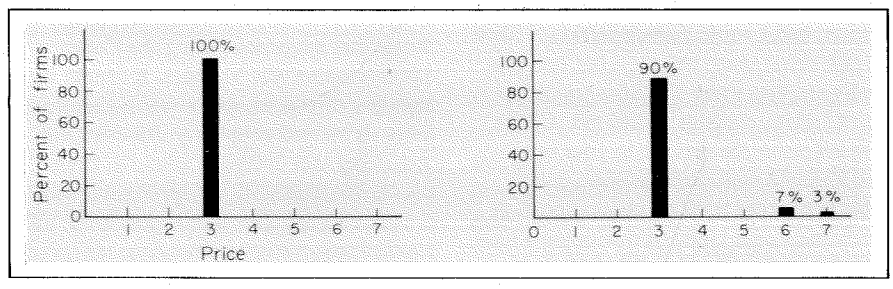
Research in Progress

Shopping Around

The bar graphs below illustrate how the market price of a homogeneous product changes as a function of the percentage (among all buyers) of shoppers who compare prices. From left to right the graphs represent a decreasing percentage of shoppers.



Case 1: Percent of shoppers sufficient to keep all firms charging the competitive price of $3.

Case 2: Percent of shoppers lower than case 1, but still enough to keep most firms charging competitive prices.

HOW much do consumers need to know to make intelligent decisions when purchasing goods or services? How much is enough consumer information to keep sellers honest without government intervention? Recent trends in consumer protection legislation have been based on the assumption that buyers need to know more facts than unregulated markets provide or to have them explained in a simple, uniform way to prevent sellers from taking advantage of them. Otherwise, regulation would be needed because competitive markets wouldn't work right if consumers were not well informed.

Perhaps — but perhaps not, say Alan Schwartz, Caltech professor of law and social science (and the Maurice Jones Jr. Professor of Law at the University of Southern California), and Louis Wilde, associate professor of economics, who have been jointly investigating the effects of imperfect information on markets. The unusual collaboration between these two arose after Schwartz, who is a specialist in contract law, discovered that a proper analysis of existing and proposed statutes regulating certain consumer product and financial markets required a sophisticated knowledge of economic theory. Coincidently, Wilde's main interest as an economist happened to be information theory.

These two argue that most consumer protection laws have been passed or proposed without any real knowledge on the part of lawmakers of how markets really do behave when buyers don't know everything there is to know — when their information is imperfect. The problem was that no one knew; very little theory existed in the area, and what did exist was buried in specialized mathematical journals. Schwartz and Wilde set out to provide a theoretical basis for the study of this sort of market behavior and make it accessible not only to economic theorists but also in practical applications to the people who are responsible for regulatory interventions into markets. With theoretical models of market behavior available, lawmakers could look at a real-world situation and see if the features of a functioning competitive market were present. If they were, the large costs of regulation could be saved; if they were not, then perhaps some regulation would be necessary. Initial results from Schwartz and Wilde's work indicate that market dysfunction may happen much less often than previously thought.

With support from the National Science Foundation, the two Caltech researchers have constructed mathematical models of markets that describe how different mixes of shoppers and nonshoppers combine with the technical characteristics of a market to yield various configurations of prices.

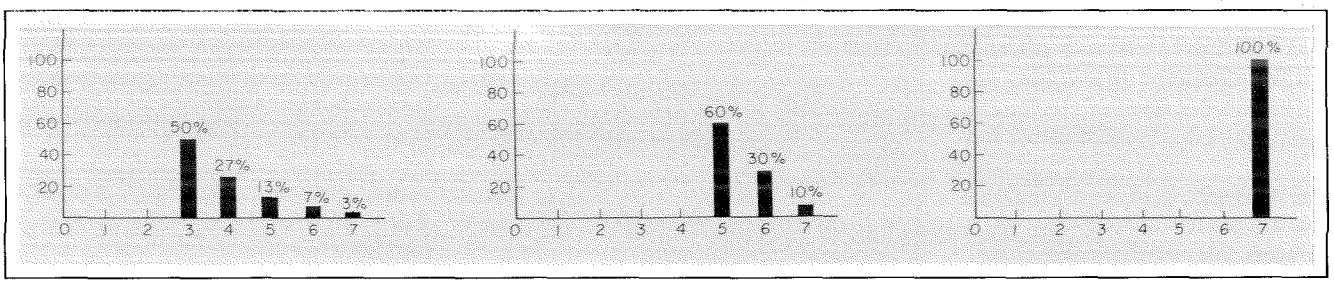
Their first model dealt with homogeneous "search" products, that is, markets in which every firm sells exactly the same thing, and all the characteristics of the product are observable. Money, for instance, is a "product" of this type and one that is also heavily regulated. When the Truth in Lending Act was passed in 1968, there was much debate about how much consumer information was necessary to keep interest rates at a competitive level. According to their model for homogeneous goods, Schwartz and Wilde have reason to believe that sufficient numbers of people were already shopping for credit and that the disclosure law was probably unnecessary. Credit consumers' awareness levels have risen since the law was enacted, but this hasn't affected the rates of interest they are actually paying. Regulation here has apparently not improved on the competitive market.

Another Schwartz-Wilde model concerns those products that differ from firm to firm not only in price but also in quality, but all of whose features can still be observed by consumers before purchase. Warranties, for example, differ greatly among firms, but a buyer can discover the features of the warranty by reading the contract. The Federal Trade Commission regulates warranties on the assumption

that consumers have difficulty comparing the quality of guarantees. Although the Caltech research has not yet been finished for publication, preliminary findings suggest that the FTC may be going about consumer protection from the wrong angle when it forces firms to adhere to specific warranty disclosures. Schwartz and Wilde's models seem to indicate that firms often may not exploit consumer ignorance by offering low-quality guarantees, but rather by raising their prices to noncompetitive levels. In such a case, existing regulation may actually be working to the consumer's disadvantage.

In all of their model building so far, Schwartz and Wilde have had to rely on others' sometimes inappropriate data on shopping patterns to test their theories. They are applying for additional NSF funds to do their own empirical testing in real and experimental markets, so that they can state their findings more conclusively. In addition they plan to pursue models of other market situations, such as those involving products that have to be used to discern features that aren't immediately observable and services that involve diagnosis — by doctors or auto mechanics, for example. They also hope to look at the impact that new communication technology (for example, making all the grocery prices in Pasadena available on a home TV screen) might have on consumer decisions. Because this kind of market doesn't yet exist, their empirical work in this matter will rely exclusively on laboratory experiments. □

–J. D.



Case 3: Percent of shoppers substantially below case 1; half of the firms charge noncompetitive prices.

Case 4: Few shoppers; no firms charge $3; prices begin to cluster near the monopoly price of $7.

Case 5: No shoppers; all firms charge monopoly price of $7.

Tracking Smog

SMOG, like fine scotch and steaks, may arrive already aged (or, like old bread, stale) for residents of the San Gabriel Valley foothills and the low deserts east and southeast of Los Angeles. The first quantitative data concerning this finding emerged from a tracer gas study conducted during the summer by Professor of Chemical Engineering Fred Shair and a group of students — the Caltech "tracking team."

They found that the San Gabriel Mountains do not act as a barrier to smog; they merely redirect a portion of it. As a result of the study, communities in the foothills and low deserts will have to reconsider former assumptions on the sources of their ozone-level peaks and in particular the ratio of "old versus new" smog that they experience daily.

The four-week-long field study, part of a year-long investigation (with Meteorology Research, Inc., an Altadena consulting firm, as co-investigator), was aimed at determining where the smog-carrying wind leaves the Los Angeles basin, how much of the smog goes into the mountains, and where and how long it affects the desert. Funded by a $250,000 grant from the California Air Resources Board, the researchers released sulfur hexafluoride, an inert, harmless gas, from nine points in the Los Angeles basin and surrounding mountain passes. They then measured the concentrations in air samples collected in a 60,000-square-mile area ranging from the China Lake Naval Weapons Center to the Mexican border and from the Pacific Ocean to the Colorado River. This is the largest such field study undertaken to date.

Detecting these low-level concentrations over such a large area was made possible by a breakthrough in the design of an electron-capture gas chromatograph that can rapidly and accurately measure a gas in concentrations as small as one part in a trillion. The electron-capture detector had been invented in 1960 by British chemist James Lovelock, who in the early

"Tracking" team members Lillemor Hastrup and Eric Chang collect air samples in the field and replace syringes for the next test.

1970s was a consultant on the Viking Lander project at JPL. Shair, along with Lovelock and Peter Simmonds, then of JPL, developed the detector into a small, portable instrument for use in the field. Shair also recognized its applicability to investigating transport and dispersion associated with complex flows, and he and students from his freshman chemical engineering class conducted the pilot experiment in tracking smog in 1973.

The Los Angeles desert-impact study was conducted during July, a typically smoggy month that usually exhibits winds and other meteorological conditions favorable to the transport of smog out into the desert. Shair and his team of students released the sulfur hexafluoride gas into the air at nine sites (each on a different day) in downtown Los Angeles, the San Fernando Valley, the San Gabriel and San Bernardino Mountain passes, and further out in the desert. Each release involved about 100 pounds of the gas per hour for four hours. Air samples were then collected in small plastic syringes in 30 different stationary locations and by members of the study team conducting traverses in cars and airplanes. The portable analysis system allowed monitoring of the tracer gas in the field continuously so that planes and cars could be redirected to follow it. About 3,000 air samples were collected during each test.

The first test started with a release of tracer gas at Culver City on a morning when the wind at Glendale was coming from the southeast. The wind then carried the gas on a variety of routes. Initial analysis showed that 30 percent of it headed directly east, missing Pasadena, barely touching Azusa, and then traveling past Banning. The larger portion — about 65 percent — flowed northward into the San Fernando Valley; some of it then continued through the San Fernando Pass into the Antelope Valley. From there some of the tracer continued on through Needles. Most of it, however, headed east and then southeast, making its main impact in the Coachella Valley. The most surprising route was that taken by a portion of the tracer gas that was apparently driven from the Antelope Valley back into the San Gabriels and down through the mountain canyons, sloshing the next day into a five-mile-wide zone in the foothills of the San Gabriel Valley. It arrived at the same time that the ozone levels there began to peak.

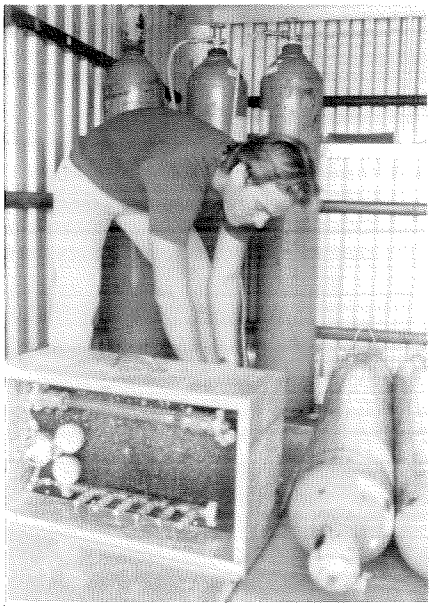
The study calls into question the interpretation of ozone profiles in the foothills and low deserts. Tracer gas from a single release was picked up three times (twice on the first day and once on the following day) in some areas in the Coachella Valley. Towns such as Indio do often have multiple ozone peaks in a day, but it had been assumed that some of them were totally locally generated; Shair's study indicates that this assumption needs to be re-examined.

Military concern about decreased visibility in the desert was an additional impetus for the study, and personnel at Edwards and Norton Air Force Bases and the China Lake Naval Weapons Center cooperated in the research. Also involved in the wide-ranging project were teams from Washington State University, UCLA, Santa Fe Research Corporation, JPL, and the Environmental Protection Agency.

Shair's investigation exonerates Los Angeles from polluting the skies over China Lake. Most of the degradation of visibility over China Lake is associated with smog transported from the southern San Joaquin Valley over the Tehachapi Mountains, says Shair. He and his field study team have previously conducted tracer gas studies of this area as well as the Salinas Valley, the Sacramento Valley, the Sacramento River Delta region, and the Santa Barbara Channel. An earlier study of land and sea breezes off the El Segundo coast of Los Angeles gave the first quantitative information regarding the transport and dispersion associated with a "Yo-Yo" effect. Although night breezes blew elevated industrial pollution in that area out to sea, morning winds brought virtually 100 percent of it back over the land at ground level, affecting a coastal zone from Ventura to Corona del Mar.

In the current study Shair and his students have analyzed 24,000 air samples in the laboratory and are now combining this information with pertinent air quality and meteorological data. The physical and mathematical descriptions that will emerge from these data will give air quality planners a more realistic picture of the transport and dispersion of Los Angeles pollutants as a basis for effective clean air policy. □ *–J.D.*

Ardi Chang types information into a digital integrator to measure the concentration of tracer gas in an air sample.



Caltech senior John King adjusts the flow meter of the sulfur hexafluoride gas release system.