

The Social Sciences at Caltech—

A Progress Report

CALTECH'S graduate program in social science represents a major break with tradition, both at the Institute and in the academic community at large. It is the first graduate program to be offered in the Division of the Humanities and Social Sciences; and it is the first of its kind anywhere: a program in social science that is interdisciplinary but scientific, theoretical but directed toward solution of current socioeconomic problems.

The program is primarily designed to prepare students to assume senior staff positions in policy-making organizations where they will be able to conceive and execute complicated research projects and to utilize the products of their research to provide the basis for actual policy decisions. Students who have more traditional academic research interests are being trained to develop and extend the basis for policy-relevant theory. They will turn to academic teaching positions in economics and political science departments and a growing number of university programs in public policy.

"We've based the program on four fundamental building blocks," says Lance Davis, professor of economics and "convener" of the social science faculty. "We want to give our students a first-class grounding in economic and political theory, in the behavioral sciences, and in measurement. During their first year of graduate work, every student should take theory courses in each of these four fields and should be introduced to the problems that arise when one attempts to apply those theories. In the second year they learn how to apply those tools, and in the third year each student executes a research project of his own."

The program differs from a traditional graduate pro-

gram in the range of disciplines covered. It recognizes the fact that few social problems fall uniquely in the area of economics, politics, or psychology, and that most have elements of all three. In a typical economics PhD program, for example, first-year students would take economic theory and econometrics, but instead of the political science and psychology courses required of the Caltech student, they would take applied courses in economics — labor economics, foreign trade, economic history, or what have you.

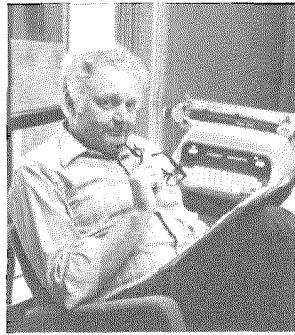
In the second year students participate in a year-long policy seminar, to which all of the faculty tries to contribute. For example, Michael Levine, Luce Professor of Law and Social Change in the Technological Society, introduces them to the legal institutions that shape potential solutions of the problems in question. Charles Plott, professor of economics, and Morris Fiorina, associate professor of political science, discuss the possibilities of applying experimental methodology to the solution of social problems. Or Roger Noll, professor of economics, who has served as a senior economist for the President's Council of Economic Advisers and as an adviser to a number of Congressional committees, discusses operational characteristics of various government agencies and the constraints they impose on the solutions to social problems. Or David Montgomery, assistant professor of economics, who also works with the Environmental Quality Laboratory and is spending this year at the Congressional Budget Office in Washington, describes research problems that occur on the interface between science and engineering. Or Robert Forsythe, assistant profes-

sor of business economics, introduces them to the usefulness of modern management techniques for certain classes of problems. Most important of all, the students are required to do some policy research work under faculty supervision — perhaps with EQL or the civil systems section of the Jet Propulsion Laboratory.

One such research project was a study by second-year students Steve Matthews and Brian Binger of base housing policies at the Naval Weapons Center at China Lake. The lower-cost housing units at China Lake had always been 100 percent occupied, with a sizable waiting list. In the middle of 1973, people began moving out after it became known that the Navy was going to impose a large rent increase. The Navy requested an analysis of the increase in vacancies and an evaluation of various plans for disposing of excess housing. The possibility of putting several hundred low-cost houses on the market also called for an assessment of the effects on the adjacent community of Ridgecrest.

Matthews and Binger's final report not only analyzed the existing situation and what brought it about, but, using established economic forecasting theory, made documented projections and recommendations about the future of the housing situation at the NWC. A crucial finding, since borne out by experience, was a prediction that some types of housing that were still fully occupied when the study began would soon experience a similar increased vacancy rate, a conclusion that the Navy found both surprising and extremely valuable. The students also concluded that the contemplated sale of excess housing would have only a mild, short-term effect on the private housing market.

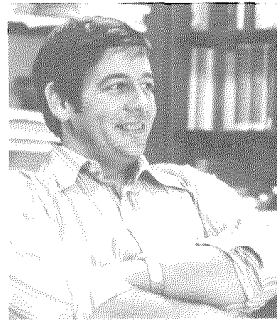
Evaluating the amount and kind of planning being done by public agencies to try to cope with earthquake-associated problems is another project begun in early 1975. Graduate students Linda Cohen



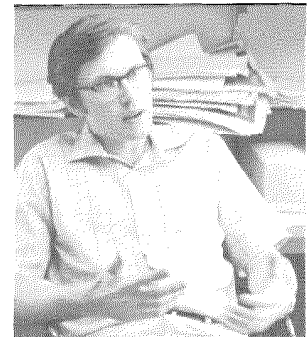
Lance Davis,
professor
of economics



Michael Levine,
Luce professor of
law and social change



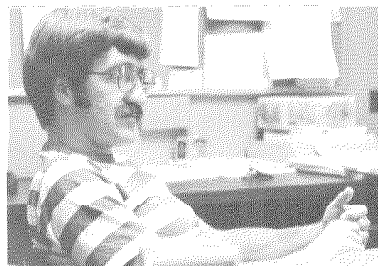
Charles Plott,
professor
of economics



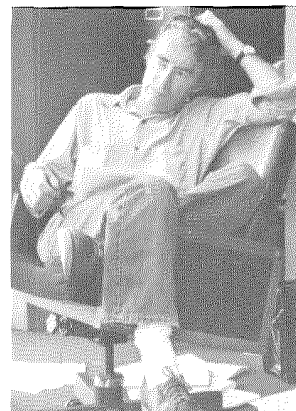
Roger Noll,
professor of
economics



Robert Forsythe,
assistant professor
of economics



Morris Fiorina,
associate professor
of political science



James Quirk,
professor
of economics

and Barry Weingast studied the response of various government agencies to major earthquakes, including the one in San Fernando in 1971, and found several hitherto unnoticed correlations between the performance of an agency and its structure, purpose, and operating procedures before the disaster occurred. Linda Cohen and her adviser, Roger Noll, are also completing a study on building codes in earthquake-prone areas. The study is unique in that it uses engineering models of the capacity of structures to resist earthquakes, geophysical data on earthquake frequency, and economic models of optimal investment strategy to determine — in relation to the earthquake-proneness of an area — what seismic resistance buildings should have for maximum net benefits.

These kinds of applied research projects are good preparation for writing a thesis, and they are also small-scale previews of what the students may expect to be doing after they leave Caltech — helping to establish the basis for policy-making on social problems. “In fact,” says Morris Fiorina, associate professor of political science, “in very simple terms this program is based on the fundamental assumption that it is both possible and desirable to study social systems. A great deal is known at a basic level about social systems, but it has been developed along separate academic lines. Small parts (an isolated economic or political event) are frequently fairly well understood, but social scientists have not been particularly successful in putting the parts together. Nevertheless, while social systems are very complicated, they are not beyond understanding, and the need for such understanding is obvious. It is difficult to predict where the important breakthroughs will take place, but it is quite possible that it will be in the area of political economy.” In the words of James Quirk, professor of economics, “We may succeed or fail on the basis of how well we integrate economics and political science to come up with something that is the social science equivalent of biochemistry or biophysics.”

It is, of course, still early to talk about the “success” or “failure” of social science at Caltech, but it may be time to talk about the end of the beginning, because last September Lee Sparling, the first product of the program, left Pasadena for a job in Washington, D.C., with his course work completed and his thesis well under way.

Sparling first came to Caltech in 1967 as a freshman. As a student, he had the kinds of mathematical interests and abilities that the social sciences at the Institute require. He graduated in 1971 with a BS in both engineering and economics and went on to graduate

school at Stanford in economics. But Stanford’s rather traditional approach to the subject was not very satisfying, and he was happy to join Caltech’s brand-new program in the fall of 1972. The chief inducement, he says, “was that the Caltech program promised to teach not only the basic theory of economics and other social sciences — which is done in any good graduate program — but also how to do empirical work. That combination makes it possible to integrate the theory and apply the empirical work in dealing with some social problems.”

In his research, Sparling has been looking into the regulation of freight transportation. Given his background in engineering and his training in social science, it is not surprising he began to wonder how much fuel would be saved if the present regulatory structure was modified so that railroads were freed to compete with other forms of transport. For shipments exceeding about 200 miles, railroads are more efficient than trucks — in terms of both energy consumption and total costs per ton of freight carried — but current regulatory practices prevent them from capturing much of this business. Because regulated shipping rates do not necessarily reflect the cost of providing service, the savings to be gained from better allocation of freight cannot be estimated directly. Instead, it is necessary to “model” the industry’s demand, costs, and decision-making procedures to determine what the effect of different regulatory policies would be.

To the layman what a social scientist means when he speaks of “building a model” may not be clear, but to Lance Davis it is a way of characterizing the world. “The world the social scientist attempts to explain is a very complex one,” he says, “and it is impossible to understand its operation in all detail. Instead, understanding depends upon simplification; and it is the choice of simplifying models that lies at the heart of the social scientists’ art. The model is nothing but a collage of postulates and inferences presented as a mathematical simplification of the processes to be explained. The assumptions, of course, relate to the behavior of the people and institutions whose actions are the subject of the explanation.

“The mark of successful model building is the simplifying assumption that permits the capture of the essence of the problem while ignoring those parts of reality that are not important. The social scientist must choose his model, estimate its parameters, and test its predictive power. Behind the model lies an understanding of theory, a detailed knowledge of economic and political institutions, and a psychologist’s insight into human behavior. Estimation and testing, in turn, in-

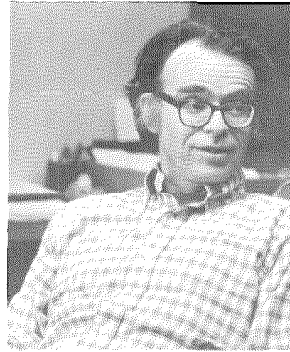
volve statistics, econometrics, laboratory experiments, and computer simulation techniques.”

If Sparling’s model is a useful description of how things *are* in the transportation industry — and the only way to test that is to see if it accurately explains and predicts the industry’s performance — then he can build various constraints into his model to tell him how alternative regulatory policies would affect the decision-making process.

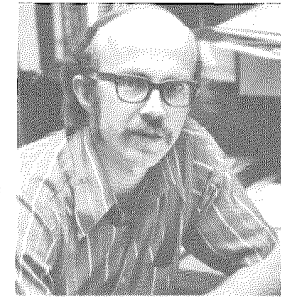
Building Sparling’s particular model of a railroad has been a complicated problem in applied mathematics and statistics. For example, he found it necessary to develop a complex non-linear programming model to *determine the least costly ways to route boxcars if wholesale changes occurred in the amount and mix of railroad shipments*. Based on his work to date, he estimates the cost to the economy of transportation regulation is about \$2.5 billion to \$4 billion per year, which, though enormous, is half of what others have estimated using cruder techniques. Already his results have played a role in the policy debate, as they were cited and discussed in testimony before a Senate committee investigating the issue of regulatory reform.

A year ago Sparling began looking for a job. Rather than pursue the usual academic openings, he had interviews with both government agencies and private research organizations. Eventually he chose to join the Economic Policy Office of the Antitrust Division of the Justice Department, where he is now involved in an investigation of what economists call industrial structure. Some of his work is in response to requests from attorneys in the middle of antitrust cases, some is research to determine whether antitrust action may be called for, but much is further pursuit of his own research interests in transportation regulation. And it is exactly what he had in mind when he signed up for a Caltech social science PhD three years ago.

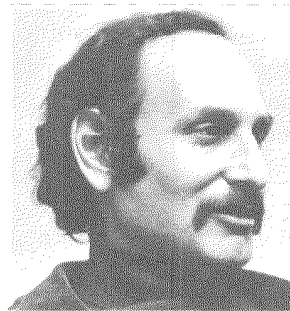
Meanwhile, back in Pasadena, the departmental faculty is working with a group of students whose numbers and needs are growing. The students, like the faculty, are diverse in their formal academic training. Of the fourteen current students, five were mathematics majors as undergraduates, six were economics majors, and one each majored in engineering, biology, and history. Four were Caltech undergraduates, and six began their graduate careers at another university in traditional disciplines. All have outstanding academic records and would qualify for admission to first-rate graduate programs in traditional fields. Of the group, six are in their first year and eight are more advanced students in the process of choosing thesis topics and advisers. In addition, one student, pursuing both a



Thayer Scudder,
professor of
anthropology



Robert Bates,
associate professor of
political science



Louis Breger,
associate professor
of psychology

social science and a law degree, is on leave, taking second-year law courses at USC.

Last June, at the end of the first full year of operation, the social science faculty and the students engaged in extensive discussions on how their enterprise was going, and how it might be improved. Both the students and the faculty expressed strong interest in the behavioral fields of social science. This interest underscores a need for expanding the program’s capability in psychology — social, experimental, and mathematical. At present, this part of the program is handled by Thayer Scudder, professor of anthropology, Robert Bates, associate professor of political science, and Louis Breger, associate professor of psychology. With only three faculty members covering the entire range of relevant behavioral sciences — anthropology, psychology, sociology, and political behavior — some behavioral areas that are central to the social science program are being completely neglected.

The students also pointed out that economists and political scientists tend to use the same tools, something that the faculty knew but had never acted upon. As a result of these comments, several courses are now being jointly taught by faculty from both these disciplines. An extension of interdisciplinary teaching ap-

appears in SS 150 abc, Social Science Aspects of Technology. Funded by a grant from the Alfred P. Sloan Foundation, this year-long course is oriented toward seniors and graduate students in engineering. The first term deals with the theory of the operation of a competitive price system; the second, with problems caused by distortions within a competitive market; and the third, with specific problems of particular concern to engineers — for example, congestion, energy, pollution abatement, land-use planning, earthquake hazards, and the social consequences of disasters. The last term is taught jointly by a member of the social science faculty and by a member of the engineering faculty. Eventually there will also be a series of seminars dealing with the social aspects of current engineering research designed for graduates at the thesis-writing level.

Not only is the social science teaching program interdisciplinary, but the faculty crosses disciplinary lines in their research. “The integrating factors,” says Plott, “are their mutual interest in policy analysis and their appreciation for the importance of basic theory and measurement.”

For example, says John Ferejohn, “On the basis of certain assumptions, an economist attempts to analyze human behavior in economic choice-making situations. He can predict, for instance, what will happen to the amount of gasoline sold in the U.S. if a tariff is placed on oil or the price of domestic oil is decontrolled. But many times the policy recommendations concern decision-makers who are not acting in purely economic settings. If you make decisions in government or industry, you want to know not only the effect of your oil policy on sales, but also what the Middle Eastern political responses are likely to be. The appropriate model contains both economic and political components. Fortunately, all our economists at Caltech are very sensitive to the need to model both political and economic behavior in analyzing public policy decisions.”

The policy orientation of the program necessitates strong emphasis on measurement techniques for testing models of behavior and predicting effects of policy changes. At Caltech two econometricians, David Grether, professor of economics, and Forrest Nelson, assistant professor of economics, share the responsibility of training students in the use of measurement techniques. According to Grether, “We feel it is important that our students receive training in the use of statistical techniques comparable to that of the best economics program in the country. In addition, the interdisciplinary program requires exposure to a different mix of techniques.”

For the last several years Ferejohn and Noll have been working together on the strategy of politicians in political campaigns. Currently they are working on the effect of information about voter preferences on campaign strategies. “At least in the early stages of a campaign a candidate makes decisions based on very imperfect information about the preferences of voters with respect to policy issues,” says Noll. “We want to determine the consequences of rational behavior for a candidate — that is, behavior that maximizes his chance of winning — in situations in which information is imperfect. Thus far, our investigations have led primarily to qualitative theoretical results, rather than quantitative predictions. For example, we have found that in circumstances that appear to be quite general, it is in the interests of both candidates to make an agreement not to campaign on the issues that are the most important to the voters.”

Although both the teaching and research programs have a strongly applied flavor, faculty research, like the graduate curricula, does not ignore basic science. Extending the theory across this boundary between economics and politics requires basic research. “Good models of behavior and choice in a purely market setting have been around a long time, but social processes which involve both political and market behavior need much more study,” says Plott. “Slight changes in procedures and organization, for example, make enormous changes in the outcome.”

To facilitate this study, Plott has developed an experimental methodology for examining the impact of subtle changes in rules, procedures, and modes of organization. Levine and Plott, for example, were able to demonstrate that within a large class of majority rule committee settings the agenda alone can be used to determine the committee’s decision. Fiorina and Plott, with the aid of a grant from the National Science Foundation, have extended the study to wider classes of procedures including even simple election processes.

Not only the institutional but also the behavioral assumptions have come under experimental scrutiny by the Caltech faculty. Economists traditionally build models by assuming that everything people do can be explained on the basis of self-interest, but evidence exists that people do not always behave that way. Since successful prediction depends upon an accurate theory of behavior, it is important to determine at what point people cease behaving in what the economists call a rational way. Experimental work carried on by Ferejohn and Grether is designed to discover under what conditions people will behave as the economists predict. Whatever they find, a combination of theory

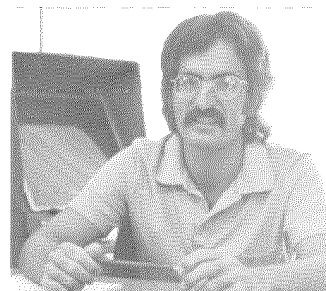
with good experimental design will greatly enhance the social scientists' ability to design effective solutions to *social problems*.

Despite the innovations of the Caltech faculty, laboratory experimentation in the social sciences is very difficult, and for most of their empirical validation, the social scientists must turn to history. Unlike the more traditional sciences, however, the behavior of people and groups of people frequently depends on their own previous experiences or those of their predecessors, and the rules that govern the relationships between the objects of the theory are not given by nature but depend upon the actions taken by the actors on the social stage. History then becomes an integral part of the social science program. Students have to be aware of the shape and structure of the institutional environment of the historical episode that they choose for their experiments, and they should be cognizant of the evolution of these structures over time. Morgan Kousser, associate professor of history and a student of nineteenth-century legislative behavior, and Lance Davis, an economic historian, offer a second-year course in "cliometrics." In their research, both use social science models to explain history, and the course focuses on the changing nature of social institutions and their importance to social science research.

History provides comparisons over time, but variations also occur across cultures. The study of such variation traditionally falls within the purview of anthropology, and Scudder's work offers an opportunity both for testing social science theories across cultures and for developing policy that is relevant to problems of development. The focus of these studies has been on Zambia, and the interdisciplinary nature of the work is *underlined by cooperation with Bates, who studied the impact of governmental policies at the village level in Africa*. In this area too, the program exhibits its ability to produce truly collaborative work by scholars from several social science disciplines and to focus this work on matters of public policy.

It is going to take a lot of research — experimental, empirical, and theoretical — by all varieties of social scientists to get very far with such problems. But at Caltech the social scientists are in the business of doing just these kinds of research — and of training a small and very talented group of students to do it too.

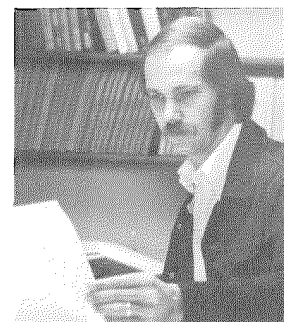
"What we're doing isn't possible in a typical economics, political science, or statistics department," says Roger Noll, who was a 1962 graduate of Caltech in mathematics. "It's multidisciplinary, requiring people — faculty and students — who have the technical talent to become expert in several different traditional fields,



John Ferejohn,
associate professor
of political science



David Grether,
professor
of economics



Forrest Nelson,
assistant professor
of economics

and have an interest in applications. There aren't very many of those people, but we have some and we're training more.

"This kind of social science is exciting and innovative. As such, it is in keeping with the Caltech tradition of getting good people who are at the very forefront of research, and then encouraging them to work on an extremely difficult problem that almost no one else has even attacked.

"It was a big risk to set up the social science program at Caltech, but when Hale came out here to build his telescope, that was a risk, too. Caltech is where it is today because it has been a place that takes big risks to do very difficult things, and that's the only way social science makes sense here."

How successful the innovation will be is still not clear. However, Robert A. Huttenback, chairman of the division, thinks this program may be on the verge of reaching its goal of integrating the social sciences and bringing that unified theory to bear on pressing socioeconomic problems. If he is right, Caltech could once again manage to do something that other institutions have long sought after but never achieved. □