about her chances of getting into medicine, which has a much higher entrance requirement than Nutrition.

As can be imagined, these students' grades have never been good, and their achievement patterns change only slightly during their stay at Cegep. More importantly, however, the way in which they take the messages of these marks to heart is very mixed and contradictory. Gord, who fails to gain entrance marks for the regular science programme, makes the following remark about Science Access (the one semester remedial science programme) which might be worth recording here:

> I mean our whole Science Access crowd was not doing particularly well....Or at least the ones I was hanging around with didn't do particularly well...a lot of my friends who had 70% averages or around there - say between 72% and 68% - a lot of them got kicked out as well and in the same way. A lot of them just went into Social Science or whatever....I remember two of my friends got dumped the same way. One of them was in Social Science at the time and enjoying himself immensely so he was having a better time than in science. I think another one was kind of upset that he got bumped....

About his own attitude, he says that he was "kind of angry I suppose in January and getting a letter two days before registration...." He says that "there was some kind of computer file or something got crossed, " but the fact is that his marks in science were all bare passes, and he has been judged as unsuitable for science. He does admit the following: "I figure it probably worked out for the best because I wasn't the strongest science student by any means in the group." When he shares what he recalls of these marks with the interviewer, he adds several points to his chemistry mark and 11 points to his final physics grade: it seems worth noting that he can, on the one hand, discuss not being the strongest student, but on the other, not quite articulate the fact that he barely passed all three subjects. Stephana says only of her marks that those in Social Science are higher than those in science: this seems to be true, as she did not even pass her physics, and barely passed the others: her Social Science marks, however, are of a low average nature, not what a realistic student would see as qualifying her for entrance to McGill Law School. Carmen and Sam are very honest and open about "failing a few subjects left and right", but Sam thinks he is doing "about average" with four failures and an overall average of 68.7% in his science courses, and Carmen, despite her 5 failures and overall average of 59.9%, is still contemplating medicine. Neither of these students is pleased with the marks they have. Sam says: "I like to perform better. I believe I can perform better but it's just that sometimes I let go for a moment. There's always that period where I let go...." Carmen is not so sure: "I can't understand why I failed. Well, I do, I think I understand why I failed in the summer...." There are indications none of these students will be able to say they are not able to cope with academic demands: they are able to talk about lack of interest, lack of application, poor teaching and course structure (see below), but the need to pursue higher education is such that they are unlikely to be able to say it is not for them. As one says, "Like I always thought you had to get to university if you're going to get something..."

On the whole, these students seem still to have a wide range of interests, but do not talk about them as much as they once did. Sam has somehow kept up with music, sports, drawing and outside-of-school science interests (mainly TV programmes). The others say they just don't have time for the activities they used to do. None has a job at this point: the two women have quit their jobs because of study pressure. All of them, even the science persisters, continue to express a remarkable enjoyment of non-science subjects, such as English, humanities, psychology, music, and so on. Those who have switched enjoy their programme courses very much. Gord explains that he finds the pace much more to his liking, that Social Science teachers are more likely to take time to repeat material than are science teachers, are more realistic about assignment deadlines, are more relaxed in class, and so on. "They weren't following a deadline or something like that." He also enjoys having more time for his English and humanities courses. Stephana enjoys psychology especially because "I've always liked kids and this and that." Sam says that he likes being "more cultivated ... so I can talk to all these different people...." He is actually talking about having a broad range of friends, but in fact his remark distinguishes his outlook from that of other pure and applied science students in the study, who take a

much more practical and instrumental view of their education. Perhaps the fact that, in his secret heart, he would like to study graphic arts and become an illustrator means that he is not a true dyed-in-the-wool science persister: he talks a lot about his continued interest in and ability to draw and do cartoons, and about the ways in which his friends' advice (become an illustrator) conflicts with his family's (do science). Carmen says of her English and humanities "They were a breeze" and that she loves English. She does well in it too. She does say that her third choice of programme at university is linguistics: again, perhaps she is only pursuing science because of her family (her father, the nurse, still pushes her to go on in science but threatens her with support for only one degree), and might, if given the psychological space, switch happily to something else. She shows some anxiety about this conflict, as will be discussed more below.

2. Attitude

Stephana has always preferred math to other sciences and continues to take math courses. The two persisters also like math: in fact, math is the subject they most consistently enjoy throughout their studies. They seem to like the clarity and neatness of it, and they seem to feel they have a greater understanding of what they are doing when they involve themselves in math calculations than when doing calculations for physics, for instance. Sam says he enjoys seeing the application of mathematics which is beginning to emerge in his Cal III course, as well as "the theories like I mean the explanation of how things are generated or done mathematically." Carmen says she has found Calculus hard: "It's not just simple addition and subtraction and all that. It's all these derivatives and the concepts I just don't understand." She prefers linear algebra because "linear is more like high school." She admits that she has begun to dislike calculations of all kinds, as she approaches the end of her Cegep studies, however. "I used to love the numbers for it like calculations and everything but now I move on in Cegep I'm starting to despise it a lot... I guess I'm starting to....I feel like I'm getting mentally lazy a bit. I don't like to have to think too much now. I just like to.... Now, I'm trying to memorize things better...." She says it is because it has fewer calculations that she likes organic chemistry. She also enjoyed anatomy better than cell structure biology: "Anatomy's something I can see better." She has consistently disliked physics and has great difficulty with it. She has not understood either her teachers or the concepts they teach. She says she is enjoying electricity and magnetism a little bit more than the others: "Maybe because...has something I like to fiddle around with...." Sam has not much liked physics either: "when he puts the formulas on the board and you don't know what it is exactly." He compares physics unfavourably with math where "you can probably like understand where it goes... I mean why it's wrong and why it is right." He also says he finds both physics and chemistry "very general": it is a little hard to understand what he means, but he seems to be saying he cannot yet see the application of these subjects, nor place them in context with other things he knows. He does say: "Like I mean probably at university I'm quite sure I'll appreciate physics a lot because that's where you can see the practical application of it and it will be explained more so...." In fact, though he does not really come and say so, he seems to be saying he has felt very lost. He has not yet taken biology, a strange move, since he said in the first interview that he enjoyed it a lot in high school. But he has discovered he has great trouble with multiple choice tests, and it is common knowledge that biology is tested in this way at Cegep. He says he has great trouble remembering things: "That's the blockage...."

These students continue to view science as a hard programme which requires a lot of work. Stephana argues against the notion that science is the best programme: "They say that Pure is much higher than Social and so they see a higher status, it's better for university.... I just tell them that Social

is not an easy programme." This student was given a hard time by some of her friends when she elected to switch: "You got into Pure and you got out? Why? People can't get into Pure. They work so hard to get in and you got in so why are you getting out?" She and all the others in the group say that interest is an important part of doing well in science, and that without the interest, one is not motivated to try. She also says that some students "don't get the chance because a lot of the teachers don't push them." It is hard not to read into this the story of teachers failing to encourage high school students whom they have decided, for one reason or another and perhaps though not always correctly, are unsuitable for science. These students also all agree that you have to keep up with the science work, that you have to do your homework, that you have to keep pace with the teacher and subject matter. Three hint that good science students have superior minds: "I guess someone who perhaps picks up on things faster than other people;" "They're usually talented but it's also the way they approach things;" "Deep down inside I don't know if it really has to do with studying a lot or not.... like, some people just understand science better." The two persisters come closest to facing their own deficiencies when discussing the top students and how these students differ from themselves. Sam blusters at first, and makes a lot of comparisons with his own drawing talent and his work at it, and famous sportspersons doing intensive training :"Either you have the dedication or not." However, when pushed, he begins to be more self-reflective. He first explains his lack of high achievement on a bad home environment, then on his many other interests. Finally, however, he does say that some of the best science students are also well-rounded people: "I know other people where they're talented in every aspect and that what I wish I could be. You know? They have all these general talents." We have here a brief glimpse of his own longed-for self-image, the reason for his many rather scattered activities, and his own awareness that somehow he isn't really doing it all very well. Carmen says: "I know some people would probably be able to remember faster or understand better and faster too...." She also comments rather bitterly "Some students they excel in science but for some reason in university they're not even in science. They do something else. Which is kind of interesting. Okay fine. If I had your brains...." She immediately slides into commentary on her father's ruminations about not being as successful as his old peers at college. This seems to be a constant theme in the family, and one which has very much affected her thinking as well.

Their ability to articulate a vision of what science is and what might improve Cegep science programmes continues to be quite interesting. They say things like :"Science is to understand things"; "A definition of matter and....Actually, an explanation of a lot of things"; "If you like punching numbers then fine you can go into science. And if you like the theory and all that and scientific research would be good...." They are not as willing to talk about the positive effects of science education as other students, however. Only one, a non-persister, says that it has taught her discipline and how to work hard. As far as critique is concerned, they have many suggestions, including such items as the need for better integration of the Science Access skills course with other subject areas, slower-paced presentation of material, more and beter-staffed resource centres, more lab work, and more subject choice. Stephana thinks that students should know more about what they are entering: what science is should be part of everyone's education.

Three of these students have a lot to say about gender issues. Only Gord, again, has nothing to say. Sam seems to be aware of pressure upon women to perform: "Because like girls are the best...girls in science from what I see. It seems like they have to perform better to stand out more so I feel I don't have that pressure." He does not really think he would have any advantage in the future, however, "because the world is changing, right?" Carmen says, of women teachers at Cegep: "Well, they're more sympathetic, I guess. The male teachers I've had they don't let you get as close.... They just

stay on the subject and.... They basically let the student do whatever they want...but the classroom atmosphere is basically the same though. But if you see them one on one it is just different." This statement is important, given that the student complains about lack of connection with her teachers, wishes Cegep would offer more of that closeness she felt in high school, and has had only two women teachers at Vanier. She also feels that certain expectations of her have been unjust:

> Not just because I'm a woman but because I'm also oriental. I find that most people have an idea that orientals are supposed to be smart but I'm not quite like that and so some people sort of find it kind of odd being like....They just look at you different. Why are you failing?

She then speculates that perhaps she might have an advantage, as a woman, since "they believe in giving the female a chance or something....It might be good." She does not really seem to believe this, however. She then tries to explore why she has come to see herself as not getting "along quite well with female friends." She says that she once had close female friends from high school, but that at Vanier, she has made only acquaintances. Then she says she really gets on better with guys. She explains this in the following way:

> I guess I find guys are just.... When guys are with a girl.... When they're with their male friends they have this whole other attitude like a whole other personality and they're just totally different. But like if I'm going to phone up a guy the conversations are deeper than just the ones that I have with females and so I guess I get along better....

Finally she talks about her boyfriend:

> Last year we were like in the same classes and that wasn't too great, I guess, because he did really worse than me. So I... and so now we're not.... Like I went up in my classes so I.... And now I'm taking different stuff. So I think it's better for both of us like that.

Why is it so problematic if the boyfriend does worse than the girlfriend? The question is rhetorical, but it certainly complicates the gender issues for this young woman who has already suffered a kind of rupture from her women friends, who has decided that because she cannot make deep same-sex friendships at Vanier (probably because of sheer numbers in classes) that therefore men have more to offer her, who feels she must not outshine her boyfriend.... As she looks ahead to marriage and family, the only one of these students now really willing to say anything on the subject, she confesses that she does not much like kids, and does not believe that marriage is necessary for a good relationship. We sense how complex this set of issues is for a student who already has great difficulties with achievement, anxiety, and decision-making. Stephana continues to show the greatest understanding of these issues, a reflective attitude even more fully developed than the year before: this fact tends to underline the point that science students really do not get enough help working out life issues, given the objective, impersonal, and instrumental nature of their programme, whereas a programme like Social Science which confronts these issues head on can really help someone work out how he or she thinks. This student says first of all that "All the guys are dropping. The girls are staying and the guys are dropping." She goes on to say: "The girls I guess have to prove something." She explains that "I find there are a lot more girls into it than guys...into studying, into listening to the teacher. Guys are more into talking." When asked to explain this difference in seriousness she says: "I guess they depend on the girls....Notes or take their classes....Well I've got the notes so I don't really care but I just tell them off."

This student also talks about teachers, especially men teachers, some of whom she was thrilled with when they attacked sexism ("Way to go, sir....") and some of whom follow what she identifies as sexist cultural attitudes. She says that her women teachers have always championed equality between the sexes. Recalling her time in science, she says that she felt that "the guys were expected to do better than the girls." Her impression is that guys usually do better than girls, and that when girls do better than guys, the guys are furious. She concludes that "in Social I find it equal."

3. Experience

Discussing methods for studying science is not very useful with those that have switched: they do not really want to talk much about what they have done or not done. They certainly seem to find the type of work required of them now in their other programmes more suited to their personalities. Gord says he is taking it fairly easy; Stephana says she is working hard, will stay up all night if necessary, but is not a very regular attender in class. She prefers to go home and "I'll do research on it by myself. I wouldn't go to the teacher." These do not sound like the work habits that succeed in science. Comparing the two persisters with one another, it is clear that Carmen works far harder than Sam. She says that she used to take weekend evenings off but now works all the time, every night, often as late as 2 a.m., or going to bed at midnight and getting up to work in the middle of the night. She says: "I finally got down to what I want to do." When asked for clarification of this remark, she explains that this is what she wants to do: study all the time. When asked to describe exactly what she is doing, it does sound as if most of the work is appropriate. She does problems, looks up difficulties in textbooks, reads and highlights textbooks and study guides, makes her own notes for certain high memorization subjects, reads over class notes, and so on. There is perhaps an overemphasis on memorization, as well as a feeling that she does not memorize well. She says she really needs to be able to see something to understand it, but she does not talk about diagrams or physical examples: she seems often to mean she wants to have a photographic memory of the page. She finds it very hard to adjust to different teachers, for some reason, perhaps because she is so determined to do things by rote. She says she is trying to keep up with all her homework much better than earlier in Cegep, so that she will not have to cram. Sam talks about working a lot, and working a lot more than he used to, but when asked for clarification he seems to be talking about "all day Saturday" or "at least three hours". This shocking contrast with the number of hours spent by the woman student whose average is ten points below his not-very-high average suggests that he must be doing something right, but it is not very clear what it is. He spends a lot of his time in the math resource centre, and gets help from whatever teachers are there. He does problems, and seems to like doing them. He also seems to study a lot with his friends, often explaining things to them. He says he feels he often understands things well and then does badly on tests. He says he thinks he forgets things, and that he so much hates to memorize that he really cannot do it. He is not a very faithful class attender, except in math. The woman student, on the other hand, attends all classes. Neither are active in class. What emerges here is that one student believes in his innate ability and somehow gets by, while the other trusts only her enormous and anxious efforts to master material. We get a sense that Sam understands a bit better what kinds of activities are essential to science and does them after a fashion, though he does not practise enough, whereas the woman exhausts herself doing some things that might not have been essential. She is also very anxious, and feels her worries interfere with her success (see below).

Once again, this group of students is distinguished from others by its negative commentary on teachers. The items critiqued are not unfair, nor are they harshly stated: what is notable is that it is again difficult to get them to describe the good teacher, or good teacher qualities. Carmen refers to

her first semester Calculus teacher again, as she does in her first interview, expressing her appreciation of the individual help she felt free to seek and receive. For some reason this situation never arises again for her. She says that in Cegep the teachers "don't know me and I don't know them and that's the end of that. But if I've had a relationship with a teacher I guess I find that good." She is able to articulate one positive characteristic: "That the teacher interacts with the students and not just writes and writes and writes...." Sam says that he has had some good teachers, as does Gord, but they are unable or unwilling to describe them. Stephana talks only about how boring teachers can be, and how they turn students off. The science persister complaints are the usual: teachers who do not explain what they are doing, who go too fast, who don't try to capture student interest by providing context, who do not present material in an organized fashion, who stray from the topic in confusing ways, who expect too much prior knowledge, who always try to add more to the curriculum, and so on. Carmen complains at length about a teacher who patronizes the students and in fact reduces some to tears. All these teacher-critiques emerge in discussions with other groups, but the notable point here is that critiques form almost the entire teacher-story "syllabus." Why these students cannot respond to the positive behaviours of teachers is unclear - perhaps, for them, in their particular degree of difficulty, a whole different teaching style is necessary; perhaps, alternatively, they are in such difficulty that positive teacher behaviour is seen only as cessation of pain, and is not mentally recorded. There is a third possibility, which we hesitate to posit: that they have been, in fact, unlucky in their teachers, that they have had teachers who are in fact either less gifted pedagogues or who were having a bad semester, and that some of the students' difficulties may relate to this ill-luck or mis-match.

There is a wide range of attitudes and experiences with respect to anxiety and competition. Once again, the men students seem not to suffer much anxiety, though they have interesting and revealing things to say. Sam says: "I guess I'm not really a worrier. I try and get through one at a time so.... Like, I don't really see too much of the future. I don't want to because like you worry too much about that then you can't.... You know?" Gord talks about how the rapid pace of science courses can erode confidence:

> It sort of takes away your confidence and the people who do get it go right along with it and keep going up and up and up and if you get stuck at one step you sit back and you want to try and figure it out while the other students are going along ahead of you. It's kind of like falling off a horse I suppose in an army and you see the army going off and you're standing there trying to get back on your horse to catch up with them....It kind of takes away your confidence a bit.

Though this student says he does not respond to competition, he certainly seems to be deeply affected by comparisons of himself with others, and his army metaphor suggests a very competitive, regimented kind of context. Sam talks enthusiastically about competition: "Like, if you're going to get into a higher level, you know, you have to compete with the best, and you know, it's always one step ahead." He is really talking about hockey, however, in which he says he excels. In answer to a question about whether he feels this competitive urge academically he says: "In my study of science? Not really....I guess like you don't see results right away. In hockey you can get the results right there. It's right down the line." The women students not only do not respond to competition, but have suffered acute anxiety at different points in their Cegep lives. Both talk about their worries about being accepted at university, and how waiting for these acceptances makes them wonder if they have chosen the right paths, and how that uncertainty has made them suffer. "I got scared at one point about McGill and thought, Oh, my god...." "Now that I got my acceptance I'm better now but like for

the past month I was like in a deep depression because I couldn't... I couldn't get anything right and I was failing a lot of stuff...." This persister talks about greater nervousness now toward the end of her Cegep life than she experienced before, perhaps because she is now much more serious about her future. Her nervousness also very much interferes with her success: "When I get nervous I just can't remember anything. I've had times when I cried before a test because I'm afraid I won't remember anything.... But I used to be relaxed for tests and....I did better when I didn't care...." Asked about her level of confidence, she says: "Not much confidence. I have the perseverance but I don't have the confidence....It has to do with my marks." Finally, she says this about herself:

> School means a lot to me and for me like not to do well or to lose control of, I guess, my path in life.... If I lose myself in what I want to do I feel so lost and I feel like I'm in the middle of nowhere and just floating around. I'm still a bit in that because I'm not quite sure of what I want to do in university. I thought, okay, yeah, right, I got accepted and that will be great and that's the end of that. But now I'm like, okay, do I really want to do that? I'm always re-evaluating my life and it always seems to change.

For some students, this kind of existential crisis seems to produce real re-evaluation of options, changes of direction, re-envisioning of one's own strong points. Somehow this young woman is as yet unable to turn all this to her advantage: she presses on with her frantic need to succeed in science, no matter what the cost, and no matter what the external messages about her achievement may be. As she says:

> I don't know if I'm willing to take the chance to change around and try a bit of this and a bit of that and is it worth it or am I going to totally hate science and then maybe in forty or twenty years from now I'll say, Oh God maybe it's time to go back to school and do something else sort of thing.

Perhaps this inability to work through the suffering, even to write tests while she feels anxiety, let alone reprocess her decisions, is part of what holds such students back. They have trouble with school, but they have trouble with life as well.

Oddly enough, these students have fewer positive things to say about their interrelationships with peers this time. The two science persisters talk distrustingly about lab partners: "Yeah. Some lab partners I'm nervous like right now in physics. Sometimes he doesn't even show up." "Sometimes when you have too much of a good partner....Like basically, he does his thing and you just follow him and so you don't learn anything." Carmen, who, in her first interview, talks about being held in class by friends now talks only of working alone, of lab partnerships "with guys....I guess I relate to them better than females," of the fact that most of her friends are now in university. She may call up an acquaintance for help with a problem, but she does not talk about this accessibility with any affect at all.(Her discussion of male versus female friends is dealt with above.) Sam enjoys his friends, it is clear, but only in a social context: nothing he says suggests that he sees connections between study and relationships. Gord chooses to recall bad behaviour in a Science Access Physics class, where students were so rowdy the teacher could not get them to stop talking and focus on the class. Stephana simply chooses to talk about how her friends criticize her for not going on in science. The portrait that emerges is not one of happy, friendly and interactive lives, but of individuals having trouble with relationships as well as study.

It is the science students who really talk about the value of Cegep, and it is not science that they value. It is the other, wider perspective they appreciate: " I guess outside of science. You know, like other things too..." "It's just to enrich my life....I'm just happy that now I have a wider perspective in life and I guess some things I understand more." As they describe these transformative experiences to us, we are reminded again of how contradictory the stories of these students are, and how their determination to pursue the sciences seems to cut across other very important issues in their lives.

VII. STUDENTS WHO PERSIST IN SCIENCE THROUGH CEGEP, BUT THEN GO ON TO PROGRAMMES OF STUDY OUTSIDE OF SCIENCE

A. SUMMARY

This group of seven contains three women and four men, three Health Science students and four students in Pure and Applied. We group them together because they all persist through Cegep, determined to get their science DECs, but they make it clear they will not go on in science. Though they seem at first to be a very heterogeneous lot, we have found some very striking similarities in their motivations, attitudes and experiences, sufficient to suggest that they illustrate a certain "type" of student who might slog through science and then drop it like a stone. The gender differences are, at the same time, very pronounced, and allow us further insight on how students with similar interests and abilities can be so greatly differentiated by gender. Ethnic and racial considerations also emerge within this group, with Asian students very much pushed by families to pursue the sciences, and a black student dealing with her feelings of marginality and the stereotypically low expectations of her performance in the science class.

Though two of the men are "tinkerers", none of these students shows very great interest in or close connection with science. Though all are pursuing the sciences for practical purposes or at the suggestion of families who wish them to succeed, there are gender differences in the ways in which these motivations and attitudes show themselves. Career motivation is strongest among the men, and seems to come direct from families. Women's career choice is much less clear, and seems to come from many different sources, much more notably from school success. None brings a top record from high school, but it is clear the women did better in school than the men, that they are still doing better at Vanier, that they are working harder, and that they are worrying more. In terms of subject preference, we hear enthusiasm only from the women, and only about biology: the men say they like math because it is more straight forward than other subjects. All are having trouble with physics as soon as they come to Cegep. Most are extremely negative about teachers, as if they have either had terrible experiences or are so teacher-dependent that their dwindling success rates have to be attributed to bad teaching. Indeed, they tend to be very classroom focused, especially the men. Most have felt rather lost socially at the Cegep, but the women are finding some supportive relationships, whereas the men are less likely to. Two surprises alert us to the possibility that these are not just below-average, grumbling students, but students who might be making the wrong choices: they show an enormous range of outside interests and already they are enjoying their non-science subjects. They show much greater gender awareness than the average science student, though they do not always follow up their observations with interpretations that might assist their own decisions. They need courses that might help them relate these observations to themselves and to society. The black student is also very conscious of race, and very much needs some support in dealing with race and gender issues.

Unfortunately, her Cegep experience does not offer her this support, and she leaves feeling, if anything, even more isolated and embattled, though perhaps tougher, than she felt at the outset. We might posit here the failure of the programme and/or institution in not helping her address these issues, and indeed, no one seems to have been there for her in this respect. We might also fault the programme and the institution for not offering the other students more help in discovering and developing their talents. They have also been a group that has been so shell-shocked by poor aca-

demic achievement and lost in large classes that they have not learned to seek out help or guidance or encouragement. They are all working harder than they were at the time of the first interview, and a little less inclined to blame the teacher, but they are all suffering from a sense that they have had to struggle through both difficulty and boredom to obtain very mediocre results in science. Many have, however, done remarkably well in non-science subjects and are willing to discuss their enjoyment of them. The women's new decisions about university programmes are dictated by these non-science successes. The men, however, have chosen paths in business or mechanics, choices dictated by forces quite outside their Cegep schooling. They have all kept up their outside interests, but we note how much less energy this group has than better-achieving persisters. Whether the lack of energy is a cause or an effect is impossible to tell.

Overall, it is impossible not to conclude that these students have been poorly served by their Cegep experience. It is true that they have made discoveries about what they ought to do, but the discoveries have been made in lonely and depressing circumstances and without very much support. Individual teachers have reached out to some of these students, and that has meant an enormous amount to them: we cannot underestimate the effect of asking a student to come for individual tutorials, or telling a student she has promise. For some of these students, however, none of this encouragement has imprinted itself, and they leave the institution wondering if they have wasted their time. They all strongly suggest that science programmes offer a greater number of options and complementaries, and their difficulties in working out their lives suggest that such a change would have very much assisted both their academic and personal growth.

B. INTERVIEW ONE

1. Motivation

This group of students is quite diverse in terms of initial interest in the sciences. While Shona and Doug quite frankly do not know what they want and therefore merely wish to keep their options open, Marc and Stan are certain about career paths and choose even their specific science programmes accordingly. Cindy says "I don't mean to brag but I'm a smart person and I want to see where I could challenge myself the most and Pure and Applied, I was told, was the place to do it." She admits "I've not always liked it." Jen talks about a real interest in the sciences, but even she opens her discussion rather neutrally: "Nothing else interests me." Though her discussion of her high school-organized hospital observation experiences is animated and enthusiastic, it is much more focused upon the patients than upon the medical work. She does call brain surgery "an interesting procedure," however. Ken is unique in his unqualified enthusiasm for science <u>per se</u>, saying: "I always liked sciences, like all through high school....It's like, I don't know, science as a whole, like, interests me because you get to find out about things, what it's made of, what it breaks down to." In general, there is less commitment to science in this group than in most others, even at the outset.

The men differ slightly from the women with respect to their discussion of their career plans. They appear to be much influenced by their families: two have been sent to private schools to improve their academic opportunities. Marc, Ken and Stan stand out as having specific career choices, all very much influenced by the home. Marc's father is an engineer: "Maybe my father influenced my choice....I always watched him to do something....I like this kind of thing." Marc says he not only wants to be an engineer, but to take his Master's and to have his own consulting firm. Despite his Franco-Quebecois background and schooling, he is determined to pursue his post-secondary education in

English. Ken wants to be a chemical engineer; he tells us his father is an engineer, and his uncle and grandfather have encouraged him to both drive and repair machinery on the family farm. He says: "I guess that's what my family life, that's what is kind of got me used to the hands on experience because, like, you're always doing everything for yourself, you're not watching somebody else do it." Stan says he wants to go into dentistry, and he connects his choice both to a broken tooth and its rather interesting repair in ninth grade and to his rejection of medicine because he doesn't like the idea of "getting blood all over me." It seems clear, however, that Stan has been much encouraged, indeed pushed by his father, an immigrant who does factory work: Stan's three older brothers are studying engineering, and when Stan, the youngest, did not do well in high school, he was sent to the States to a private school. Asked if education is important to his parents, Stan says "Yeah....A lot." Although Doug speaks very uncertainly about "business...technical stuff like computers or something or engineering possibly," he tells us his father is a civil engineer. He was sent to a very prestigious Montreal private school for boys which in his words "has really strong academics for science and everything." He finds it hard to explain this to us, but he gives the impression that he has been set upon a science career track which he does not much question.

The women are ambitious for the future but their vision of what this might entail is more open to question, more multiply- determined by schools, personal experiences, interests, family background and loyalty. Jen is enthusiastic about some health career, perhaps dentistry. She has been very much influenced by the school visits to the hospitals, and her deep concern for a child having brain surgery and for a woman who could speak neither English nor French and who was having a baby without anaesthetic reveals her caring motivation for this type of work. She is also influenced by the family, as there are two cousins who are dentists, but she only mentions them in passing. She dwells more upon her immigrant parents who work in factories and "want me to get a good education and stuff and they support me all the way." They do not, however, seem to be pushing any particular career, nor even the study of science. Shona has rejected dentistry since an aunt told her the field was "kind of saturated right now" but she does admire this aunt who is herself a dentist and "has a great situation." There is some sense in which this woman has become a model, particularly as the rest of the family is in business and has discouraged her from following in their footsteps, telling her: "You can have, like, an easier life", presumably by becoming a professional. The family business affairs seems to be suffering from recession. Shona does not seem to have been pushed academically, though she too has come from a private school where she developed her fondness for biology: "I had a good teacher and she really got me into it." Finally, she says she would like "some health career" but she admits "I'm very, like, not determined."

Cindy tries out a number of ideas: "Coming out of Sec V I got a prize for computer science or something and I thought maybe I could try that and I did pretty well in physics and I thought maybe I could try engineering." She then says "I thought it would become clearer as I went along. But no, I still have questions.... Even if you've narrowed it down to engineering then they have mechanical, civil, computer science, chem....There are so many options; I don't know...." Cindy tells us that her parents, a draughtsman and a nurse, have very much encouraged the study of science. She was also sent to private school for some of her high school. At one point she says that "my mom kept nagging me and saying, take physics, take a science and okay, fine, fine, and I took it just to get her off my back and wouldn't you know I liked it." At another point she says "The way I talk about my parents you'd think they were brutes but they're really the sweetest two people I've ever met." There seems to be a real appreciation here of the encouragement her parents have given her. At other points she connects this encouragement with increased self-esteem as a black woman (see below): the race issue is not articu-

lated with reference to parental encouragement to pursue science per se, but it is definitely implied. The one common feature here among all these students is that so many of their motivational factors come from without, and their own feelings about what they are doing are not very strong.

Given their somewhat loose connection to science, it is not surprising to find that these students have a number of other interests, some of which have academic potential and could possibly pull them away. Leisure activities range from music, through writing, reading, church groups, drawing, cooking, construction, dancing, running, and various sports activities including camping and hiking. Cindy tells us that her interests in reading and writing almost led her into Liberal Arts or Literature and Languages. She loves to write creatively, but she also enjoys the reading and writing required by college courses like humanities. Shona regrets the fact that all the art courses she might have taken as complementaries were closed at registration. Stan talks about his interest in advertising, which he might pursue as an alternative career choice, and how that relates to an old interest in drawing. Doug talks about his interest in religion and his enjoyment of courses in both ethics and psychology. He says "I can't really see how you can study ethics in science." Ken is involved in religious activities at Vanier and has plans to become a pastor. "But the thing is, like, when you go to Bible course, there's so many graduates and there's not enough churches.... So, then, I can go back to chemical engineering until there's a position that opens...." This is the first clue that suggests engineering is not his only choice. Ken also enjoys his non-science courses in Russian and humanities because of a personal connection. Only Marc fails to show a broad range of interests outside of science.

These students do not talk much about their achievement either at high school or so far at Cegep. The attainment of adequate grades has certainly been important to allow them entry to their programmes, but to what degree marks per se motivate them is unclear. Ken stands out in the group at this point as one who does talk about high marks in high school (he does not specify, however) and about being sent by his chemistry teacher to the extra chemistry classes offered interested high school students by Joe Schwarcz. He has not done as well so far at Cegep, but says he is recovering and "I'm planning to finish Cegep and get honours like right through." It does turn out that his first semester grades are adequate, but by no means in the honours category: we are hearing here the voice of hope, which later fails him. The other men are much less forthcoming, but if we listen closely, we can get some idea of how they are doing and how little they feel about their grades. Marc is not entirely pleased with a physics mark of 70: "I could be more higher." Doug tells us he has failed the first two physics tests. His reflections about this record do not express deep concern, however: "I'm pretty positive that I'm competent to do it." He seems to base this idea on his high school experience: "I have a good physics background." Both of these young men refer to other marks as being vaguely better than those in physics. Stan says in a non-committal tone: "I'm passing." He indicates that he thinks 70's are "average" grades, and his are "A little below." The women are a little different. Shona and Jen indicate that "doing good" means getting 80's. Neither are doing that well in physics, and Jen especially is displeased with her 60 which she calls "not so good." There is just a hint here that these young women have slightly higher standards for themselves than Doug, Marc and Stan and that they take lower marks more seriously. They are also, as it turns out, more realistic than Ken.

Cindy stands at the extreme end of this mark-concern continuum. For her, doing well "is a nice 90 or 100 or something." Her recent marks in Cegep physics are 83 and 86, marks the other students would be glad to have, but marks which, for Cindy, are "not really what I'm used to getting." She also expresses concern that "You don't get like weekly reports about how you're doing. I don't really know how I'm doing mark-wise but like I have a feeling I'm not understanding the chem as well as I should and I'm not getting cal as fast as I should." Without the reassurance of frequent high grade

reports, Cindy begins to feel anxious (see more below). Cindy tells us she wanted to get into Science Plus but was refused because she lacked some prerequisites; she also tells us she wrote SATs, did well and had some letters of encouragement from American universities. "I just got a letter from Princeton the other day but I don't think I'll be going there....Cegep isn't going as well as I thought it would." This young woman's achievement ambitions appear to be very high: there is no way of knowing at this point whether they are unreasonable, but they certainly set her apart from the group.

2. Attitude

These students have come to college with clear preferences among science subjects, preferences which suggest that some still define subject matter in high school terms. For instance, all of them speak of liking math, being good at math, yet all of the young women are having trouble with calculus and complain that it is "totally different from anything I've ever done before." Ken is also having trouble. He says: "Like, calculus is totally new to me. I have a slight background like, I'm trying to feed off of what I learned last year in 536 math. and the thing is, this year, they're only using bits and pieces of it." He also wants to do calculations in his head and just put down the answer, and is shocked to discover this is not acceptable. The other young men do not complain about calculus: for Stan, it is his favourite because there is "less to memorize"; Marc says math "comes easily for me" but does not mention calculus per se; Doug says math is his best subject but he is not taking calculus because his high school marks in math were weak enough to indicate he needed to repeat. The students also make a distinction between math itself and math as it relates to working out problems in physics and chemistry, which most find very difficult for reasons explained below. Both Shona and Jen talk a lot about biology as their favourite science, but again they can only call upon high school experience. Jen says: " I like to discover stuff. See new things and to have them right in front of me.... Biology is all there. It's concrete...." Later she says: "I'd like to dissect a human but animals represent....They're sort of like us. Their organs are the same so it gives me a good idea of how we are....Just how the body is."

Shona says that "biology is more like a natural thing. You study the body and you study this and that...not as much calculations and stuff like that." Ken enjoyed high school biology too. Both Doug and Cindy say that their favourite subject is dictated by how well they are doing and to what extent they understand what is being taught. Cindy says very frankly this feeling can change from class to class. She talks about not only losing interest when she does not understand, but actually giving up. With respect to chemistry, none of these students expresses great enthusiasm: for Shona, there are too many calculations; Jen enjoys the visual nature of the lab work ("the experiments are right in front of us") but complains that "We talk about atoms and we've never seen atoms;" Stan enjoys using the chemicals because "you don't know what you'll get" whereas Doug finds labs boring. Ken, whose favourite subject is chemistry, says: "My chemistry teacher here is almost exactly like my chemistry teacher in high school....Nothing about chemistry I don't like." The real problematic course appears to be physics. Only Marc is happy with physics, though he admits it is hard, harder than math "because you have to understand the law." Jen and Shona speak at length about not being able to visualize things, not understanding the theory, having difficulty applying the formulas, and not being able to relate to the examples such as bouncing balls. Cindy once felt physics was her best subject but Cegep has changed her mind: she still likes it, but her difficulties are beginning to dampen her enthusiasm. Stan complains that he often thinks he understands and has done the physics problem correctly but then discovers he has not: "It's application in different things. I apply incorrectly." Again, Ken's comments about physics suggest difficulty adjusting: "Like physics, at the beginning, I didn't understand

what was going on because they changed the different, the formulas, like, they changed, like, the constants and stuff...." It appears that, overall, the college level problem-solving demands of the science program are posing difficulties for these students from the very outset.

All these students seem to feel that science is a "heavy load," one that requires some serious commitment. "We study more." They talk about "the stereotype" of the "genius" science student and most deny that it is necessary to be particularly gifted to study science. They all list the behaviours that students can control, like organizing one's time, keeping up to date, having a goal and being determined to reach it, spending plenty of time studying, not being afraid to ask questions when points are unclear, and so on. However, they each let slip one or more characteristics that suggest that at least some science students (perhaps not themselves) have other advantages, such as the following: "I guess it helps to be like smart and logical. Like possessing some logical reasoning;" "You would have to like it, even if you have, like a good attitude, you have to be good at it;" "You need a good background;" "You have to have a sort of quick comprehension...I guess you develop it. Well, some are born with it. Some people I know;" "It doesn't just come to you - some people, although some people it does"; "Maybe they have family members who help them to understand better." Since none of these students is doing remarkably well, some of these remarks might be half conscious explanations of the fact. Cindy talks at greater length about "nerds" and "normal students," and it is clear that she's still sorting out what she thinks. Cindy says:

> I thought it was sort of a myth maybe or a stereotype thing, you know, people in science are nerds. You walk in to the class and these people are like a whole lot smarter than you. I feel sort of intimidated and I'm going maybe I'm in the wrong class; maybe this is not for me.

Later she says "I think they just sit down and read these books and like absorb all this info and I'm wondering where do they get it from." She also says :"These people are like `smart'. Like, just generally. But then when you talk to them about it, it's not really interesting; I guess so; just sciences. So I guess I'm more well-rounded than some of the people in those classes." Near the end of her interview she says with great conviction:

> Normal people can take science too and enjoy it. You don't have to kill yourself studying and you don't have to sort of let it take over your whole life. You can do sciences and be a well-rounded kind of person. You can still do the activities and you can still play a musical instrument and be editor of the school newspaper. Just take everything in perspective and sort of let everything have a place in your life sort of thing I guess. Yes, that's right.

Cindy is clearly articulating the kind of student life she wants for herself at Cegep, and it is certainly true that many of the women students in our sample fit this description.

Any vision of science as a field of study is difficult to find in the talk of these students. Generally speaking, they seem to view science as a world of fact. Doug says: "It's usually always a right way to do it. Do this and that's the right answer." Cindy agrees: "Numbers and digits and figures and you learn them and you go on." Ken says that science is "exploring everything I don't know". Not surprisingly, two of the young women cannot see why they must study physics: "If they give us examples like a ball going up and down, what's that going to serve us in life?" Doug suggests that science programmes could be more attractive to students if they could take more non-science courses, and discover what they like. Others speculate about whether perhaps the workload could be cut down, since science, as Stan says, could turn you into a "workaholic." But Marc, Ken and Shona appear to

have accepted that science has to be hard, and has to be pressured : "I would say to make the programme easier but then, but then I would say, like, it's not useful because we would have to work harder anyways, sooner or later, so might as well do it now." There is a great sense of the absolute nature of the science curriculum behind this remark and Ken's "You really can't change the structure of sciences so that it appeals to the people. Either you like it or you don't like it. That's the way it works." Marc says: "Students in high school don't want to be in the science programme because you have to study a lot, you have to work hard. But this is science and you can't change." Practical suggestions for improvement include more films, more pictures, more field trips: all the things that would help the students visualize abstract material and see the context in which it becomes operational. Cindy would like the stereotypes to change, stereotypes about needing to be a genius to do science, and stereotypes about subject difficulty: she seems to feel that the way a subject like calculus is perceived by students interferes with their learning of it. How does the study of science affect one? "I guess someone who has more knowledge of life in general and someone who is more respected in a way because he has a high position in society." This answer, which most of them would agree with, certainly helps explain why these students are still in science.

These students have rather a lot to say about gender issues but do not always show much awareness of the significance of what they observe. Both Stan and Shona had experience of high school science teachers who were easier on girls; Jen and Cindy had experience of high school teachers and counsellors really discouraging girls pursuing science in Cegep. At first glance these stories may seem contradictory, but in fact both behaviours are clearly condescending to women. The important thing to note here, however, is that neither Shona nor Stan realize this fact. Interestingly, none of the students talk about sexism in their Vanier teachers. Almost all of the students talk about differences between men and women students. In general, they would agree that women are more serious: when they talk in class, they are talking about the work, says Jen, and she is outraged that teachers do not understand this. Doug says he notices a great difference in decorum now that he is in a co-ed educational setting: "Girls I don't think they blurt out stuff or whatever." Jen says: "But guys don't study. I don't think they study as much as girls...I think the boys care, the guys care but they don't really push themselves to their max." Shona says she thinks that "males behave differently. I think they might want more attention. Like, I know always, like, the loud ones are always the guys...." Marc thinks men are more independent, both of teachers and parents, but then he notes that though women students ask questions in chemistry, "in math or physics they don't." Ken seems much less aware of the subtleties, when he interprets the following as an indication that men know what they are doing and women do not: "Like the girls, like, will just wait till the guys have finished fighting over the equipment, then, like, then they'll get their stuff. It's like, we'll be out of there in , like, in a half hour, and then, like the girls will still be there, like, maybe an hour later or so." The story of student behaviour here is remarkably in accordance with what we have heard, observed, and interpreted. Again, what is interesting is that these students see it but do not allow it to inform them of gender issues in the larger sense. All the men students in this sample declare an enthusiasm for marriage and family that is a little more pronounced than in other groups, though Stan says he wants to make sure he has a strong financial base first. Interestingly, the women are more tentative, either unwilling or unable to discuss their hesitations, but all of them emphasizing the importance of education first ("for sure, in university... yeah that's for sure") and commenting, about family, "only if I could have a good situation." Whereas Shona frowns and pauses as she talks about marriage, family and career, Marc grins and says "A family? a big one!"

Cindy, however, as one of very few black women students in science, is very aware not only of her marginal status but of gender relations among students. First, she speaks to us about gender balance in Cegep science:

> So I was coming into Pure thinking I'll be the only girl in this programme and not only that you'll be the only black girl in this programme. And I got there and these girls were just keeping up with the boys sort of thing. Like, I think they've maybe made too much out of this 'not enough girls in science' thing.

Nevertheless, she says that "I guess I still think of science as a male thing to do. And if a woman is teaching it I feel as if she's only a woman...and if it's a man I give him a little more respect than he deserves before I know what he's like...." Race and gender together, however, make for real problematics for Cindy:

> It's not really a big thing but it's just I feel that if I'm the only one I'm always going to be compared to the other kids...She's a black girl so don't expect much from her....When I was coming out of high school I was expecting that because my guidance counsellor is sort of like that....

This marginal status has given Cindy insight into student gender relations that other students do not have. About choosing same sex partners in labs, she says that "as a girl you don't want the boys to think you're dumb but you don't want them to think you're too smart. And if you're a boy you don't want a girl thinking you're dumb." Cindy's insights set her apart from the other students but they are painful for her: it is not clear that they will help her achieve in science.

3. Experience

The way in which these students experience the study of science is strangely at odds with their definition of what such a study requires. On a personal, experiential level, Cindy is irritated by the amount of work she finds she must do: "I find I have to study and ask questions and sometimes I'm still going, What are you talking about? It doesn't come easily and I guess it just turned me off." She also says: "Well I'll be there for maybe an hour and I'll be, Well, this is not getting any clearer so why waste our time doing this and I just close the book and say, okay, next subject." This is not the determined, persevering behaviour profile that is recognized as required in college. Jen, too, admits that "after a while I give up. I stay there and I work and work and I can't get it so...." It seems, however, that Jen is willing to stay at her problems longer than Cindy. Cindy also admits that she takes notes and looks interested in class but is often tuned out to what is going on. She seems to think that looking interested is a useful, teacher pleasing behaviour. Nor do these students ask questions: both Doug and Shona are very forthright about not wanting to ask the teacher for clarification of their difficulties, though they might ask a friend. Some of their notions of "a lot of work" are also very odd: Marc spends one half hour reviewing math for a test, and perhaps one hour doing physics problems before the class for which they are assigned. The others are rather vague: Stan says he finishes classes at 6 and works on homework till 11 at night, but he is not really telling us how many hours he works, since neither travelling time nor dinner are mentioned. The young men seem very classroom focused: they *talk* about following carefully in class, only very occasionally making notes and sometimes never looking at them again. Marc says he never uses the textbook except where he needs to try to learn the English terms; Doug and Stan use their texts to guide them with homework. Doug talks about

limiting his work to very specific preparation for quizzes, and he seems to be aware that he is leaving a great deal of the work untouched. These students do not seem to hear the discrepancy between their definition of what science requires and what they themselves are doing. On the other hand, none of them holds his or her work habits up as exemplary. Ken seems to be doing more work than the other men, putting in several hours on weekdays and some on Sunday afternoons. His description of his work situation is disturbing, however: "I have a ...break on Mondays...and that's when I'll sit down in one of my club offices....I have office hours and knock off, like everything, anything that's backed up, just knock it off right then." We begin to wonder how focused he is.

A strange gloom pervades these students' discussion of the science teacher. The qualities which they list as important are reasonable and familiar: clear explanations, concern for the student, willingness to answer questions, use of real life examples, reasonable and flexible pacing, tests that are not too tricky, and so on. It is when they describe their teachers that we sense how unhappy they have been and continue to be in so many of their science classes. As Stan says of his high school teachers: "They just wrote notes on the board, you copied them....It was like copy the notes and study for the test." Shona says: "Well, he just, he sat there and he just read his notes, like, he wrote on the board. He was very, like, he wasn't really into it at the time." Marc, too, complains of the endless chalk and talk procedure in which "the students are there to take notes." These students seem to feel completely shut out by lecture-style pedagogy, yet they offer few stories of the alternatives they might have met. Stan suggests that humour would help but says his science teachers have rarely used it. Doug also describes an anxious, hostile atmosphere in a pre-calculus class where students are having trouble understanding the subject: "Although what the teacher is doing is right they think it's wrong and they'll just say screw this, this doesn't make any sense at all. I don't know if this guy is trying to make me fail....You know?" He goes on to say that he himself is not drawn into this reaction, but it is clearly not pleasant for him. Jen and Cindy talk about teachers who are not only difficult to understand, but unpleasant to students. Jen says "Well, there was one guy who told this teacher, Sir, you're going too fast. He's like, Well just remember that I could go faster. We were like, okay." Cindy, as usual, has a longer story:

> I remember the first day he went from one subject to another to another to another and I still did not know what he was talking about....And then I would ask a question and he goes Well, that's quite logical and how could you not see and answer.... I was like well, yeah, I feel special here. Well, Sir, could you just answer my question and just let me die....And he'd answer the question...but that's the last time I ask a question in that course....I found that a teacher is supposed to encourage you even if it's a mistake, you know, you learn through mistakes. Just let me make my mistake and live with it and don't embarrass me and put me down....I find if you put me down I'll go so far down it is not even funny. To pick myself up again takes so much energy.

These are important words, both in what they say about Cindy and how she may fare in science, but also about poor student-teacher relationships and why students who have difficulty in science have such depressing experiences in classrooms. As Doug says, teachers need "good social qualities", but this may be particularly true if those teachers wish to help communicate with average and below average students. Only Ken is relentlessly cheerful about his teachers, but his talk is sometimes disturbing in that he seems best to like teachers "cracking a few jokes", cancelling classes, and so on.

There is clearly a great deal of suffering and anxiety associated with studying science among this group of students. Even the men, who are often not so forthcoming about nervousness,

admit to feeling "nervous before the test". The women, however, describe experiences such as the following: "I feel like why is it only me. I feel it's only me that doesn't understand." "...I don't want people just looking at me and just saying, Okay, this one doesn't know what she's talking about." "I'm scared I could blank out because I've heard that happens. Well, it's never happened to me, like...but I don't know, you never know, it could happen." "If I understand I go through it and it's okay. But when I stumble then I start worrying." As usual, Cindy has the most to say:

> I really worry about not doing well. I came to Vanier saying I'm going to make the dean's list and I'm going to do this and I'm going to do my activities and my parents are going to be proud of me and I'm going to get a scholarship to the States....Things aren't going as planned....I'm not so satisfied with myself and...I haven't really been pushing myself as hard as I should. I don't spend as much time on my homework as I know I should....I get the feeling that no matter how long I study I'm still not going to understand....Like maybe I'm the only one who's not understanding this....Oh gosh I'm behind again and I get panicky and I feel I'm not good at this and I'm stupid and ...I'll go into a deep depression and say, Okay get rid of this....I feel nervous because I don't want to disappoint my parents they sent me to private school and I thought that was enough. I think I should do something for them.

Cindy's anxiety is obviously partially related to her sense that "maybe I'm in the wrong class; maybe this is not for me." She tries to manage this concern by talking herself down in tests ("Okay, you can do this...just relax a little...") but it appears to be a constant battle. None of these students really likes competition. Marc says that high school competition was friendly and that was enjoyable. Jen says she enjoys sports competition: "I hate losing," she says, but though she feels that competition in school pushes her to do better, "I don't really like it." The rest of her discussion indicates that if she could be among the top students, she might like competition more. Shona says that competition "might discourage a person." Stan agrees: "There's always someone who's better than you....Puts me down, confidence." Cindy has very bad memories of high school competition: "Well, I got 96. And then all of a sudden a person won't be your friend any more and I'm like well, what did I do?" On the other hand, she is so used to comparing herself with others that she is very anxious to know "where I am in relation to the rest of the class." The competition seems inescapable: "Apparently universities are looking at that, where you are, with your rank in the class."

One gets the impression that this particular group of students is a little lonely and lost in the Cegep. Cindy rather blames herself: "Then in the second week I said, well, I can't go on in Cegep like this, I must meet people." She seems to feel that the pressure to perform at the college level has impinged upon her need to interact with others: she is intimidated and a little lost. Marc finds it very difficult to meet people in the English milieu: he has one friend, who is also francophone. Doug admits he only knows people's names, and that he basically "minds his own business" in class. He is irritated by people who have to talk just to make themselves heard, and he really prefers working by himself. He seems to have worked out a system of collaborating in the lab, but the system appears to be based upon the personality of the partner: if the partner is dominant, the partner decides how the work is to be done. Jen feels shy in class with so many students she does not know after a high school experience where she knew everyone. Shona and Stan seem to have less difficulty meeting people, but even they do not show any real awareness of how their friendships might intersect with their student lives. Ken really stands out from the group in this respect as he seems to have had no trouble finding old friends from high school to work with, as well as making new friends at Vanier. He does seem, as he says, to be more of a "people person" than the others; it is notable, however, that his locus for interaction is a particular student club.

B. INTERVIEW TWO

1. Motivation

Though none of these students decides to pursue the sciences, in the final interview the women students are much more positive about science than are the men. Both Jen and Shona say: "It was a good experience." They particularly appreciate the fact that they really found out what science is, and what they like and do not like. Jen liked what she learned, and continues to feel that other programmes would not have interested her. Shona speaks about her reduced interest, principally due to low achievement and overexposure ("only science, science science" - "it's really hard" see below), and says "I don't want to continue in science but it's not because like the atmosphere was bad or because the teachers were bad it's just that I didn't like it." She talks also about the advantages of finishing her Science Dec: "I don't regret staying in science at all because when I was doing my application I was very happy, actually. I could choose whatever I wanted." Cindy talks about failing subjects, losing interest ("It's too dry...It just doesn't give me that little yen") and momentum : "I couldn't see the point and the little light at the end of the tunnel just wasn't there." She makes it clear that she is finishing her Science DEC to prove herself: "And then I said, I can do this, I can do this....And I did it." There were also some pleasures in it: "When you get something after lots and lots....You just feel like sitting there for ten minutes, I get it!" All the men, on the other hand, speak much more dismissively: "Science isn't for me." Stan says it was "pretty unpleasant"; Marc says "It was hard and I don't like to study this kind of thing;" Doug says that "science is not really my programme;" Ken says: "I just lost interest....I'm like....Why am I killing myself in this programme? Am I really going to use it?" Only Doug and Ken admit they are dropping because they have not done well, but it later emerges that this low achievement is at least true of the others, if not a motivator for change of direction (see below).

Naturally, these students have very much changed their career plans. Jen maintains the closest connection to science, as she has applied to a three-year Cegep medical technology programme. She has found that she loves the lab work of science (though she dislikes writing lab reports long into the evenings), and can see herself as a lab technician. She has rejected dentistry for two reasons: first, her grades are in the 70's, and she knows this record will not be looked upon favourably; secondly, she has thought through her chances of passing a dental aptitude test, and decided she does not have sufficient manual dexterity. She is happy with her choice, and sees no other ("Maybe in computers but I have no knowledge of computers right now"). Shona has applied to Concordia for admission to Information Systems Management in the Commerce Faculty. Her interest in computers has soared, partly due to a course she liked in Mass Media (see below), partly because she has always liked computers and has access to the internet at home, and partly because she has an uncle who has a computer store and who gives her some sense of connection to this area. Family still seems to be an important influence for Shona: one recalls that her family is all in business, that they hoped she would follow some professional path, and a university degree was made to seem essential to her future. Her choice seems to fall into some kind of compromise among these influences. Cindy sees herself pursuing psychology which she says is " science with a more human side that you see in the people type of thing." The key to this choice, however, appears to be that she has done well in it: "I got my first test back and I got a 90%! Whew! Okay, I like this." (See more below). She is still determined to show the world she is somebody: "I'm going to be rich. So I know I have to go all the way to a Ph.D. even if I have to scratch and like claw...." Cindy actually changed programmes after her first year, switching to Social Science in despair of ever succeeding in science. "I was studying and then I just didn't see....Why am I doing this? Why am I studying? To get a mark? What's the mark for? To please

my mother? That doesn't make sense." At another point she explains: "I was so discouraged and I thought I couldn't do it and my parents are, You can do it like....And I said, alright, alright, alright.... Like, I needed to prove it to myself." She switched back to Pure and Applied Science in September of her second year. Parental encouragement is helpful in enabling her to finish the DEC, but family pressure is clearly not enough to hold her in science, nor is it the only factor in motivating her to continue with the DEC. It is interesting to see the complexities of family influence upon the women's choices: such influences are never direct nor single.

Career choices for three of the men seem to fall mainly into the business area. Marc wants to pursue Business Administration in university, and seems to be considering UQAM now, despite his earlier intentions to study in English. He feels he was too much influenced by his father in his original choice to become an engineer, and he attributes some of his change of heart to his girl friend, who helped him see "it was not my subject." But his parents seem to have agreed to the change. In fact, he now says "Well, my father has a company. I always see him as a businessman and I want to be a businessman." Stan has stopped thinking of dentistry and reverted to his original second choice, that of advertising: he will pursue Marketing at Concordia: "From what I know, marketing is like trying to project ideas. Like it's trying to sell stuff. I don't know, it just gets my imagination." He says that his pursuit of science was "just to please my parents," but he does not say what they think of his change. Doug is still interested in psychology but will not pursue it: "I guess I would prefer like a more traditional job. Not that I prefer, it's just that I feel more comfortable." He has some trouble explaining this choice to us, but he finally says he rejects fields in which "you have to like express yourself or something like that whereas in business and science there's less of that." He too will go on in Marketing, but he admits the choice is more like a "process of elimination" than any real knowledge about or interest in commerce. He comments again that his father is an engineer, and at another point that "I think if I moved out of the house it would have a beneficial effect on me." He tries to explain this in terms of needing to develop independence, but perhaps he still feels pressured by family values as well. The men seem to be more overtly influenced by such things, and to experience change as a kind of rebellion, however peaceful, rather than personal evolution. Ken, who will go to a trade school to study car mechanics, has experienced a strong sense of futility with science education:

I know how to do it and build a house with it and everything but it's just that when you're actually doing it you're never using these formulas. So that's why I'm sitting there and it's like, my dad never uses those formulas; he's never shown me those formulas and we still do....It's like why do we really need that?

He reasons that "there's always going to be cars that need fixing" whereas two of his friends have engineering degrees and no jobs. It does not seem to be the job certainty that concerns him as much as his impatience with science courses which require intellectual work rather than manual labour. Since his father very much wants him to have a science DEC, he says he will persist, but he is far behind due to many failures.

It is not surprising to find that this group still shows a wide range of interests and has, on the whole, enjoyed the non-science courses. Jen demonstrates the most instrumental motivational profile, viewing her academic life in terms of its usefulness for her future in a medical technology. She says of her non-science courses "they took up a lot of time." Even she, however, can say of studying English: "I think it's important to know how to write and how to read and how to comprehend, you know, literature or something." All these students have liked English, even the francophone student. Most have enjoyed humanities and various complementary courses such as art history, sociology, psychology, geography and communications. Interestingly, however, it is only the women who have made their

university plans according to their enthusiasm for these complementary studies which they call "fascinating", "cool", "not just books", "new things", and so on. Cindy has enjoyed English so much and has been so much encouraged by an English teacher who told her she "had a lot of promise" that she says she is sure she will always write poems and stories as well as practice as a psychologist. The men's choices for future study are not based on any of the subject interests they developed in Cegep. As Doug says, "Working and hobbies seem to be different things" and "Like, you get what work you can and like a lot of times it's not work you enjoy so... I guess that's why a lot of times work is getting portrayed as something you do...." All the students have kept up their outside interests, the women in writing, computer play, nature walks, dancing, aerobics and the men in church groups, cooking, drawing, and organized sports. Only two students work, one man and one woman: the others who speak of jobs say they do not think they could handle a job and study at the same time. Ken is, if anything, even more enthusiastic about his outside activities than he was in the first semester: "I have to do everything I want to do. Like, I have so many dreams and so many ideas and like I just want to do it like now." He has been president of a student club; he has been a ski instructor; he works for a construction company loading and unloading trucks, a job which, he says, "I just love." In this enthusiasm he is alone: the others are not high energy personalities, nor are they driven by any of the motivations that seem to encourage high productivity.

None of these students has done very well in science, and this lack of achievement seems to be a primary motivation for changing their future plans. Only Jen has maintained an average in the 70's, and interestingly, she defines success as "To know that you have done your best no matter what the grade says." She does not feel her marks warrant university aspirations, but she is not very discouraged, since the technical programme appeals to her. Shona is a little more discouraged, as she feels she has worked very, very hard and not done well at all, even in a subject she expected to excel in, like biology. She admits her science marks were "mostly on the borderline." Cindy makes it clear that she has not worked, and that her low grades, particularly in second semester - a failure in physics and "Chemistry, oh, that was not pretty....Calculus I passed because I think she liked me" - were the result of not being able to make herself work. "I'm not pleased with what I did. Like, I didn't do as well as I thought....I didn't do badly but I know I could have done better...but I didn't. I don't know why." The men are clearly displeased with their achievement in science and have had much better marks in other subjects. Marc talks about being shocked to discover "I have to work to succeed" because "in high school I didn't study and I had good marks." He talks about being "discouraged" by his low marks in science. "I'm not proud because I didn't get good marks." He does not overtly relate this lack of achievement to lack of effort, but he implies the effort required was a bit too much for him to adjust to. Stan is more frank about his poor record ("I failed like five and barely passed the rest") when he says: "I didn't try my hardest either....It really shows in my marks. That's why. But maybe my marks could be higher and maybe I'd still have an interest in it." He does not seem very sure which comes first, the low mark or the loss of interest, but clearly sees that they are connected. Ken has actually done disastrously, though his cheerful personality demands that he characterize his achievement in rather neutral terms: "I'm not doing overly good in my sciences."

2. Attitude

The attitudes of these students to science subjects has understandably become less favourable overall, but the general profile of subject preference within the sciences has not much changed. They seem to have made some slight adjustments to what Cegep level courses require, at least enough

to persist in the programme and to pass the courses, however marginally. Their liking for individual courses has been very much determined by the teacher, as will be discussed more below, but even where they like the teacher, certain deep problems with subject matter persist. Most still say that math is not a big problem for them: Marc and Doug actually say they like math, and Stan says math is his strongest subject because he can see "what you have to do to get the final answer." Ken has not enjoyed math, however, and has failed many courses. However, even the women who dislike calculations in general say that math is tolerable because they can see what has to be done and they do not have any conceptual or theoretical difficulties with it, "it's very straight-forward." Marc says his second favourite continued to be physics, though he says "In physics I'm not comfortable" because there is much he does not understand. Cindy is enjoying her last physics course because "there are laws you can follow and you plug in some numbers and you understand the law." She goes on to say: "Oh, the calculations are kind of tricky and so you go back and fix it with your little eraser but you end up with a definite answer." Jen and Shona have had great trouble with physics, as they had at the outset, and have never liked it. The difficulty visualizing things in three dimensions, understanding theories, and applying formulas continued to haunt them throughout. Neither Stan nor Doug have liked physics, and both have found it conceptually very difficult. None of the students is enthusiastic about chemistry, though this subject does not seem to have caused as much grief as physics. Cindy says: "There's no reason for doing anything in chemistry and I can't understand it because nothing stays still long enough for me to be able to say, okay, it does this because of this." Jen has found organic chemistry very difficult, very different from earlier chemistry courses that were "more like high school." As they expected, Shona and Jen have enjoyed biology: "it's mostly like our life, how we live, and like how our bodies work, and everything around us." Stan, Marc and Doug do not like biology because it requires so much memorization; Ken prefers it to the other sciences since he can relate some of the physiology to his concern with skiing accidents. About all other sciences and math as well, Ken asks: "What am I going to need this for? When am I really going to apply it?" These generally negative and somewhat static attitudes help to reveal how little their science education has actually touched them: they have gone through the motions, and are now ready to leave.

These students certainly have not changed their minds about science being a difficult programme. Nor have they much changed the list of characteristics required to succeed: great interest in the subject, great curiosity, good time management, willingness to ask questions, great persistence, the need to get things right, and willingness to work very, very hard. There are also still some hints that some think the very top students have certain advantages, like "previous good courses they've taken" or "Some people have it" or "they're born with it." The effect of science education is something the women very much appreciate even though they are leaving science behind. They say that it helped keep them serious, that it developed their curiosity, made them more "intellectual" and better informed about the world. Three of the men do not talk in these terms at all; in fact, they deny that it has any effect on them. Ken tries to explain that studying science has given him a bit of appreciation of different ways of thinking and doing things. In terms of the future, guaranteed success of top science students is only mentioned by two of them, however, whereas others say things such as the following: "Like a routine every day going let's say to the lab and doing the same things over and over again" or "Like, they can read a book and take the information and spit it out on a piece of paper but then I can't see them being able to sit in the lab and then come up with something on their own." Cindy in particular is convinced that many science students become very narrow, and that this is a distinct disadvantage for their future lives, even in science.

Their vision of what science involves as a field of study has not much evolved, but we can certainly note some changes of tone in this area. Jen and Shona talk in terms of "the search for truth" and "answering every question that's asked about nature, about how things work, about why plants grow this way and why does a machine work that way?" Marc says "Science is something important but it's something you have to be interested in to like it." Doug says "It's like more of a discipline thing, more of an impersonal thing." The critical tone here is typical: these students are full of suggestions for improving the science programmes in Cegep. They feel there should be much wider choice of courses, especially in the non-science area, but even among the sciences, they feel certain subjects should not be required. They feel something should be done to help students retain what they are learning better: less material, better testing procedures, better schedules, better teaching, smaller classes, perhaps even greater rigour. There is a sense in all of this that the science programme failed them in some way, that courses and teachers swept on past them without giving them real incentives and opportunities to get involved.

Gender awareness has not much changed during the two years of these students' stay at Cegep, though a few of the students talk with a little more understanding. Shona still has almost nothing to say on the subject, though when she talks of wanting a future life "doing many different things at the same time" she is unwittingly describing the adult life of women. She seems to feel such a life precludes science, as well, since science, for her, is very narrowly focused. Jen is a bit more conscious of how her gender affects her view of the future and her choice of the technology programme rather than university. "I think it's because I don't want to spend a lot of time in studying. I want to like study until like a certain point - until my mid-twenties, let's say, or maybe even earlier - and then just get a job, you know, get started and then have a family as early as I can." She is also still very conscious of sexist and non-sexist teacher behaviour: she talks about a woman teacher who very much encouraged the women students to persist in science, and a man teacher who used all male examples and would not change, even when asked to do so. She also notes that there are fewer and fewer women in her advanced science classes, and she feels the men "look at you differently....They think you're in a way not smarter....I mean less smarter than them...." Stan is still finding examples of men teachers who favour women. Doug shows an awareness of how career stereotypes seem to play themselves out for others, but about himself he says: "I don't consciously say I'm a male and I have to do this or something like that." Marc shows new insight when he says: "I think guys are too confident about themselves in science. They think they are good and I think women study more than men in science. They are more, you know, interested by the subject? " He wonders if women are "more comfortable" than men - he does not say in what respect, but he implies they have greater affinity for study and school. "Well, my sister studies a lot....I saw her each night from 8 p.m. to 10 p.m. Four hours a night." This is much more work than Marc is prepared do, and he recognizes that. But the interesting point for us is that he is able to consider it as a possible gender difference, something he would not have done two years before. Ken now understands that what he once thought was women's slowness and ignorance is really greater care, and he acknowledges that women do better in their courses.

Cindy begins to comment on sexism, and does give one example of a physics teacher who called several of the girls stupid and seemed to imply that they did not belong in science. However, she rapidly turns her attention to the double issue of race and gender: "Not only am I black but I'm a woman and so I'm always sitting there going, Oh God, I have to prove it to this one, I have to prove it to that one....Why do I have to prove it to anybody? I just have to prove it to me." In fact, much of her struggle in Cegep has been her need to prove to herself, as well as to others, that she belongs among the elite, in the science programme. "You have to be good because you're black and the white person

is looking at you and you have to prove yourself. It's hard enough to get through it and I don't see why I have to prove myself to someone at the same time." One of the problems is that there are so few black students in science. "Like I can count myself sort of like in Chem I....Oh there's another one way over there. So, two of us in our chem class. I feel better already." She goes on:

> There are so few of us. When I accomplish something some people like become shocked type of thing. They'll be like, what did you get, what did you get? I'll be like, Oh, I got this. You did? It's a big shock. Did you study? Yeah. You studied?! Or, like, do you play... that's the dumbest question...do you play basketball? No. You don't play basketball but you're....

Cindy says "I didn't think it would be such a big problem at Vanier but I find that it is." She talks about a lot of "antagonism" between blacks and whites, and how often she is reminded that people are "looking down their nose". "Like, I was never reminded of this until I came here." Perhaps she refers here to the atmosphere among students: she has certainly suffered racism before, and she describes her high school counsellor who "made it very clear that because I was black she didn't think I could do it." She goes on:

> And I came with the biggest chip on my shoulder. And then after two years I said, Look, this is really hard enough on its own and there's no need for me to make it any harder. If she or he or whatever wants to have their own ideas let them deal with it and just blah! My father taught me that once. Let them do what they want to do. You do what you have to do and get going.

It is good to hear that her father supports her in this way, but it is a sorry thing for the institution that this student was left so much on her own to deal with such difficult race and gender issues.

3. Experience

The study experience of these students has been very much differentiated by gender. The men students all admit they have not worked hard. "I'm not someone who studies a lot," says Marc. "I open the books in physics and sometimes I don't understand and I leave it there." His efforts are very much classroom focused. "I listen to the teacher very carefully and I write only what I understand for the exam and I read my notes and it's finished." Stan tells us he does not do homework, but he is now trying to start studying for tests a little further ahead (he used to leave such study till two days before). He complains that his notes from class are useless because he so rarely understands what the teacher is saying. He tries to use the text book, and does problems where appropriate. He says he does very little on weekday evenings - "I either sleep or I just go out." He does his work Saturday and Sunday afternoons, from noon to five. Doug admits he is never ahead, rarely up-to-date: "it's more of a catch up thing." He finds it hard to listen in class, though he makes an effort to do so. He also says "I've always had problems studying." He says he can't seem to work hard: "I just want to get by." Ken still sounds better organized than the others, but he still seems to be using mainly his breaks during the day for study and homework. He also describes some of his behaviour as "slacking off". All of these young men talk about being unwilling to participate in class because "there's so much I don't know" . They don't want to ask a question for fear it will call attention to their lack of understanding. "I think it's everyone looking.... You know? That's true. You ask a question and the other students...." Doug actually says he likes the large, impersonal science class where the teacher does not know who he is. He does

not say so, but it seems he finds this anonymity protective. He also calls himself "passive" and the word seems to be an accurate descriptor. These students do not seem to seek out teachers for help, either. Marc says he will go if a teacher asks him personally, but he will never go when the teacher suggests office appointments to the class as a whole.

The work patterns of the women are quite different. Jen and Shona have worked consistently and conscientiously throughout their years at Cegep. Jen works at least three hours a night on her science homework and spends more time on it on Sunday. She says she likes studying. She likes to take notes, and is critical of teachers who do not help her do so with organized blackboard or overhead work. If she does not understand, she will try to do some outside reading or go to see the teacher. Shona does not say she likes studying: studying science has been too discouraging for her. However, she has always tried to keep up to date, working from about 6:30 to 11 or 12 four nights a week, then Saturday afternoon and Sunday all day. She talks about reading notes, reading texts, doing problems. Neither of these young women will ask questions in class because they are too shy and they don't want people to "look at you like." It is very difficult to know how much work Cindy does: it appears to vary a great deal. However, she does seem to work harder than the men, and to expect herself to work much harder than she does. She says she tries to take good notes, to do her homework regularly, and to prepare for tests ahead of time. She says she does not read her texts very carefully, but reads the summaries, the headings, the main points: she highlights what seems important and ignores the rest. There is something a bit haphazard in the process she describes, and she knows it: "I was sitting down with a book and I'm saying, you're not studying. Like, the book is open but you're not studying. You know you can do better." She finally explains her behaviour as a kind of rebellion: "I guess I was getting tired of pleasing everybody else and not pleasing me." But in fact she has not pleased herself much in the process. She too speaks at some length about asking questions - how important it is and how very very difficult "because I always feel like the only one who doesn't understand."

These students continue to rely very heavily upon teachers to motivate them and to help them through their work. "It's up to the teacher, I find, to get you interested the first time," says Cindy. Their discussion of teachers tends to be much more cheerful in this second interview, however. Clearly they have all had some good experiences and are willing to acknowledge them. Cindy talks about the science teachers who "would get into it and go, come on guys, you can beat it; it's not that hard, you can do it. Just like little cheerleaders.... You could tell they really liked the students and they would try and help and they'd be like joking and you could ask questions and you didn't really feel afraid...." She talks about the woman psychology teacher who was so "encouraging" and the woman English teacher who "just made me feel so good." She also talks about admiring teachers, particularly a black humanities teacher: "I want to be like these people. I want to be smart and I want to know what I'm talking about." As sensitive as she is to good teachers, she is even more sensitive to teachers who "hated their jobs" or the teacher who is "just a board writer" and refuses to engage with the students, or the teacher who puts students down when "if you put your hand up and they're like, you don't understand; you're so stupid." There is real hostility in remarks such as the following: "Like I've gotten to the point now where I don't take some of the crap those teachers dish out any more" and "So you go back and say, Look, Sir, I don't understand this and I don't know why but you're going to explain it to me....If you don't explain it to me I'm going to get really upset." Teachers might be finding Cindy somewhat provocative, but she does seem to have had a large share of really bad experiences with science teachers. Jen, Marc and Stan have all felt somewhat alienated by many of their teachers, who did not seem to know them, care much about them, or engage with them other than putting material on the

board. Still, Jen speaks enthusiastically about the biology teacher who tried to encourage the women students and who made herself so available outside of class. Her enthusiasm and encouragement were inspiring for Jen: "It made me, you know, think that if she can do it then I can do it. You know? It's possible to be done. To lead a career and to go to school and get some knowledge." Ken still talks glowingly about his first semester teachers who would explain things as often as he asked; he tells us, however, that later semesters brought him teachers who did not want to help him and either did not seem to know who he was or "made me feel....I was struggling and I didn't need them to make it worse." It is hard to know what exactly happened between Ken and these teachers but he says: "Some of the teachers need to take a class on teacher-student rapport because it's like non-existent." . Marc speaks of a chemistry teacher who spotted his difficulty after the first two tests and "he was always asking me to see him and we're doing work....He helped me. I really liked this." Doug is very vague about bad teachers and good teachers but concluded that "more bad teachers you see." A bad teacher does not explain well and is completely uninteresting. Stan has had a clear and interesting physics teacher this semester and is actually enjoying the course. Shona is the most charitable of all: she says that all her teachers were helpful and kind, and that it is not their fault if the classes were boring: it was the material. She clearly much preferred her mass media teacher who was innovative and personal, but she says she does not think a science teacher can be either:"I wasn't really looking for that in a science teacher."

These students have been through some very anxious and depressing periods. Most had very bad second or third semesters, when they first began to realize they were not going to do as well in science as they had hoped. "I didn't get the grades that I wanted and I felt really bad because I was putting all this work and time into it and I wasn't getting the grades. But I didn't know why," says Shona. Deciding that she did not like the programme has made her feel a bit better, but now, like Marc and Doug, she feels she is struggling to finish something that has lost its appeal, is harder than ever, and must be completed before she can do anything else. Many of these students have summer courses to take and fear they will not pass them and will therefore not get into university in the fall. In this sense Jen has an advantage, though she is still anxious:

> I would get anxious before a test. Always. I still do. Actually, before it was worse because before my marks....You know, I thought I was going to university and I thought my marks had to be good. You know? No, I'm not planning like right away and it's not as high; my anxiety is not as high but it's still there. You still have a feeling....You know?

Both Jen and Shona admit to not being very confident of their ability. Cindy has suffered intense anxiety in relation to tests, particularly after the test when "I know I flunked it and it was all just, how could I do that...." Often she discovers she has not flunked the test, but this experience does not seem to change the cycle. Her second semester problems were compounded by family illness and employment difficulties, and she talks about the experience in a strange and distanced manner: "But it wasn't me any more it was just a person sitting there and all this stuff was happening to her and I was watching all this stuff happening to her...I said, that poor girl must have a rotten life and, then, no, that's me." Her words ring out the intense sense of helplessness of the student who suffers such bad experiences in school, and the tremendous passivity that sets in. Clearly it was not till the following semester that it occurred to her that she could take repossession of her life. Doug does not articulate his depression but it is evident in his bearing, his voice, his lack of specificity about anything. "Sometimes you don't feel like doing it. Sometimes you can't really find a reason to do anything like for the

courses." Doug can find no reason for competition, either, since he does not "keep a tab of how well other students did in comparison" and he says he would have to enjoy something in order to compete. We sense that he has such low energy about much of his life that he almost never puts himself into a competitive framework. Marc says he left competition behind with his good grades in high school but some of his comments betray him: "I feel discouraged. I look at my friends who are in other Cegeps and they're going to university now and have no problems. Their marks are good and...." He also comments on the pressure he has felt from his father to "succeed and...go to university in September...." He may not feel he is competing, but he is very much comparing himself with others, and the experience is not pleasant. Jen talks about students who do this: "I know people and they go nuts...they always complain and they always say oh, that wasn't fair...." She says she tries to compete with her friends, secretly, "you know, just a bit to get, you know, higher grades than they do but it doesn't mean that you know if I get better grades I'm smarter than them it just means that, you know, it feels good." Neither Shona nor Stan feel competitive about their studies, perhaps because they have lost interest to such a degree. Ken says: "I don't mind competition. Competition is.... I like competition. But when it gets to the point where people are belittling you and I'd say, I didn't do so good...." He also admits: "After the past semesters when I've had problems my confidence I must say is waning." Cindy, who is intensely competitive, has a similarly ambivalent attitude to comparing herself to others. This can work very well, sometimes:

> I need someone....I'm a tail chaser...and I need someone at the top above me to say, Okay, she's not that much smarter or she's not that much smarter and I'm going to get her.... I need to catch up to her. And then I need the little ones below me so that when I can turn around and feel kind of smart for two minutes and say, Oh, I can explain this to you.... I need the mixture. I need the smarts with the averages and I need like the big melange.

Sometimes this can back-fire, however:

> I have these two groups of friends and I call them the dumb-dumbs and the smart-smarts. When I compare myself to the dumb-dumbs I'm doing really well. When I compare myself to the dean's lists then I'm not going to hang out with them any more because they don't make me feel good.

Students who do not do well cannot just stop comparing themselves with others, especially if these comparative, competitive habits have been deeply ingrained. And they suffer a great deal when they see how far below their admired peers they have fallen.

A striking gender difference within this group can be seen in the way in which they have interacted with their peers. Doug never speaks about friends or working partnerships. One gets the sense that at Vanier, at least, he is completely alone. His friends seem to be centred in the church. Marc speaks of relationships in entirely instrumental, practical terms: "It's useful to have friends in science because if you have a problem you can ask them." He says he has two friends, both francophone. His girlfriend, of whom he has spoken more, is not at Vanier. Stan speaks only of unsatisfactory working partnerships at the college. He has occasionally spoken of going out with friends for relaxation, but he, like the other two men, does not connect friendship with his Cegep studies at all. Even Ken, who values friendship much more than the other men, now complains: "But the friends who are with me right now in my science programmes and everything they're discouraging me more like in the aspect of sciences and stuff and to do into other things and it's like, Good friends, good friends...." The

women students are quite different. They can see the instrumental value of their relationships, and they make sure that they operationalize connections that can help them with their subjects. But they also thrive on these connections. Cindy says: "It's just the coolest feeling. Everyone learns from everyone else. Like, Oh you learn from this person and you learn from that person and you just stick it together." She says: "If it weren't for other people I really wouldn't be here. Yes, I like working with other people. Yeah. Like in biology I had a lab partner and, well, we had a ball." She only wishes she had had more close friends in science, who would "know what she was going through," but most of her close friends appear to have been in other programmes. This mutual support through the times of trouble is exactly what Shona and Jen have most treasured in their Cegep experience. They both talk about good lab partnerships; both also talk about working on homework or study in a kind of parallel formation, independently but together for help with it as needed. The ways in which the women integrate their relationships with the whole spectrum of their lives is unique to them; the males either do not need to do this, do not want to do this, or do not know how to do this.

The value of the Cegep experience varies a good deal. Stan says he has found it a waste. Doug wonders if it has been a waste, then says that the non-science courses saved it, "more broadening of my tastes." Marc says he feels he proved his courage in coming to an English Cegep and "I've survived." The women are much more enthusiastic. They talk about learning about themselves and learning how to manage the freedom Cegep has given them. They talk about the enjoyment of college, with its social life and various activities. Cindy talks about developing self-esteem and learning to like herself. "I think I've grown up, sort of. ...I have more confidence in myself...and I can see myself actually going out on my own now and saying, yep, this is the future. Big adult now, you've got to do things. Yes, be part of society." Ken says that he has found it all valuable, and that he has learned a lot, especially in non-science subjects. In fact, however, aside from Ken, the women have obtained a lot more out of this experience than the men. They have been touched by it in a way that Marc, Stan and Doug do not seem to have been.

VIII. STUDENTS, HIGHLY SUCCESSFUL IN SCIENCE, WHO ENTER UNIVERSITY IN DIFFERENT DISCIPLINES

A. SUMMARY

All of the students who correspond to this description are women. From the very outset of their Cegep studies, these young women express both enthusiasm for science and uncertainty about restricting themselves to it. They like the precision of science but they clearly look for transformative experiences in education as well as mastering material and complex procedures. They are very unsure about their career plans. Their discussion of careers in the first interview, in fact, is so wide-ranging that it is clear they are pulled in many directions by multiple interests, in drawing, writing, music, and so on. They are trying to think how they can combine their many interests in one clear path, and they cannot do so. Clearly, keeping the doors open is an important motivator for them. They have been much encouraged by their families, all middle class professionals: two of the fathers are engineers. School, according to them, has had less effect, but two have been sent to private schools by interested parents, and one remembers her math teacher as turning her on to science. They have always done well in school, but they are remarkably reticent in their first interview about highlighting their achievements: they talk instead about low points and the difficulties they have had.

Their attitudes to science in this first interview include a good deal of awe about its difficulty and some trepidation about their ability to do it. They think there are, indeed, students who are much more gifted than they are, and who do science "naturally." They insist they can only do it if they work very hard. Their greatest difficulty seems to be physics, even at this early stage. They are already a bit critical of Science Plus, in which they are all enroled, for demanding so much of its students. That they love to learn, and will lap up almost anything, however, is probably their most striking characteristic. The experiences they describe in the first interview include a very rigorous self-initiated programme of homework and study, a great deal of teacher respect and even dependence, enormous and inordinate amounts of anxiety about their achievement, and great pleasure and comfort with their peer relationships.

When we meet them again two years later, they still like science, but they do not like it enough to stay inside its boundaries. It has become too small, and it excludes too many of the things they love and have excelled at or longed to pursue in college: writing, drawing, history, psychology, political science, and so on. They have done extraordinarily well, two with most of their marks in the nineties, and one with good solid eighties. They are very pleased, now, about their achievement, but they are also surprised. Doing well has, they say, increased their self-confidence, and they do seem more prepared to say "I'm good at this." However, they have suffered enormously to acquire these grades: the anxiety level has been horrendous, almost enough to cause each one to describe her third semester, the time when each was making plans for university applications, as a time when she almost broke down. Science is critiqued, therefore, as being too hard, too restrictive and too demanding. Science Plus is seen as being too competitive, and some of its teachers as asking too much. They are aware that they have had, on the whole, good science teachers, but they do criticize some of them, and they have not bonded with science teachers: to the extent that they have favourite teachers, these teachers are always of other subjects, usually English and humanities.

They attribute much of their pleasure at Cegep to their friends, and most of their friends do seem to have been in Science Plus. They have continued to be remarkably able to integrate their peer

relationships with their lives as intensely dedicated students, and it has been a relief to them to have a group of peers who is "in the same boat" in terms of dreams, goals and difficulties. Clearly it is good for high achieving women students to have each other. Two, however, have never made close relationships with the opposite sex, and one has had some trouble with boyfriends who either criticize her for her ambitions and hard work or distract her and cause her to feel guilty. She does not see this type of experience as a gender issue, but it clearly is, and we are struck by a generally low awareness of gender problems among these young women: because they have been together with other young women doing better than the men in science, they seem to believe there are no more gender issues in the world out there.

Nevertheless, when they tell us that Cegep has been "wonderful," mostly for what it has taught them of themselves, but also because of the rich range of experiences and knowledge they have gained, we cannot help but agree. Nor can we help feeling it is a great loss for science that none of these young women has decided to persist: two think they might return to medicine and architecture, respectively, but they may not. Both will take Arts subjects at university. The third will go into Psychology. If they never return to science, we cannot help but feel that science has lost creative, resourceful and highly gifted students who might be able to transform the discipline in ways which are emerging for us as necessary.

B. THE FIRST INTERVIEW

1. Motivation

From the very outset of their Cegep studies, these young women express both enthusiasm for science and uncertainty about restricting themselves to it. Vera really captures the problem well:

> Why are you in science? It's a hard question. Well, there are certain aspects of it that I really like and I didn't want to give that up because I find the problem with the Cegep system is that it's way too, like, 'You're in this' or 'You're in this'....or 'You're in this' and that's it, and stop there, you know. And, I mean, I don't know, I just, there's so many aspects about science that I just love. Like, I love the precision of it, I love that it's right, you know, it's so clean...it's such a clean subject. And then you just, you have a theorem and you have a problem, and you just solve it, and it's so clean, and there's no...there's no, you know, well, 'This could be this, but then it's probably this but...', you know. So I like that about it. And I didn't want to give that up.

All three enjoy the precise answers offered by their science studies: "You figure out how things work and why things happen in terms of the very concrete, physical world around us," says Anne. Jan says: "Why is the big question" and "when I'm studying, like, I feel, like high. Because so many things fit together in the sciences, like, fit so well. And I just get happy...." On the other hand, she also says: "I don't know what I want yet. And I don't want to, like, just go into science and then regret it later." Anne says she has always liked the sciences, and Vera says her interest is rather new. The intensity of their non-science interests being what they are (see below), it is important to note that what brings them to select the sciences is clearly that they can do what they like thereafter, whereas other choices would not keep as many doors open. All of them are very frank about this aspect of their choice.

Their discussion of career plans is, accordingly, very tentative. Anne and Jan are considering architecture, but very hesitantly. The main attraction of architecture seems to be the way it appears

to draw together science and the arts. Anne, who is in the process of rejecting civil engineering because she is not enjoying physics says: "I also realized that I have to do something that's balanced. I have to do....I can't do something that's just science or something that's just art so...." Vera is distressed by her own indecisiveness but very articulate about it:

> I find it really hard for me to decide right, everyone else seems to know exactly what they're doing except for me.... 'I'm going into this, for sure, I am'...'I'm going to be a lawyer.' 'I'm going to be this.' But everyone seems to know. And I....I'm not sure. I have things that I'm thinking about, but nothing is, nothing is concrete at all....I wanted to continue, you know. I feel, it's hard for me to explain. I find that a lot of the fields that everyone knows about are really restricted, for me, in a sense. And so, once I talked to this man, who's a, he's a naturalist, and he told me that he also found the same thing, and so he made up his own field and I, totally, I was, like, 'Wow! What an interesting idea!' And, so, that, I just sort of try and think of things where I could incorporate everything that I like to do. Like, I really like biology, but I also really like drawing. So, I was thinking, you could become a sort of, like, illustrator, medical-type books...or you could even go into medicine, but you could still take a different approach to it, a more, you know what I'm saying?

Like all beginning Cegep science students, these young women have been influenced by various adults. With this group, the predominant influences appear to have been those of family. All are from middle class professional homes. Jan and Anne have fathers involved in science, an engineer and computer science university professor. Clearly both young women have been much influenced by these fathers: "Oh my Dad, he's so smart you know." The third father is an English teacher. Two of the mothers are full-time teachers in non-science areas. They all talk about the influence of these very encouraging sets of parents, who help them with homework, strongly support their continuing in the sciences, help them schedule their time so that they can do the multitude of things they wish to accomplish, and offer a lot of TLC when things are difficult. Jan talks about her father actually trying to get her to work less hard, and to offer herself more "rewards". None of them seems to feel pushed by her parents. Schools do not seem to have been that influential with respect to science: Anne and Vera have been to private girls' schools, and neither have very much good to say about the science programmes there. Anne had actually left the private school to continue high school in the public system because she was unhappy, though this unhappiness did not seem to relate to science but to overall acceptance by teachers and students. Only Jan talks about a teacher as a strong influence:

> It took me time, like, I was never good in math. It's funny because like even now, I sometimes still have problems....So, like, I never even, like considered science, like I dreaded it. And then I had that Grade 10 teacher....Well, I guess, well, I guess mostly what she did was like, she was a good teacher. So, like, I never really understood, I can't like, the feelings, like I'd have to think about them. But I, I think it was that I'd never realized that I could understand it....So, but I mean, I think the difference was that I was trying harder because I realized I could do it, like in math and all that stuff, like I, I don't know, I guess I just developed into, like, new study habits or something.

The way in which this teacher gave the student faith in her own ability is exactly what Vera says she hears from her mother, who says "No, you can do it, you can do it." The interesting issue here is the

extent to which these extremely high achieving young women rely on this type of support: all are in Science Plus, yet are very diffident about their abilities (see below).

Like many other young women entering the sciences, these students bring a broad range of interests with them. What distinguishes these particular students from all others, however, is the intensity of these non-science interests. All three are very fond of various forms of art - architectural drawing, sketching and painting, theatrical set design. All love to write creatively, and Jan actually says she would "love to be a writer." As they talk about their interests, they always complain about the programme restrictions that keep them from taking more courses in these areas of interest: they do not view these other interests as merely leisure activities. Vera tries very hard to explain what her favourite non-science interests have in common with her interest in science. Her word for science is "clean" (see above) and she uses it again to describe both painting and creative writing.

> Yeah, I'm taking a painting course. I just had it this morning actually. It was really fun. I love it...it's so clean. Like, if you paint...it's so there, it's so there. Like the problem with, like, economics and some subjects like that, 'Is it there? Is it not there?' you know. You never know. Nothing is ever clear. It's always 'It could be this, but then if you run into this problem, this could happen?' and I just don't know...[and] if you write an essay, you can always write more and more...and more, and add and add, and keep going and going and it never stops....I also, I really enjoy creative writing - but that doesn't fit in anywhere else. ...But it's also really clean. Creative writing is really clean....The essay is such a mess...it's such a mess.

One can see some of what she is saying here, that uncertainties and lack of control of some kinds really trouble her. She also characterizes swimming and dancing, her favourite sports, as clean:

> There's something very precise about dancing for me. There's something very there and there's something really precise about swimming lengths....I love it. I love the way you just go back and forth and back and forth, and I just, I love it, and I love dancing because it's so clean, you're so in control of your body and it's so, there's no mess, there's no....

The other students do not try to link their wide ranging interests together, though there are hints that some of the same outlook might be there: no one, for instance, shows enthusiasm for speculative activity or debate. Outside of writing and the arts, the only academic area that is mentioned as particularly enjoyable is psychology, and that only by Anne who finds the class boring but the material interesting.

Though these students show great anxiety about their achievement status (see below), they talk remarkably little about their actual marks. Since all are in Science Plus, it is clear that they entered Cegep with excellent mark records, 85 or above. None makes much reference to these past records, except when asked directly. In response to direct questions they often refer to the lowest mark in actual numbers, and are vague about better grades, calling them "high" without specifying; sometimes they just say they are not doing as well in Cegep as they did in high school, without giving specific marks for either. Jan feels she would be doing better in regular science than in Science Plus. Anne says: "I got 85 [in physics mid-term]. That's a pretty good mark. Especially since I thought I'd failed it.... Yeah. I was pretty sure or I thought I just barely passed." As she goes on to speak of this test, she makes it clear that her reticence to talk about her marks is not a reflection of lack of concern about them:

> When I do a test normally if I have time I go over it and try to give myself a minimum number of points I think I got on a question. Whether I didn't lose any points on....So when I added that up I didn't do well but it was because I was really hard on myself.

What appears to be expressed here is some feminine modesty as well as a strong sense of the fragility of success: these young women generally do very well indeed, and have learned not to discuss or count on their successes. Discussing anxieties, however, is not a problem for them, as seen here and below. Their expectations of themselves are complex: they feel they ought to do well, but they are not sure they will.

2. Attitude

These students, like many young women, bring a clear set of subject preferences with them to Cegep, among them a dislike of physics. They talk about being taught physics badly in high school, but they also talk about having difficulty with Cegep physics, having "trouble sometimes imagining the situation", converting "theory into reality to understand it well", knowing what information is relevant for solving a problem, figuring out how to check their answers. Anne is having a particularly difficult time:

> I was doing really badly. Like I failed a couple...I failed a quiz and a test. But I studied very, very hard. Most of the problem with physics is you have to do a lot of stuff on your own. A lot of doing problems and understanding them yourself. He does a few in class, he explains sort of the rules and the theories and then you have to learn how to apply them and make sure you understand them.... It's such hard work....Really just ploughing through it and just you know not getting...even though I was really working....

"Like, even just the units," says Jan,"I don't even know if my units are right....I don't even know if it's negative any more...So, I feel pretty stupid sometimes, but I'm doing OK actually." Vera says:

> Well, sometimes physics is really fun because it's a bit like math, and sometimes the problems are really fun to solve because they're a lot, they're really clean and there, and you can even draw a cool little picture with a rule and stuff...but then sometimes, I don't know how to explain it, it just, it doesn't it doesn't make sense.

Vera and Anne are very fond of mathematics and always have been. Anne is doing fine in calculus: "It's like a game I get to work through." She also says of herself: "I loved to work on problems when I was in elementary school and I enjoyed doing them and I understood them." Jan, however, seems to feel she is "not that good with numbers" and that this affects her in both math and physics. She likes chemistry, especially when it is connected to the modern world, and biology:

> I like, I don't know, like, biology, like animals and stuff, but I also like the brain and...like chemistry of the body....Because, like...I like learning how our body, like, it was amazing, like all these things you found out. And I had a good teacher for that too. He was young and he was, like, he had all this energy, you know, and I still actually, he moved away it came right down. But he was, I don't know. I don't know he brought in examples, but it was just biology itself, like, you weren't....These things, like, I'd never known that you could know. Like I always had, I always had questions about everything, you know, like, because I wore glasses so I did a project on the eye, and I found all these things, and that was good.

She chose Health Science partly because of these earlier interests, though she still talks about architecture because of her interest in drawing. Vera, also a Health Science student, also says she loved ninth grade biology: "I loved, it was fun dissecting things. It's so clean....No, it's so clean, it's so, little incisions and it's so much fun." Anne, who is in Pure and Applied, does not mention biology, but says that chemistry is of interest to her especially when classes deal with issues like the atom bomb or history of photography, "stuff that makes it a little bit more human". She also has an interesting take on the invisible aspects of chemistry, which other students complain about:

> I usually don't get too confused in chemistry because I just accept what the teacher tells me. Like I accept the rules and the laws and stuff and the theories that have been developed. I find that a lot of people get confused because they try and understand them . Like a lot of it is very abstract and you're also dealing with things that are tiny, tiny, tiny, and so you can't really picture it that well. You just have to accept that this is how it is, accept the evidence that people have come up with and the evidence you can see for these theories and not try to worry about the nitty, nitty, gritty.

There is a certain attitude both to learning and to teachers underlying these remarks, a mixture of openness and compliance, that is not uncharacteristic of these young women who enjoy learning, often for its own sake, and often seem to find the material easier than other students do simply because they are not combative with it. This emerges in other sections of this narrative, and is discussed below.

These students have a very strong sense already that their Cegep science subjects are part of a big picture which they can only dimly grasp, but know is there. They all say that, at certain times, they do wonder about the relevance of some new piece of knowledge, but they generally feel that there is some sequential process being explained to them that, if they are patient, they will understand. As Vera says: "I go on faith. They know what they're doing...and it always ends up somewhere else. So, all my past experience, it has ended up in another area where I can apply it." Jan says:

> Like, you'll do, like, you'll do one thing and then, like, you don't understand it, and then you do the next thing, and you understand the first thing, so by the time you get the test, the first thing's really easy, and you didn't really know why you were learning the first thing, but except that it helped you do the last thing, you know.

Later she says: "This is a little dry, but I don't think it's going to stay this dry because we have to learn, like... how are we going to do anything interesting unless we know, like the fundamentals of it, sort of? So it's not their fault." Anne says: "I guess I like learning stuff. The more I know the better. I love learning new stuff and so I never really think about it too much. If they want to teach me this, I'll learn it." Here again one notes the strange combination of openness and compliance that characterizes these young women and quite possibly plays a big role in their achievement pattern. It is only the difficulty of science that they really criticize, but even there, they seem to feel that is just the way it is:

> Something seriously has to be done. Something has to be done now. Because I know, like, the majority of, I mean, all my friends went into the sciences. But that's just a fluke, that just happens to be because we hung around together and.... But the majority of girls that I know, 'Are you kidding?' No way, no way are they going to go near anything in science.... But they can't change the fact that it's hard.... What can you do? You have to learn the material, right? So, how is there any way you can make it easier?

All of them say that science is hard. "I feel so bad about the sciences, it has the worst reputation....And that, because it's so hard...and people go, like, That's insane. It's so hard." About Science Plus, Jan says:

> It's very stressful but I'm trying to decide whether or not it's worth it. Because I can take it, I could but I don't know if I want, like, I don't know if I should. Because, like, I know at university it's going to be really hard, OK. So, I don't know if I should alleviate that a little right now, and, like, learn a few extra things that, like, will help me, like, when I'm freaking at university, like, have a little to fall back on, like, in the beginning....

This student is very critical of Science Plus. She says she thought it would be a "Joe Schwarcz type of thing", by which she seems to mean a rich experience in the relevance of science. What she finds on the contrary are a lot of activities like compulsory lectures and field trips that she has not really enjoyed, mainly because they are compulsory. Vera does not complain about these activities but talks about how counter-productive they have been, since students do not want them, particularly the lectures, and the non-attendance and resentment have created a very negative atmosphere. Anne says she likes the atmosphere but has heard quite a number of students are considering dropping out. They are all very uncomfortably aware of the way Science Plus students are viewed by the community, as very, very smart and rather arrogant about it. They joke about being nerds, and seem to be aware of a certain possibility of becoming a "narrow-minded, irritating individual". Anne has a fairly positive view of a science type:

> When you think of people who are good in science like in universities they're more sort of quieter people, usually. Well, not necessarily quieter but they just really think about things and spend time on their own just thinking or playing through something or whatever.

They also recognize that there are certain people who have a kind of genius for science. In fact, this little group of students makes a great distinction between what they view as the excellent science student on the one hand and themselves and most of their friends on the other. They seem to feel that most of their peers in Science Plus are like them: very, very hard workers with many other interests. As Anne says, "The class I'm in ...everyone is very creative and well-balanced. Most people have other interests other than just science." They emphasize how hard they have to work to do well. They also recognize that, as in any programme, there are lots of other science students who do not work hard - and therefore do not do well.

All these students acknowledge differences between men and women students. They say the men make more noise and tend to get more attention from teachers. Vera complains that the men in Science Plus "think they're so smart, you know, they think they're `I'm right. Of course I'm right.'" The result, in her opinion, is that "they get listened to a little more carefully." The men are better in the lab, in her opinion.

> Oh yeah and they know, like my physics lab partner, he totally, he knows how to put the track and whatever, and I know nothing about anything, about, you know....Well, because he's a guy. Guys know those things. Well, they're guys. They play with those things... you know. I never played with electrical wires and... girls aren't allowed to play with those electrical things. What can you do, you know, what can you do?

They say their Vanier teachers are absolutely non-sexist, though Vera talks about sexism in the high school. Vera also tries to explain the difference between men and women teachers. Much of what she says is very unclear, but this point comes through:

> Sometimes they're not in control, women are not in control. They're not, unless they end up being in control... they're not... and it makes me feel like doing that especially because I'm a woman, so, I just, I end up just copying them.... Oh my God, Oh my god! you know, and....

Interestingly, both Vera and Anne say they are determined to have children, and will work very hard to find a way to support them well, but they are not keen to marry. Jan thinks she might marry but not have children. Clearly these students have a gender awareness that is not entirely conscious, and is very unsophisticated, but they do see themselves already as perhaps somewhat disadvantaged in their chosen field, and, in future, possibly not fulfilling all of society's expectations of women.

3. Experience

When asked to describe how they approach their learning, it is clear that these students do, indeed, spend a lot of time working. They do homework and or study every night and much of the weekend. They seem to be very well organized, keeping up to date in all their subjects, taking little breaks during an evening which might be as much as five hours work, allowing themselves one favourite television show per week, and, of course, keeping some time for their other interests. Much of their homework time is spent doing problems, but they read their texts very carefully, all of them stressing how important it is to understand everything. "If you don't study, you'll never understand, if you don't understand, you can't like, you can't, like, you can't appreciate it." Two of them seem to be memorizing some of the material, especially in chemistry in this first semester, "going over it and over it, you know." They all feel it is very important to ask questions. Jan and Vera feel very free to ask questions in class ("People who go to girls' schools, they don't care. It's just, they've been used to asking questions, so they're going to continue asking questions"), although Jan wishes the classes were smaller so that more of her questions could be answered. Anne rarely asks questions in class "because I've always asked my Dad the night before if I've had any questions with my homework." However, if she did have a question, she says, she would ask it. They are meticulous about making notes and following what the teacher is explaining.

Teachers are seen to be very, very central to their success. They all have very vivid memories of the good teachers they had in high school, and equally vivid memories of the angry, defensive, uninterested teachers who caused them both pain and frustration. The most important characteristic of the science teacher is patience: "Being able to explain something over and over again, and not get bored with doing the explanation over again." They feel the need for a teacher who does not "expect us to know everything already"; the teacher should also "be able to approach the subject from more than one angle. They have to be able to approach because to understand science people have different ways of learning stuff and understanding stuff so...." They all want to be able to go to see the teacher privately. Vera says: "Sometimes I don't understand but I always feel, I feel as though it's OK if I go ask the teacher for help in her office hour." Jan says: "I know he knows his things, but I don't think he gets them across well. But when you go to his office later, and you ask him specific questions, he can do it a little better." Anne does not go to see teachers much since she relies so much on her father at home. They all most enjoy one-on-one contact with teachers, and rely on being able to seek this assistance. They also want their teachers to enjoy their work:

> They have to be interested in their subject... enthusiastic about it. Because it's so nice, it's such a change for me from high school into Cegep. Because the teachers here, they get so excited about electrons and things falling down from the air. And it's so nice to me, finally, some one getting excited about it. Because in high school, my teacher, he was never excited about anything. He'd always get angry and there was nothing fun about it.

They are generally very pleased with their Science Plus teachers, but they obviously depend upon them in every way.

There is a range of affective response to the stress these young women are experiencing with their studies. Anne says that she considered dropping "but I stick to things. You know? I'll get through it. Although initially I was. That was my first response: I can't handle this. But, no, I think I'll definitely stick to it. Even if my marks aren't as good as they used to be." Jan feels that "I'm never going to be able to do this" as she sits in class and feels that others know more than she does. She says:

> Like, every time we go into a test, I don't think I'm going to fail, but I don't think I know as much as I know. Always. And it's stressful like that, and if you sort of, like sometimes like, like sometimes I know that that pushes me on, so I'll study a little bit harder and learn it, like, well. But, sometimes I, like, sort of, like, let myself, like, in the back, kick myself, I guess, because then I get too nervous too, like, then I just get too stressed out.

Vera agrees that her experience is "really extreme" and says that she has "really low confidence." Her feelings are nothing short of torment. Before tests, she says she feels "I'm going to fail, I'm going to fail. I can't." After the test, she tells herself "I failed, I failed, I failed."

> All the time...except in the test. You see, this is the thing about tests: the thing about tests, I don't mind the test, it's before the test and after the test. The worst is after the test. For instance, I had my physics mid-term last week, and I've had the worst week, the worst week. Since then, I lie there every night, I think 'I failed, I failed.' and I just get so nervous and I just blow it all out of proportion and just because it's ...I have a tendency to do that. And I know I shouldn't but I just can't help it.

This girl says she hates competition, and feels there is a great deal of it in Science Plus. She complains about it, and about the insincerity in people's remarks such as "Oh, I'm sorry you didn't do well": "But they're so happy. They're, you can see it in their eyes." One might well wonder why she goes on, and how long she can continue dealing with so many negative emotions. She herself wonders, then says "But I just, I don't know, I just do it anyway, you know, I think I can't do it. But, I mean, I could totally see myself, if I had, I don't know, I could have said `No I can't do it. I'm not that...'" She seems to feel it can go either way: she may sometime simply find it too much.

These students are thrilled with the friendliness of their Science Plus classes and are already forming excellent work partnerships, whether for labs or for help with difficult problems. They note how much easier it is to make friends in the science classes, where they see the same students for three different subjects. They are impressed with the cleverness of their fellow students and with their general willingness to help one another. Anne and Jan confess to having trouble co-operating in the lab, revealing that they tend to take control of things, sometimes to the chagrin of the partner, and sometimes just making themselves feel a bit guilty because they end up "having all the fun". They

clearly respect their partners enough to try to curb their enthusiasm and "perfectionism". Jan actually finds it helpful to study with a friend, sometimes staying overnight at a friend's house to give and get moral support. They do their work in parallel formation, however, each working alone and then comparing figures when things get difficult. A notable and mature trait which they all share, therefore, is the way in which they are able to interweave their personal relationships with their very busy study lives, and the extent to which they wish NOT to isolate themselves on their own individualistic paths to success. One student says that it is so much easier to be herself at Vanier than it was at her private high school: she is not very specific about what she means, but one gets the sense she is talking about being serious and high achieving and having fun doing it.

C. THE SECOND INTERVIEW

1. Motivation

As these young women review their Cegep experience in their final interview, they are both enthusiastic about science and certain that science per se is not enough for them. They all mention the pleasure of understanding how things work, "the high" of grasping something after a struggle or of solving a difficult problem. They say things like "I love knowing that I got the answer"; "Like right or wrong - I don't like to think in grays"; "I like the fact that I can understand a lot of things and it makes me able to speak..."; "I enjoy...having that comprehension of the world around me." They all recall that they came into science partly to keep their options open, and they are glad they did so. They all speak about being glad they "stuck at it" and how much they want their science DEC. They also feel so very uncertain, however, about how to focus their ever-widening range of interests, that they are still trying to find ways to give themselves time: "I think I'm going to spend my life keeping my options open," says Vera; Jan says: "I remember coming into Cegep and hoping I'd learn to love something... but I'm not..."; Anne says: "If I was doing just science I would go insane." No one will quite say that it has been fun. Jan says: "I can't grasp it as well as I used to. I'm still doing ... better than I did originally mark-wise but I'm enjoying it like half as much." She goes on: "Sometimes I like it when I understand it but I'd rather be writing an essay or reading a book." That it has been very, very hard is something else they all agree upon, but their difficulties tend to be viewed positively, as they talk about having learned to be more logical, more focused, even more confident. This slight increase in confidence does seem to be true of all and is discussed in greater detail below: what strikes one about these feelings in the context of their liking for science is that confidence has been gained by succeeding in the face of what they see as the most difficult task. That programme difficulty is at least partly prestigious is hinted at by Jan's remark: "I see it as high like a rainbow, sort of, a good thing, like I like science."

The wish to have "a balance" of arts and science is reflected in the choice of university programmes made by these students. Jan's comment is characteristic: "I don't see myself closing myself off to science but I don't see myself in sort of a pure science stream." Career plans are still not very fixed, although Anne still talks about architecture. However, she has applied to the Faculty of Arts with a view to one year "to give myself the chance to try all those things that I was supposed to get a chance to try at Cegep but didn't quite get around to doing everything I wanted to do." She says she is "desperate to take some history", to try a language, to do some philosophy. She sees some of this as potentially helpful in her future career, but also necessary for herself. She says she can not see herself in "the lab stream of research. I need people around me and I need.... Like, I could probably do something out in the field....My interest is low cost housing and so it's very people oriented and it's very,

you know, trying to help people." She also hopes her career may take her overseas: "I like that sort of excitement....South America and the orient are right now good [housing] markets that are opening up." Jan, who also considered architecture because she loved precision, logic and drawing, has turned away from it because of her difficulty with physics. She says: "It sounds stupid but like I'm not so happy. I'm not so eager for the future in a way because I don't really know what I'm going to end up doing and I'd really like to know by now.... I can't see myself in any kind of career." She seems to want to be a teacher, but to be deterred by the prospect of low income and low status except in university but "in university you have to do research and I don't know if I'm cut out for too much research." Her solution has been to try a B.Sc. in psychology, possibly industrial psychology, and then possibly an M.B.A. But she is very tentative. Vera has, at some point of her Cegep studies, discovered "the perfect programme" at McMaster - an Arts and Science program. However, since she cannot leave the province, her decision is to take "the broadest, most liberal program at McGill University" which for her is a Bachelor of Arts in Political Science, which offers her a chance to study history, economics, and sociology, and still allows her to continue many science subjects. She sees herself as getting the B.A. and then possibly applying for medicine. She has rejected Pre-Med partly because of the stress factor and because of her uncertainty: "How can you know at this age what you want to do? Maybe I'm just saying that because I'm jealous that they know what they want to do and I don't but anyway...." All these young women see themselves as having the potential for prestigious careers ("Like I know I'll be good in whatever I do like my family tells me"), have a desire to work with people, sense that their science education will be useful in some way for them, but really are not ready to zero in on a career. Some worry about this more than others, but they have not allowed the pressure to decide force them to make uncomfortable choices. Perhaps they feel less of the concrete pressure to have careers than do the men, and their openness may be a gender and social class privilege in this sense. They also hope the future will always allow them to follow their hearts. Anne says: "I think I'm going to be one of those people that will always be taking courses on the side when I can. Go back and take night school for awhile or you know work for awhile and then go back and do another degree in something."

Needless to say, their other interests continue to be many and to include non-science subjects as well as leisure activities. Their enthusiasm for writing has increased over the two year period. All have continued to write and to publish, both locally in Vanier literary magazines and in student columns in The Gazette. Jan says: "I love writing but I'm just too scared to like....I don't think I'm quite good enough to get into journalism or something like that. I'm not a natural." She has, nevertheless, just won an essay contest, and says she hopes that perhaps writing might form some part of her future work. Vera has won first prize in the Vanier College Creative Writing contest, two years in a row: she does not talk about career possibilities to do with writing, but just wishes she had more time to do it. Anne speaks of how much she loved an English course which involved poetry, because it gave her a special perspective on her own. All of them love English, and talk about English courses and teachers as among their favourites. They continue to talk about their interest in drawing and about the art classes they have taken, but the discussion now includes enthusiasm for humanities courses in which art history and the history of culture are featured, and they talk about how much they enjoy going to the museum to see current exhibits. Vera still studies the flute. Anne is particularly enthusiastic about a photography course which she is taking: it seems to yoke together the arts and sciences, as she discusses both visual imagery and the chemistry of photographic development. They have acted as peer tutors, Vanier ambassadors, day-care volunteers, executive members of the Science Club, and so on. All talk about the importance for them of exercise and sports (skiing, dancing, swimming and

weight training) but the reason they give for their interest is chiefly that they found the activity fun and relaxing. They present an amazingly well-rounded portrait of their day-to-day life. "Yeah, I get a lot done," says Jan.

They all three speak modestly but with obvious pleasure about having done well. "I've done better than I ever thought I could do," says Vera; "I didn't expect it," says Jan. These two students have been on the honour roll throughout their Cegep studies. Anne, who has done not quite so spectacularly, with a solid mid-eighties average rather than marks in the nineties, says only that "I do well, I do well. I have the right frame of mind but I can't do it alone." Jan and Vera are a little worried that they have let marks become too important to them. Jan says:

> Like I still, I see a 90 and I'm happy but in a way like I worry about that....I mean I don't want to.... I mean marks are good and I like getting good marks but I don't know.... I've already put myself under pressure and I don't want marks to be another pressure.

Vera is less ambivalent but still aware of the problem:

> Maybe we shouldn't be so mark oriented but then we wouldn't do so well....My friends have gotten their acceptances and they've gotten their whopper scholarships and I'm so impressed. You know? I'm so happy for them. And I know that if we hadn't been working as hard we wouldn't have gotten all this money. So it clearly pays off. You know? There are just obvious, obvious benefits to working hard. I guess it's okay to be happy about a good mark. You know?

What is notably lacking in her remarks is any feeling of superiority for having done well: all success is attributed to hard work. It is also notable that she sees herself as part of a high achieving group, rather than as an outstanding individual. Competitive individualism does not seem to be part of the pleasure of these young women's success.

2. Attitude

The subject preferences with which these students entered college have shifted somewhat and become more a matter of learning situation preference. Vera's rather extreme statement clarifies this well: "I don't have favourite subjects; I have favourite parts of subjects. There's a part of every subject that I really enjoy...." The most enjoyable learning experiences seem to have fallen into two categories: being able to solve difficult problems, and learning things which they can apply to the real world. All cite math as a basically satisfying activity because of the challenge of problems and the satisfaction with solving them. Even Jan, who came to college believing she was "not good with numbers" says: "Another high was like I realized I really like math." Vera says she went through "this total organic chemistry revolt a couple of weeks ago, but it wasn't because of the subject. I realized it was because I didn't have enough examples to do and I'm an example fanatic." Once she found some further problem sets to practice with, she was happy. There is very little discussion of chemistry as a subject: it does not seem to have emerged as either a favourite or a problem. Biology is mentioned to be "a heavy course"; though the content seems to have held its interest for them, there is not the enthusiasm one might have expected, given the way they looked forward to it at the outset. They clearly have not found it any more central to their concerns than anything else. Anne says:

> Like organisms and stuff I enjoyed and plants especially.... Like bio is really interesting. Like I learned so much about how the body works and I found that fascinating....But for bio there's so much stuff you have to know.... Like I guess what interests me most is there's so much other stuff that you're going to have to learn before you can get to what you're really interested in. Like for instance, 301. I'd love to do bonding but I don't want to do all that other stuff to do botany....

Physics has proven the most problematic subject. None of them has much enjoyed it, and all complain of certain times when they felt very alienated by the subject matter:"...sometimes I feel like nothing applies to the world." Jan says: "I don't get physics...It's almost like in physics I'm just plugging numbers in and I'm just like...." She found one physics course in particular a problem:

> First semester I had a good teacher and I liked him a lot more and maybe it was the subject.... Like it was mechanics and it was more touchable....You know? But then we moved on to relativity.... I'm so confused and I've been reading books everywhere and I had a tutor for a while and like my father is like an engineer and it's just not sinking in and maybe it's my fault because I see it and I think, Oh I can't do this. But I hate it, I hate it.

Anne, who has disliked all her physics courses, did find this one particularly difficult, as did Vera who found it did not "fit into reality". The latter says: "I was completely lost because there was a little man in a spaceship and in his time frame and yet in my time frame when I'm studying on earth and I was completely...." Anne says: "Like, I think I'll go back sometime and learn physics because, you know, some of the ideas you really need and I would love to understand it. Especially with things like relativity and philosophy." One gets a sense that these young women have tried to be open to the subject matter, have sensed that there might be ways to connect with it, but have never been able to forge the connections. It is about physics that they are most likely to make complaints about teachers and teaching methods, although, as illustrated above and discussed more fully below, they often accept equal responsibility and blame themselves for their own negative attitudes. Overall, however, their view of their science education is much less as of a set of discreet subjects and much more of a set of related learning activities, some of which they enjoy more than others.

Hence it is difficult to explain why these three excellent students have so little to say about the image of science as a way of knowing the world. Perhaps their words on this matter reflect some of their dissatisfaction with science, that it has not, in fact, offered them a full enough vision or philosophical perspective. Jan says: "I don't know. I always take things so literally, and I don't know what to say.... I guess it just means logic. That's what I would say." Vera answers almost irritably:

> I don't know.... I don't know.... I really don't understand the question.... What is it? The study of matter and how it interacts with other matter. It's the study of things and what they look like and what they do and being able to predict what they're going to do next before it actually happens.

Anne replies: "I guess it's more looking at facts and, you know, how you can explain things using what you know for sure.... Like what you can prove through experiments and through theories that can be proven." She tries to explain that teachers do not really concern themselves with the big picture:

> Because I think.... Science can be sort of closed and I didn't sense that so much that you know....It's like we're focusing on this. We're not going to talk about that other stuff. Not because it shouldn't be talked about but because we have to do this....

Even Jan, who says she sees science "high like a rainbow" criticizes the programme, saying that by the end "I found like everything physics and chemistry it was getting like smaller and smaller.... We were getting into smaller and smaller things and I don't like it." All of them feel that the programme is too restrictive, that there ought to be more chance to branch out and take other subjects. As Vera says:

> I wish that...this isn't something that could be changed, this is just my ridiculous castles in the air. I wish that the science programme and the science teachers and the science students were more into the arts. And I wasn't the only one who was going around, Look, I just read Plato. And everybody kind of looked at me and goes....

As she continues her critique, it is clear that she sees all programme boundaries as far too narrow, and that she feels that everyone's education suffers as a consequence. The other two students also critique the difficulty of the programme, though they do not suggest remedies. Jan just says that Science Plus teachers have expected too much of the students and "they were sort of heaping on the work and it was...." Anne says:

> Like, I don't see how the workload could be decreased because you have to do a certain amount of stuff. Like, if you're going on to certain courses in university, you need that background. yeah, there's not much you can.... Because I know that was really...the workload and the stress was.... It started like last semester it was bad. And like a year ago... the semester I had a year ago was really, really bad....

That these students have found the two years hard is either stated or implied in all of their remarks about their attitudes. When they talk about what kind of student can be successful in this context, they stress hard work. "Well, for sure, it takes hard work. You don't get anything without that." They also talk about "discipline - self-discipline" and a willingness "to spend time working and you know not distracting yourself and thinking, there's better things I could be doing with my time." Anne goes on to call good science students "conservative". When challenged by the interviewer to explain why her hard work paid off when that of others' did not, Vera explains how she too was puzzled by this phenomenon, and took it upon herself to observe a friend spend six hours in the library getting very little done: "But the thing is it's not six hours work. It's work, go talk to this person, go over there, photocopy this, get this, and it's very scattered." If a person works with real concentration, not just imagining work is being done because one is in a library, she says, "our grades are proportionate to the amount of time we put in." Good science students also have to make sure they understand what they are learning "and if you don't understand you have to go see the teacher. You can't just skip over parts that you don't understand because then you'll get shafted." As far as innate ability is concerned, Vera says: "We had a couple of really smart people....There are a few people who are like that and I feel who are naturally bright." Although her average is in the 90's, she obviously does not include herself in this category. Another student talks about the need to be curious, to have a logical mind, and to be able to make connections in an imaginative way. In talking about the high percent of her old high school friends who have now abandoned science, Anne talks about the need to have a goal to keep one in there.

Gender awareness has definitely been affected by the fact that the Science Plus class started out balanced, lost about ten men students in the first semester, and is now clearly headed academically by high achieving women students "that have like a 98 or 99 average. I'm serious. They're just brilliant." As the students say, men can't make any comments about women's unsuitability

for science or inferiority in any way "because with 76% girls we'll just jump on them". These three students feel that they have been neither disadvantaged nor advantaged by being women: they are aware of affirmative action and have different feelings about it, both negative and positive, but feel they have not been so far touched by its ideologies or practices. Given this context, they seem to have no fear that the future will present them with discriminatory situations. They all talk about careers as complementary to rather than contradictory to family life: Anne and Vera still express great interest in having children and Jan still feels unsure about that. Anne and Vera seem not to have "boyfriends" and do not talk much about marriage either. Jan, who seems always to have had a boyfriend (not the same boyfriend, but a male companion who is important to her), does show some awareness of conflicts arising between her scholarly seriousness and the male-female relationship. In the first interview, the boyfriend felt she should not be in Science Plus, that it was too hard, and that she felt she was better than he was because of her programme. That relationship is clearly in the past, two years later, and a "new boyfriend" has been found in Science Plus. However, certain difficulties are arising once again:

> I met him about a month ago and it's been taking up a lot of my time and like I'm keeping up with my work but doing less than I would have normally done so I have a test now and an essay due next week and a physics test and like now I'm just..... I don't know, I'm getting worried a bit. I was saying to him, Like I can't when I'm like this I can't even talk to you like, I can't feel any emotions like I turn into a robot and I have to work and get it off my chest. Yeah, yeah. Like I worked last night, all night, I had to finish something. You know?

When we remember that this is a student who shares her anxieties with women friends, studies with women friends, and needs her women friends for support, her inability to interact with her boyfriend in times of high stress stands out as a gender issue which is worthy of some thought. Jan can trust her women friends to understand when she turns into a "robot". She does not feel comfortable imposing this behaviour on her boyfriend. What will happen to the others as they begin to consider relationships with the opposite sex? Or will their aspirations, priorities and attitudes preclude such relationships? They will certainly not have had much practice in dealing with the conflicts that arise. Hence it does seem that gender issues have been very, very superficially confronted by these students and that this lack of awareness may provide unforeseen difficulties later on.

3. Experience

The study habits of these young women are an area of much discussion, and they are all rather proud of having learned to study better. "I have an ability to concentrate for three hours at a time without stopping. Just straight. I could never do that before." "I think I've learned how to learn better and better.... Like how to read my textbooks and how to make the most of my time." They often explain their many hours of study, however, as a kind compensatory behaviour, as if the brilliant student might not have to struggle so hard. "Like, I don't think I'm stupid but I have to work really hard to get good grades and some people don't." Vera says: "Well, I tend to be very visual so as opposed to auditory so I take down the notes in class but I end up learning everything by myself." She seems to fault herself for not being able to learn better in the class. Jan seems to see her whole life as a student as an increasing curve of work, at least partly self-imposed: "You start off doing well and like as you go higher and higher....I don't know, it just seems like every time you pass a level, like you work harder, you know how to work harder." They seem to spend most of their homework time doing all the

problems, finding more problems to do, and doing the problems they have already done again, sometimes three and four times. They buy or otherwise acquire extra study guides, note sets, and problem sheets, and they work through them thoroughly. They read and reread their textbooks, work with class notes, make their own notes, summarize all their notes, and work through all of this material many times. They do not appear to have particular schedules for doing their homework or study - in fact, Jan says that would be impossible, since all she can do is to work on what is most pressing at any given time. However, they all say it is important to keep up to date. They appear to spend all their weekday evenings working, and much of the weekend doing the same. The real organization in their lives is not so much what should be studied when, but that study has to be done, and if one also practices the flute or does weights at the Y, one fits those other activities in around the studies. Jan even justifies not having a study schedule by saying:

> I probably should schedule it more but like it works the way it's working and maybe there'd be less work but like I have to have some spontaneity in my life. You know? I have to learn to be less rigid....I'm sort of learning that half-an-hour here or there won't make that much difference.

Their need for genuine understanding of what they are learning is very powerful: "I can't stop half way through and not understand. Like, I can't do anything or I have to do it all. I can't just study half way." Their greatest frustration is not understanding: Jan even says she hates labs because she feels she is either just going through the motions of some pre-conceived procedure or floundering about: she wants more control over what she is doing, and a greater sense of its purpose. Anne says: "Like I find it frustrating that I have a course where, you know, I can pull off an 80 and I don't understand anything...." They talk about the need to seek out teachers to gain this understanding: Anne and Jan say they will occasionally ask questions in class, while Vera now says only amazing students can really ask questions and that she "rarely" asks "questions in science", though she clearly does in other subjects. She seeks out the teacher on her own. It is difficult not to compare this with Vera's behaviour two years ago, when she said that girls from all-girls' schools always ask questions. None seems very satisfied with the class format for resolving comprehension problems however: even Jan, the most vocal and active of them, finds the classes too large for a really comfortable question-answer situation between herself and her teachers.

> Like sometimes I wish I could have a tutor like in some courses just because like I have so many questions and like I can't go on if I don't get those questions answered. You know? It's like I do it to myself and I block everything until I can have that question answered.

Though these students say they have been generally well taught in their science classes, when asked about their favourite teachers, they usually mention English and or humanities teachers, rather than teachers of science subjects. They seem to have formed relationships with non-science teachers and not with teachers of science. Still, they each comment favourably on at least one science teacher as being "very funny and lively" or "she made us learn" or "he explained things a lot in class." These students are not entirely teacher dependent, but they see the teacher as very important. Vera says: "A good teacher will increase my interest in a subject but the interest is usually there. Because I've had bad teachers and I still like the subject." However, she hastens on to say that at Vanier "I've been so lucky, I've been so lucky in my teachers." The other two are quite outspoken about particular teachers from whom they have not been able to learn:

> I guess it's just like a personality thing and how well you get along with the person and how they are in the classroom. Because like my ... teacher for the last two semesters.... In terms of them as persons, like, I get along well with them.... You know? He's a nice guy but he just doesn't teach very well and it's not the way I learn.
>
> I was really excited about [that course].... I figured it could be really handy.... You know? I don't know... it's nice to know about things and I feel like our teachers could be making it a lot more applicable to real life and he's not and I'm just really disappointed. I don't know, I'm just upset about that. Because.... Like, I didn't always hate [these] ... courses.... I never really felt that great about it but I didn't hate it. You know? Now I dread it.

Only Anne talks about finding teachers "intimidating" or being "scared of" them; of the three, she seems to be the one most sensitive to how the teacher might feel about her, the subject, the class. It might be worth noting that Anne is also the student whose marks, though very good, are not outstanding, and who seems in general to have had more trouble keeping up. In any case, her exact words are worth noting:

> I need people; I need like teachers that are interested in what they're teaching and care about their students. I need that sort of like, Wow, this is neat stuff we're doing. You know? Not like just Here's the facts, learn them. I need sort of like that interest. Hands on is good like when you actually get to try things and you're not just sitting there and listening to what they're saying. You know? Basically an open environment and very like.... Yeah, you know, where people are receptive to what you're saying and you can be receptive to what they're saying.

The other two students would certainly agree that this atmosphere makes for the best learning, but they do not seem to miss it as painfully as Anne does when it is not there. Whether this need is a cause or an effect of not being a top achiever is unclear, but one suspects that it is at least somewhat related to achievement status and how the student views her success.

These students have continued to experience great anxiety and stress in relation to their studies. Stress points continue to be very related to anxiety about achievement: "The low points are usually after a bad test or before the test that you know will go badly and the high points are usually after the test that went well or before the test that you know will probably go well." They also experience anxiety about workload: "Generally, like when I feel things are sort of loading up on my head and I just worry that I won't have time...." "I mean I work well with deadlines but there's a difference between deadlines and not sleeping well for a week. And, you know, you can get to a point where you can't handle it." "My mother always says, things get done.... But I worry they won't get done properly. You know? I mean I could always go into a test and not know anything but I would feel horrible." Each of these students describes her third semester as her worst. "I decided that my marks were very important that semester because I was looking at applying to university and I decided I was going to focus on working really hard and not worry about the rest of my life." "At one point last semester I thought I was going to die.... Like, I almost wanted to die.... Like, I was just really upset.... I worked so hard. Like, I wanted the scholarship, I wanted everything...." "Like last semester.... I was getting migraines all the time.... I thought I had never been through such pain in my life.....I was stressing and I was going, oh, Pre-Med, Pre-Med, oh, my God, what am I going to do, dadadada."

These high achieving women put so much pressure on themselves in preparation for their university applications that they have sometimes literally made themselves ill. "Like, you know, I tend to handle stress well most of the time but I had friends that would like have breakdowns. And I actually....Like last semester was the first time I broke into tears in a teacher's office. I had never done that before." They all criticize themselves for this behaviour, but it does not really seem to have been within their power to act differently. Interestingly, they all fault themselves for "not going out more", not "taking more time with friends". They all say they find they have to force themselves to take the pressure off.

> Last semester at the end of the semester I adopted the attitude that I didn't care and I was just going to do what I had to do and I really.... It was good because it was more relaxed so when I was actually working I could focus as opposed to, you know, being totally stressed out.

Vera says it was not till she went away over the Christmas holidays that she could say "Who needs Pre Med?" and start to think more clearly about what she wanted. Anne says:

> I don't know. Just because of my personality type I've always had a sort of a.... Not a serious problem with depression but enough of a problem that if I forget these sort of things, like if I don't see people and if I like close myself off then I can get really depressed or my confidence goes down and then.... Yeah, it's something I know how to deal with most of the time so it's not a huge problem but it is something that I'll probably....

One of the added complications to her bad semester was the death of a friend: "And there was that thought that it could happen to me and do I want to be remembered for how hard I worked in school? I realize that there's more to life and you've got to pay attention to that stuff." But even the final semester is stressful. "I think I'm still totally stressed and totally worried." "I know I've always done it before but every time it happens again I still worry. But I suppose if I thought about it I'd say, yeah, I'll be able to do it but it just takes a lot out of me, that's all." The two students who have had consistently high marks feel their moods are still controlled far too much by their marks: "You get like a 98 and you walk around for the next two days and you have this ridiculous smile on your face and it's just.... Maybe we shouldn't be so mark oriented." Anne, who suffers from the occasional low mark, says she can get very depressed about poor results and has to work hard to remember that "Like it's just a mark and it doesn't relate directly to who I am." They admit that being in Science Plus has made them especially mark conscious, and that there has been a very competitive atmosphere in the class.

> But our class is a little bit over-competitive. It's a little bit out of hand and we all know it. You shouldn't compare but you just don't feel special, you don't feel like smart sometimes. Like if someone else gets a 95% and you get a 90% you don't realize that some people will be getting 70s but....You know? You do lose perspective.
>
> Well, the thing is the competition was more like when the marks came in. It was more like, Well, I got a 90, what did you get? And if you got an 85, Oh, well. But it wasn't like.... It wasn't a personal thing. Like totally marks, marks oriented. Yeah, like you could go along perfectly fine but when those marks came it was sort of like.... Or, if someone got like 98, well, they're sort of for that time until the next comes up it's like David is better than me. But it was really like... You know? I guess the marks representing how smart you were.... Because in terms of like.... People

> had no problems.... Or at least, most people have no problem just asking questions in class and stuff. Like, it wasn't a problem of looking.... (pause) I was going to say, it wasn't a problem of looking stupid. There was some of that, you know? You didn't want to look like you had no clue of what you were doing but it was okay to admit to someone that you had no clue about what you were doing.... Yeah, it was mostly marks. That was the competition.

They do not really criticize either the system or their peers for this competitive atmosphere; they do not think it terribly positive, but they seem to accept it. However, this intense competition has clearly added greatly to their stress and undermined the confidence even of the best of them, when they were not at the very top. Interestingly, Jan and Vera say they have much greater confidence of their abilities in subjects other than science, and suffer much less anxiety about these other areas. Something about the science programme, especially in Science Plus, exacerbates the stress and anxiety which these young women experience in relation to their studies.

They have much the same things to say about their relationships with other students as they had two years before. Friends are vitally important to them, and one of the great pleasures of Science Plus has been being able to find excellent friends who understand them and support both their dreams and anxieties. Two speak about the difficulty of making friends outside of Science Plus: Jan says she finds students in her other classes unfriendly, and Vera says she finds students outside her programme bewildered by her studiousness and rather put off by it. Anne says she has some friends outside of Science Plus, and that she enjoys them. However, she seems most to value her Science Plus friends who "helped me stay focused" and "who will try to explain it to you". She says that her Science Plus friends are the science students who have a range of interests outside of science, and in fact, Anne and Vera have become close friends. Jan still seems to like to study with her friends; Vera asserts she can only study "completely alone at my desk which faces a wall". It is clear, however, that a lot of discussion about work goes on between these students, and much moral support is gained. They all make the distinction between getting a small procedural explanation from a friend and dealing with a basic problem in understanding: for the latter, Jan and Vera go only to teachers ("I need it from the authority," says Jan) and Anne still works with her father. They value their working and supportive relationships with their peers very highly and do not expect from them what they felt might be inappropriate. Here one should cross reference what they say about anxiety and stress, and how they say their social withdrawal in third semester was a "bad idea" (see above). They need like-minded friends to interact with: "I think that's the only way you're going to get through it."

It is not surprising to hear these students sum up their experience at Cegep as "very valuable". They talk about learning "things" and "things you can apply" and "a way of approaching things". They also talk about learning "a lot about myself". Here are two comments in full, the first from Vera, the second from Jan:

> Very valuable. Extremely valuable. Both in themselves, valuable in themselves, because now when I look at things...You know it's funny even when I eat I sort of imagine what is happening to my food. It's really odd. Or, I'll be looking at... and I'll be like... or something will drop and, you know, it's strange how science penetrates the most mundane things. It's very weird. So that is beneficial. And also, well, I think I've grown since I came here which I think is important. I should hope that I have grown....

Well, I feel stronger. I feel more confident. I feel like being able to struggle and do well has made me like much more confident in myself. Like, I like the outlook it's given me on science. I'm glad I'm not someone who's sort of stuck back like my grandmother with all her superstitions and stuff like that. I'm glad I understand; I'm glad I read the paper and be able to understand what I'm reading and be able to actually agree with an educated opinion. You know? The main values that I've gotten are like overall and not just science. Like I've gotten a pretty well-rounded education.

IX. STUDENTS WHO ENROL IN SCIENCE, THEN SWITCH TO OTHER PROGRAMMES

A. SUMMARY

This grouping of twelve students includes all those who enrol in science in 1993 and then switch to other Cegep programmes. The group includes many women students who enrol in Pure and Applied Science: of the eight women, seven begin in Pure and Applied. This weighting mirrors the overall trend of women moving away from Pure and Applied Science. Of the four men in the group, two are in Pure and Applied and two in Health. Some of these students seem to decide immediately that they have made a mistake; many wait until the end of the first year before deciding to change; some even change as late as their fourth semester. All but one of the changes are voluntary. In general, they switch because they are neither enjoying themselves nor doing well: there is no incidence, in this group, of students succeeding in science and yet still making the switch. There are both similarities and differences among them in terms of motivation, attitude and experience: the most striking common feature is that they all seem to have entered the programme either for the wrong reasons or under very serious misapprehensions about their own skills and preparation. That some might well have been able to succeed in science is also clear, and it is important to recognize what are the experiences that prevent them from doing so.

Most of these students come to science because they have done reasonably well in high school and have been convinced that science is the best programme to enter if you can. Few show real intrinsic interest in science subjects or activities: they are much more likely to talk about future options, perhaps careers, though those have often been suggested to them by parents. Family influence has a powerful effect on this group, whether it be the middle class professional family urging the son or daughter to maintain that status or the working class family wanting upward mobility for the child. The students feel these pressures to weigh very heavily upon them, in some cases very resentful of them, in some cases guilty in their knowledge they cannot fulfil family dreams. They do not have many outside interests, though quite a few of them have some interest in other subject areas that will clearly be alternative choices for them in the future. Science, however, has so much prestige and importance that we can see it will not be easy for them to give it up. On the whole, they are not workers: they have done well by being alert and quick in class, and many expect teachers to continue to explain everything well enough so that they will not have to do a great deal of homework and study. Some are working, however, but are clearly very easily discouraged by poor results and, especially, by lack of teacher interest and encouragement. The women are anxious; the men are not. They have, at this moment, extraordinarily poor relationships with their peers: we sense very unhappy young people who cannot deal with others because they are having such difficulty dealing with themselves.

When we interview them again, once they have transferred, they have little that is good to say about their attitude toward and experience of science and, indeed, it is true they have suffered a great deal. They have found it hard and discouraging and they are not students who have ever had to face this type of experience before. Their reasons for transfer are many and individual. They have had to face all the false motivations they brought with them, and to resist the family pressures which are inappropriate. Three of them have switched to technology programmes which they love, but to do that they have had to deal with a whole range of prejudices about status. Notable among their

reasons for transfer are very bad experiences with teachers who have told them they are stupid when they know they are not. They are, in fact, the group most vulnerable to teacher behaviour of any in our sample, and the question arises: how should the institution deal with students such as these, who might be taught how to work more independently, how to persist through error, how to use their strong points to deal with their weaker areas? Should extra resources be designated for this work? Wherever they have been helped by caring teachers, they are grateful and give full credit. They have very much enjoyed all their non-science courses, and all have found programmes where they are more comfortable and doing at least marginally better, and in some cases extremely well. They have developed greater confidence; they are suffering less anxiety; they are enjoying their peers much more. Their reflections on gender are especially rich, particularly with respect to technological programmes: we see courageous feminism among the women who have moved to non-traditional programmes, and some disturbing sexism in one man.

In some senses, this group is the most problematic, and leaves us with the greatest number of questions to ponder. If institutions are concerned about students dropping out of science, these are the subjects that ought to be scrutinized. Should high schools continue to urge such students to take science? Are there ways to keep such students in Cegep science programmes? We see the minutiae of their experiences as very instructive in this regard, and we have recorded it in exhaustive detail. This is an area that deserves very careful study, and much public discussion.

B. INTERVIEW ONE

1. Motivation

These students all say they have done well in science in high school, and for five of them, that is their only real motivation for entering Cegep science. Ricky says: "Well, I used to be pretty good in math and things like that in the early grades and well, when you're good at something you think that that's what you want to do because you start enjoying it and because you're good." A few of this subgroup carry this self-reinforcing thinking a little further, as does Rani: "I had really good grades in high school in physics and chemistry. All my friends used to say like whoever isn't going into science isn't really studying... just like spending time in college." The prestige factor is a powerful incentive here, emerging at many points in these first interviews and developed below. We strongly suspect this motivation is what has directed so many to Pure and Applied, since it seems to be the most prestigious programme. Three of the women can only speak about keeping their options open: "I have to think of the future," says Nanci. Only two students talk about intrinsic interest in science. Donald says: "Well, I love, I don't know. I've always liked science. Just sort of a habit, you know. I don't know. I'm curious." Rochelle says: "I guess I enjoy science because you can always discover new things. You're always learning, it never stops. I guess just the thought process that goes into it, the logic...."

Career motivation is here, as elsewhere, most strongly noted in the Health Science students, and family background and ethnicity feature most strongly as influential factors. John's single motivation is to be an orthodontist, an idea that seems to grow out of his own experience with braces. He also mentions that "you get to help people....You get to make people's lives a little better, you help them correct problems and get better self-esteem." This caring motivation seems somewhat connected to his Christian beliefs and is very much supported by his father who is a pastor. Donald talks about being a doctor or doing medical research, though this idea is chiefly his father's and is not, as we will see, where Donald's real interest lies. Nevertheless, it is with the possibility of medicine in mind that he has come to Health Science, and he travels four hours a day to and from Vanier because his

father thinks Vanier is a "serious school". Donald talks about his father wishing he had gone further with his own education: "Well...my dad used to push us to be the best, you know, and that's because he's Chinese and, you know, he always believes every generation should be better than the one before." A further part of this advice is framed as his father's saying: "Don't go through what I went through." Already Donald is restive under this pressure ("Don't make me") and says that he knows he could never be a doctor "because I have, like, no patience with people." Interestingly, Donald also talks about a high school chemistry teacher whom he much admired, whom he felt very close to. Nanci would like to become a biological researcher, to work with animals. She too has been much influenced by family: "Because on my father's side both my grandmother and grandfather, they are doctors. So, my father wants me to be a doctor. I'm not really interested to be a doctor.... Because I'm afraid to see blood." She says her brother and all her friends are in science: "I think mainly it's very... because the Chinese have language problems to study.... They feel comfortable in science...." Nanci emigrated from Taiwan three years ago and is very concerned with her future here: "It's more hard to think of my way in Canada. So I want to do something scientific so I can maybe be in research with people.... I have the condition that I have to speak good, good, English." As we will see, this complex network of incentives is enough to bring these students in to science, but not to hold them there against other pressures.

Among the Pure and Applied students, we do find some isolated examples of strong career motivation, but even among the strongest, there are hints that the programme choice has been arbitrary or even incorrect. Cécille has always wanted to be an architect, a desire very much influenced by her mother who wanted to be an architect also. She originally wanted to enter Architectural Technology, but was encouraged to enter science because of good high school grades, and because an English Cegep science diploma seemed a good way to get into architecture at McGill. Already she is beginning to regret her decision, realizing she does not enjoy the programme for reasons discussed more below, and that going on to a French university from the technological diploma would be quite possible. She is also worrying about the professional responsibility, and thinks she would rather work at the design than shoulder responsibility for it. Aimée would also like to be an architect or a landscaper, partly due to her interest in drawing. She too has been encouraged by teachers to come to an English Cegep, take science, and continue on to McGill for architecture. She says her parents "stopped school quite early so...when I was explaining to them what I'm doing they enjoy it but they don't really, really understand." She goes on to say that "they know my brother won't go to Cegep because he's not really enjoying school. He wants to travel. My parents are proud of me because I've gotten this far." We do not get any sense that Aimée is being pushed by her parents, but there are some suggestions that upward mobility is of interest to the family. It is they who have suggested that she approach architecture through science "so that if I change my mind so have something else to do." Rochelle's interest in science and math appears to have been much encouraged by a mother who is a high school science teacher. She tells this story:

> We used to live in the States my mother.... I had gymnastics classes and it was like a two hour drive and on the way up we did these little penny games where if I figured out the mathematical problem I'd get a penny and every time I got it wrong I'd lose two. And so I'd sit there with a little notebook in the front seat of the car and she'd give me things to do and everything and it was really fun....

The love of math seems here very intricately connected with love of mother. She is very positive at this point, however, that "further down the line I'd like to go to medical school." She considers medicine for two reasons: her father is a doctor whom she clearly very much admires, though she sees him rarely as

he does not live with the family any longer, and she is also looking for a profession she can do from the home, when she is married with children. Why is she not in Health?

> Well, at the time I made the choice of Pure and Applied I wasn't exactly sure....I had thought about doing computer analysis or programming to go through university programmes or engineering so I wasn't really sure what I would go on to....But now I'm pretty sure and I'll be switching to Health.

Despite her decided tone regarding medical school, we sense that here is a student whose vision of the future is very much in flux.

In this sense, Rochelle's changing career plans are typical of this group. They cite a variety of occupational possibilities such as medicine, physiotherapy, sports medicine, psychiatry, architecture, and engineering, often citing two or three each, and frequently naming careers for which their particular science programme is not really appropriate preparation. The two men are particularly lost. Though Ricky's father is a doctor and his mother an x-ray technician and both have encouraged him to pursue science, he has no interest in a medical profession at all. Sammy's mother is a nurse, but there seems to be no particular encouragement to persist in science, and he actually complains of having no support when he has trouble. His main concern seems to be to find something to pursue that would not "be too too long" and that would bring him a comfortable life style.The women students in this group seem to be most driven by the sense that they must have specific, prestigious careers, often very much encouraged by their families. Arlette, Lila and Donna all say they have wanted to be engineers. Arlette explains why: "I think the prestige of being an engineer and making $60,000 ... just having the social standing...." She adds that she is also interested in "how things work", but this is definitely a secondary motivation. She admits she has "had this thing about going to Waterloo, you know...like the best school in Canada...." Her father is a math teacher and her mother is a nurse: one senses a certain amount of family encouragement, but not outright pressure. Lila says "I want to work like big, IBM or.... I was thinking of people working for me....Well, I've always wanted to have like my own thing. You know?" However, she admits that, about the programme: "I chose it because it's something my parents want me to go into...." This pressure turns out to be very strong, but finally counterproductive. Donna says: "I want to be wealthy... and have a very good career....A woman engineer, an architect....I'm not sure what I'm going to do yet." However, she also says: "My father...he keeps saying, my daughter is an engineer and my son...my brother is 13...he's the architect and when you guys get your Master's or whatever I'll build a company for you." She goes on to ruminate: "Sometimes I think.... I don't know, I want to make him happy... and sometimes I feel like if I don't...." She is not at all sure that she can do it, as will be discussed more fully below. Her uncle is an engineer and she feels he has a greater talent than she does. Rani, who has very unfocused career plans - psychiatry, psychology - and is already not enjoying the programme, still feels a need to push on with the possibility of Pure and Applied at least partly because of her father's influence:

> My dad like he has finished his degree and everything....He wanted to be a doctor but there was war and all that stuff and he came here and he ended up being coached in decorating....But he always used to take physics. He was so interested in it....So when we sit down and we discuss that - me and my father - it's like it's interesting and everybody looks at us.... What are they talking about? It feels good. You know? That's a good feeling.

Despite this pull toward Pure and Applied, she says that "for me I want to have a career that's going to help me help people....In physics it's like how the car goes and friction...."

When we examine the interests which these students bring with them to Cegep, we see certain patterns that suggest alternatives which some are beginning to see as educational possibilities. It is notable that they do not, however, as a group, have a great array of interests or enthusiasms. Lila and Donna, who do not mention any outside interests, have always liked math, and they do say that commerce would be a second choice as a programme of study. Cécille talks about her artistic interests, in drawing, ceramics, sewing, sculpture and theatre, all of which she connects with her primary interest in architectural drawing. Arlette talks about interest in many social science subjects such as geography and economics and says she thinks she would enjoy them more than science; she also talks about enjoying English and humanities. Rani talks about loving literature and sociology and about wanting "to deal with problems, social problem, which I could solve." Though John's childhood interest in making models does suggest some orientation toward science and technology, his other interests - cooking and photography - are quite divergent. Donald identifies himself as "interested in violence". He has taken karate and collected military memorabilia, both of which he connects to this interest. He would like to join the army, and would much prefer to pursue Police Technology than science. Ricky describes a clear preference for social science subjects that "involve humans"; he says that "for some courses like history or politics I just do it instinctively and I just go on for hours without even thinking....Okay? But for science it's like I look at my watch every five minutes." As we shall see below, these students are already feeling their way toward new paths.

Nanci, Aimée, Rochelle and Sammy show a rather different interest pattern from that of these other students. Whereas it is easy to see where the other students might turn, should science not work out for them, with these four students, that is not the case. Nanci is completely torn between her love of the Chinese arts - literature and painting - and her love of the many exotic animals which she used to have as pets in Taiwan. She says she could never pursue her interests in the arts: her family would not permit it. Aimée and Rochelle do not show any interest in anything but what they have cited: architecture for Aimée and general science studies for Rochelle. Sammy is not very interested in anything. At this point, it would be impossible to predict what the second choices of these four students would be.

When asked to discuss their achievement, all these students say that they did better in high school than they are now in Cegep, and it is this difference that they most want to discuss. Clearly marks are an important matter for students whose choices have been very much based on their high school achievements. Even John and Donald, who tell us their marks were always uneven, are not doing as well as they did, and are struggling with the work. Lila says she is happy with her 70's, since others are failing. Nanci is not pleased with a low math mark, but has high marks in her other subjects. All the other students, however, talk about the shock of falling far below where they consider they ought to be in terms of achievement. Donna says: "Like in high school they were very good....Now they're in the 70's." Arlette says: "I was an honour student at high school and I'm quite close to failing Cegep, so I really don't think that shows that I'm prepared at all for Cegep." Later she says that "I'm not going to get through my first semester, you know. Like, I'm trying to figure it out. I don't understand." Rochelle says that in the States she got 90's and above: "Here I did average which I am not used to...." Ricky and Sammy seem to be failing tests and feeling quite hopeless about the possibility of turning themselves around. Cécille says: "No matter how hard I work I'm not going to get high marks and nothing else really interests me and I don't see why I should continue." Her remarks resonate with the general feeling of this group, that if results do not pick up, they will have to re-think their choices.

2. Attitude

Attitudes towards and preferences among different science subjects are not nearly as clearly marked with this group as with others in the overall sample. Few have entered with a real love of any subject. Ricky, for instance, admits that by the time he finished high school, he really was not enjoying any of his sciences, saying they were "boring" and that he just "couldn't relate to it". If there is one subject that stands out as preferred in high school, it would be mathematics. Cécille seems to have brought an enjoyment of math from high school, and is still really calling it "fun". Arlette, Rochelle and Rani are finding their calculus classes clearly more enjoyable than any other subjects, and in that sense are continuing a slight preference for math over other subjects. Rani says: "In math, everything is in front of you" and "In physics you miss something that's it, you cannot move. But in cal you try and try and maybe....I mean maybe it's abstract and that but you always have something to do, you can't just stop." Lila, however, who says she has always been good in math, says that "the math from last year has nothing to do with calculus." Sammy will only talk about high school math. John says math is "not too bad, as long as I can get the homework done, it's o.k." Ricky, Donald and Aimée actively dislike math. None of the three seems to have liked math much, even in high school. With respect to physics and chemistry, however, these students find that science subjects in Cegep are often not what they expected. Cécille's remark is typical:

> So I thought, hey this [physics] is going to be fun because it's going to be like high school. And then he started doing things and it was okay and with the same equations we used to use but the teacher turned the question into something that looked like Chinese and so it was like.... He said, Okay, you do this, you do that and that's it and so after that I like freaked.

Lila says she used to like chemistry but does not now because "I'm not used to the way he teaches." Arlette, Rani and Sammy feel they have been very badly prepared by their high schools for both chemistry and physics. Ricky has already dropped physics by the time of the first interview ("I didn't have a clue of what I was doing after about a week") but is enjoying chemistry "because we're doing stuff we did last year." John, Nanci, Lila and Aimée say they like physics because they can "see" what they are studying, whereas they cannot "see" the atom in chemistry. Nanci and Rani look forward to biology, but the two men in Health do not seem very enthusiastic about it. When they express real distress about not enjoying a Cegep science subject, these often say things like "they expect you to know this or this" or "people in class have learned it already" or "he started yelling at me for not knowing enough." Certainly, being told one is ignorant or ill-prepared is not encouraging, but they seem rather easily discouraged, especially by teachers who do not make it "fun". No one talks about the challenge of solving their problems with these subjects. If they are not doing well, they tend not to like them.

As indicated above, the prestige of being in science is not lost upon these students. This kind of image has often worked in a negative rather than a positive way. Ricky says that his parents "were always inclined to believe that the sciences were the only things you can do." Rochelle says part of her reasoning was that she did not want to be mocked:

> [Students say] yeah, go into Social and everybody is going to ask you what programme you're in and when you say you're in Social they're going to look at you, Ah I'm in Pure and Applied and they're going to show off.... So I thought, Oh my God, if that's going to happen then I'm going. But it's not true at all.

Rochelle says that teachers contribute to this elitism: "The teachers - they do. Because the first things they tell you, We're not sitting in English class now, we're in physics....It's not something as simple as you think it is in a humanities course and so concentrate." Seven out of the twelve say the first thing that comes to mind about science students is that they are "smart". Arlette says that in high school, students who were not in science were seen as "losers". These students are not altogether sure they want to claim greater intelligence than non-science students, but they don't mind the label. Sammy says:"They think I'm a brain." When we ask him if this is true, he says: "Yes. No. In high school I, in high school, I think I was, Like, I was getting 85 and over....Now, like, college, it's harder." A slightly more critical but nevertheless non-disclaiming remark comes from Cécille:

> For some reason like when I told all my friends I was in science it was like Wow! You know? Like, hard stuff and it's really tough and like you must be really smart. And I see it as, okay, you need good grades and stuff like that but you also have to enjoy it.

Some giftedness is recognized as important for being the top student, just as hard work is recognized as important for everyone. They all have felt that science is the hardest programme and that science students work harder than other students. Sammy feels that good science students always have background and supportive advantages, from both home and school. Ricky and Rani talk about different behaviours as conducive to doing well, such as sitting in the front row to engage the teacher's particular attention and doing outside reading and exercises. There is almost a sense that such students are peculiar, but neither will really say that: they certainly make it clear that they do not do these things. Rani is beginning to feel that "when you've never looked at it really and in a different way except in class - as a lesson in class - I don't think you really like it." This remark seems to capture something about these students, whose attachment to the sciences proves to be so very fragile, after all.

Visions of what science as a whole is really all about vary a good deal. Sammy says: "I just figure, Oh well, if a teacher teaches it, then I guess it's science" and Aimée agrees: "It's like science is science. Obviously, physics is science and major courses are science and so it makes science." Many are interested in seeing how subjects overlap, however, how calculus helps them understand physics, how organic chemistry relates to biology and so on, and they are irritated when they do not see how subjects fit. Some do see science as a highly structured set of interrelated subjects taught in a sequential manner; Rochelle says: "So it's a little bit like a ladder where if you learn everything here you'll be able to climb....It will be easier to climb up...whereas if you have to jump to the 5th rung, you know, you're just going to have a harder time." Rochelle also has an overview: "I think science would have to deal with how things work. Those are broken down into smaller groups." She goes on to fit each subject in under this general heading. Ricky and Rani muse about the differences between science and social science. Of science, Rani says that the social sciences look at people, whereas in science "it's not how people work, it's how things we create work. You know? it's knowing what we are creating. That's when you're interested in material stuff. It's material stuff. It's basically material stuff." Ricky focuses more on outlook:

> Like someone that's taken Social or something might look at the flower as a symbol or something like that and someone in science looks at it like what the strain on the stem is or something like that. It's like there are different ways of looking at the world.

These two students here demonstrate very limited views but they are notable for their attempt to identify difference, rather than superiority. Donald, Rochelle, and Nanci all comment that the study of science is rather "civilized", "less emotional", and "calmer", and they believe it might have this type of effect on the character of those who pursue it. None of these students has been able to think through the issue enough to have a really critical perspective on science or its curriculum, though they are quick to suggest minor improvements such as more subject choice, clearer texts, clearer teacher notes, more enthusiastic teachers, more labs and demonstrations, more and better resource centres, and more group work. Their focus is solely upon what might offer immediate improvement in their achievement.

There is more interest in gender issues in this group than in some others, though it is not easy to see why. They are particularly vocal about the classroom: perhaps the fact that they are not entirely attentive to the problems and procedures of their subject matters has allowed them to notice more; perhaps they are just more interested in social issues than some of our other science students; perhaps they have less to lose by acknowledging difference and disadvantage than the students who are still in the top group. Speaking of science teachers, Cécille thinks that "women would understand a little more how the students are feeling"; Ricky says that his one woman science teacher "was a lot more patient and stuff"; Donald thinks that women teachers are more "open"; Sammy describes watching a woman teacher explain and re-explain something to someone, then says of his male teacher "my teacher wouldn't do that"; Lila says that women teachers "make you do your work". Though these are the only teacher comments here, there seems to be some agreement on the greater caring and nurturing role assumed by women teachers, in their experience. The tone of these remarks seems to be approving. Eight out of the twelve students have comments which differentiate men from women students, and it is interesting to note how these particular men characterize the male student. John simply says that "more of the males" act up in class and some of the women are afraid to speak out. Here is Sammy:

> Guys, guys tend to sit and relax and pretend, like, they're some kind of god or something, like, they know everything. So, the girls, like, they'll ask questions.... Well, the guys tend to get like,like, if they ask questions, like, they tend to get like, like they're the class clown or whatever, they tend to get that.

Ricky adds his comments:

> Well, some guys they really don't take it seriously. It seems like a lot of.... Like the girls are usually in the front taking notes and stuff and a few guys also. I don't want to generalize but in my class they're the ones that are stopping the class not....

Donald's remarks clearly refer to high school, but they certainly underline the point:

> There's, the girls have, they pay more attention. I mean, the guys, like, they're just, you know, do nothing.... Yeah, they pay attention more... and care more about the class, you know. The guys, we used to have, we used to sit around and throw erasers at each other and when one guy's reading, you know, you try to hit him or something so he screws up.

Donald is so clearly and unabashedly talking about himself here that he reminds us that the others, too, are very possibly identifying themselves as the less serious students, a fact which emerges as patently obvious of at least three of them as their Cegep lives unfold. Donna and Cécille agree that "the boys are always fooling around" and Arlette agrees with both when she notes that the girls have

always, in her experience, been more successful in school. Rani feels, however, that more of the men are participating in her physics class:" I have been in that class for two months and I've never seen a girl ask a question, except for, I don't understand. But the guys would go, What's the force of friction? What the tension doing here?" We find her comment useful in that it distinguishes between different types of questioning, that which shows vulnerability and that which shows mastery. Clearly, the men students are not showing real bewilderment when they pose questions such as these. Four of the women students comment on the historical reality of women's unequal representation in the sciences, but three say that the problem is now solved. It is interesting, however, that when these fairly ambitious young women talk about their futures, some do recognize some of the gender issues which their career plans pose. We must emphasize here the vehemence with which they speak about these careers, and their wish to "be somebody", as we have discussed above. When speaking about marriage and family, only three see the issue as entirely unproblematic. Rochelle, as we noted, is already choosing a career which she can practice from the home so that she can look after her children herself; Cécille is not sure she wants to have children, as her career is more important to her, as is the "nice house and everything, you know, like I designed it"; Nanci wants neither marriage nor family, since "if you have a family you cannot concentrate on your work"; Arlette would like both career and family but would put the family first. As is almost always the case, questioning the men about marriage and family is a conversation-stopper, though Sammy surprises us with a terse "No wife or nothing", while the others say, as usual, "Yeah, yeah."

The study and work expectations of Cegep science have come as a great shock to most of these students. Whatever they have said, in general, about the need to work hard, most of them clearly feel that this hard work can take place at the institution, and that it is up to the teacher to clear their way toward understanding. We will have more to say on this point below, but it is impossible to separate the study problems of this group of non-persisters from their expectations. Cécille puts it very well: "I'm coming to school to be taught and I don't see why I have to go home and like spend five hours trying to figure something out." These students are astonished by teacher expectations that they read the text ("The way he teaches makes you need to look at the book") or that test problems will not be identical to those done in class ("he's supposed to have explained it in class"). Arlette remembers: "Like, we use to, like in high school, you'd spend days and days until everybody knew it. And now, it's up to you. And you have one day to learn it." Rochelle says much the same. Lila, Donna, Aimée, Cécille, Sammy, Donald and Ricky do not really do much if any homework, though they know they should. Lila says: "Like I've never been the type to study like a lot." This seems to be true of these seven, but what is even more interesting is that they do not seem willing to adjust to a situation which requires different behaviour. They might study for a test by going over the problems which the teacher has done, but they do not make good notes, read texts, review notes or do practice problems. Some seem to work perhaps an hour a night, but Sammy's story, though extreme, is not a complete anomaly:

> Well, I think that, like, if you had to really understand, like, some of the science, you'd have to sit down, take your time studying, read and stuff. But, like, I just, I just go in class, take notes, go home, sit down and watch TV, wake up, go to class, take notes, and that's it, you know. I won't review my notes, like, or try... stuff like that. I'll just, like, maybe pretend like I understand like, if I know what's going on, but not try and do anything about it.

This is a student whose expectations of everyone are extreme: he thinks the teacher ought to have made the material clear to him in the class time, but he also expects other students to help him - he does English assignments in physics classes and then is outraged when the student beside him will not

lend him notes. He says that "If I had someone to help me, like, I would be, like, ringing down their doorbell, like 24 hours a day." He does not really want help, however: he wants someone else to do the work for him. Ricky talks much more reasonably about his lack of application: he says that "If I really try to persuade myself, convince myself to work at it and I get something it's really... you know, I feel good because it's tough." This is exactly what good, hard working students say. What would be interesting to know, however, is why this satisfaction is not enough to prime the pump, for Ricky. All he is able to tell us is that he does not like the material: "Well, if I was interested in it I could probably try to understand it. Like, you know I'd want to. Like I'd do a problem and I'd want to try and understand it. I don't necessarily enjoy it so I just memorize." He realizes this memorization without understanding is useless. These two students in particular, but others as well, talk about how easy it is to give up or, as Lila says, "I just go, Forget it, you know?" Even Rani, who appears to be trying and has had two tutors already, says in a defeatist tone: "When the teacher is explaining something that you don't really understand... if you watch it or not... you're going to get lost anyway." These are not students who ask questions very often, either in class or afterwards. Rani says: "It's better if you go see him after class because just by asking the question in front of everybody where everybody knows everything it's really embarrassing.... but in my case I'm not interested at all and I don't want to stay after class." And Ricky says, too: "If everyone seems to understand then you're less likely to go up to him after class...." Donald just says of himself: "I just sit there and do nothing. I just watch...to me it's sort of just my knowledge....Like ... I just wanted to go into science just for the knowledge...." This extraordinary passivity is not atypical: these students are particularly unable to be sparked into action by a lecture-type situation in which they are not being shown exactly what to do. We do not mean that none of these students studies. Nanci works five hours a night and on weekends too; John works five hours a night two or three nights a week and on Saturday or Sunday; Arlette, Rani and Rochelle seem to be working, though it is hard to know exactly what they are doing or how much time they spend. In general, though, these are not hard workers, nor do they really want to be.

As indicated above, these students expect a great deal from their science teachers. Though their wish to be taught so well that they do not need to work is patently unreasonable, some of their pedagogical preferences seem very fair. Serious learners like Nanci, for instance, and John, talk about their need for teachers to provide context and visual examples, and John in particular remembers a high school physics teacher who did this well. Donald's respect for his high school chemistry teacher is based at least partly upon his skill in introducing interesting examples into his classes. Arlette and Cécille very much like their Vanier math teachers who create a relaxed and friendly atmosphere in the classroom, one in which these two women feel able to learn. Methods seem to be made very clear in these classes, too. Clarity of presentation is praised by several other students, who like physics teachers who "show us what to do" or who are willing to repeat explanations: "You ask him something one time, two times, and more times, he will not get angry. He will just teach you," says Nanci. It is the teachers they do not understand that they criticize, whether they fault the teacher for "expecting us to know it already" or "going too fast" or "talking to himself not to us". Ricky makes two remarks which we find pertinent here:

> Because it's like sometimes the teachers go at a pace where the top few get it all the time and are always getting the best marks and the rest of the class is falling behind. It's not doing anyone any service because the smart kid could read the book and do just as well. So, you know, it just teaches the few and I think they have to like motivate.... Like it's also just to motivate you, it's not just to teach. You know? To motivate those who might not be as sure. Some students that aren't sure might not actually be suited for science but there's always....

> Because if a teacher sees that you're not doing well they go, Well, this guy doesn't care. Why should I bother teaching him. It's like sometimes they have an attitude.... Well, I'll just teach the guys that want to learn....It's not that simple. Some people are trying but it's like they're not motivated and it's boring after a while.

The powerful sense that the science teacher is just teaching "the smart guys" and that these students are no longer numbered among such students is a view that is frequently expressed. They feel very left out, and frequently say they feel that their teachers "don't care" about them. They feel dismissed when they ask questions to which the answer is "you should know that already", and they have a sense that the teachers do not understand that they might be troubled about their work. They are students who are easily intimidated by a teacher stance such as Donna describes: "At the beginning, actually, he was like so sure of himself in that I'm the best teacher and if you pass through me you'll pass through anything. But if you fail with me then I don't know why you failed because I'm a good teacher." Rochelle feels frustrated when she asks for help and her teacher is only able to offer her times when she is in another class: she does not say this, but she implies she would like him to try to accommodate her somehow, and the fact that he does not discourages her and makes her feel unimportant. Cécille struggles to explain:

> Now I'm here and I'm at the bottom of the list and I guess that has some reason some effect on why I don't like science any more but basically it's because of high school like the teachers they made it fun... here everybody is serious and the teachers don't really care....Like they do....My chemistry teacher says hi to me in the halls when I see him and stuff. Like he's very polite and he'll help but it's like after class he has his own life and he doesn't bother...because I'm in science it bothers me more. If it was something else it wouldn't bother me as much because science is so tough because of the chemistry and physics and I think the teachers should care a little more.

It is notable that these are the only students in our study who complain that teachers do not care, and the question arises as to whether this is a problem for the students or for the teachers. Though they are not, on the whole, a group who talk about close relationships with high school teachers, they have for the most part been recognized as superior students by those teachers, and they were all encouraged to take science because they did well. Their relationships now with Cegep science teachers are very different, for many reasons, not the least of which is that they may now be, as Cécille says, "at the bottom of the list". It is possible to argue that these students are asking too much, especially since they are not putting out a great deal of effort on their own. But even hard-working Nanci feels her teachers are not giving her enough: "Sometimes I really have like upset...about studies. Maybe the teacher can give... their sense of their experience, how to study, how to catch the basic ideas...." And, as Ricky argues, is it not the task of the teacher to try to motivate the marginal student, and perhaps to entice him or her to work? It appears to us that the "fault", if there is one, lies on both sides: the students ask too much, but the teachers do, possibly, write these students off too fast, when in fact they might well develop an attachment to science.

This is not a highly anxious group, but there are some anxious women students here, and we get a feeling that self-esteem is not very high for most of them. At the extreme end is Nanci, the most serious student, who feels disadvantaged by her poor English, pressured by her parents, and worried about her future as an immigrant. She is having serious intestinal problems which a doctor has told her are stress-related. She says Chinese students tend to be very competitive because their families are,

but she feels different: "I like studying, not what I get." Donna describes anxiety both about her studies and her future: "It is very scary sometimes... I'm not sure what to do next." About her father's great plans for her being an engineer, and his talk of her being at the top of the class so that she can have her pick of employment, she says: "He knows I'm not a 90 student. I don't know if that bothers him. I don't think it bothers him but he thinks I can do it. You know? I don't know if I can do it." About her physics, Rani's present state of mind can best be characterized as depressed. She says "I don't know, I feel that everybody in my class knows everything except me. I'm the idiot who's sitting there." She also says: "About physics you don't say what's going on with you because they will laugh at you." Cécille is quite worried about what is happening to her at Cegep: she worries about whether teachers will help her, and she worries about her grades. She also makes these remarks about competition: "I don't want to compare myself with someone who got 90. It makes me feel bad." "I always feel like if I did better on a test and my friend failed I'd always like try to make her feel better by putting myself down and saying, Oh listen...." Rochelle is also anxious about the future, about whether she will get into medical school. If we look at this list of names, we note that these, on the whole, are the more serious women students of the group: they are some of the hardest working women, and they are the women who experience family pressures which they take very seriously. Lila and Aimée do not seem to be as troubled by either anxiety or competition: we can connect here the fact that Lila is in science under duress, and Aimée's parents, although supportive, do not really understand what she is doing. Arlette has been frustrated and angry, but since she has already decided to switch, she is not really showing anxiety about her performance in science. On the other hand, despite all the family pressures on them, none of the men talk much about anxiety, though John says he can feel anxious "one hour before the test", and Sammy is beginning to be afraid to speak up in class for fear of being laughed at. Only Donald says he really likes competition, a preference which he attributes to the fact that "I'm a power hungry sort of guy." Ricky says he does not feel competitive - he is focusing upon "survival".

Most of the students in this group have only negative things to say about their peers and, particularly, about their work relationships with them. We feel they surely must have friendships that matter to them, but they hardly speak about this part of their lives. Instead, except for Rochelle, Aimée and Nanci, who talk about enjoying working with others and having good lab partnerships, and for Lila who is so vague it is impossible to tell what is happening, these students do almost nothing but complain. Cécille, for instance, says she tries always to work with friends, but even in these relationships she sounds irritable: "If you can pick someone that you know that you're more comfortable with that if you say, Listen I don't have time today to sit here and talk about your weekend...." She also says: "I don't feel like sitting there and explaining it to them when I'm already having trouble." Perhaps this last clause is the key here: if the student is not succeeding, any interaction which asks but does not give is intolerable. Rochelle works with a friend too, but finds her friend is taking advantage of the relationship and expecting her to do all the work. Arlette is also in totally unbalanced lab partnerships, as is John: they feel they are doing much more than their share of the work. Sammy talks at great length about lab partners who "ditch" him, but when he reveals that he comes late and totally unprepared, it is not difficult to see why. Donald describes himself as a total loner, though when he must have a partner, he has to be the boss. Ricky seems to be collaborating well with his partner, but the work is divided along gendered lines, as he fetches, carries and performs, while she writes and calculates and, as he says: "Most of the time we don't necessarily understand what we're doing but we pass it in anyway and get good marks so it doesn't really matter." Donna says that she feels so shy she is incredibly uncomfortable both finding a partner and working with someone. Why these particular students should be having so much difficulty is hard to say: certainly their difficulties with science are

mirrored in their interrelationships with their peers, but the lack of discussion of other, more positive interrelationships suggests that either the problem with personal interaction goes deeper, or that they are beginning to be so unhappy in science that they are generally unhappy with everything.

INTERVIEW TWO

1. Motivation

By the time we meet these students again, they have all transferred out of science and they are at various stages of an alternative programme. Since some transfer immediately after first semester and some after as many as three, our conversations cover greater or lesser ground, depending on the length of their stay at Cegep. Those who stay longest in science are those most attached to its elite status. Rani stays for a year because "everybody was like, Come on, you can't switch from science like Pure and Applied to Social.... They called me dumb when I switched." Others like Rochelle, Lila and Donna stay for three semesters for similar reasons, although, as is hinted in Rani's words, this elite status is an idea presented to them by others, not necessarily something they themselves believe. All are extremely articulate about their reasons for transferring from science, and some give us a much clearer perspective, this time, on why they chose science in the first place and why they think that choice was wrong.

Since the experience has not been pleasant for any of them, it is not surprising that there is little they have to say that is positive about science. Still, there are parts of what they have studied that they still value. Nanci values some of her subject experiences: "I get a lot of fun with physics...but I couldn't get a very high marks." Arlette and Rani remember chemistry and math as very positive science studies, and both have stayed with math; physics, however, was the great downfall for both. Still, Arlette says: "I still like the sciences. I'd love to take physics again.... I'd like to take just theory and that's it.....No equations, no problems. I just want theory." John says: "I liked it a bit, science, but I felt there was a negative pressure. It was a good pressure also but for me I don't like that kind of pressure." Donna says: "I liked it but I couldn't see myself doing that, as a job, let's say, in the future." Donald says: "I like science, that's one of my things I like....Actually I was thinking after I finish my DEC...I want to go back just for like the knowledge but not for making a career of it."

These rather cautious positive remarks are the only good things this group has to say, however, and the comments which relate to low marks, pressure, and career possibilities, are the main thrusts behind the negative commentary we have heard from the rest of the group. On the whole, these students switch because they are not doing well: none of these non-persisters is a high achieving science student. The specific ways in which marks determine persistence is explored more fully below, but it is important to note that both the words of the students and their transcripts indicate that low marks have, in these cases, led to programme switch. In terms of their reasons for dropping, the only gender difference we have found is in the intensity of the negative experience: the women appear to have suffered more, and to have felt much more relief about their change of programme.

Specific career motivation works very quickly to inspire programme transfer. Cécille and Aimée, who both came to Cegep with aspirations for architecture, maintain this interest, and then find different ways of fulfilling it. Cécille leaves science at Christmas, takes a term of core and complementary courses and transfers to Architectural Technology as quickly as she can. She even enlarges upon her original motivation for entering science, as if her experience has led her to a greater degree of self-reflection:

> I was supposed to come into Architectural Technology and not science but my parents changed my mind and when I came here to open house the guy who was a student who was demonstrating.... Well, the guy who was there for open house for Architectural Technology like I was trying to talk to him and ask him about the programme and stuff but he didn't seem to know too much and he told me if I was doing really, really well in high school that I should go into science and then go to university and not come to this programme. This programme isn't about not going to university. It's not about just the end. A lot of the guys in my class they want to go on to university, they want to continue, but the way he was making it seem is like if you take this programme then that's it and you can't take anything else after that. He said I was too smart to come here. You know? It's not true but I mean that's what changed my mind.

Clearly, Cécille has had to deconstruct some of the elitism and misinformation she has absorbed. She is very much enjoying the new programme, and still talking about her preference for the technical side of things: "I'd rather have the responsibility of like doing my work but not worrying about everybody else whereas that's what the architect does." If she goes on to university, it might be in art to teach in high school, but only if she cannot get a job in an architectural office doing drafting. Aimée, finding science difficult especially in English Cegep, switches to a French Cegep after her first semester where she transfers into Building Systems Technology as soon as she can. Her reasoning has been based, like Cécille's, upon what she knew of herself from the outset, in this case: "For me, it's the part concrete...the concrete parts. You know, the labs and all the things you have to do with your hands and see with your eyes. It's not all the, you know formulas that you have to understand. It's things you can test." She is also very much motivated by a wish to find a job related to her interests:

> Last semester I thought about, you know, what I was doing and I got to the conclusion that after like my studies I'll have nothing but a science diploma. If I want to go and work there is nothing like.... No specification.... I've done nothing concrete and so I decided to go into a technical programme. After my diploma I could go to work and do something really related to what I like.

She says she wants "independence and you know the feeling that I'm doing something. It's like not just going to school and doing nothing else." She might go on to university, but it seems unlikely. These two women stand out as students who knew very well what they wanted to do. We have presented their stories in detail since they represent for us the prototype of the young woman who has to fight her way into what have been seen by many as non-traditional fields for women.

In similar ways, other students in the group have begun to rethink the process by which they came to science and to examine new challenges. Rani says: "Where I come from, my high school, my teachers never used to ask me, what are you interested in, what do you feel like doing? Never. They just used to say, Okay, your marks are good enough to get you into this programme." As we saw in our first interview, she was never very comfortable in science because of her difficulty with physics, and she saw at once she could become a psychologist by another route. She tells us much more frankly now: "My parents expected me to be in science. As a matter of fact, my mother wanted me to be a doctor. Sorry I disappointed you but I can't be what I can't be. You know?" Her transfer to Social Science, for which she waited a year because "my God, I'm in the best programme", and "it cost me a lot because I used to be so nervous all the time and I used to like go crazy", has allowed her to concentrate on psychology which, as she always knew, she "loves". Rani is not alone. Donald trans-

ferred to science at a Cegep closer to his home and then switched into Police Technology in the fall. As he told us in the first interview, this is what he wants to do. He still has certain aspirations to join the elite, but they are concentrated in this field: "Not, not as a policeman, because a policeman to me is like low. You know? ... My goal, like, is I have to be a lieutenant." As he talks about his plans, there are many conflicting wishes: his family is not pleased with his programme switch; there are pressures on him to get a job; his ambition tells him that he will need a good deal more education; living at home is more and more of a problem. He sees some of these personal difficulties in larger terms ("It's cultural," he says of his problems with his father), and he is also much happier in his new programme than he was in science, but many conflicts remain to be resolved.

There are other stories, too, which exemplify the ways in which all of these students have taken us so much further into their reflective and decision-making processes in this second interview. As Donna tells her father she cannot do the science because "it just wasn't in me", he adjusts much faster than she expects, saying, "I don't care what you go into as long as you become a professional." Elsewhere she quotes him as saying: "Just become something." She transfers to Commerce after her third semester, and now plans to go on to study business at university. She says:"Now I feel a lot better. I feel very motivated and I feel up to speed." She is already talking about a business with her father, importing chairs. Rochelle, in her way, has had to deal with a deeply troubling family situation. She has also had to take a job. She says that "everything just got compounded and I was just like the worst horrible person you could ever imagine. I was just like angry all the time." As she deconstructs her original motivation, she comments that she went into the sciences first, because of her mother's encouragement ("She has absolutely no respect for Social and a minimum for Commerce and the technical courses like, Screw it because you'll be training people with like bachelor's who will then go higher than you"), and second because "all my science scores on those standardized tests topped... I mean the top 10%...." But her first love, as we recall, was math, even as she sat with her mother in the car as a little girl, and as she entered Cegep, she was still very interested in working with computers. After her third, disastrous semester, she transfers to night school and will take a Commerce diploma and continue in Management Information Systems at Concordia. Such studies will satisfy her interest in logic, she feels, and she is very excited about her future now.

In much less dramatic ways, Arlette, Ricky, John, and Nanci work out what they must do, but their paths are very unclear, and some of their discussion is ill-informed and probably unrealistic. Immediately following the first semester, Arlette and Ricky transfer to Social Science with great relief and find their new programmes thoroughly enjoyable. Neither have very clear career plans, though Arlette's interest in psychology leads her to think of various kinds of counselling, perhaps Funeral Direction. She is doing very well in her courses. Ricky does not talk about the fact that he is not doing well, despite his enjoyment: in fact, he talks about possibly going into Law, which his marks are clearly inappropriate for. John follows his interest in photography into Communications but is concerned that the programme does not offer him much in the way of a job future. He says he is sad to give up his plans to be an orthodontist, "but when I think of all that it takes and all that I'd have to do I don't really think I want to do that." He talks about engineering without really coming to grips with the fact that he will have to do the science if he is to go that route. Nanci has transferred to Commerce, her second choice from the outset, and plans to go into international business or accounting. She likes the fact that Commerce has forced her to make oral presentations which have helped her with her shyness. She agrees that language is still a problem, but does not connect this problem with her future plans. She still feels she cannot consider pursuing her interest in the Asian arts.

Sammy and Lila exemplify the students who stay in programmes doing badly until they are

caught by the Review Board and told they must reassess their situation. Both say they might have gone on in science if this had not happened, though Lila had grown to hate her courses, to skip her classes, and to do none of her homework, an extreme of behaviour which she knows to be a sign she was in the wrong programme. She always knew she was only in science to please her parents. She is happy to be in Commerce and is actually doing rather well. She sees the Commerce programme as having some status above that of Social Science, and plans to go on in finance or business in university. She still feels that education will allow her to be "like the big people": "I won't have to work like for somebody else....Like work my ass off for them and they'll make all the money." Family voices seem to speak through this rhetoric. Sammy actually did so badly in science that the Review Board refused him re-entry into the day programme, and he spent one semester in night school and is now back at Vanier in Communications. He talks vaguely about going on in cinematography, but seems as unmotivated and undisciplined as ever. It is very difficult to know where he is coming from, though he does comment that he thinks he was always misled by the view that non-science students are "not going to get anywhere or nothing".

In general, as noted above, it has been high marks that led the students into science, and low marks that, ultimately, drove them out. That being said, we remind ourselves of all the complex reasons why student marks rise and fall, and we refer particularly to those aspects of genuine interest and motivation which we have just explored. Many of these students come into science because, as Rochelle says, "I was used to getting everything so easily." A student who is quick and attentive can, it seems, do rather well in high school math and science without having any particular interest in or aptitude for it. Without much thought about what they really want to do, these students use their marks to set their study paths, and high school counselling encourages them to do so. And, as Arlette comments, "in science, marks mean everything". She actually tells us, even in the second interview:

> If I hadn't done so poorly in the first few tests in physics....If I hadn't done so poorly in the first three tests in all of the science courses I would have stayed in it....Because of that I didn't think there was any hope of me actually getting a job in science.

She says that now in Social Science "my marks are so much higher so I guess that's why I'm happy and I feel I'm accomplishing something." Arlette is the extreme case here, but her focus on marks is not entirely unique, and she has not come by it alone. Lila's remark makes it seem as if only the mark is of real interest to her: "It seems like exciting to get a good mark really. Like you know, if I do something and I get something good out of it like it makes me happier." Without low marks as indicators, not even Aimée or Cécille would have dealt with their programme transfers. What none of these students seems to have been willing or able to do is adjust to the kind of work pattern which might keep the science marks up. We discuss these study habits more below, but it is important to remember how much they have always wanted and expected the marks, and how little they ever seem to have been able to integrate the idea that maintaining such marks requires a particular kind of application.

As these students talk about their interests, we still hear the voices of young people who do not include a great variety in their lives, but what they talk about does still shed some light on who they are. Hobbies and activities appear to be ever fewer, with this group, and completely unrelated to what they are doing. Five of the women students have sales jobs, and only for Aimée, who works in Canadian Tire and sees it as an opportunity to learn about plumbing fixtures, is this work in any way related to their studies. We must remark that this is the highest proportion of part-time workers we have found in our overall sample: in general, science students do not have jobs during the semester. In discussing their non-science courses, however, these students show not only great interest but the kind of interest that suggests they have found where their aptitudes lie. As Rochelle talks about computers

and some of her experiences with them, we hear some of the pleasure she once demonstrated about doing math problems with her mother. She recalls for us the fun she had helping the teacher run computer labs in high school, and now helping her employer learn to use a computer in the store. We hear again how closely her pleasure in doing things is bound up in doing them with people with whom she has some connection. This social connectedness seems to be a common theme for many in the group. Rani tells us: "Social Science is working together in class. Like everybody being at a similar level. No one is smarter than the other one, no one raising his hand very fast to give the answer and making the other one feel like he's dumb because he didn't know the answer." Donna says she has found she has "asserted myself more on those than on my science courses", and Ricky speaks at great length about his pleasure in talking with others about the issues social science courses raise. He says he remembers science classes as very "impersonal" and without interaction, whereas "in my social science class everyone is like interested and we have great discussions in every case and you learn so much just listening to people. Everyone is like so involved. I can't believe it. Everyone actually wants to be there." Even Sammy seems to have found some kind of a place: "Because I'm more of a joker kind of guy and so I can go in class. Like, I'm taking theatre now and so I go in class and we're doing skits and stuff and, I don't know, I feel more comfortable." The students also talk about the special appeal of non-science subject matter. Donna feels there is a "common sense" backdrop to her commerce subjects that helps her understand it and answer questions about it on tests. Arlette talks about the pleasure of learning a disciplined way of looking at cause and effect in psychology or group and category in sociology. Rani also likes learning a discipline with which she can make real connection, as she tells us when she mentions the fact that "I knew all those things but I just had to look at them in a way that psychologists look at them." Ricky likes the way "it just registers things about history and stuff and it just goes in before you can read it....It really interests me and you don't even think you're learning and you just read it and it's like a story and you just memorize it without even thinking." These Social Science transfer students have all enjoyed English and humanities courses, and so have those who have gone on to technologies, like Donald, Aimée and Cécille. They have also enjoyed complementary courses in art and languages, and they have got good marks. John has not only liked his photography and film classes, but he has taken some computer courses which he has found very absorbing. There is certainly some feeling that all this non-science subject matter is "easier" and that "working just as hard gets you much better marks than science does", but there also seems to be much greater comfort because there is less pressure, less competition, more connection with other people and with their lives.

2. Attitude

Though not every student in the group would agree with every other, there is quite a consensus on what science subjects are preferred and which most disliked. Seven out of the twelve both like math and see its usefulness, while an eighth, Donald, certainly would agree with the useful aspect of math and is quite complacent about having mastered two math courses in science to such a degree that he finds his statistics in Police Tech ridiculously easy. Rani says: "I love math....And, I even finished it. ... I think math is a part of life. If you don't take math, you don't know anything." Donna says: "Yeah, I liked math. I had a hard time...I failed calculus twice. I'm taking it for a third time now and I have a 75% so far." Aimée says: "Calculus, I had a really good teacher and she cared about the students if you tired....And that's the course I did the best in." Arlette decides to take math as a concen-

tration because of her great liking for her first calculus teacher and she says: "I still love math. It's going to help me in anything even in Social or even for every day life." Rochelle says: "Okay. Math, I still love and that's why I went to commerce and not Social. Math is fine and I love it...like math I still love. I know it's in me and I love doing problems and doing the numbers and writing it all out." John says: "For example, I like math, I'm still taking math courses."In spite of failing it, Sammy says he found calculus "easy" and he liked it. This general enjoyment of math is very much bound up with teachers and their relationships with the class, as will be discussed more below. On the other hand, physics has been almost universally disliked by the students in this group. Some comments suggest the very decided nature of this dislike: "I hated physics"; "It was too difficult and way beyond my level"; "I basically left because I was having a really bad time with physics"; "I thought I'd love it and I thought I'd have a blast in it but I was sitting there and everything was going really fast paced and I was running to catch up and I was like, I don't like this any more"; "When I came out of high school I liked physics a lot more and then when I came here I just changed". No one really gives us an overall insight into what goes wrong here, though a great many of these students say that they found their physics teachers harsh and discouraging, about which we will say more below. It may be a certain kind of abstract thinking is also difficult for these students, and there seems to have been no bridging this gap. Only Nanci and Aimée say they like physics, Nanci because she appreciates the way it explains forces which she can see (the way her paddle makes a boat turn), and Aimée because of its connection to construction principles. Chemistry seems to have been difficult for most of these students, but it is not a subject which they much discuss.

It is not surprising to find that these students' attitude towards and description of the good science student continues to stress hard work. It is the work that shocked most of them in their first semester. Some recognize that science students are harder workers than they are: "Because sciences is a lot of studying and I'm not used to it," says Aimée; "I can't just stay home and study all the time," says Donna. Others like John and Rochelle feel that their time in science actually did teach them good study habits, and they have taken these with them to their other courses. John and Rani say that science students are very "smart" and Ricky says a good science student understands easily: there is some suggestion here that superior giftedness is required. They also recognize that science must be enjoyed, that the science student needs to be self-disciplined, and that a career goal is an enormous help. Aimée also posits the notion that good science students can control anxiety and limit stress: "they're able to not let school bother them. If they had a bad day they could just forget about it....Even though they weren't doing well in school they managed to pull through it and they didn't let school ruin their life." The elite image of the science programme and the students in it has been a terrible burden for these students to deal with, as has already been discussed. Most of them have now deconstructed these images, but not without pain and sacrifice. They still take pleasure in some of the knowledge they have gained, whether it is the applications and approaches, such as Arlette mentions, or the recognition of chemical ingredients on a package, as Donna mentions, or some mathematical application, as Rani suggests. This knowledge gives them a certain degree of confidence and some sense that their time was not wasted.

This group is the least able to articulate an overall vision of what science is about, possibly because they have had so much trouble with it, but also because they have had much less exposure than the rest of our sample. Three students try, however, and their answers are interesting. It is also interesting that the three who try are possibly the students who had the most potential for science, and have chosen paths quite closely related to science. Rochelle's musings seem to us to be very important, especially since they come from someone who has abandoned science <u>per se</u>:

> It would be a lot of memorization of the laws and then incorporating those laws and drawing equations from those laws and applying them to everyday life. That's what.... Physics would be mostly that. Chemistry would be understanding basically what the world is made up of and how, you know, combining different things would give you different reactions and then you'd have organic chemistry which is, you know, confines it to the body or on living creatures and biology, I guess, would be, you know, understanding how things work inside our bodies....Yeah, it's all connected. Well, the only one you could probably hold apart would be physics from chemistry and biology because it has to do more with gravity and mechanics. Except like the mechanics you can work with in biology and the way your muscles work and everything. They generally all go together and math, well, you have all the equations and everything so you know math is in there somewhere.

Since we know Rochelle comes from a scientific family, we can presume some of this might well have been discussed at home with her mother. She has also told us there are many books on science subjects in her household, and that she often looks at them. We find it interesting that she understands how memorization has a place in science learning, but that it is only an initial step toward making use of that basic knowledge: so many students seem to get caught on at one extreme or the other, either refusing to memorize anything, or trying to make memorization do the entire task. We also note especially how she, at the last minute, is able to connect physics to the body, and we wonder whether, if her courses had done that, she might have found it easier to deal with. Aimée, who has not really abandoned science but has turned to an applied science technology, sees science as follows:

> Science.... I think it's more like culture. It's not like really something that you can use after. It's more like something personal that builds you up after when you do what you like....You have really the basics and all that stuff....And if you don't like science you have to do some anyways because it's like an exercise for your brain or something like that I think.

It is an unusual insight for a student to recognize science as culture, and to see it as so essential a part of human life. Intensely practical, Nanci says that the function of science is to "develop technology and make the country stronger for man...."

Naturally, since they have not much liked science, they have many suggestions for its improvement. None of these suggestions is much different from those that others make: greater contextualization, more caring and sensitive teachers, a more flexible curriculum, better preparation in high school, stress management courses, and so on. Fifty per cent of these students do stress, however, that much better counselling is required, so that students know what science involves, and whether it is what they should register for.

These students have different things to say about gender than they did in the first interview, mainly with reference to student behaviour in various programmes. We hear little if any discussion of future marriage and family aspirations: of the few who deal with the question, two-thirds of the women still want simultaneous careers and family and see no difficulty. Aimée and Cécille do have interesting remarks to make about their non-traditional programmes. Aimée says there were two women in her Building Systems programme in September, and three more have applied for entrance for the next year. She finds this an encouraging sign. She also says:

> I don't know, I feel like if I got there it's because I'm as good as the guys. So in the programme I'm going to be more.... You know, it's not competitive but maybe I'm going to show them that I can do better than them. That's what I think. Because all my life I wanted to do something, you know, not really traditional. You know? Architecture or.... When I decided to go in there, there were only guys...and people were telling me, there's no girls in there? and I was, why couldn't I go there if you can? I'll show them that I'm better than them.
>
> They're quite open - like the guys I talk with - they talk about, no, there's not enough girls. The guys are motivated, you know, when there's girls around in the sense that like they know that we can do better than them. So they want to compete with us and we get better too. It's like... I don't think they're going to resent it because we're going to be there.

About her programme in Architectural Technology, Cécille says:

> I don't know who was in the class like five years ago but I know that in the programme now I look at the first year's and there's just as many girls as there are boys if not more. And in my programme a lot of the guys dropped out. All the people that dropped out there was maybe ten people that are gone and the majority were guys....Because they were slackers. They never did their work.

Even of the men who have stayed, Cécille says "The guys are babies. They're always complaining, they're always trying to get out of doing work." Of their attitude to her, she says:

> Well I don't think that they're prejudiced against women but there's a few guys in my class that think that because they're guys and they have the knowledge that they can draw the best and think of the best plan. And they'll look at yours and, Oh, that's nice, but like themselves which is okay I guess because it doesn't bother me because I get better marks than they do and that's all that matters.

The experience of these two young women has given them much insight into gender dynamics, and they are, if anything, challenged by stereotypes rather than deterred by them. In this respect, Rochelle's remarks about herself are very similar, again in relation to her somewhat non-traditional interest in computers:

> I know one thing that shocked me was talking to a friend about computers and he said, You're the first girl who I can actually talk with about computers and be understood and I was actually surprised. You know, I never really gave it much thought. You know, the male-female thing. But like in my science courses you always see a lot more guys. I'm not sure.... I always thought it had to do with more guys interested in the sciences and everything but.... Me as a person.... Like all my life I've been more of a tomboy. I've had more guy friends than girlfriends and I was like.... I guess you could say more aggressive than most girls and I was like, I can't do this because I'm a girl? I don't think so. I'm going to do it and I'm going to do it better than you. So if they ever brought up the question of sex or anything I'd go, yeah? And then I'd get my back all up and everything and I'd go, You'll see. And then I'd end up doing better than them. Some people, you know.... Like there were a couple of guys who were like, You can't do this, you're a girl.... Like, excuse me!

A few others make comments that suggest science, too, is male-dominated. Donna thinks that there were more men in her science classes and that they did better; she says there are more women in commerce, and the women excel there. Nanci, Ricky, and Rani agree with this notion, which we as researchers know to be untrue. The reason they say this can perhaps be explored through Donna's remark about women's behaviour in commerce classes: "They know to say, they speak a lot more in class...." Participation calls attention to numbers and is also often interpreted by students as knowledge or high achievement: all these students continue to say that the women are much quieter and more attentive in science classes than are the men, but that there are always talkative, teacher-engaging men who take up space either positively or negatively. Rani says: "I have a feeling that my teacher used to like boys, guys in physics class because he always used to be so.... You rarely saw any girl sitting there and talking to him. Never. It was only guys. All the time." She also complains:

> And sometimes I used to want to go see him and he has another appointment. This guy that I saw yesterday, there, and before yesterday, and the week before.... I think that the teacher used to relate himself better to them. That's it. That's the feeling I had because I never saw a girl with him. Never, never, never.

John thinks the teachers engage the boys to capture their restless attention. If it is true that there is greater attention given the men, whatever the reason for it, we cannot help but wonder whether more positive attention paid to these women students might have made a difference.

We are somewhat surprised by Donald's extremely sexist remarks about women in Police Tech, how "they will never pass their physical exam. Because they're women, you know?" He is certain that being "in really good condition" involves height and large muscle mass which the women do not have. He also seems to have been discussing women in police work with teachers who make disturbing though understandable comments:

> Like, I asked my teacher about that. He said, I would rather have a male who's like 150 pounds and up who can like hold himself up like in a bar fight or something than a 125 pound female. You know? He said for the safety. He said, like, you know, for my safety, I don't want to depend....

Perhaps it is this concern that causes him to hope the women do not pass. In any case, it is interesting to set Donald's remarks against Aimée's and Cécille's: further research into the complex gender dynamics of these non-traditional programmes is obviously much needed.

3. Experience

As we listen to these students talk again about how they studied science, we are struck by how little they changed their habits before they transferred out. Only Aimée talks about real change, about realizing that she should try to work at least two hours for every three in the classroom, that she must concentrate when she is studying, that she must organize her time so that "this is work time, this is fun time." She says she began working in this much more focused way as soon as she transferred to the French Cegep and that it has paid off. She feels it has been a maturing process, "you don't act like you're in high school any more." This is precisely what many of the rest of the students did not learn, at least while they were in science, and some have not learned yet. Sammy is still saying: "I'm more the type of person if I go to class and you explain it to me I'll understand it. If you're getting the message across properly, like, if you're sending it out properly I'll understand what's going on." We hear some of the same thinking from Ricky, when he tries to tell us why he was so lost: "Maybe it wasn't explained properly or maybe it was on too high a plane or maybe I just didn't enjoy the sciences at all." This

completely unself-conscious refusal to accept responsibility still dogs these students' steps, and neither are doing well in their newly chosen programmes. Donna and Lila confess again they never worked, never wanted to work, and, as time went on, began skipping classes and so on. Their work habits have not changed very much, and the fact that they are doing better suggests they can get by in commerce with less study than in science. One gets the sense, however, that they are willing to read and to write essays and that they do not call this "homework" or "study". We hear again the tremendous teacher dependence of this group, even among the better students, as John tells us: "That's one of my problems. I can't teach myself very good. I find that a problem. So even when I would read the book I wouldn't know if I understood or not. I could do some problems and get them and still maybe not get the concept." We find this a good insight, well worth noting as a descriptor of many students who do, indeed, need things explained "properly", but perhaps even more than that, need to be taught how to learn more effectively on their own. Rani and Arlette remind us that they dropped science because of physics, and that their teachers had a great deal to do with their discouragement. Again, however, the mind-set is part of the problem, as we hear from Arlette: "I know I'm not going to do it right and then I just don't do it and I go to the next one and I get something wrong there and I end up with like a page of problems and I never get back to them because there are mistakes and so I don't want to do them." Rochelle and Cécille also talk about working at problems for a while, having trouble, getting discouraged, and giving up. With these two women, whose interest in science continues to be high, we cannot help wondering if this type of experience could not be dealt with as part of the pedagogical thrust of the sciences. Strategies and incentives for sitting through the difficulties that science poses seem to be lacking for these women, and might be taught. In any case, they did not learn them in science, though Arlette is working hard and well in her new programme, actually winning a prize for a top essay. Perhaps she is right when she says that, for her, "it's better if it's words", but even that preference could be harnessed to assist the student of science.

It would be easy to assume that these students' comments on teachers are without validity, simply because they expect so much. When Lila says she thinks she would have stayed in science if she had got better teachers, it is impossible to use this as a serious critique, and when Sammy says teachers should push students more, we know we are not hearing valuable insights. However, when John and Nanci say they did not have good science teachers, we listen a little more closely. For some reason which they do not fully explain, these teachers did not reach them; John and Nanci feel they did not want to. When Donna surprises us with total recall of all her physics and chemistry teachers by name, and describes who helped and encouraged her and who did not, we see a much more discriminating picture and one that suggests how important some sensitivity to student problems can be to help students get through. We are particularly attentive when a student like Rochelle praises a less-than-popular teacher for careful and meticulous organization of material, judging him finally to be her best teacher. We therefore pull out for consideration certain teacher comments made by these students which, in their view, were highly instrumental in causing them to transfer. Of her first physics teacher, Rani says: "If you go and ask him, he tells you I have no time to explain them to you, go take 111 [remedial physics]. You know?" Of her first chemistry teacher, she says: "I said, I'm sorry sir, but I don't understand what you're talking about. I never took this in high school he didn't want to explain it to me." She continues:

> And even my teacher I learned by the second time I took 101 Physics he told me, let me ask you something.... What do you want to do with this? Well, I don't know. If I took it I'm going to go into something like engineering or something....He looked at me and he goes, Switch programmes, you have no hope....Excuse me, but if I have no hope you don't have to shove it in my face.

Aimée describes her experience with one of her math teachers in the French Cegep as follows: "You know, if we told him we don't understand this he said, You're stupid, that's all. And it was like, Oh, my God! so I just quit. It was too hard." On the other hand, she describes a relationship with a physics teacher there in quite different terms: "Here in my physics class the teacher was like really close to us. He was speaking with us and he was asking questions and if we understood and something like that.... You know? It was really close and that's why I liked it a lot." She also says: "Calculus I, I had a really good teacher and she cared about the students if you tried hard. So even if I was having problems she would always be there to help me which....And that was the course I did best in." Arlette has a similar story:

> I worked hard in physics and I was preparing for a test but I didn't do too well at it and so my teacher thought it was my fault because I was negligent and he started kind of raising his voice at me for not preparing as well as I should have and not coming to him for help when it was the day right after the weekend so I had prepared well enough but he said I didn't.

Arlette makes it clear that this experience was a turning point for her, a large part of her decision to transfer. On the other hand, she stays in math: "In Cal I really loved my teacher and she helped a lot. So I really liked Calculus and I'm going to take math as my concentration because of her. I really liked calculus." The fact is, Arlette was having trouble with both these courses in her first few weeks, and it was the way the teachers dealt with her difficulty that made all the difference.

When Aimée tries to put all this in a larger context, she touches upon the subjective content of teacher-student relationships in a way that leaves us pondering:

> Because you're just one little person in this teacher's hundred and fifty students. You know? And if one day he doesn't like you because you didn't do well on his test you feel like....You know? You feel, that's it, he doesn't like you and he doesn't want to help you. That's where I got the impression from my physics teacher. And, I don't know, some teachers are really nice and some teachers aren't and I guess I got....

Is it only an impression that the teacher does not like the student who doesn't do well in his test? Certainly it is not an impression that every teacher gives, as is suggested by the many positive comments quoted above. If, indeed, it is only an impression, how could a teacher avoid giving it, since it is so daunting? If it is not just an impression, but true, is this not an issue of ideology that ought to be addressed? Do some teachers see themselves as gatekeepers whose serious task it is to discourage some students from continuing? If so, why do other teachers not agree? If it is the concern of the institution that students persist in science, perhaps this particular issue needs more frank discussion.

Most of these students feel a good deal better about themselves and their studies now that they have switched programmes. Several of the women recall how they once panicked over their science courses, and then got so depressed about their results that, as Arlette says, "I was grumpy all the time. It was discouraging because I'm not that stupid." This last comment is certainly an important point to note about these students, who decide to persist at Cegep if not in science: they do have some faith in their ability to succeed in some other area. Nanci, Ricky, John and Rochelle talk about enormously improved confidence in themselves now that they are in programmes where they feel they understand how to perform and are, in most cases, performing much better. As Ricky says, "Well of course when you get high marks you feel more confident...." And as they feel better, they work better, and there is an ever increasing cycle of improvement. In general, they seem to feel their new pro-

grammes are slightly less competitive and they are comfortable with this relaxation of tension and comparison. Lila describes two people cheating in a science test, and the point of her story is not a moral one, but an issue of competition: "They were showing each other the exam. You know? I was like....Okay, like for me they're friends, and you know, they would never have shown it to me even though.... So it's like competitive in a way because they wouldn't give it to you because you're an outsider to them." Shocking as her attitude may be, she does touch on the way in which competition for marks can in fact lead some students to cheat or to want to cheat, and how even this cheating has its exclusionary aspect. Rochelle talks about herself as a very competitive person and as rising to challenge. However, she does say: "Like, being challenged but not to the point where you're going to break the person." She feels that, ultimately, that was happening to her in science, and she quit. She admits that her personal life problems very much complicated the experience, and gave rise to additional anxiety and despair. She does not seem to have felt she could seek help from the institution, and we wonder why. Donna is now experiencing anxiety about the future, wondering whether her poor science marks will militate against her entry into commerce studies at university. We note here that again we are hearing mainly from the women. Aimée describes herself, and we recognize the great difficulty so many of our students have, balancing so many pressures:

> Some people they can not worry about it and they can let their personal life not interfere with school. But to me it was just too mixed up. I can't explain it and it just seemed what I needed in my personal life and in school was overwhelming all that. But they were able to not let school bother them. If they had a bad day they were able to just forget about it. But, me, I couldn't. And I think those were the people that did well because they were able to concentrate on other things that were happening that were good... they didn't let school ruin their life.... But school for me was always...if school wasn't going well then my whole life was in shambles.

Though she is wrong that only the calm student does well, it seems to be true that students who are not top achievers are easily overwhelmed by their anxiety and can do less well as a result.

Discussions about experiences with other students are much more positive this time. Some of the students did learn even in science to turn to one another and to work together, especially Arlette, Rani, Donna, Aimée and Nanci. They tell us they found these friendships both instrumentally helpful and emotionally supportive. Other students like Rochelle and Donald seem to have opened up to people now that they have left science, and they talk about participating much more in class and enjoying group work of various kinds as their confidence rises and their comfort level with the new programme increases. Aimée and Cécille particularly like their new programmes because they are small and friendly. Whether this ability to interact positively with others and to integrate these interactions into their study lives develops in science or after transfer, it seems to have been part of a maturation process which many of both the women and men in this group have experienced. They seem much happier, and we cannot but think that at least some of this better feeling interrelates with their improved relationships with their peers.

X. TEACHERS OF CEGEP SCIENCE: THEIR INSTRUCTIONAL PARADIGM

A. SUMMARY

We have tried to gather here the attitudes of a representative group of teachers, thirteen in all. Four are women, two biologists, one math teacher and one teacher of chemistry. We have chosen three men in physics, two men in chemistry, one man in biology and three men in math. This selection is very roughly representative of the gender balance of teachers in those subject areas. In terms of ethnicity, we have tried to tap that variable as well, including anglo-Canadians and teachers who have emigrated from the British Isles, western Europe, the Indian sub-continent and Asia. We have also tried to capture a range of attitudes to Cegep and to the Cegep student by approaching teachers whom we know to see themselves as representing both a "soft" and "tough" attitude to their pedagogical role. We have also included very popular teachers as well as teachers of a more modest reputation. It might be argued that only serious and dedicated teachers would agree to help us in the study, and that this in itself might affect the validity of our research. We certainly have found this teacher sample to be both serious and dedicated. It must be pointed out, however, that none of the teachers we approached refused us an interview. Our general feeling is that we have, indeed, captured the attitudes of science teachers, that it is remarkably coherent and homogenous, that there is little evidence of gender difference, and that it tends to support the hegemony of science among Cegep disciplines.

Most of these teachers say that science study demands superior intellectual gifts, and those that do not say so suggest it in more subtle ways. There is a strong suggestion that everyone should know something about science, but many of these teachers suggest the need for science courses for non-science students, courses which would not be damaging to student egos by presenting challenges students could not meet. They do not seem to feel that way about those courses now deemed compulsory, such as English and humanities. The non-science science courses sound very much like the highly contextualized and explanatory courses which the students whom we have identified as part of the second tier (especially the very superior women students) long for, but these teachers say there is not time in the science programme to offer them to science students. There is also a suggestion that science students ought to know more about other subject areas, but again time constraints are seen to make this impossible. It is clear that these teachers see giftedness as quite important for success in science, much more important than the students do. They also identify the advantages of background in terms of schools and family influences: it is clear they see successful science students as an elite group.

They also have a vision of science which involves a clear hierarchy of subject matters, with math as the basic gate-keeper and physics as the "hard" subject which they all must be able to master. Chemistry is seen by some as somewhat softer because some of its principles are less abstract and can be learned by rote, but not all chemists would agree. Biologists see their subject as "soft" because at the Cegep level it is more language-based and requires less calculation. Some actually suggest it is not important in the Cegep science programme. Other biologists suggest that in reality to do biology one needs to know all the other sciences. All view the learning of science as incremental and instrumental to further science learning. They also all agree that science requires hard work, and their list of what is required resembles that of students enough to suggest that this message is abundantly clear. A few teachers stress communicating care and personal concern for the students. Their discussion of the

role of the teacher, however, contains enough caution about getting too close to students, and about allowing students to be too dependent, to help explain some of the alienation felt by students who want to bond more closely with teachers. All express a truly "tough love" attitude to what most recognize as the very stress-inducing evaluation measures they feel they must use. They say that the students must be able to communicate and perform, and they have to learn to do it, however much anxiety they suffer as a result. Many of the men consider the intense anxiety of women students as "pathological". Most see real gender differences among students, some saying the women do better and some saying the men excel, but most agreeing that women work harder, are more careful and are more concerned with their studies. The women teachers have a very full awareness of the historical significance of our women students' success in science. All these teachers appear to try to avoid gender discrimination in class.

The teachers' view of the value of a Cegep science education is, as one might expect, highly instrumental. Few of them consider enjoyment and personal growth. They stress the mastery of basic material and methods which will help the students in university. It is perhaps this section of the teacher interviews that most contrasts with the interviews with students, except those students persisting in pure or applied science. In other words, only pure and applied persisters share the teachers' instructional paradigm: the needs of students who look to a more transformative educational experience are not much addressed.

B. INTERVIEWS

As we begin our discussions with the teachers, we see the initial shaping of a paradigm which is transmitted and moulded by teachers of different genders and ethnicity but which has a force of its own. An important component of this paradigm emerges when we examine their views on which students ought to take science. When asked whether they agreed with the present situation, in which other Cegep subjects were compulsory but science was entirely a programme of choice, they give what at first appear to be very different responses. At one extreme is the biologist who says without hesitation: "I think at the college level they should generalize education. Even at university, you know, they should be taking English and humanities or philosophy or whatever." Close to her is a chemist who says: "I think everybody should be exposed to more science... and of course it's desirable for science students to take more humanities and art courses." When we listen more carefully, however, we hear certain indications that these teachers are not as committed to an open curriculum as they at first seem. On the one hand, the chemist says: "We live in a world where technology is so important and where we have to make decisions every day, decisions that are related to scientific knowledge. So I think it would be a good thing for them." On the other hand, she says: "The thing is, do we find time for them to take all these courses." This teacher would like everyone to know more, to be better informed, but she does not have a vision which includes radical changes to the heavy concentration of specialized courses in the present system. The biologist's reasons are equally informative:

> Either you're in arts at the very beginning and then when they want to change their mind in Cegep, they find out that they have to catch up so many things. But in a way it's not really too late but in a way it's late for some people. So I prefer that, you know, that a student should have everything, arts as well as exposed to science or science exposed to art.

This teacher's vision is, after all, intensely practical, like the students': all students should keep their options open, and since science demands the prerequisites, everyone should study it. At base, then, neither of these teachers sees the need for opening the doors of science to all students as important enough to demand fundamental change.

All of these teachers agree with the idea that everyone needs some "scientific literacy", but five of these thirteen teachers see this as the job of the high school. One biologist simply stops there. Two math teachers say that they would never want to see math or science as compulsory since they are so aware of math haters among the student population. One thinks it should be easy and enticing for all students to register in math courses, but believes the courses should be optional for the sake of the students choosing them or not. The other seems to be very concerned with the overall "morale of the class" if these students are made to take subjects in which "their enthusiasm is not that great". One chemist and one physicist reveal in their discussion that they believe science requires more than other subjects from students, and that not all students are equal to it. The chemist says that since the high school is at a "lower level", then "everybody is capable of doing" science there. For reasons of "talent and background", however, not all students can manage Cegep science. The physicist is not so outspoken, but he basically agrees. He speaks about the "question of budget": "I mean it costs a lot to teach in science." He wonders if it might not be a waste of time and money to teach students science if they are not going to continue. He also thinks it might be very emotionally and psychologically "demoralizing" for students to find they are failing science subjects semester after semester. "I mean if a student is not going to survive emotionally, he better not take science." A math teacher says the following:

> I used to think that everybody should be obliged to take the regular science and math courses. I don't know if that's the case as we dip more and more deeply into the admissions....And there is a great danger if we give them another type of course that we trivialize the subject until it disappears. There's a pressure to let people through the courses, willy nilly, I think....

Seven teachers from a variety of disciplines feel that science is so important for us all that they see the need for a different, less specialized kind of science course for non-science students. One math teacher wants everyone to have a course in symbolic logic. Others suggest courses such as a history of science, the general objectives of science, an interdisciplinary descriptive course combining chemistry, physics and biology, current topics in science, and how science touches our lives. As the math teacher quoted above says, these courses are "better or less damaging than trying to give somebody who has really no ability and numerical skill" a regular science course; he sees the latter as "a waste, just a waste of their time, it's frustrating for them and it's frustrating all the way around; it doesn't help them as human beings later on and it surely doesn't help society."

In much of this teacher discourse we hear a view of science as demanding something of students that other Cegep programmes do not. None comes out and says that science is "at the top", as the students do, but this attitude is implicit in what they say. When a biology teacher tells us he counsels potential drop outs that perhaps they should follow their instincts, and when he describes his attitude as "I mean it's, it's, you know, if you turn to another endeavour, I mean, you're not going to be brilliant at that either, but it might be a little bit easier for you", we can certainly see where science resides in his assessment of Cegep programmes. When a teacher of Science Access, the remedial program which offers students a chance to take science pre-requisites and attain science programme entry marks, tells us that though she likes the students and most will pass because they work so hard, 60% do not have the potential for science study, we hear again judgment that a student might be appropriate material for Cegep but not good enough for science. The image of the good science student that emerges from our discussions with the teachers stresses giftedness much more than does that suggested by the students. The teachers have different ways of describing this quality: "a certain amount of innate intelligence", "mathematical abilities", "talent", "intellectual capacity", "mental ma-

chinery", "native intelligence", "brains", and "scientific intuition". Only two of the teachers never say that special and superior gifts are necessary: one, a math teacher, simply does not seem to think in aptitudes or the lack of them, but in terms of difference ("the non-science student would ...have a different look at the way things work"); the other, a biologist, says that "in order to be an excellent student, you don't have to be a genius." Both these teachers acknowledge ability range within the student population, but say nothing which could suggest that good science students are a priori superior. There is something about the language which the others use which suggests they do think in these hierarchical terms.

Even as they list the other qualities necessary for success in science, one senses that we are dealing here with an elite group. Though both the teachers and the students whom we interviewed list interest in science as high on the list of required characteristics, the teachers have a way of presenting this interest, too, as a superior characteristic. A chemistry teacher says that good science students have to be "universally interested ... interested in as many things as possible, not necessarily in science.... And what has always amazed me is that, you know, how some students are just not interested in anything, no matter how amazing it may be." Several teachers develop this idea by describing interest in science as "inquisitiveness", "wanting to know the answer", "curiosity about nature". Two teachers, one from math and one from physics, talk about the ways in which this curiosity shapes the good science student, long before s/he arrives at Cegep:

> Certainly the top science students demonstrate that curiosity early on, in middle school, by reading popular science or reading some articles in Scientific American, maybe even getting books from the library. So I think it's really a matter of when this thing starts and manifests itself more securely. And, then it sort of becomes a self-perpetuating thing, that you, you have the head start, you just maintain it. And that's exactly what ... you maintain that thing, you're always ahead of your peers.
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> The better ones also have this ability to somehow sense the interconnections between things.... Oh my guess would be that those were students or those would be students who already had a prior interest in the sciences in general, so they would already in their high school science courses probably have done more work than the ordinary student and, or had even hobbies connected with science. A lot of students, for example, like astronomy and know, you know, about planets and all that and.... So they're already more widely read in science than their... than others. So far as even in a regular science class there ... you sometimes see students who, who don't have that integrative ability. Maybe actually that may not be fair, they may have the ability but they haven't been exposed... to this stuff.

As they identify the good science student in this way, we hear from these teachers a description that fits very few of the students whom we have interviewed, even those attaining excellent marks: one or two men students in Pure and Applied science might be said to have these characteristics. According to at least two other teachers, one in chemistry and one in math, background has a great deal to do with success in science. The math teacher talks about how great a head start the student with good high school preparation has in his subject. The chemist stresses the importance of the family, how parents teach their children to think and to think logically. "Education is not just for teaching, it's a combination of family, friends and teacher."

In fact, most of these teachers do seem to be saying that the students need to bring certain learned behaviours and attitudes with them to Cegep, and it is difficult to see some of these behaviours as those which the average student would pick up in the average high school situation without special encouragement or superior gifts. The biologist who stressed that "You don't have to be a genius" says, on the other hand, that students come to Cegep "with very little degree of professionalism in their attitude to learning." She says they are "passive learners and they are waiting for learning to happen to them and they don't go out and... they aren't active... they don't go out and look for books to find out things...." She wonders if this might be called a certain "intellectual laziness," but it might equally be a rewarded behaviour in certain learning situations, where students are prepared for exams with class notes provided by the teacher and all learning is directed toward exam questions. A chemist says that chemistry requires an ability to visualize things in three dimensions, an ability which studies have shown to be very much related to patterns of childhood play and, in many cases, to the availability of certain types of toys and materials. Many also make reference to the requirements for abstract thought, especially in math and physics, "a certain level of intellectual theorizing that some students haven't reached yet". If abstract reasoning ability is strictly developmental, then only the more intellectually mature student will have it. Certain other requirements seem almost to be matters of character development rather than anything else: persistence, ability to postpone gratification, powers of concentration, refusal to leave problems unsolved, and so on. In referring to the "cultural influence of the home", one of these teachers makes a veiled reference to what no one will quite say: that success in science is at least somewhat related to social class, and is much more likely among students from educated families or at least from families where education is understood and prized.

Just as there appears to be some hierarchy in the student population, with science students near the top, so there is a recognized hierarchy among science subjects taught at Cegep. Almost every teacher of every subject comments, without prompting, that math is basic to all the sciences. And, as even a biologist says: "Everything they end up doing is going to involve math." All three of the physics teachers declare math to be the foundation of physics, and say that to do physics, students need "competence in mathematics and ease with mathematics". One physics teacher and three math teachers call attention to the fact that students must make use of their first calculus course in order to manage their first physics course. Two of these teachers say students would do much better in their physics if they had more math first than they now do. Math is also noted as an important component of chemistry. Despite this recognition of math as the foundational subject matter, there is some disagreement as to which is "harder", math or physics. A physicist suggests physics because of the need for "the translation of that math into the non-mathematical, into a physical context"; a math teacher suggests math, because "Physics attempts to describe a real world. Mathematics doesn't. Some of it is totally abstract." In any case, physics is seen as "harder" than chemistry, by chemistry teachers, since physics is more abstract and cannot be accessed at all by memory or rote learning. The biology teachers agree that biology is "the soft one of the sciences". Its descriptive nature makes it "maybe not so intellectually challenging... in terms of the abstractions, in terms of the logical thinking, in terms of that paradigm, that mind set". One biologist also speaks of the mystery of the animate, how he can know how a cell functions, physically, chemically, biologically, but there are "no definitive answers" to explain the essence of life, and this lack of answers is, to him, part of the "softness" of biology. Biologists all agree that introductory biology requires very little math, and that it is basically a language-based subject at this level, where students must learn the terms and understand the processes by reading about them. At the same time, one of the biologists says:

> ...to me biology may be the softest science but it's the toughest one. Because you have to know your chemistry, you have to know your physics, you have to know your math, because you can't get things to do, or you can't get cells to do things that disobey basic, fundamental principles.

The fact that Vanier organizes its science programmes such that biology is taken only by second year students suggests that this sequence is recognized by others as well. Another biology teacher says that she is not sure Cegep students should be taking biology at all, that the more important courses for students are math and physics:

> Those are the basics. Because it involves a lot of thinking, problem solving skill. Biology, right now, basic... you don't really... you still have to think, I mean, I'm not saying that it's not important, it's also important, but the most important is if a student can do the math and physics well. I think then they can do everything well. If they have problems in those things and even though they say, because I'm not good in math I'm not good in physics, that's why I am in biology and they will find that they will be disappointed at the very end. Because when you go to graduate school, it's no longer just this biology that they are interested in that they will be doing, it's something else that requires physics and math skill, including chemistry as well.

Again we hear the assumption that science students ARE going to graduate school, as well as the assumption that the purpose of knowledge is to prepare the way for further knowledge acquisition. For this teacher, at least, learning science is instrumental to some external goal, whether it be educational or professional. And the biology which she finds important and significant is that which calls upon the more abstract "harder" sciences at a higher level of learning than Cegep.

In this sense, this biology teacher illustrates important features of the pedagogical paradigm in science, in that science is seen as a fixed body of inter-related knowledge which can only be learned in sequence and in which each stage of learning serves principally to set the stage for the next. None of these teachers, for instance, is very critical of the very rigidly fixed curricula provided by DGEC for them to teach: they say it reflects a universal vision of what each subject is and how it can be learned, and they are surprised by our questions, inviting them to critique it. They may lament that the curriculum is now "watered down" because of poorly prepared students, or they may say they think there is too much in the curriculum, and they choose to leave certain concepts out. Two of them comment that they think that students don't get a real overview of what science is, and how the subject matters connect not only with each other but with other subjects, like humanities and history, since science is, after all "aspects of life...and there are very few issues which don't have their, you know, tentacles in all kinds of dark corners". But they conclude these remarks with the oft-repeated comment "We don't have time" and "there's just too much work to do", "there's too much to cover." Raising their eyes to the wider horizons of science seems, for them, a luxury they cannot afford if they are to give the students "what they need to know". Oddly enough, these more reflective and perhaps transformative visions of science are those they would include in courses for the non-science students because "there, you see, I don't have the ... constraint of having to finish a certain amount of material to prepare them for whatever they do after that, you see". This particular speaker comforts himself a little by saying that the science persisters will, eventually, get to see the larger picture, as they reach a higher level of learning.

All these teachers agree that science in general is hard and that students must work at it. Every single teacher talks about the importance of preparing for class by looking over the work to be covered by the lecture and thinking about the difficulties the topic poses, of coming to class regularly ready to follow what the teacher says and to make accurate notes and/or make appropriate corrections of homework, of doing assigned homework and/or reading on a very regular basis, of using the number of class and lab hours as a rough rule of thumb for how much work they should do at home. A certain engagement or involvement is also seen as necessary: "They think that, you know, staring at their notes is studying....You, you... there's no such thing as studying without pencil and paper, you have to write, you know, you have to solve, you have to do." For the biologists, this engagement is often spoken of in terms of making notes, highlighting texts and study guides, and writing out what they can remember after they have read. One teacher shows the students how to make concept maps. Math, physics, and chemistry teachers all talk about the need to do problems, a process which they call "practice", many of them using the analogy of the musician learning to play an instrument or the sportsperson learning the game. Watching "a film beautifully acted ... is not the same thing as maybe actually being in the film and doing the acting," says a math teacher. A physics teacher explains:

> It's practice... exactly, that's right, you can't expect to be able to play an instrument with... without having some frustration. But frustration is not necessarily bad. See, I mean, there are many instances in which a student sees a challenge and then overcomes it and then gets the sense of satisfaction from having overcome the challenge. But if you're so...uninvolved that you don't want to suffer that frustration....

One math teacher says that this struggle takes "courage", and a chemistry teacher says that when students are discouraged he tells them to stay and "fight". We are struck by the way in which the language of art (and, elsewhere, sports) begins to move into the language of battle.

There is some disagreement about the extent to which teachers should provide help and support for students. Certainly all these teachers speak very responsibly about their role in the classroom: they prepare carefully, organize their material, try to provide examples which contextualize the learning, and even carry models and exhibits around with them. One chemistry teacher tells us how he used to practice his blackboard work, determined to make it clear and helpful. One of the biology teachers talks at length about how she reworks her subject matter constantly to suit changing student interests. They talk about trying to find ways to make sure students understand the meaning of what they are doing and what its purpose is in the grand scheme of the subject or science as a whole. They want their students to be more than "technicians" following procedures, matching their answers to the back of the book, or memorizing facts without understanding. One physics teacher tells us how he tries to show the students how to be true to the data in writing up their experiments, how to be good and honest scientists, even if the experiment doesn't quite prove what it supposedly should. He also talks about how important it is for students to learn the methods of physics, and not to scramble for the right answers. A math teacher tells us how he struggles to get students to concentrate on proof, to be careful about details, and to think on their feet. Another physics teacher tells us how hard it is to get students to grapple with the idea of uncertainty and how important it is to him that they confront it. Another math teacher talks about teaching students to recognize the types of mistakes they make - careless, ignorant or stupid - not to confuse the three, to deal with their carelessness and ignorance while assuming they are NOT stupid. All these behaviours seem to us to be those of very committed pedagogues.

Where the disagreement arises, however, is over the whole area of the nurturing role of the teacher. For instance, one physics teacher makes a point of communicating to students that all questions are good questions, and he will stop at any point to answer them. At least three other teachers, however, talk irritably about "stupid" questions and how such questions tell them instantly who is "not going to make it". There seems to be a particular problem, for these teachers, with students who keep asking the same questions: one physics teacher says that students do not pay attention; another says that they "switch themselves off" because "they don't think they're going to get it." A math teacher complains about students who interrupt her explanations before she is finished, when, if the students just waited, "their questions would be answered." Those who discuss this problem say "you have to have your patience under control to not embarrass the student," but it is clearly difficult. This issue seems connected to the larger issue of teacher-dependence. Three women teachers and, to a lesser extent, two men stress the importance of students coming to see them to discuss their problems with the course. For others, this kind of extra help poses a pedagogical problem. As one math teacher says: "I think it's probably not a very good idea to make the student too dependent on the teacher." Another math teacher agrees:

> I think you could go overboard, one can spend too much time and then they would be quite willing to let you carry them through the rest of their lives....I fall into this mistake all the time, you can spend so much time with the student, the student eventually scrambles through the course and then the next course he collapses....And they're not children, these are young adults....

Even teachers who are quite willing to spend long hours in the office will talk about student dependency as a problem, sometimes a really inefficient use of teacher time as well as bad for students. One woman chemist says: "You have to show them that you care." There are other teachers in this group, however, who might argue that this is not part of their job and might, in fact, encourage the wrong kind of relationship.

This tendency, for some teachers to view their role as to "get them up wobbling along and then teetering off on their own", is reflected in the somewhat `tough love' attitude which all these teachers share with respect to evaluation. All these courses use quizzes, tests and exams as the major components of evaluation; lab reports, homework assignments, and small discretionary mark allocations form a very small part of the final grade. As one extremely sympathetic chemistry teacher says: "Unfortunately, sometimes their marks do not reflect their actual ability, but, you know, I guess if they want to be successful, they would have to be able to deal with stress." Science students have to be able to write exams. Why? Students have to be able to "communicate" what they know; "you have to be able to perform this alone, on your own, in class in a test situation." Another teacher says: "If you're trying to learn how to play the piano in public, you've got to go play the piano in public. You have to be able to perform better." How to deal with the problem of nervousness, of performance inadequacy? A math teacher, who expresses great sympathy with student anxiety and admits she experienced it herself as a student, explains:

> I usually say to students, what you have to do, you have to over-practice the examples so that when you get to the exam when you look at the questions, you know it and you know it so well, your pencil will almost write it by itself. Especially with low level students where the number of things they are going to have to know is very few for each test. But it's always very hard to know whether they...

> some of them are really genuine students who do have these panic attacks.... You see, the way the system is geared, I mean examinations are very important and the only way you can achieve a degree is examination. And so at some point you have to cope with it.

Some teachers recognize the problem without expressing undue concern about it - a kind of "that's life" attitude. Other teachers are much less sympathetic, saying there is always plenty of time ("the exam is designed to be written in two and a half hours - they have four hours to do it") and assuming that the student who blanks out on the exam "didn't do the work." Poor test performance is seen as the first sign that a student will not be able to continue. Again, since the future of these students is seen to be more of the same only worse, they see their role as part of a linear process of preparation. No one is satisfied with work prepared outside of class without artificial time constraints, since it is impossible to control "cheating". When we ask about individualized essays or projects, the teachers say they do not have time to mark or set them. This is likely true, if they see they must also mark the tests and quizzes and exams. The fact that the type of exam used seems most likely to arouse anxiety - multiple choice tests, true and false questions, and problem sets - is explained by the fact that other types of testing create enormous evaluation problems for science teachers. Students challenge them for marks, and poor writing makes it difficult for the science teacher to decide how much the student knows. The biology teachers continue to use some essay-type questions, but rely heavily upon more quantifiable questions. What works for the teacher, however, does not always work for the student. Again, the least anxiety-provoking kind of work is the home-assignment, and for all the reasons given above, the science teachers do not feel that they can rely upon it.

In general, these teachers do not see Vanier students as being very competitive, and in general they seem to think this absence of competition is good. Only three of the teachers suggest that competition can be a really healthy thing, and even these three are careful to call it "friendly competition" and "a little bit of competition" or "a striving to do better". Many mention with relief that Vanier students do not seem to be tearing solutions out of the reserve materials in the library or taking other actions which aggressively interfere with the learning of their peers. They, like the students, see competition as the opposite of collaborative learning behaviour, and most of them value at least an atmosphere of mutual aid, even though a good half do everything in their power to make sure students do not "cheat." Only three of the teachers really encourage any form of cooperative/collaborative learning, and only one of these makes formal team efforts compulsory (other than lab partnerships). The competition that exists, they say, has to do with the system whereby access to certain programs like medicine is limited by numbers. This competition tends to be viewed as normal and necessary or at least unavoidable. Competition is most frowned upon and critiqued when the students come to quibble for quarter marks in their anxiety to do better than their fellows or to get a perfect grade. Some of the teachers, particularly the men, call this behaviour "pathological" or "nutso" and say that such students require "a certain amount of psychological counselling." They lament that this quest for marks interferes with a more genuine quest for knowledge. Having already interviewed the students, however, we find it difficult not to conclude that some students have few options besides behaving in this way, and that the teachers may be missing some of the inevitable logic of the situation which they accept. If the "system" demands that students fight for places in elite programmes, surely this will inevitably interfere with the pursuit of knowledge per se. Surely there is nothing pathological about a concern over marks when marks are used to determine at least eligibility for if not winners of all scholarships, university programme entrance, and interview status for medicine. However, we have to agree with the teacher who says:

> What I find sad is that, that they have their total sight on this one ideal and that they have never even contemplated there are other things to do in life and then they see their whole world fall apart when they don't get accepted, or if they're afraid of not getting accepted.

There seems to be some important message here for the institution as well as for society as a whole.

Most of these teachers do recognize some gender difference, and their comments often reinforce the observations which the students have made and the conclusions we ourselves have drawn. They say that the women students tend to work harder, to be more serious, and, in the opinion of many but not all teachers, often to do better. They say the men make more noise in the class and tend to raise questions to hear their own voices. Women attend class more regularly and come to the office to ask questions which many are reluctant to ask in class. The biology teacher who uses cooperative learning groups always makes sure there is at least one woman in every group: "My thesis is that four guys together are uncontrollable. Women have that civilizing effect." Women are more careful in the lab: "You ask them to take ten millilitres of a solution and they'll pour it into their graduated cylinder and watch, to make sure it's ten. A guy will pour and say, That's about right." Women have neater handwriting which tends to help them in math, according to one teacher: in any pile of tests, it's the ones by male students "where the writing is so sloppy and badly written up so that mistakes occur because of the writing." However, one math teacher says that the top math students still tend to be males, since the males tend to be the real risk takers, who make the brilliant leaps in thought. A physics teacher says that women are more conservative: "more often than not the best student would be male and more often than not the average mark for females would be higher than the average mark for males." On the other hand, this same teacher says that the best students he ever had were "a trio of Hongkong girls". Another math teacher says that the gender difference tends to be that women students fuss over unimportant details - busywork, he calls it, re-copying notes, underlining headings in colour, reviewing material they already know - and men students just don't work. He says his job is equally hard with both sexes: he has to get the women to stop working so inefficiently, and to get the men to start working, period. One biology teacher says he feels women are now under undue pressure to take science, whether they like it or not; one physics teacher says he still finds women who are certain they cannot do physics because they are women. A chemistry teacher points out the anomaly that, though the women work harder in her courses, their achievement rate is the same as that of the men. She agrees there is something odd about this fact, but can see no explanation. Two of the women teachers, one from math and one from biology, had a real historical analysis for the emerging success profile of women in science, and take great pleasure in what they see as profound social change. "I have to say that in about the last five or six years I've become increasingly impressed with our female students. They take themselves seriously, they see futures for themselves." She notes the self-respect the women have, and their independence:

> One thing I really like to see is that boyfriends seem less important in their lives.... I mean, when I was a teenaged girl, if you didn't have a boyfriend, like there's something wrong with you. You existed like a pre-married woman in a sense....Lots of these girls, they don't talk about that at all. No, and I think that's very healthy at this age. They go around in groups or have friends in groups. Or, they have a boyfriend maybe, but the boyfriend, you know, fits into their life. They have a life. The boyfriend isn't their life.

The biology teacher identifies the seriousness of women with their knowledge that "we have to work a little harder still to get somewhere." She points out how many prize winners at the various Cegep graduations are women, and how pleased this makes her.

We are impressed with these recognitions on the part of the teachers, and equally impressed when the men particularly talk about trying to behave in egalitarian ways, using male and female pronouns in examples, refusing to allow students to behave in sexist ways with one another, ensuring that the women take active roles in the lab, and so on. We are not surprised, having talked to the teachers, that our cohort of students has so few complaints about overt sexism in Vanier science classes.

When we ask the teachers what students ought to take away with them from their science studies at Vanier, we hear a range of replies, but we are struck by how few of them focus upon anything but practical incremental acquisition of skills and knowledge. Only three of the teachers mention interest and enjoyment, and even in their talk we hear certain reservations about whether this might be possible and/or worth while. One biologist hopes they will "have that same sense of wonder and awe about science that they hopefully had when they came in." She goes on to comment on how many get bogged down by hard work and outside pressures, and lose the fun of it. Another biologist hopes they will take with them an enthusiasm and engagement with his subject, but he worries about what that will give them, ultimately: "They get through university but at the end of it what are they going to do?" Only two teachers mention an overview and general understanding of science as a hoped-for goal. One teacher hopes, along with other goals listed below, the students have learned to be comfortable about their ability to learn, and another hopes they will have "pleasant memories" of their social and academic experiences. Ability to think and scepticism about what they have learned are also mentioned. The instrumental goals of Cegep science education, however, are detailed and emphasized by eleven of the thirteen teachers. Half the teachers mention increased scientific knowledge as one important outcome; half the teachers mention technical and or procedural skill; half talk about good study skills which seem to include, for some, independence of teachers; more than half talk about "good preparation for university." When we compare these teacher answers with the ways in which our students describe the value of their Cegep experience, we see an enormous difference in the significance attributed to the hours and hours required of students in science. Only a small number of the students in our sample have answered in like terms, and these few are those very committed, narrowly focused Pure and Applied students. It is possible that the teachers interpreted the question differently from the way most students did, and that is quite understandable. Nevertheless, the differences here are sufficient to make us pause, and to make us consider whether some shift in emphasis might not be appropriate.

XI. CONCLUSIONS

We undertook this research because of our interest in and concern about women's under-representation in the sciences, particularly in pure and applied areas of science. We had at the outset two hypotheses: first, that there is a complex set of gender differences in attitudes to science learning, and second, that the vision of science held by instructors interacts with these gender differences in ways which serve to perpetuate the ratio of men to women in the sciences.

Our longitudinal study of 63 science students has demonstrated that the complex set of gender differences not only exists, but can be seen to shape persistence patterns in the sciences. Our study of teacher attitudes suggests that teacher expectations include an intensely, instrumentally and narrowly focused attachment to science which is much more characteristic of our men students than of the women. That women can and do persist is also clear in our study. However, they more rarely persist in pure and applied science, and this pattern seems to be related to gender differences in the orientation to science study. The orientation which many of the women bring to their studies seems to us to be poorly addressed by the expectations and curriculum of the science education which students receive at the Cegep level. We would argue that the numbers of fine women students who do not go on in science at all are one index of this reality.

We briefly summarize our findings here with particular attention to the issue of persistence. As the detailed discussion of each chapter reveals, students are, indeed, best understood in terms of a gendered continuum; many factors come into play, and individual differences are to be recognized and valued. Nonetheless, our data suggests that in some areas it is valid to speak in terms of women as distinct from men and we do so in the pages which follow, always with the intention that such differences should be read as neither fixed nor absolute.

A. GENDER DIFFERENCES IN PERSISTENCE PATTERNS IN THE SCIENCES

Women's persistence patterns differ from men's principally in motivation. In the introductory chapter to this report, we quoted one of the women in the study as saying: "I see my friend and he has a different motivation which is totally personal. As far as a man from a woman, men have already done that, have already so to speak proven themselves. I'm trying to prove myself and I'm trying to prove it for the women as well." Although few of the women in our sample see themselves as the bearers of women's fate in quite so dramatic a fashion, we want to suggest that the vision expressed by this young woman is, in fact, archetypal. Represented in broad and general terms, women want "to be somebody" who can "make a difference" and for them, these two wishes are frequently connected. Men are more likely to seek to enter specific, prestigious, traditional careers. This overall difference in orientation, explicable in terms of the social and economic history of gender, particularly the marginalization of women, is we believe, central to the issue of women's persistence in the sciences. Interwoven with issues of class and ethnicity, it is the framework which lends coherence to a range of related tendencies. We also find evidence of gendered socialization patterns in that women more frequently express desires to enter caring professions and to make human connections in their professional lives.

The men in our sample who persist in the sciences resemble more closely than the women that group Tobias (1990) refers to as the "first tier" of science student. They, and we are thinking here in particular of the men in pure and applied science, are more likely to have intense and private connections with the material of science, or to have strong aspirations for careers in the sciences. The

women's connections to their science educations tend to be less specific both in terms of interests and future goals. These women bring to this education a broader range of interests and, one cannot help but feel, a more flexible orientation to career choice. Indeed, the women allow themselves to have more interests; they do not see interests as distracting but as enriching possibilities, whereas the men are more narrowly focused in terms of study on the one hand and relaxation on the other.

We think that this difference also finds expression in the number of women in the sample who look to their education for a transformative experience which will help them to become the person they wish to be. We here use the notion of transformation in a way analagous to that developed by Aisenberg and Harrington (1988) in their study of university women. The men in our sample, and particularly those who persist in science, do not look ahead in this way, except at the profession, in a very general way, and they want education which prepares them to do it. Given the above, it is hardly surprising that the women are more likely to want educational experiences which captivate them and interrelate with the world as they know it. The men students have a much more instrumental view of what their education can do for them: each thing they learn should serve their future learning. This difference of orientation helps to make sense of the greater sensitivity we find in the women with respect to the experiential nature of their education, how it feels, how they are treated, how they see it affecting them. The students who are least sensitive to such things are those whose eyes are focused on specific career goals, and, for the most part, these students are men.

By the same token, it is the women who appear to be more vulnerable to bad experiences, and open to good, encouraging ones. Women live their education, day by day, alongside each other, and try to interrelate it with the rest of their lives. Men do their studies and then relax. All these differences mean that women bring a greater investment to the educational experience. It is within this context that we can begin to understand the greater anxiety of women, their more fragile sense of achievement, their tendency to self-doubt, which we find over and over again in the interview data. On the other hand, women's different orientation to and investment in the educational experience also means that they work harder at it and that they are more likely to connect with greater intensity with the people who are part of it: other students and teachers. Men do not disdain such connections; however, they are less likely to make them and they seem less drawn to the integration of school into the fabric of their lives. The extreme of this orientation is represented by those men in pure and applied science, gifted students, who literally wipe their minds clean of any distraction, including friends. This gender difference with respect to the integration of peer relations and academic pursuits, well documented in the narratives which make up the body of this report, has pedagogical implications. Our interviews, which underline the importance of peer relations to successful science study and point to gender differences in the ways that such relations are used, speak eloquently to the need for some self-conscious attention by the science teacher to the relationships among the students in the classroom. The magistral lecture with a heavy emphasis on fast and copious note-taking is antithetical to such attention.

All of our students negotiate a complex relationship with the elite status of science among the disciplines. The women who want "to be somebody" are drawn to science for its prestigious status, and frequently enter pure and applied studies as the most prestigious of all. Men, too, seek the prestigious programme, since this programme leads to the prestigious career. These aspirations resonate with particular meaning for those of our students who are the children of immigrant and or working class parents. We would argue, however, that these aspirations, on the surface the same for women as for men, are, in fact, gendered in the sense that women, for a range of social and historical reasons, are likely to want more from their education. To the extent that education in science is

conceived in instrumental terms, as preparation for career, it ultimately suits the men but to the extent that it offers no place for personal growth, it is less likely to satisfy the women.

We see the consequences of these gender differences in a variety of areas but most particularly at the Cegep level they are manifested in the fact that few women persist in the pure and applied sciences where personal connection, helping motivations, connections to life have not been made part of the learning process. The women in our sample who go on in science, like the women represented in the national statistics, choose the health or biological sciences, an area of science where we would argue they see these connections and transformations as possible. It is not always a subject matter choice, though it often is: physics is a sticking point for many women. The women in our sample get much higher physics marks than the men. However, physics appears to many women as not related to human lives and problems, but to objects like cars, bullets and balls, which some of them have a hard time relating to. Their paths are chosen where they feel they can have the experiences they desire and make the impact they want. The small minority of women students who persist in pure and applied science share the singularity of focus which we have come to associate with the men in our sample; however, even they express the kind of self-doubts about their futures which we have suggested are related to the broader range of personal issues which women bring to their studies. The men go on in pure and applied sciences because they offer these men those career paths which they see as valid for them. Some men who initially wish to study medicine quite happily switch to engineering when they see they cannot get the grades for entrance to medical school. Pure and applied sciences clearly suit these men and they value those studies which involve incremental learning of subject matter that is of use for later learning in university, directed toward clear career goals.

Science education as it is experienced in Cegep is hard for most students, but women students across all the persistence categories do seem to suffer more from the pressures than do men. As we have already suggested, we suspect that this is related to their greater investment in the educational enterprise per se, and also to the fact that at this stage in history, they feel that they have a wider range of issues at stake. There may also be some historically conditioned psychological differences at work here. We are thinking here, in particular, of the gender differences which have been explored by object relations theorists such as Nancy Chodorow (1978), Dorothy Dinnerstein (1976), and Carol Gilligan (1982 and 1985). We have considered these more fully in other publications (Davis and Steiger, 1993 and 1994). We have not found that this suffering, expressed in terms of greater anxiety, more self-doubt, has been a major deterrent for large numbers of them. The women who persist do so in spite of these feelings but the feelings register, and they do so profoundly. We wonder to what extent later defections from science may be traced back to the requirement to perform on tests in ways which women find particularly hard, which do not allow them to use their language skills, their collaborative skills, their willingness to spend time on tasks until they are done, and so on.

From our interviews it is clear that the students who drop feel they have been judged unsuitable, and have been discouraged from continuing. The students who continue and take a science DEC but who decide to go on in some other area are those who have been convinced that either they cannot continue this high-powered study or that they want something richer, more transformative and more relevant. There are several messages here. First of all, students who do not get good marks in Cegep science are screened out: they may be encouraged and helped by some teachers, but other teachers simply use the first test as the indicator. There is a great sense that the student must come to Cegep possessed of certain knowledge, skills, abilities, talents and character traits which it is too late to teach them at Cegep: if they have them, they can succeed; if they do not,

they should switch "down". Significantly, at the Cegep level, when we look at those who switch and drop, we are often looking at women who are good students. The men who start in science and switch are, without exception, the bearers of disastrous records. If the goals, models, and practices of science programmes function to exclude women in this way, surely they should be reconsidered.

For example, those women who are among the most gifted in our sample do not go on in science at all. To their numbers one may potentially add those excellent students who opt to continue in the biological sciences at this stage, but who do so with uncertainty. These are not students who have hated science. On the contrary, most of them have taken pleasure in their science learning but they are unhappy with an educational experience that includes only science - they long for humanistic studies like history and literature and music and politics and philosophy and art - they say that science gets "too small". These women have often taken top honours - in science and other subject areas - but then they opt to leave science. Some plan to return but it is clear that they leave Cegep in search of that transformative education about which we speak.

Cegep education as it is presently designed offers science students a tiny morsel of non-science subjects. It is significant how many of the women love these subjects. These non-science subjects often offer them the transformative experiences which they seek, as well as giving them opportunities to develop their wide variety of skills and interests. It is of interest to us to note how many of the men learn to like these non-science subjects also, and begin to grow and change in ways which they can appreciate as they graduate. It seems regrettable that science programmes not only allow so few such courses to be taken, but do not look to these other subject areas for ways in which they could make their own studies more contextualized, more relevant, more personally meaningful to students. This type of change might, we feel, not only hold some of the women but give greater breadth and scope to the men who tend to maintain rather narrow personal goals.

Finally, it must be noted that our interviews with the students suggest that important gender differences persist in their orientation to combining career and family in the future. In our sample, the question of integrating career and family is a virtual non-issue for the men. The women offer a range of responses with the vast majority seeking some form of integration; however, it is clear that very few of them regard this as entirely non-problematic. It is difficult to predict how these students' attitudes will affect their behaviour when they actually come to make decisions about family and career. We, nonetheless, draw attention to this gender difference since other researchers have found that family commitments are seen as more problematic by women at a more advanced stage of science education (Erwin and Maurutto, 1995).

B. TEACHER ATTITUDES

Our interviews with teachers of science confirm that, in spite of personality differences and different requirements associated with the different disciplines of science, one can indeed speak about a vision of science education shaping learning in this milieu. In fact, it is striking how much consistency there is in the teachers' and students' articulation of this vision. Like the students, the teachers emphasize the importance of persistence and hard work in order to succeed in science studies. Like the students, the teachers operate with a sense that the sciences stand at the top of a hierarchy of disciplines. The teachers also confirm what so many of our students suspect, that beyond hard work, commitment, and interest, good science students possess skills and abilities which are possibly innate. Of particular importance, given all that we have found about gender differences in the orientation to education, is the fact that the teachers of science whom we interviewed share, in

varying degrees, a view of science education as being incremental and instrumental, with the work of the Cegep years being preparation for the next level of education. No science teacher talks about education in transformative terms. They see it as skills and material to learn in order to prepare for the next stage of education. They hope that students will like it and maintain their enjoyment, but their main job is to bank it.

Most science teachers have a certain compassion and interest in students but they do think in terms of tiers: they expect students to come to Cegep with specific knowledge and they expect a certain level of intellectual development and scientific skills. The students who do not possess these attributes are seen as not suitable for science. Furthermore, it is striking that the portrait which so many of the teachers paint of the "top science student", one who demonstrates a curiosity "early on", who has already developed a private and personal connection to the sciences by the time he or she arrives at Cegep, who pursues these interests on his or her own, who reads scientific articles and magazines, resembles in striking detail some of those students in our sample who persist in the pure and applied sciences. Our interviews, however, suggest that not only do these students tend disproportionately to be men, but they also represent a very small minority of the students in Cegep science programmes.

These teachers also see a hierarchy among the science disciplines. Math is primary, but physics is a key: no student is seen as good science material unless s/he can do math and physics. We have to point out that the women like math and keep on in math: that is almost never a problem. At this stage, it seems necessary to consider how it is that students who enjoy math and persist in it are unable to transfer these abilities and enjoyments to other science subjects like physics. Our interviews suggest that this is an issue which has particular importance for women. But none of the teachers seem to see why the physics is so remote from these women. One teacher has told us (off the record) about an "old" physics course that used muscles and joints to illustrate forces. We recognize here exactly what might capture the women, but this type of course is not classic physics: it was a course for non-science students. In fact, most of these teachers describe a fascinating, well-contextualized type of science course for non-science students that, in our opinion, would be of great interest to some of the science students, particularly the women, whom we have interviewed and might keep them in science. However, the teachers say there is no time to give science students such frills.

The students who are treasured are the students who persist. The ones who go off are lost. However, some of those who are lost are gifted, creative and intellectually superior students who have much to offer science, perhaps more than those who persist in the interests of securing for themselves prestigious careers. Our research suggests that women are highly represented in this "gifted, non-persisting" group. It also must be said that many of the students who persist at this stage are, in fact, ambivalent about their commitment to science. Here too we have found that women are well represented. Ironically, across all the persistence categories, those students who express the greatest certainty about their connection to the sciences and who are often the most tenacious in the face of failure are those students who have the fewest options in terms of other interests and abilities.

Inspired by much of our student data, we would recommend that programme requirements, curricula and pedagogical practices need urgently to be examined. We would hope that such examination would include some consideration of the ways in which incorporating greater contextuality and personal growth possibilities in Cegep science studies might attract those students who currently choose to move on to other fields. It seems likely that such a development would create a more hospitable environment for those women who have heretofore been excluded. Surely such a development offers the promise of shaping better, more self-reflective and socially responsible future scientists, men as well as women.

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APPENDICES

June 20, 1993

Dear Science Student:

Welcome to Vanier College! We are pleased to know that you will be pursuing your interests in science with us, and we are looking forward to meeting you in the fall.

The Ministry of Education is interested in knowing how Cegep students feel about their science subjects and how they experience their years at Cegep. To this end, a small group of students has been selected for a study which will inform Cegep educators how to help students get the best from their science programmes. You have been selected as one of this group.

We will be meeting with you twice during your stay at the College, and we will be asking you to fill out an interest survey when you arrive in the fall and again when you graduate. Everything you tell us will be strictly confidential. Nothing that could identify you will be used in the reporting of results of the study.

We hope you feel this study is as important as we do. We believe that the quality of students' experience at college is as important as the credits they receive.

Since Vanier College has a policy of confidentiality with regard to student addresses and phone numbers, we have asked the Registrar to mail this letter to you. In order that we may contact you directly for meeting times that will be most convenient for you, we would appreciate your signing the accompanying form and mailing it back to us as soon as possible in the enclosed stamped envelope.

We look forward to hearing from you, and thank you for helping to further the cause of excellence in science education.

Yours sincerely,

Fran Davis and Arlene Steiger
Researchers, Quebec Ministry of Education
Teachers, Vanier College

Name_____ Student Number_____ Sex_____

All your answers will remain confidential with the researchers.

DIRECTIONS

The following statements are about the study of physics. Please read each statement carefully and decide whether it describes the way you feel about physics. Then, find the number of the statement in the answer column (or on the answer sheet if one is provided), and blacken one of the numbers according to the following directions:

If you strongly agree with the statement,
blacken number 1.

If you agree with the statement,
blacken number 2.

If you disagree with the statement,
blacken number 3.

If you strongly disagree with the statement,
blacken number 4.

Be sure to answer every question. You will have about 20 minutes to complete the 48 statements of the inventory. Remember to answer each statement according to the way you feel at the present time.

Appendix 2: Continued

		Strongly Agree	Agree	Disagree	Strongly Disagree
1.	Physics is useful for the problems of everyday life.	1	2	3	4
2.	Physics is something which I enjoy very much.	1	2	3	4
3.	I like the easy physics problems best.	1	2	3	4
4.	I don't do very well in physics.	1	2	3	4
5.	My physics teacher shows little interest in the students.	1	2	3	4
6.	Working physics problems is fun.	1	2	3	4
7.	I feel at ease in a physics class.	1	2	3	4
8.	I would like to do some outside reading in physics.	1	2	3	4
9.	There is little need for physics in most jobs.	1	2	3	4
10.	Physics is easy for me.	1	2	3	4
11.	When I hear the word physics, I have a feeling of dislike.	1	2	3	4
12.	Most people should study some physics.	1	2	3	4
13.	I would like to spend less time in school doing physics.	1	2	3	4
14.	Sometimes I read ahead in our physics book.	1	2	3	4
15.	Physics is helpful in understanding today's world.	1	2	3	4
16.	I usually understand what we are talking about in physics class.	1	2	3	4
17.	My physics teacher makes physics interesting.	1	2	3	4
18.	I don't like anything about physics.	1	2	3	4
19.	No matter how hard I try, I cannot understand physics.	1	2	3	4
20.	I feel tense when someone talks to me about physics.	1	2	3	4
21.	My physics teacher presents material in a clear way.	1	2	3	4
22.	I often think, "I can't do it", when a physics problem seems hard.	1	2	3	4
23.	Physics is of great importance to a country's development.	1	2	3	4
24.	It is important to know physics in order to get a good job.	1	2	3	4
25.	It doesn't disturb me to do physics problems.	1	2	3	4

Appendix 2: Continued

		Strongly Agree	Agree	Disagree	Strongly Disagree
26.	I would like a job which doesn't use any physics.	1	2	3	4
27.	My physics teacher knows when we are having trouble with our work.	1	2	3	4
28.	I enjoy talking to other people about physics.	1	2	3	4
29.	I like to play games that use numbers.	1	2	3	4
30.	I am good at doing physics problems.	1	2	3	4
31.	My physics teacher doesn't seem to enjoy teaching physics.	1	2	3	4
32.	Sometimes I do more physics problems than are assigned in class.	1	2	3	4
33.	You can get along perfectly well in everyday life without physics.	1	2	3	4
34.	Working with numbers upsets me.	1	2	3	4
35.	I remember most of the things I learn in physics.	1	2	3	4
36.	It makes me nervous to even think about physics.	1	2	3	4
37.	I would rather be given the right answer to a physics problem than to work it out myself.	1	2	3	4
38.	Most of the ideas in physics aren't very useful.	1	2	3	4
39.	It scares me to have to take physics.	1	2	3	4
40.	My physics teacher is willing to give us individual help.	1	2	3	4
41.	The only reason I'm taking physics is because I have to.	1	2	3	4
42.	It is important to me to understand the work I do in physics.	1	2	3	4
43.	I have a good feeling towards physics.	1	2	3	4
44.	My physics teacher knows a lot about physics.	1	2	3	4
45.	Physics is more of a game than it is hard work.	1	2	3	4
46.	My physics teacher doesn't like students to ask questions.	1	2	3	4
47.	I have a real desire to learn physics.	1	2	3	4
48.	If I don't see how to do a physics problem right away, I never get it.	1	2	3	4

INTERVIEWS

A: Why are you in science?

1. What do you want to do? (Reference: Question 11)
   Where did this idea come from?
   Have you always felt like this"
   How far do you plan to go with your education?
   What are your plans for marriage and family?
2. What are your hobbies and pastimes? (Reference: Question 9).
3. How do your parents feel about your choices? What is their relationship to the sciences?
4. Are most of your friends also in science?
   How do your non-science friends view you?
   How are science students in general viewed?

B: Actual experience in the sciences:

1. What kind of student does well in the sciences?
2. What is your favourite science?
   Explore: What makes a subject interesting to you?
   Is this the science in which you feel most knowledgeable?
   Is this the science which is most relevant to your life?
3. What is your least favourite science?
   Explore: Why?
4. What are the sciences about which you feel neutral or which lie on the middle ground? Why do you feel the way that you do about these? (What about other subjects?).
5. What makes a science subject scary for you?
   Do you experience anxiety in any particular subjects or school related situations?
   What causes of anxiety can you identify?
6. What would you do if you were not in science?
7. What sort of person do you believe your science education turns you into?
8. Have you ever thought why certain things are on the science curriculum? Why are you being taught these subjects? What is the purpose?

C: Attitudes to teacher:

1. What makes a teacher a good science teacher? Are the qualities the same for all the sciences? Are the qualities the same for all teachers?
2. How many of your teachers in the sciences have been female? Male? How has that affected you? Do men and women teach differently?
3. Do teachers give equal attention to boys and girls in the class?

D: Attitudes to other students:

1. Tell me about the relations you have with other students in your science classes.
   a) Are these relations the same from course to course? If there are differences, what accounts for the differences?
   b) Is there a lot of competition? How do you feel about competition?
   c) Were there equal numbers of boys and girls in high school science classes? Why do you think that is? (For boys: Why do you think you guys like it more? For girls: Why are you one of the girls who stayed?)
   d) Are there differences between boys and girls with respect to: who talks out in class, answers more questions, participates more fully in labs, etc?
   e) Do you do course work with other students? Do you like working in this way?
   f) How do you approach your homework and studying? Any particular strategies or systems?

E: Our overriding question:

How could each of the sciences, or the sciences in general, be made more attractive to you?

Perhaps you could think about this as you go through your programme.

Interview with Students Transferring Out of Sciences

1. Why are you leaving science?

2. Where are you going and why are you going there? Tell me about the new programme. How would you describe it? What are the positive and negative aspects of this new programme? If you were to compare it to the sciences, what are the points of comparison which you would highlight? (How does competition come in here?)

3. Explore the details of the science experience subject by subject. What is the impact of particular teachers?

4. Describe your experiences in your non-science subjects.

5. Was there anything positive about the experience in science? What did you get out of the courses?

6. What do you think the sciences are about at this point?

7. What kind of student does well in the sciences?

8. Do you know other students who are leaving the sciences? Why are they leaving?

9. What have been the reactions of those around you to this decision? Parents and family? Friends? Do many of your friends remain in the sciences? Who are your best friends and where are they? What do you do with these friends? Do you see them out of school?

10. What are the things that might have made a difference? Under what circumstances might you have stayed? Do you think that different kinds of connections with other people might have made a difference? Teachers? Peers?

11. What are your career plans now?

12. How confident do you feel about your ability to succeed at school? Has it changed? Does it still change or vary from situation to situation?

13. When we last met, we talked briefly about gender differences in the classroom. Did gender differences change over time since we last met? i.e. Is there a difference between men and women with respect to who talks in the classroom, asks questions, participates?

    Does it feel different in your present programme as opposed to the sciences?

14. What would be your advice to a student entering in science in A94?

Gender and Persistence: Final Interview

1. How would you describe your experience in the science programme?

2. How much of what you have experienced was what you expected? What are the differences?

3. What were your favourite subjects? What factors made them so? (success, subject matter, teacher, etc.)

3b. What were your least favourite subjects? What factors made them so?

4. Did you have any favourite teachers? What where they like? Was teacher gender a factor in this preference?

5. Have your interests in the sciences and your preferences among the sciences changed since you first entered Vanier?

6. Did your reason for studying science change at all during your time here?

7. Do you think that you have done well in the sciences? Describe what doing well means to you.

8. When we talk about science, what does this word mean to you, as opposed to a textbook definition of the word?

9. What sort of person is successful in the sciences? Could you describe this person in some detail - what they are like, how they act, what they might look like? What do you think this kind of person would be like at 40? What would the life of such a person consist of? How are you like or not like this person?

10. Do you feel that studying science has changed you?

11. Are your friends in science? If not, where are they? Does this make a difference to you?

12. Are you planning to continue in science? Why or why not?

13. What would you have changed about your science education? What do you think should be left the same?

14. How has being a man or a woman affected your relationship to the sciences? Do you think it will affect your future relationship to the sciences? How?

15. What kind of environment makes you most able to learn? Do you like competition? Does it help you to learn or not?

16. What were the moments over the past two years when you felt best about yourself as a learner? What were the worst? Have you been anxious about your ability to do science? Has that changed?

17. How do you organize yourself as a learner? Do you do homework regularly? How much? How do you study, and when? Do you like to work with others or alone? Describe any work partnerships which you had.

18. How much do you like doing the work of science - the actual sit-down and solve-the-problem work? Do you get lost in this work and find it fun?

19. How have you felt about your non-science subjects? Describe some of your experiences here.

20. What do you do when you are not in school, or not doing school homework?

Coding Categories and Their Dimensions

1. Interest in science	high	low
	everything	specific
	romantic	practical
	rel. to certainty	not
	future focussed	holding pattern
	entry rel. to marks	instrinsic
	superior programme	same as others
	always	new
	cont. rel. to marks	intrinsic
	teacher involved	not
	multiply det'd	single det'n
	persist	drop
b) Science Carreer	focused career choice	unfocused
	career chosen	t.b. disc.
	uncertainty is frightening	uncertainty not frightening
	comfortable re science career	uncomfortable re science
	always	new
	caring motive	other motives
2. Other interests	many	few
	perceived as academic	not perceived as academic
	great	little
	job (# or hours)	no job
	related to science	not
3. Non-science career	focused	unfocused
	conceivable	inconceivable
4. Aspirations for marriage & family	yes	no
	simul.	serial
	problematic	not
5. Aspirations for future education	Degree	
6. Family/Friends: Involvement in science: Mom	yes	no
	persistence encouraged	not
	specific science encour.	general
Dad	yes	no
	persistence encouraged	not
	specific science encour.	general
Siblings	yes	no
Relatives	yes	no
Friends	all	none
7. Image of Science Student	smart	
	works a lot	
	enjoys science	
	abstract thinker	
	the best	
	accurate?	
	talent innate	
	logical	
	knowledgeable	
	determination	

Appendix 6: Continued

8.	Image of Science	positive	negative
		hard	easy
		accurate	inaccurate
		opposed to other disciplines	independent
9.	Marks	high	low
		past	future
		ach. eval: extremely high	low
10.	Studying Science	understanding important	not essential
		takes long time	not long
		hard	easy
		takes work	spontaneous
		persevering	is not
		patient	not
		practice with problems	none
		studies notes	does not
		uses texts	does not
		uses repetition	does not
		sees teacher	does not
		finds it stressful	does not
		perfectionistic	does enough
		asks questions in class	does not
		workload heavy	not heavy
		external motive	internal motive
		labs mp. connect	not
		needs to visualize	not
		teacher dependent	self dependent
		tutoring required	not
		varies subject to subject	stable
		listener	actor
		write to learn	not
		self control imposed	natural
11.	Preferences among science subjects	clear	unclear
		stable	unstable
		intrinsic	mark related
		teacher involved	not
		affect bound in	not
		related to challenge	not
		related to career	not
12.	Perception of non science subjects	very different	same
		important	peripheral

13.	Anxiety	test related?	before	after
		related to workload	high	low
		related to teacher	high	low
		related to teach covering course	high	low
		related to comparison with others	yes	no
		related to sense of subject mastery	yes	no

14.	The curriculum	related & interconnected	disparate
		taken as gtiven	understood
		seek roundedness	seek spec.
15.	Interrelationships with peers	important	not
		practical	emotional
	Lab Partners?	source of mutual help	need to measure up
		require compromise	require control
		male	female
		seen as mutual	imbalanced
		winner	loser

Appendix 6: Continued

16. Competition	intensive	not		
—With self?	positive association	negative		
—With others?	positive association	netative		
—For self measure?	extreme	negligible		
	winner	loser		
17. Gender issues	Perceives none	some		lots
	Exp. science as balanced	imbalanced		
School	single sex schools			
	self-confidence for girls			
	encouragement for girls in science from teacher			
	discrimination			
	different behaviours (marks, discipline, work)			
Cegep	discrimination	no		
	different behaviours (marks, discipline, work)	no		
Family	discrimination	no		
18. Effect of science education	discipline			
	control			
	strength			
	prestige			
	logical			
	knowledgeable			
19. Science teacher	care about students	no		
	make it interesting	no		
	enthusiasm	no		
	explain clearly	not clear		
	fair tests	unfair		
	goes too slow	too fast		
	rigid, scary	lax		
	accessible	can't find		
	organized	disorganized		
	asks for questions			
	has had good teachers	has not		
	provides context	no		
	same as non-science	different		
	expectations high	low		
	know stuff	don't		
	patient	impatient		
20. Continuities				
High school with Cegep	curriculum	yes	no	
	marks	yes	no	
	expectations	stable	changing	
		high	low	
	preparation	good	bad	
	pace	same	different	
Throughout Cegep	marks	yes	no	
	expectations	stable	changing	
		high	low	
21. Improving science	self	"they"		
	possible	impossible		
	visual components			

Teacher Interview

1. What are the particular student aptitudes and qualities which your particular subject demands, that might differentiate it from other subjects? What kinds of students do best in your classes? What kinds of students do worst?

2. Describe what you consider to be a top science student: What are the characteristics you think important?

3. Who do you think should study science? Should everyone study science in Cegep, as everyone studies English, for example, or should science be a specially chosen area? If so, by whom?

4. How should science students organize themselves as learners? How much time should they spend on your subject per week?

5. Talk to me about competition. Do you see your students as being very competitive?

6. Describe what you consider to be a good Cegep science teacher: what characteristics/behaviours do you think are important?

7. What methods do you use to evaluate your students? Why are problem-centred tests and quizzes (plus lab reports) so popular in the sciences?

8. How do you feel about curriculum which is given to you to teach? Explain.

9. Do you think that gender makes a difference in the study of science? Have you observed gender differences in your students' behaviour, attitudes, performance, etc.?

10. When you look at a class, and as you teach it during the semester, are you conscious of seeing very clearly who will continue in science and who will not? If so, how can you tell? If not, why not?

11. How many students ever express things like anxiety, frustration, or hostility in relation to their studies? What kind of students are they? What do you do about it? Do they ever talk to you about quitting? How do you respond?

12. What should a Pure and Applied/Health Science graduate of Vanier College take away with him/her upon graduation?