DOCUMENT RESUME

ED 156 500 SE 024 478

AUTHOR Smith, Mary Lee
TITLE Case Studies in Science Education, Booklet II: Teaching and Science Education in Fall River.
INSTITUTION Illinois Univ., Urbana. Center for Instructional Research and Curriculum Evaluation.
SPONS AGENCY National Science Foundation, Washington, D.C.
PUB DATE May 77
CONTRACT NSF-C-7621134
NOTE 31p.; For related documents, see SE 024 476-491

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Case Studies (Education); Curriculum; *Educational Research; Educational Trends; Elementary Secondary Education; Field Studies; *Instruction; *Mathematics Education; *Science Education; *Social Sciences
IDENTIFIERS *National Science Foundation

ABSTRACT

This booklet is the third of a series of 16 booklets that together describe and present findings for a study which involved field observations and a survey of science teaching and learning in American public schools during the school year 1976-77. The study was undertaken to provide the National Science Foundation with a portrayal of current conditions in K-12 science classrooms to help make the Foundation's programs of support for science education consistent with national needs. Eleven high schools and their feeder schools were selected to provide a diverse and balanced group of case study sites. One field researcher was assigned to each site and instructed to find out what was happening and what was felt important in science (including mathematics and social science) programs. The case study report from the "Fall River, Colorado" site is contained in this booklet. (MN)

Booklet II
Teaching and Science Education in Fall River
Mary Lee Smith

Table of Contents

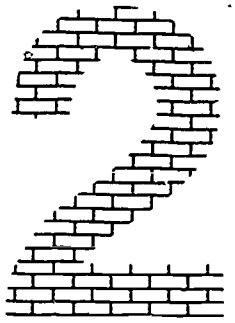
Case Studies in Science Education
A project for the National Science Foundation
conducted by CIRCE and CCC
270 Education Building
University of Illinois at Urbana-Champaign

BOOKLET II

TEACHING AND SCIENCE EDUCATION IN FALL RIVER

Mary Lee Smith
Evaluation Research Services
Boulder, Colorado

May 1977



Fall River is a relatively small city on the high plains a few miles east of the Rocky Mountains. In recent years new industries have attracted a rapidly growing population of professionals, highly skilled technicians and industrial laborers. With these new residents have come new values and expectations. The nearby mountains with their potential for aesthetic, recreational and economic opportunities exert an ever present influence on values related to conservation and/or exploitations of natural resources.

As one might expect, these differing values are reflected in the expectations that various members of the community have for their schools. Often, administrators and teachers are placed in the middle of conflict about such issues as open space schools or accountability. The absence of power to resolve the conflict leads to tension and frustration.

In her case study, Mary Lee Smith has done a masterful job of portraying the prevalent issues and how they affect the various people associated with the Fall River School System. When I read the study I could very easily picture the places and people about which and about whom she was writing. With a sensitive and artful prose she has interwoven quotes of students, teachers, administrators and parents into a sometimes subtle but always insightful view of the total school scene.

Mary Lee Smith's concluding comments to her study deserve special attention. These same conclusions could have been drawn from any of the sites that I visited. Any national "movement" or program would be remiss not to take them into consideration.

"THE MATERIAL IN THIS REPORT IS BASED UPON WORK SUPPORTED BY THE NATIONAL SCIENCE FOUNDATION UNDER CONTRACT NO. C 7621134. ANY OPINIONS, FINDINGS, AND CONCLUSIONS OR RECOMMENDATIONS EXPRESSED IN THIS PUBLICATION ARE THOSE OF THE AUTHOR(S) AND DO NOT NECESSARILY REFLECT THE VIEWS OF THE NATIONAL SCIENCE FOUNDATION."

TEACHING AND SCIENCE EDUCATION IN FALL RIVER

Mary Lee Smith

The study of science education programs at a single site, Fall River, Colorado, exposes bits of the history of the field. In this archaeological dig can be found remnants of each era: the pre-Sputnik traditional disciplinary science--still used in some classes; the textbooks, equipment and institute-trained teachers left by the first two generations of National Science Foundation activity; the enrollment decline and disillusionment with science coincident with the romantic rebellion; the enrollment resurgence that has come with the new pragmatism; the recent popularization of the ecology movement. All of these historical eras have had effects at Fall River, and all left some relic. In each case the impact was deflected or diffused in some way, as if an alien culture had attacked an older one, entered its territory, but gradually lost its language and separate identity, absorbed into the older one.

People outside the schools have relatively simple ideas about how schools work: to change education in a desired direction (e.g., to get more physicists, more science-literate citizens, equal opportunity, better human relations), one must merely manipulate one or two variables (e.g., improve teacher training, write better textbooks, enforce rules, abolish rules, write behavioral objectives, enforce standards, remove walls, add walls). This site revealed once again that schools are complex social systems with histories, customs, values, enforced standards for performance, authority and status relationships. All affect the education which somehow happens to occur and frustrates efforts to change it.

IMPRESSIONS OF COMMUNITY AND SCHOOL

The subject of the study was Fall River High School and the elementary and junior high schools within its attendance area. All are located in the city of Fall River (population 36,000). Old Fall River was a self-contained community of 10,000 until the growth spurt of the 1960s. This core area remains, but is now surrounded by tracts of housing development. It is not uncommon to see two residential development tracts separated by a field of corn or a cow pasture.

Main Street divides the old Fall River into what the residents still believe are the more and less desirable halves. A quiet Hispanic community occupies part of the eastern section. Nowhere is there striking evidence of poverty or deliberate segregation. Although the older downtown and Main Street shopping areas still have an Old West look about them, farther out on Main Street one encounters all the features of a suburban strip such as might be seen anywhere, with shopping malls and "fast food" chains. The people who live in these newer areas are likely to commute to the metropolitan area or to the major electronics firm in the next town. They are only now beginning to make inroads to the social and political life of the community, of which old Fall River still has a disproportionate share. The ambiance is rural, conservative, religious.

The school construction program is said to be almost always behind the growth of the community, and Fall River High is chronically overcrowded. Five years ago a new high school was opened in the adjacent town. Students from the most prosperous of the new housing developments as well as most of the Hispanic community were sent there, leaving Fall River High dominated by old Fall River. Next year a third high school will open in the northeast corner of the city, now just cornfields.

The Board of the Fall River Valley School District governs these schools, plus others in several remote rural communities. The district stretches from the foothills of the Rockies, down the rich river valley, to far out east on the plains. The district maintains fifteen elementary schools, nine secondary schools and a career development school in the district, with a total enrollment of 15,000. The current enrollment growth rate is two percent per year, a rate much lower than that of ten years ago.

Observers of the community say that sentiment toward the school can be divided three ways. The majority of the community tends to be supportive, even proud of the schools. Members of this group are quiet unless aroused by an extreme situation, don't come often to the schools or participate on advisory committees, and so far have approved school bond referenda. But there is usually a light turn-out for school elections, and school officials are careful not to ask for very much. When people speak, they are concerned that education stress the basic skills and prepare the students for future work. Occasionally they talk of problems with the schools--too many administrators, lack of communication and trust, innovative gimmicks, too many special programs, not enough being done for the able student, not enough discipline. Old Fall River still views Fall River High School as the hub of the community, and many turn out for its musical and athletic events. The second group is small, vociferous, active, and have what the other groups perceive as disproportionate influence. These people seem to distrust professionals and worry about encroachments on local control of schools by federal and state government. Much energy is spent in all parts of the educational system to cope with this group. The third group is a cadre of parents and citizens who serve on the Accountability Advisory Committee and other study groups. They are the allies of the school people. They work hard and take their responsibilities seriously. They occasionally feel frustrated that the board of education fails to pay them much attention.

The board of education reflects sentiments of all three groups. Most board meeting time is spent in business matters. One departure from the usual activity was a decision to raise graduation requirements, a decision which reflected an apparent community concern that seniors had too much free time and took too few "solid" subjects. After the vote was taken, a board member contended that, regardless of the number of credits required, the students would still graduate without skills because they were allowed to take science fiction courses rather than required to learn how to write. The superintendent reminded her that the board's role was to set policy and the professional's role to determine what educational programs would satisfy it. Few people attend the board meetings--some of the concerned parent group, all of the school administrators, a handful of teachers there as watchdogs for the Fall River Educational Association.

The association is at that stage of development in which most of its attention is spent on issues of salary, security, and consolidation; relatively less on educational issues. Members are assertive but not militant. The relationship between the administration and the association seems almost paternalistic at times. The association, for example, readily accepted as authoritative the administrators' interpretation of the results of research on class size and dropped class size as a bargaining issue.

The administration of the district travels in an uneasy orbit held in place by the centripetal forces of attempted centralization of management and curriculum coordination and by the centrifugal forces of territoriality and building autonomy. Although the central administrators have attempted to organize the principals into a team to make

decisions for the entire district, the image of the principal as Lord in His Domain remains strong. The central administrators strike one as conscientious and competent, although the cast of characters changes fairly often. One senses that they believe teachers ought to be managed rather than served.

One of the primary centralizing forces is the curriculum planning process, which involves stating district goals, detailing the district-wide curriculum in the form of behavioral objectives, implementing the resultant curriculum planning guides (the current stage), and evaluating. The process, given additional impetus by the state accountability legislation, has absorbed enormous amounts of time and energy of teachers, administrators, and advisory groups. The last group generally feels that the process was worthwhile and the product will play significant role in classroom instruction. Administrators are proud of the guides. Teachers' reactions are mixed. Some feel that the process was a good way to involve and communicate with the public or a good way to organize the curriculum. Others feel it was an empty exercise, a way to turn teachers into bureaucrats, or to decrease their prerogatives. No one effectively addresses the question of exactly how the guides make teachers more accountable or instruction more effective.

The major role in developing and implementing the guides belongs to the curriculum coordinators, for whom it is one of several duties. Mr. Johnson, the math-science coordinator, is occasionally resented by some of the teachers for "pushing" the planning process, though few doubt his effective advocacy of science education or his vigorous pursuit of district resources for math and sciences. For a variety of reasons, there is no one in the district playing Johnson's role for social studies programs.

FALL RIVER HIGH SCHOOL

Fall River High School impresses initially with its automobiles. Cars full of young people cruising around the school grounds and adjoining streets--older cars mostly, no sports cars betraying excess wealth; some have been rebuilt to move at a rakish angle or garishly painted in the style of the 1950s; many pick-up trucks. Kids sit in cars in the student parking lot, smoking, some talking on citizens' band radios, all delaying entry to the school building or waiting out free periods or getting ready to drive out to the "fast food" restaurants or the career development school for vocational courses.

Buses arrive and flocks of students emerge heading for the south hall. Near the door are clumps of students, smoking, somewhat isolated from the in-groups. Inside, a trophy case is a reminder of past athletic feats and present athletic aspirations. Hand-made posters exhort football, cross-country skiing, tennis, and girls' gymnastics teams to victory. Farther along the corridor are two distinct eating areas. In the first, students are reading, finishing homework assignments, and talking quietly. In the other, a dozen boys gather around two foosball tables while their cohorts talk loudly and indulge in mild horseplay. Groups of boys distinguished as athletes by dress and swagger line the walls, occasionally reaching out for or calling to a passing girl, and comment on the "talent." Three teachers supervise these areas--others are stationed around the building. They spend the time doing their own work, stopping only when the noise or horseplay exceeds a certain known but unspecified threshold.

Despite the presence of teachers, this is clearly student territory, where student roles are enacted and taught to initiates. The school world does not intrude. There is a feeling of regularity, of sameness, of ritual--almost as if one would see them doing, saying the same things, sorting themselves out in the same way five years in the past or future. So much happens, but the activity is without spontaneity or vitality. (This feeling is in

marked contrast to the adult, purposeful, business-like atmosphere of the career development school.) The student world at Fall River High spills out of its assigned territory into the halls and library. The scheduling system they use, similar to that used in colleges, allows free hours between classes; the students who are free create noise enough to disrupt academic work in classes near the student areas. The public complains about the amount of freedom allowed by the scheduling system. Yet the system represents, not the 1960s philosophy of freedom, but the necessity of cramming 1,800 students into classroom space meant for 1,400.

The library, well stocked and staffed, fulfills its traditional functions for only about one-third of the students there at any one time. Always crowded, it is the crossroads for all the identifiable cliques in the system. One table seems to be reserved for the athletes, and another, within hailing distance, for the "blue-uniformed girls"--the cheerleaders and pompom girls. Other tables are filled with kids talking about their jobs (many students have them). The intellectuals/student leaders (two interlocking categories) rush in and out, conducting the business of student government or working for the campaigns of political candidates or preparing for debate meets. "Tight" couples cuddle at corner tables. The "cowboys" don't often come in. A few people work seriously, although the noise and movement play havoc with concentration. Not much work gets done, here or elsewhere, in the view of many of the students themselves and several faculty. One of the students reported:

> *. . . Kids here have the feeling that high school should be fun, the happiest time of your life, like on "Happy Days" or "American Graffiti" . . . so they do about the minimum necessary to get by and get out. . . . A lot of them are just hanging out, you know, it's the place to be with your friends and see people.*

The teachers have their own social group and their own territory--the lounge. Few teachers have sole access to a particular classroom, contributing to a nomadic feeling and necessary use of the lounge. It is a sanctuary and site for traditional ceremonies. It is a shabby room; yellow cinder-block walls and dilapidated stuffed furniture surround the lunch tables. A room divider shields the room from student view. There is a rack of professional journals and a bulletin board for professional asspciation notices, ribald cartoons, schedules, etc.

At any hour there are at least a half dozen teachers there, relaxing during their preparation period (that euphemism!), eating lunch, spending time before and after their work day, and some shaving time from their hall duty assignments. The conversation is banter, joshing, and sports. No athletic team escapes expert analysis. The merits of particular football defensive strategies are debated, the physical gifts of athletes judged, and the prospects for the next season contemplated. When the coach himself comes in, the company offers him their pet plays. Bets are made and discussed.

All this leaves little time for discussion of other matters; but matters of insurance, course loads, salary scale, pensions, have some share of the talk. Occasionally the talk is about administrators--not the ones in the building, generally respected and considered part of the group--but the ones "downtown." The tone is usually negative. One gets the feeling that "We" and "They" are not playing on the same team.

> *There are guys down there that don't even have a job description. They run around trying to do things to justify their jobs.*
>
> *Administrators ought to have to teach one class a year just to keep in touch with reality. They get down in that central office and forget what it's really like. Education professors should have to do the same.*

There is a little talk about students, how they've changed, how they can no longer be made to work, how they don't care as much now. In general, though, the teachers don't talk

about professional matters, how to improve their teaching or their subject matter knowledge, or of ever ("God forbid") ascending to an administrative position. There is that same feeling of regularity and sameness, as if the lounge patterns were laid down years ago. It's a comfortable, friendly place for those who fall into the patterns. Not all the teachers do. Some deliberately avoid the lounge and don't share the interests and values of those who abide there. If a department has a headquarters, there is opportunity for other sub-groups to form and pursue their interests. One of these is the math-science room, crowded with desks, supplies, and equipment. The teachers use the quiet to study, prepare for their courses, and exchange ideas and feelings about teaching.

The academic life at the high school (speaking only for science, math, and social studies) appears to be confined to the classroom. Even there, academic business is in almost constant danger of being overwhelmed by the student society. What takes place in the classroom is the province of the individual teacher. The building administrators occasionally observe and evaluate, but teachers rarely intrude on one another. If a teacher chooses to lecture, run discussion groups, or confine himself to showing films, an unwritten rule seems to hold that others will say nothing about it. Curriculum--the coverage of a single course or the relationships among courses--is discussed and agreed upon in informal department meetings. Incursion into this system by central administrators or committees is likely to be resented, sabotaged, or passively "waited out."

The students appear to accept the primacy and authority of the teacher, for the hour they sit there. There is rarely an outburst in class; one never sees the student flouting the authority of the teacher. Truancy is the only serious discipline problem in the school. Classroom problems that exist are problems of acquiescence and passive non-involvement. Many teachers express concern about conducting discussions. It is difficult for the observer to pick out the best students in any class. They are as quiet as the others. They don't seem to provide that spark that can help a teacher strike a lively pace and maintain a taut intellectual tone.

The academic life in a classroom is maintained only so long as student attention is directed at some specific activity--a lecture or problem to be done on the spot. When this condition is not met (e.g., when class time is made available for student study), students relax at once; attention is directed immediately to each other. Social processes are so much more compelling than school business. Work can always be postponed until those lonely hours at home; during class there are more important things on students' minds than bookwork.

> *[Observation of an advanced science class.] The teacher had assured me that he would start a new unit today, but the students had performed poorly on the unit test and he had agreed to review and retest them. During the review the students quietly and diligently took notes. Then he asked for individual students to approach him with problems while the others reviewed their tests. Immediately what had just been one class broke into several conversation groups. The noise increased. One student went back to the lab to perform an experiment he had missed. The banter started with usual game of "wha'ja get?" but talk about science was soon replaced with talk of girls, dates, cars, the latest track meet, the injuries suffered in Friday's game. Although the teacher tried to bring the class back to science, the hour was lost. Two girls from the hall opened the door and beckoned to a boy to leave class early. Several students sat staring, waiting for the hour to be over.*

The High School Science Program

The high school science program consists of eighteen courses. Despite lenient graduation requirements, enrollments are high. The courses are staffed with an impressive

group of teachers, most of whom have advanced degrees in the disciplines and have attended National Science Foundation institutes.

The biology program has the largest enrollment and staff. All students who elect biology take a one-semester introductory course, after which they can choose one or more follow-up courses in ecology, plant structure and function, social biology, microbiology, heredity, and animal anatomy. Some students fail or opt out of biology after the introductory course. An advanced placement course in biology is also offered.

The content of the introductory course is largely the same regardless of who teaches it. The text used is from the Biological Sciences Curriculum Study (green version). The instructional methods are largely lectures, lab investigations, review sheets, and occasionally films and guest speakers. Although the BSCS text emphasizes developing students' interest and heuristic inquiry, the classroom instruction at Fall River High tends to be formal, didactic, and organized. Almost the entire text is covered. This is a large quantity of material for one semester, but it provides the background needed for the more specialized follow-up courses. In the ecology course, for example, the students review the relevant BSCS chapters and then go on to more specialized texts. They participate in simulations designed to show the relationship between values and environmental processes. Topics covered include ecology and the law, mountain eco-systems, and the food chain. Laboratory investigations on photosynthesis and chromatography are conducted, as are field investigations in small eco-systems near the school building. The students conduct independent research on biomes.

Although the other follow-up courses are not so directly related to the environment, a strong environmental consciousness pervades the entire department and has been adopted by many of the students who participate in Earth Club. When asked about principles that underlie the program, three teachers made the following statements:

> *[The purpose is] to make them better citizens, help them understand the issues in society that are related to science, help them make better decisions. Like I ask them how much longer they're going to be able to drive up and down Main Street. I don't try to impose my own view on them, but I do try to make them think.*

> *You can't separate out values and science anymore. When we talk about population growth or genetics, controversial issues come in. I tell them they should learn the material, if only so they can determine their own futures.*

> *The person just can't be an effective citizen unless he can read and understand political issues that have scientific overtones. . . . The average citizen has to have the awareness and appreciation of how his actions affect the environment and what is likely to happen depending on the choices he makes now.*

In addition to the notion of developing environmental consciousness, the teachers believe their purpose is to provide a strong and diverse academic experience that puts the students in touch with the major body of knowledge in biology and the processes used to arrive at it. One teacher reported, "Any systematized body of knowledge is part of the foundation of civilization. It's part of their responsibilities as citizens to be aware of it. Science has applications in all their lives."

The biology program is not without its rough edges. Students in the introductory course fail in higher proportions than other courses. Most teachers are determined to hold to their standards, however. Based on previous experience, they are convinced that students will take the easiest possible path and dilute the content of the course and make the follow-up course structure impossible. The teachers feel that any student who makes the effort can pass.

Another serious problem is lack of space and facilities. There are two well-equipped laboratories, but sometimes four sections must share them in a single class period. Therefore, the teachers have to coordinate classes so that while one section is doing lab work, the other teacher must lecture in the classroom designed for physics. No space is available for advanced lab preparations. They look back wistfully on the year they had a teacher aide.

> *Not having the facilities lowers my interest and energy and influences what I teach. The situation has discouraged every bit of open-ended inquiry I've got. A question comes up from the class and I think of an investigation that would be related, but there we are in the physics room, so I lecture.*

About forty percent of each graduating class go to college. A greater proportion of students follow a traditional college-preparatory course of study. Most of this group take chemistry in the junior year. The chemistry classes are packed, but it is unclear whether the high enrollment is due to students' scientific curiosity, the genial personality and showmanship of the teacher, or the abundance of A grades. Although there was some complaint from the best students that the class "wasn't tough enough . . . didn't go too deep into chemistry," the instructor primarily wants

> *them to be interested in science and to master the basic material in the field. I feel like anybody can learn at the level I teach them. The kids who are really interested then can go off on their own and learn more.*

The text Modern Chemistry is used, but the approach is traditional. The vast majority of class time is spent in lectures and laboratory experiments. The lab areas are well equipped for a basic program, but the teacher longs for materials that would support more advanced work. The labs are terribly overcrowded and the teacher worries that someone will be injured in an accident.

The physics course is taught by a man with experience and impressive credentials--advanced degree in physics and math, several NSF training institutes including training in the use of both Physical Science Curriculum Study (PSSC) and Harvard Project Physics (HPP). His lab is well-equipped and under his leadership the science program has always received a healthy share of the school budget. He now uses HPP in his three sections of physics. For several years PSSC was used but "NSF backed a real loser with that one." He found that few students were capable of learning the PSSC materials, enrollment dropped, and the physics program was jeopardized. He decided to change over to the HPP course and textbook, somewhat less theoretically and mathematically rigorous and appealing to larger segments of the school population. A few students and parents complained. One parent stated:

> *I've been very disappointed with the district for watering down the courses. There used to be a really strong physics program [under PSSC] but then [the teacher] decided he needed to accommodate the low to middle achiever so he threw out the good program and came up with this other one that is less comprehensive. It really hurt the well-motivated kids.*

In answering a question about the purpose of science education, the physics teacher spoke of his own philosophy:

> *In recent years I've wondered if you could justify it. Earlier I would have said that physics was a part of cultural knowledge, something enormously practical, like all sciences having something philosophically to offer the public, an intellectual integrity which could carry over into politics and society.*
>
> *Now I don't know. We live in a technological society so it is necessary to propagate information to some parts of the society. But for the general person in high school who will eventually go into business or become a*

homemaker, they really don't need to know about physics, except in a very superficial way. If you want a kid to know how to change a tire, you teach him about levers . . . I'm a good sailor and I apply my knowledge of physics, but other people are better sailors and have no physics background.

That is too pessimistic. Let me state it this way. Everyone deals with nature. Every high school student knows a great deal of physics and the teacher merely encourages him to abstract his knowledge to form more general and sometimes more useful patterns of thought. If the student can deal with ideas in the abstract, he learns this before going to college and can thereby make a sounder choice of careers. He may not do better than another competent college student, but he has had the benefit of guidance and proven academic discipline. Finally, and this is important for all ability ranges of students, a sense of being at home in the universe must be transmitted. The physical world and the technology of man must be dealt with as an important part of the total culture he is to inherit.

My greatest contribution is to get students to grow intellectually as much as possible. If a kid doesn't appreciate a subtlety of physics it doesn't bother me. I'd like to bring each kid as far as he can go. What I'm definitely not doing, but used to do, is to prepare Ph.D. physicists. I was looking for that occasional student--but he only comes around about every four years, and running the class at that level . . . that's no longer how I want to work.

I don't think that this [less rigor] hurts the college-bound. From the statistics I've seen it makes no difference in college freshman physics whether the person has had physics in high school or not. How he does in college is more dependent on his intelligence and motivation rather than his high school preparation . . .

I now expect less of the kids than I formerly did. This is true of almost all teachers. Now I pay more attention to the kids--to relate to the kids on an emotional level . . .

[On the absence of science clubs and science fair activity] It's the general wind-down of interest in the sciences, after we got out of the competition with the Russians after Sputnik. Much of the interest in science was really interest in competitions. Kids did become aware of science and interested in learning about it, but the principal reason was to catch up with the Russians. Much of the science fair activities were generated for the competition aspects more than pure science. . . . The student who can do research is a relative rarity. . . . Research is a terribly frustrating activity very unlike the experiences that students have. . . . If you form a science club, most of the interest is generated over who is going to be president. Once they get the officers elected, they're ready to go out for pizza. So the kind of interested students you would like to think are there, just aren't. . . . You don't see much intellectual curiosity or discipline. That's just the way it is, and there's no point in trying to make researchers out of ordinary students. . . .

In addition to the more traditional track of three courses, the science program includes a great variety of offerings: astronomy, archaeology, geology, conceptual physics, electronics (less mathematical than the physics course), introduction to chemistry (a student-centered, laboratory program using discovery techniques and emphasizing the process of science), and space science (a rather easy course for students who have a previous failure or little interest in science).

The man responsible for several of these courses is a former geologist who runs his classes very informally, trying to structure each one around the interests and questions of the students. Environmental consciousness appears strongly in his courses as well. In the course description for geology he wrote:

> *Our study of geology will be centered around the following concepts: Geology, the study of the earth, is essentially an environmental science. . . . Man . . . must learn to function in harmony with the earth environment. . . . Citizen roles dictate an understanding of the environmental problems confronting man, solutions to these problems, and the responsibilities of citizens and government to work toward their solutions.*

These objectives are not mere educational cant. During his classes, this philosophy is never far off, injected even into a presentation on the physical properties of minerals.

In his courses perhaps more than those of others, scientific methods are given prominent attention. In the archaeology class he listed the following among his objectives.

> *Demonstrates an understanding of the process of identifying and defining a scientific problem or question to be investigated . . . of proposing a logical test of a hypothesis . . . of testing the effects of variables and controlling relevant variables . . . the ability to synthesize data from several sources to arrive at generalizations or conclusions . . . withhold judgments or conclusions until adequate information has been validated.*

In interviews he spoke of his frustration (shared by several other teachers) with both students and the district administration:

> *I have also had to modify my practices for kids that can't assimilate material from lectures and films. When you have such a large range of student abilities it becomes difficult to come up with a satisfactory compromise. I've had students who were five to six years behind in reading ability. This shows up not just in their ability to read but in their ability to sit in class and listen and understand. . . . We're just trying to come to grips with the student who isn't interested in science and we have quite a number of them. This is hard for us because we have always been interested in science. In the past even if you weren't interested in science you knew you had to take it because it was important. Now the public is questioning the value of science, for some good reasons. Sometimes it has appeared that science has been misused. People are upset with the high costs of science, particularly the space program. What they don't realize is that this enjoyable society has been brought about by basic research. . . . I spend a lot of time in class explaining the benefits of doing basic science. Like last year when the Senate was upset by the studies that were trying to figure out why people fall in love. That may seem silly but perhaps the results of that might help us solve our social problems. . . .*
>
> *I've had a lot of spark taken out of me in the last two years. We hear [central] administrators talking about meeting the needs of students--individualization. But we never get time off to develop these things or the financial support. We don't get the help we need from counselors, in terms of placing kids in the right science courses. I've talked to them [central administrators] about getting materials and they say that materials aren't as important as the student-teacher relationship. But I find it very difficult to stand up and play Johnny Carson everyday. The kids don't want to hear lectures, they want to <u>do</u> things. . . .*
>
> *I always thought that the main goal of education was teaching kids, now I find out that the main goal is management. We want more money, so does every other department in the school. I have some opinions about the amount of money they spend on athletics. I'm biased. I'm in the minority. . . .*

Some teachers are no longer interested because of frustration. You can ... and try, but you never get any recognition or monetary reward for your efforts. It doesn't gain anything to innovate or analyze or revise or evaluate.

There seems to be a gap between teaching and learning in the science program at Fall River. The teachers are interested in students and extremely well-prepared in the sciences. The curriculum is strong. Instruction is effective. Yet the students are not very involved in study. One teacher responded to a request for the names of the serious science students by asking, "What serious science students?" Independent study, research, free time participation in scientific activities are rarities. One of the highest achieving seniors explained her motives for taking an advanced science course as "a way to get some college credits out of the way."

One teacher accounted for the discrepancy this way: "We lack the element in the community that knows what gets people to the top and keeps them there. These are the people who put pressure on their kids to excel in science, and interfere constantly to make sure the school is providing the best, most rigorous education."

The High School Mathematics Program

The math teachers are proud of their program. They have a sense of purpose--to provide each student with as much math as he is able to learn. Students follow three tracks. The most difficult consists of geometry (first-year algebra having been taken in ninth grade), a second-year algebra plus trigonometry course, math analysis and an advanced placement calculus class. The second track is for students who move more slowly or find out later that they want math courses: Algebra I, informal geometry (with less stress on formal proofs), a year-long Algebra II course, separate trigonometry and math topics courses. Students who haven't passed a math course may wait a year and take a business math course. Personal finance and computer math are also offered; but for the latter, students must be bussed across town to Stockman High. A seminar is offered for advanced math and science seniors.

What strikes the observer is the uniformity of philosophy and methods among the teachers in the department. Except for two younger teachers they have all worked together for many years, are comfortable with one another, make curriculum decisions easily, informally, consensually. The scope of geometry is determined by the knowledge and skills needed to begin in Algebra II-trigonometry, which in turn prepares students for math analysis. Most of the students who follow the sequence to the end pass the advanced placement examination that follows the calculus course.

The classroom processes are remarkably similar among courses and teachers. The following is a description of a geometry class visited several times.

This is a light, pleasant room with seats in straight rows and students at attention. The opening classroom housekeeping is fairly business-like, but there is warmth and humor exchanged between Mr. Bennett and the pupils. He asks one of the girls how her track meet went. Mr. Bennett is a veteran in math education, yet he still loves to teach geometry because it is a tough subject and he enjoys helping the kids struggle and finally grasp it. Students speak fondly of him yet respect his toughness. He begins as he usually does, with a general introduction to the topic (today it is mathematical induction), giving some common sense examples, then turns immediately to the problem assignment for the day. He calls on students to give their answer to the assigned problems. Then he asks which problems caused particular difficulty. He goes over the tough problems step-by-step on the chalk board (sometimes

he uses the overhead projector). The emphasis seems to be to try and find the step in the problem at which the student got on the wrong track and correcting him with the proper algorithm. The next assignment is then given and class time allotted to work on it. As a student runs into difficulty he approaches Mr. Bennett, who tries to diagnose the difficulty: tracing the student's process down to the fatal turn, correcting him, and reminding him of the principle or procedure. Productive work on the assignment is expected and deviations rapidly corrected. Silly questions receive abrupt answers. He ends class with the admonition to do the assignment. "If you need help, you can always catch me after class or call me at home tonight."

In all the math courses the approach is didactic. The pace is relentless: they must go a certain distance in a fixed amount of time. Most of the teaching takes place between the student and the problems in the text (the textbooks consist of the Dolciani Series of Houghton-Mifflin), mediated more or less by the teacher. The "more" is characterized by the advanced mathematics teacher who runs his course in the following way. He asks for a troublesome problem from the daily assignment, having the students trace the steps they took, at each step asking "How do we know that?" and getting the relevant postulate or definition. When they have gone as far as they can go and reached that critical junction, he asks them to give a possible next step; then follows that up to see where it will lead, identifying the fallacy in the process; then backs up again for another suggestion, until someone makes the right one.

In interviews the math teachers expressed confidence in their program.

We offer excellent training for the college-bound. The non-college-bound student never knows when a particular trade requires mathematical training. For both groups we offer the discipline that comes from a rigorous regime of study.

The study of mathematics takes levels of maturity. You have to take step one before you can take step two. There is a definite hierarchy of material. You can't hope to be creative until you've mastered the basic program of studies.

We've found that traditional methods work. This is the way it was taught to us in high school and the way it was taught in college and the way it works for us. The real changes have occurred in mathematics itself, not in the teaching of math. . . . I don't think kids can handle inquiry. They can't by themselves put ideas together and get the concepts. They just don't have the background or sophistication. They would just take the opportunity to play rather than work independently.

High School Social Studies Program

The social studies curriculum at Fall River High School is comprised of four government courses, two in sociology, six in American history, five in world history, five in geography, and one each in religion and philosophy. The program has no underlying and unifying principle. Much more than in the other two programs, each teacher has his own ideas about what should be covered in his course and how it should be taught. The important issues that concern the field of social studies education--the teaching of values in social studies, the use of social science methods in social studies, or the humanistic, self-discovery focus in social studies--are interpreted differently by each teacher. Such diversity resists description. But perhaps the following hypothetical trip down the hall will provide the flavor of the department.

The first classroom in the hall is subject to an auditory harassment from the cruising hotrods on the street. The noise fails to overpower the stentorian voice of the teacher of Civil War America, however, or divert the rapt attention of the students. He is lecturing while also pacing the classroom, calling on students with questions about previous material. Teacher and pupils are serious. The subject matter is history, yet the content is studded with frequent mention of social science concepts. He explains the terms and their bearing on the historical period--supply and demand, scarcity, market, inflation, political spectrum, political parties, social stratification. Then he gives the students a quiz and shows a movie on causes of that war.

Next door is a class on ancient civilizations. The teacher is standing at a podium, gazing into the middle distance, and lecturing on Mesopotamia. He uses the story-telling approach to teaching history, full of place names, dates, major causes, principal results; and dry as dust. The students take notes for the most part or fill in work sheets or stare into the opposite middle distance.

In the next room a well-qualified man with experience on the city council teaches a class in government. The content of the course is solid and should be engaging attention, but the students are not appreciative. He is lecturing about the relationships of government and the economy. "Some people say that the government plays too big a role in the economy. How many of you think it is now too much? [Two hands are raised.] How many think it is too little? [One hand is raised.] Well, Marty, you must not have heard the question."

"I heard the question. I just don't care."

In the geography class down the hall the High School Geography Project is being used. The students are working with stereoscopes on stereograms of New Orleans, searching for indicators of land use and answering questions about the significance of the river in cultural and economic life.

There is a film about an Amish colony playing in the next room, a sociology class. The content of the course is quite similar to a first-year college course, and the teacher stresses individual research and field work.

In the psychology class the atmosphere is different. The students and teacher are talking about themselves, their characteristics and problems. He is relating to them a four-part structure for understanding personality--four combinations of what one knows and does not know about oneself and what others do and do not know about one. Each pupil is making a list of things he or she is, and classifying them into the four-part structures. Students aren't forced to reveal things about themselves; most want to learn something about themselves. Other course topics are transactional analysis and Maslow's need hierarchy, as well as several areas of academic psychology. (In an interview this teacher related the purpose for his course: "The kids need basic understanding concerning behavior, adjustment, about how people deal with frustrations and conflicts. . . . They want to be understood, just as people. This involves discussion, especially acceptance. . . . Nowhere else in school can they get this acceptance. No one else treats them as whole persons.")

Current events are regularly discussed in the history and government classes. In the American history class the teacher is reviewing the papers on current events turned in the previous week. He speaks energetically:

I'm glad to see you people are really thinking about these issues. Some of you chose to talk about women's lib. Equal pay for equal work is okay, but we all know that if the woman works, that means that somebody else has got

to take care of the kids, and that means day care centers and then we've got the government controlling the development of our kids, and then what happens to the family?

The students listen intently.

Later the teacher expressed his opinion about the place of values in the teaching of social studies:

Values are important to a society. Without value and moral structure, countries fall. . . . You worry about the crazy teacher that doesn't believe in the norms of our society, that they will confuse the kids and tear the system down. Teachers are an extension of the parent and as such should teach the value system that is consistent with the community. The community has a vested interest in the schools and has a right to demand that certain values should be taught and certain others not be taught. . . . Every year I live and teach my values become more solidified. What I believe in I believe in. I know I come across strong. That worries me to some extent, because I realize the impact teachers have on kids. You can hear them going down the hall mouthing the things you just said in class.

The most spirited class observed in the social studies department is philosophy, taught jointly by a pair of teachers. The content of the course--a review of major philosophical systems and examination of personal philosophies--is really less important than the students' involvement in the class. Their contributions are hesitant, halting, unpracticed but nonetheless authentic; undeniably present here while absent in other classes.

One of the teachers, who is the guiding influence for the course, gave his rationale for social studies. His philosophy was expressed in everything he did.

Social studies should help a student to become an effective competent human being, comfortable with living, able to cope with life and change. . . . [The way to translate this into the classroom is] for me to live it--for them to see me adapting to situations, being a model, with dignity, treating others with dignity, recognizing feelings both good and bad. But dealing with them as human beings, by itself, is not enough. There must be the element of learning. That is why they are there. If you just focused on what they wanted to learn and left it up to them, there would just be confusion and frustration. Their self-esteem would suffer because they hadn't done anything or learned anything. But if you can give them material and guide them to the point where they master it by some activity on their part, they experience success, they know they've accomplished something important and they really feel good about themselves. So the material is a vehicle for achieving that human relationship and that joy that can come from teaching and learning.

The same teacher characterized the principal and his assistants:

They give us excellent support for our programs. I never have the feeling that they're looking down on us. Instead they're looking up to us and saying "What can we do to help your teaching be more effective?" I view the administrator's role as making it possible for me to be in that classroom without having to worry about administrative details, papers and pencils.

The principal is viewed as young, dynamic, intellectual. He works with the social system that makes up the high school without being preempted by it or fully assimilated into it.

THE JUNIOR HIGH SCHOOLS

Two junior high schools serve the students who eventually attend Fall River High School. East and West Junior High Schools have the same general curriculum, but otherwise could not be more different. West has self-contained classrooms with an atmosphere to match. Though certainly not a martinet, the principal runs a tight ship with clear expectations for order and quiet. With some exceptions, the teachers work independently. Perhaps by coincidence, the educational philosophies of the teachers reflect the physical characteristics. Several spoke of the need that students of this age have for structure and organization and freedom from distractions. "We do kids a disservice when we let them pick what they want to learn or leave them free to manage their own time. They just aren't ready yet." As a consequence, there is heavy use of instructional objectives, structured learning activities with memory work, preprogrammed lab exercises and achievement monitoring.

East Junior High is an open space school, noisy, casual, buzzing with activity, often vilified (quiet unfairly) as a zoo, having more discipline problems than West and greater ethnic and socioeconomic variety among its students. Perhaps because of the open space, the instructional processes are more varied.

There are identifiable social structures at both schools, differing from each other and from the high school. Neither junior high is very old. Students and staff have shifted among the schools a bit, so that tradition and custom have less effect than at the high school. The student culture is less well developed. The behavior of the seventh graders is largely determined by adults, the parent-authority relationships carried over from elementary school. As the students get older they start to discover that their interests have less and less to do with those of the teachers, that it is the other children who can pass out more immediate and personal rewards and sanctions. By the ninth grade the students have been sorted into subgroups with varying identities possessing varying degrees of attractiveness and varying access to reward and recognition. By that age they have determined that practicing the group rituals and interacting with their friends is just as much a function of school as whatever the teachers are expecting of them. By the ninth grade, the worship of the body has become, perhaps, the main function of school.

East Junior High Science Program[1]

To the newcomer, the science area may be even too stimulating. The first time one walks in he is almost shocked by sights, sounds, and motion. There can be as many as six teachers and 150 pupils in a space about the size of six classrooms. When everyone is there doing science activities, the din is overwhelming. But when the teachers have preparation periods or students are doing work at their seats, there is less interference among the groups and a

[1]Except for a few digressions, the description of junior high programs will be about East. This choice was not made because one school was better than the other, but rather because of the space limitations of this paper and the personal inclination of the author.

pupil in one area can easily filter out the noise coming from the other areas. Four-foot partitions, movable chalkboards, and screens divide the room into three sections: life science (seventh grade), earth science (eighth grade), and physical science (ninth grade). In one corner is an individual research area where students can go when they finish their work, and "Check Point Charlie" where a teacher aide and a student aide help manage the individualized program.

[Observation of life science] In the life science area, some of the students work on an individualized program and the others have more of a structured classroom, working as a group under the direction of a teacher. The latter group is studying the protists. Because of the limited number of microscopes, the teacher has subdivided the students. Half are working with textbooks and worksheets, looking up definitions of vocabulary words (bacteria, algae, etc.) and writing down the characteristics of several simple protists. Several different textbooks are required to answer the questions, so the students have to use their initiative and not just copy the material. The teacher keeps them going at a fast pace. The other students are looking at slides prepared from beakers of water with different materials (wheat, hay, beans). They have a worksheet which requires them to draw what the microorganisms look like and to name them using the pictures in the text. The teacher moves around adjusting the microscopes and asking questions about what they're doing. At one point he says "Today we'll just be observing and recording. Later we'll make some guesses about what we've seen." After some initial frustration, the children finally spot the little creatures and then run from station to station excitedly comparing catches.

On the other side of the screen, a teacher is orienting and coordinating individual work on what are called TREKS, the current topic being classification. Having had an initial TREK on how the system operates, the pupils start to work on their own, pulling work sheets for the objective they are currently working on, choosing the right textbook (several text series are used), or approaching Check Point Charlie for materials and supplies. The objectives for this TREK include learning how to construct a classification scheme, why organisms are classified, the basics for classification, the order of the major categories, the significance of the Latin scientific names, the three kingdoms and the characteristics that distinguish them, the number of phyla in each kingdom, how certain plants and animals fit in the scheme. Specific learning activities are keyed to each objective. Small lectures and filmstrips are introduced. Extra-credit options are also available. The students test themselves to see if they know the material. When they are ready, they get their post-lesson tests from the aide. When they pass they have appointments with the teacher who asks them thought-provoking questions to supplement their objectives tests. The pupils work hard and enjoy the TREKS.

The life science course covers many of the traditional topics in biology. Here as in the high school, the environmental consciousness is apparent. The two teachers have helped develop a nature study area by the river and have written science lessons that take place there. They involve their best students in writing lessons for elementary school children and leading groups through the area. These teachers believe their purpose is to "get the kids interested in science" and to have the students experience as much science as possible.

The earth science classes are organized in the same way, with the students who can work independently working on TREK activities and the others covering about the same material, but as a group under a teacher's direction. The units covered are chosen from astronomy, meteorology, geology, and oceanography. Material for the unit on galaxies and the universe had been collected and organized by the two teachers from the scientific and popular literature and from slide tape presentations developed especially for this class. The objectives included defining the observable and unobservable universe; defining galaxies; knowing the different kinds of galaxies and classifying pictures of them by shape; knowing the name, shape, location, size and number of stars in our own galaxy; defining clusters and groupings

of galaxies; locating the planet Earth in the universe; and explaining the Doppler effect, the Big Bang and Steady State theories. The teachers view these topics as necessary background for the topics which genuinely interest the pupils, such as black holes in space and UFO's. For the latter topic a slide of men landing on shore in a rubber raft was projected onto the screen for a minute. After it was shut off the students were asked to list everything they could remember about the picture. What was produced was an assortment of actual and fanciful items. The teachers used this exercise to show how different phenomena can be interpreted as "flying saucers" when viewed briefly in times of stress. They then presented six cases of UFO sightings--what the people reported, what the environmental circumstances were, and finally the explanation for the sighting.

Another exercise was the writing of a science-fiction story starting with one of six story lines (e.g., "You are part of an expedition of light-sensitive creatures from the planet Riegel 6. You crash on a planet that has no night. What happens?"). Still another lesson involved the "Message from Mankind" which was sent with Pioneer 10. A bulletin board contained a replica of the message and the students were asked to decode it. They discussed radiowaves and were given a message in binary code to decipher. In all these activities there was plenty of good science and plenty of student interest.

The teachers, Mr. Carlson and Mrs. Wright, have worked together to develop the program and write the TREKS. According to Mrs. Wright:

> *We needed some way of working with kids individually--to let them have a chance to learn how to learn. . . . We got some static from the science coordinator and the principal when we first started writing the TREKS. There was a lot of pressure. We had to prove ourselves. . . .*
>
> *We write all the TREKS ourselves. We borrow some things. Mr. Carlson used to be a geologist and has a ten-year accumulation of rocks and fossils and slides. He has forced me to go back and do a lot of research. [In some of the topics] my background is weak, but working with him has helped me make it stronger. . . . It takes a lot of pressure off you to team, because you've got somebody else to bounce ideas off of and somebody to interact with. . . . But the writing time is just overwhelming. We spend one month each summer and get together to write for three hours per day. We don't get paid for it. . . . We buy a lot of things ourselves. Stan recycles about ten percent of his salary into materials and equipment.*
>
> *Sometimes we overwhelm them with content. We also try to expose them to where science is going, what kinds of problems science is trying to solve. We go right to the fringe of knowledge and speculate about what scientists will think in the year 2000 about life in the universe or continental drift or whatever. The students' favorite things are on the frontiers of science. What we try to do in class is to get them ready to learn those few speculative-type things. They couldn't learn about black holes without going through the whole astronomy unit. The interesting things you have to prepare them for.*

These two pairs of teachers have evolved special relationships. The four meet each week to talk about science and teaching and other things that matter to them. They expect a certain amount of planning, writing, and revising of each other. They give each other support. It is a rare phenomenon in this district--perhaps anywhere.

Most ninth-grade pupils at East take the physical science course, although it is not required (everyone must take either math or science). The course is taught by Mr. Taylor and Mrs. Jones; the latter divides her time with the math department. They work in close quarters, but do not work as a team. When one is conducting a lecture and the other a lab investigation, there is interference, sometimes disruption. Mr. Taylor is young and independent, with definite ideas about how the course should be taught. Like the rest of the

science department he resists using a single text, preferring to piece together units from a variety of kits and published materials with activities he has developed. He stresses building scientific skills, with lessons and activities to teach the metric system, scientific measurements, the scientific method, and lab procedures. Building on these skills, he moves through the introduction of chemistry and physics. He characterizes his approach as "hands-on, activity-oriented" but also presents a great deal of science content. He opened a unit on light by asking the students to copy the material that was on the overhead projector into their notebooks. It was an explanation of wave length and amplitude. Then he took out a slinky--a steel spring that expands to several yards or contracts to a few inches --stretched it across the table, moved it so as to demonstrate wave length, asking questions such as "what happens to the wave length when I increase the amplitude?" The overhead projector showed a chart with the amplitudes of the different rays, to show the spectrum of visible light. He then directed pupils to six stations where he had set up demonstrations of properties of light. One was an aquarium with a mirror at the bottom. The pupils were told to shine a flashlight into the mirror at an angle and measure the two angles with a protractor, then to explain what they found. Later he reviewed what they should have discovered at each of the six stations. The lecture proceeded from there to the next point.

Mr. Taylor is enrolled part-time in a graduate program in counseling. This side of his personality shows through in his class and his philosophy of science education:

> *I carry on a reality therapy in my classroom, like Glasser's Schools Without Failure. I try to base my class on that. That's where you make a kid be responsible for his actions. . . . Responsible behavior builds a success identity. . . . I establish for my success identity that no person will get less than a C in my class if they have demonstrated responsible behavior in the laboratories and have tried on all the tests to do their best. . . . In a majority of cases, this is successful. . . . I've removed the pressure of the tests so they do better on the tests. You can't get an accurate picture of what the kids know with all the pressure and anxiety that's built up from the tests.*
>
> *The most important thing about science education is treating the students like human beings--thinking of student first instead of the subject first. You teach alot more subject in the long run when you treat them like people. . . . You have to find their level and teach at it, otherwise you've lost the battle as a teacher.*

The contrast between Mr. Taylor at East and Mr. Smith who teaches physical science at West is worth noting. Both teach the same general content and both classes are oriented around science activities. But the difference in philosophy and style is evident in Mr. Smith's interview (he calls himself the "last bastion of intellectual rigor in the district"):

> *I never talk down to the kids. I lose some of them, but listening is another study skill; they have to learn to stretch a little. . . . You know, if you have to work with the hogs you get dirty with the hogs. If you get down on their level you'll become infantile too. I tell them: "You're not going to understand everything I say. But stick with me, if you'll listen we'll still be able to communicate." I'm sure I turn some of them off. But you've got a lot to compete against. . . . I know I'm not going to have them, all of them, all the time, but I wouldn't even if I talked on the second-grade level.*

In many ways, Mr. Smith is like teachers in the three secondary science departments. The science teachers are more likely than others to have had thorough undergraduate, graduate, and institute training in academic disciplines. Like Mr. Smith, several have had vocational experience in some field of science. Most importantly, they have an identification with something outside, perhaps larger than, the public schools; namely, the scientific enterprise and the community of scientists. They are more likely to have connections with universities and scientific institutes, to value these contacts, to attend science education con-

ventions and read the literature of their profession. These few teachers have kept open a window on the larger world of ideas. Most teachers have only a mirror that reflects the values and ideas already dominant in the public schools.

East Junior High Math Program

Like the science department, the math teachers work hard together as a group. They operate as one large team that during the day is located in one space about the size of three classrooms. The algebra classes, however, are taught in separate, quieter quarters. Although there are usually four teachers holding forth at a time, there is little interference across the partitions that separate the small groups.

Once a week the teachers get together to discuss math education and their program--what problems they are experiencing and how they might improve. Their joint efforts have been responsible for an individualized math program which they decided to build independently, as a way of coping with the highly variable math skills the students brought with them. The teachers examined published curriculum packages, visited school districts with a program they viewed as compatible, and asked the district office for money to support collaborative development. Once the program was developed, however, the teachers concluded that over half of the students could not work effectively on their own. This year they made an adjustment. Starting with everyone (except the students who elected algebra), they reviewed whole numbers and fractions, then gave a placement test. The high ability and eager students were put into the individualized section. The rest were grouped by ability levels and are taught in structured classes.

By standing in one spot in the math area it is possible to observe one class trying valiantly to fill in a multiplication table, another working on areas of rectangles, another doing problems on improper fractions and mixed numbers on work sheets, another hearing a lecture on number theory. The students who are working on the individualized materials are all doing different things. In this program a student sets his own goals: the number of units he wants to complete and the grade he wants to achieve on the units. He begins a unit with a pre-test. Unless he passes it, he receives the unit, which has objectives, the instructional material, sample problems, problem assignments. The students work through these, getting help as needed from the supervising teacher. Extra problem sheets are available. Then the student gets a post-test from the aide. If he makes his grade goal, he goes to the next unit. If not, he studies supplementary materials and takes a parallel post-test. A second failure lands him temporarily in a classroom instructional unit. The students who can work this way enjoy going farther and faster than normal. Some are ready for geometry by the time they enter the ninth grade.

The math teachers work hard on their program, even electing to evaluate it themselves by pre- and post-testing student achievement. They talk about getting together and writing up a lesson or revising a unit, or deciding how to solve a problem in the program. This is clearly a group with shared expectation for working, reinforced by the mutual support of its members.

East Junior High Social Studies

The working groups emerging in science and math have not evolved in the social studies program. Cultural geography is taught in the seventh grade, American history in the eighth, and civics and state history in the ninth. No common philosophies or compatible styles unite the three courses.

The ninth-grade course is popular with students, the first one that they regard as relevant. The team of teachers combine formal presentation of governmental and political facts and ideas with individual student work on case studies. The seventh graders cover map skills using Science Research Associates kits and area cultural studies using lectures, films, and the Scott-Foresman Spectra Program on People of the World.

The eighth-grade program merits closer examination. Until the present graduation requirements were altered, this course was the only experience many students would ever have with American history. Two teachers, Mr. Tyler and Mrs. Harrison, divide their classes in two groups according to reading ability. Each group then receives a separate textbook. Typically one day a week is spent with the students reading from their texts. Another day is set aside for a lecture or "simulation game." The next day is for free reading, the next for a film and the last for current events. War is the theme of the class. There is a library shelf of books for each American war. War photographs decorate one wall. On the blackboard is a matrix, rows of which are the wars and columns of which are causes, results, opponents, dates, and leaders. "Mr. Tyler feels that America's history is the history of her wars," Mrs. Harrison stated.

[Observation of American history classes] Mr. Tyler divides the groups and reminds everyone to take their projects home (these are models of colonial buildings, forts, etc. that the pupils have constructed). He begins his lecture with the question "Why do you think that the colonists wanted to get away from England, wanted to break the ties?" A student answers in terms of the absence of religious freedom and opportunities to acquire riches. He says no, that's why they came over in the first place, and reviews that material. "Now we get to a different situation. Colonists were tired of English control. Colonists believed they were there to develop a life for themselves to give to their kids. . . . Colonists felt they had separate problems from England but their voices weren't heard. . . . They felt they needed a representative to go over and tell their problems to England. . . . Colorado has special problems, doesn't it? What if Colorado didn't have any representatives? . . . At that time most people didn't want to separate. They just wanted to send a representative over and say, Hey, we've got special problems! . . . But there were terrible conditions in England like Dickens wrote about in Oliver Twist and Tale of Two Cities. . . . The idea started changing. The laws weren't being obeyed cause we said "We didn't get a chance to say yes or no. You're taking advantage of us, we aren't going to obey. We re not going to play that game. Chuck it! We'll take your tea and dump it into the ocean."

The teacher continues in this free-wheeling style, devoting no more than a few sentences each to the Declaration of Independence, the war itself, the Articles of Confederation ("They didn't work so we dumped them"), the Constitutional convention and the Bill of Rights, ending with the interesting note that in the U.S. House of Representatives there are now 350 Representatives, 7 or 8 from Colorado.

Across the aisle, Mrs. Harrison has the other two groups. Her lecture, designed to help the students fill in the war matrix, consists of perfunctory answers to rhetorical questions ("Why did we fight the Revolution? Why were we so mad? Who were some leaders that came to the forefront? What advantages did the colonists have?") and including this astonishing statement: "I won't go into the Constitution; you'll get that next year and you probably would be really bored if I went into it this year."

What follows is a simulation in which the students are divided into teams of colonists and English and asked to debate and then decide whether to go to war. Unencumbered by facts or understanding and unchecked by Mrs. Harrison, the students' debate quickly assumes the tenor of a parent-child confrontation.

"You wouldn't be anything without us."
"Don't let it bother you."
"Indians would wipe you out without us."
"We work our tails off and you get all the profits."
"We helped you get started and now we need money from your resources."
"Why can't we have our independence? You've got yours!"
"All you guys do is sit and drink tea. We're all in shape."

And, of course, at the end one student expresses the will of the colonists.
"We call you out!"

ELEMENTARY SCHOOL PROGRAMS

There are commonalities among the separate elementary schools: common textbook adoptions, district curriculum guides which specify what content and objectives should be covered in what grade levels, and subject matter coordinating committees. Aside from these centralizing forces, the elementary schools have evolved into quite independent social structures. In fact there is some question about whether these centralizing forces are enough to counteract the strong tendencies of territoriality and autonomy. The philosophy and style of the principal and the traditions and social structure within a single school probably have most to do with the educational program there. If the principal does not retain for himself most of the authority for managing instruction, the educational program fractionates even more, now determined by the individual teacher. The result is that within a single building, so many different philosophies and personal styles are being acted out that no general, district-wide "educational program" could be described. There were almost no reliable differences between the schools observed that weren't swamped by the variability among teachers within each single school. This is less true in teaching math, which everyone agrees is an important subject, than it is in science and social studies, where the teachers have much discretion.

One important characteristic of elementary schools in this district is whether or not the school is participating in PLAN*. Several years ago the superintendent suggested the adoption of the Westinghouse PLAN* program and it was accepted by the principals of several elementary schools. PLAN* is an individualized, computer-managed instructional program in language arts, math, science and social studies. The heart of the program is the Teaching-Learning Unit (TLU) which has one learning objective (e.g., "Divide fractions or functions and whole numbers") and learning activities ("Use the Fraction Tiles . . . Do Part One of the Activity Sheet . . . Study the picture on p. 256 of Mathematics Around Us and do all the problems . . . Play 'Divide and Conquer' . . . "). A teacher works out with one or more students which TLU's will fit together into a Program of Study (POS). The student takes a test at the end of each TLU and POS. A computer-management system records the TLU's begun, completed, and the test scores. The teacher becomes more of a tutor, counselor, or manager with this system and less a dispenser of information.

Many points for and against this system have been raised. None of the published arguments anticipated the furor raised by people in this community against a system so different from the one they had had in school. One can hear many PLAN* horror stories in this district --how some of the pupils simply stopped functioning altogether and wandered around the classroom; how some parents were so angry that they would come to school everyday, sit in the back of the classroom and glower; how some parents put their children into private schools. Fingers were pointed in many directions. The board of education made a policy called "Options in Education," which sounded like alternatives but really was only a way to get traditional classes operating in PLAN* schools. Now there are only four schools which use PLAN* and these have traditional classes as well.

Bringing up PLAN* (almost like mentioning open-space buildings) is guaranteed to precipitate an argument among parents, teachers, or even the students themselves. "My mother thinks I do better under PLAN* than traditional," one of the fifth grade girls said, "because I can go at my own pace." (The ability of pupils to pick up the educational jargon is amazing.) A mother said that PLAN* should be abolished because it was too expensive and "kids can't concentrate when there are so many distractions." One teacher who was forced to use it one year said, "The kids were just copying each other's work." Another teacher who seemed to be using the system quite effectively said the following:

> *The fact is that PLAN* doesn't work for all kids. Some of them just seem to need somebody standing over them all the time, saying "today we will work on X and you'll have to have it done in an hour from now." Most of the time under PLAN* the kids were managing their own time. I pace them by saying they have two weeks to finish a POS, but then they go on and do it. These are the kids that don't need constant attention. I think we had problems with PLAN* more because of the way it was introduced. We had never seen the materials before. We had inservice on the system but we were afraid to deviate from it at all, we couldn't adapt it to our kids. Then we got really defensive about it because parents were coming in and attacking us. Parents were not informed in advance or prepared at all and then, boom! All of a sudden it was TLU's and POS's and computer printouts and achievement test scores. The whole thing was just totally alien to them. Now we can sort out the kids who can perform under PLAN* and we've learned where we can follow it, or deviate from it or write our own TLU's or whatever. Now I like it. I think it works out well.*

Whatever the merits and faults of PLAN*, it does focus some attention on the low priority areas of science and social studies. Although each teacher must cover the two subjects, how they do so, with what emphasis and concern is an individual matter. "We do math and reading in the morning when the kids are fresh. We do science and social studies, in the afternoon, if there's a chance," one teacher said. Although there was a schedule of both subjects, actually finding instruction taking place was sometimes like tracking the Sasquatch. Requests to observe science and social studies were sometimes met with "You should have come yesterday, we're doing vocabulary today." "We're baking cornbread in science today." "I'm not going to do anymore social studies until after Christmas." "Social studies? Uh, yeah, come back tomorrow."

On the other hand, when an individual teacher was adequately trained and so inclined, instruction could be excellent. One primary teacher had organized a very sophisticated package using the newspaper to introduce the children to society, even government and economics. One sixth-grade teacher gave a lecture on the functions of the three branches of government. After the material had been assimilated the students entered into a role-playing with teams of students acting out the roles of Senators, Congressmen, the President and the Supreme Court justices, going through the process of how a bill becomes a law. A PLAN* teacher was observed guiding small groups of students through a series of science investigation and discussion of their predictions, findings, and conclusions. A teacher in a traditional class was observed conducting a review of science material that they had learned, and the amount was considerable. "They like science because I like science," she said. Another sixth-grade teacher was using the science text as a way of teaching study skills: taking notes from lecture, outlining chapter, writing down main ideas.

One sixth grade teacher had more science models, supplies, and equipment than many whole schools. "I bug the junior highs. . . . We try to do two science activities a week. . . . I take every science class I can get my hands on. There are about fifteen of us in the district [elementary schools] who identify ourselves as science teachers. The others don't know too much about it or pursue it too diligently."

The district adopted the Concepts in Science series with its accompanying portable Classroom Laboratory, several of which are available in each building. Science resources are plentiful, but the allotment of each school's budget is up to the discretion of its principal.

The training and inclinations of individual teachers determine not only how much science is taught but how it is taught. Almost every philosophy is evident. Some teachers merely have students read and answer questions from the texts. Others provide "hands-on experiences." Still others prefer to demonstrate the investigations. The textbook series is oriented around the "big ideas in science," but some teachers confess that they themselves don't understand the big ideas. "Messing around with science" is almost completely absent as an approach to science education.

A lack of training in science and social science disciplines was perhaps the biggest obstacle to the elementary programs. One sixth-grade student interrupted a review of ecology concepts to ask, "If scientists can cause an explosion by splitting an atom, why don't you get an explosion when you saw a piece of wood in two?" Another chimed in, "I've been wanting to ask this question for two years. What's the difference between an atom and a molecule?" "Those are both good questions," said the embarrassed teacher. "I don't know. Why don't you look it up and make a report on it. Now we've got to get back to this review." Later, she confessed that the only science she had had was one year of biological sciences in college and one "module" in science education during teacher training. She could keep up by studying the elementary textbook, but departures such as the one that day caught her unprepared.

One common element in the district's elementary science program is Eco-week, an experience in environmental awareness for all sixth graders. This project is the brainchild of Mr. Johnson, the district science coordinator. The sixth graders go, one school at a time, to a mountain camp ground for three days. Their teachers who have received in-service training for Eco-week supervise their activities. They conduct a forest investigation (e.g., determining the age and growth patterns of trees), water investigation (e.g., investigating the physical characteristics and aquatic life in running and stagnant water), soil investigation (e.g., tracing food chain, discussing man's effect on the soil), animal investigation (e.g., identifying habitat and inhabitants), compass activities, and a scavenger hunt (e.g., "find evidence of animals changing nature," "find a piece of quartz," "find evidence of wind erosion"). In all, the students are encouraged to use their senses to appreciate more fully the environs and to communicate their thoughts and feelings. Back in town the students and teachers conduct investigations of the city water system (e.g., trace Fall River's water system from source to river below the sewer treatment plant and investigate water quality, treatment of water for human consumption and after human use), and an urban study ("tour the local city community and identify common environmental problems caused by the needs of man and list possible solutions").

People throughout the district point with satisfaction to the Eco-week program. The pupils love it. Many of the teachers appreciate the chance to play a different role with the students, more like a cooperative partnership. The content, unlike some of the academic science, is more accessible and less threatening. One teacher expressed it this way:

> *After I had done it a couple of times I realized that what was nice is that we were all up there and working on one thing. I mean I didn't have my mind on getting my kids to the music room on time, or what I was going to do about math today, or how I was going to fit in the film that was supposed to come yesterday and didn't, and whether an outraged parent was going to pop in. We were relaxed but really working at the same time.*

CONCLUSION

Three statements conclude four months of watching the teachers of Fall River, probing their motives, listening to students, parents, and administrators, reading the records and studying the evidence.

Virtually nothing meaningful can be said about the Fall River "science program" in general. The district has developed a science curriculum packed with articulated objectives and brimming with specified content; yet there remain differences in content, method, and sense of purpose from one grade level to the next, among schools, among departments within schools, even from teacher to teacher. This diversity and complexity, even within Fall River, suggests why national efforts to reform the curriculum become transformed, attenuated, or lost entirely before they reach the classroom. The schools have lives of their own, existing as organisms exist, to "be on with it," perpetuating themselves and protecting against assault from without.

People in schools are conscientiously doing the jobs they have defined: tutor, scholar, but also at times, counselor, steward, custodian, and social director.

Teachers must juggle the expectations of the invisible, distant, and mostly impersonal profession of science education and the local, powerful, and relentless demands of teaching. The two roles do not necessarily conflict; but the latter usually overpowers and preempts the former.

Mary Lee Smith brings to her participation in the CSSE project a wealth of experience as an educational evaluator. Currently, she holds the positions of Research Associate in the Laboratory of Educational Research, University of Colorado; Director of Evaluation Research Services, Boulder, Colorado; and Counseling Psychologist at the Student Life Center, University of Colorado. Included in her previous experience are six years of work in educational evaluation and research on such topics as experimental, case study, survey and assessment methods. Her major research interests are in the outcomes of psychotheraphy and counseling, and in sex bias in counseling and psychotherapy.

Recipient of a Ph.D. from the University of Colorado (1972), Mary Lee is the author of numerous papers and articles. Among her major publications are: "Influence of Client Sex and Ethnic Group on Counselor Judgments," Journal of Counseling Psychology, 1974, 21(516-521); notes on "Perspectives on Counselor Bias: Implications for Counselor Education," The Counseling Psychologist, 1973, 4(93); and "Sex Bias in Counseling and Psychotherapy," a research paper for the Laboratory of Educational Research, University of Colorado, 1977. She has co-authored (with Gene V Glass) "Meta-Analysis of Psychotherapy Outcome Studies," The American Psychologist, 1977 (in press) and "Factors Influencing the Evaluation of Educational Programs: Analysis of Judgmental Policies," Occasional Paper #77-1, Evaluation Research Services,

1977. Also, along with R. Gabriel, J. Schott, and W. L. Padia, she has written "Evaluation of the Effects of Outward Bound," included in Evaluation Studies Review Annual, Volume I edited by Gene V Glass (Beverly Hills: Sage Publications, 1976).

Among her hobbies are tennis and cookery, and she cites as her biggest accomplishment, "mastering the top-spin backhand approach shot." (So much for cookery, Mary Lee, but what about tennis accomplishments?) Latest books read include TM for Tots and Principia Mathematica. Favorite Scotch? Of course--Barry MacDonald.