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JUNE 2001

Fighting Parasitic Disease

COEH researchers, in collaboration with scientists in Sichuan, China, are seeking to meld mathematical modeling, extensive field studies, and modern remote sensing technology in an effort to monitor, predict, and, eventually, prevent the transmission of schistosomiasis, a parasitic disease that infects almost one million people in China and threatens millions more.

While virtually unknown in North America, schistosomiasis is the second most common parasitic disease in the world today, after malaria. Caused by an intestinal parasite, schistosomiasis affects large populations in China, the Philippines, Africa, and South America. If untreated, the disease can cause the liver and the spleen to enlarge and can ultimately be fatal.

The parasite cycles between two hosts: mammals, and fresh water snails. In China, these tiny snails live on the edge of irrigation ditches and lakes, and they release a microscopic form of the parasite into water at a prodigious rate. The parasites penetrate the skin of anyone in contact with the water in which they are swimming—fishermen, farmers, women washing clothes—and then work their way through the circulatory system to blood vessels near the liver. There, they become worms and mate, generating eggs that clog the fine blood vessels, block blood flow, and create a build-up of fluid. Humans excrete quantities of these eggs, which hatch when they hit water, becoming a form of the parasite that seeks out and infects the snails, thereby repeating the cycle. Because human “night soil” and animal excrement are the preferred



manure for farming in the region, this transmission cycle is extremely difficult to break.

Public health officials in China have long tried to understand, monitor, and control schistosomiasis. The disease can be treated successfully with chemotherapy, but a high re-infection rate, scarce resources, and the complex transmission cycle have thwarted their efforts to eradicate the disease.

COEH faculty member Robert Spear, professor of environmental health sciences in UC Berkeley’s School of Public Health, Professor Peng Gong of UC Berkeley’s College of Natural Resources, and their team of scientists and engineers have been working with researchers at the Sichuan Institute of Parasitic Disease (SIPD) in Chengdu since 1995 to assess what intervention strategies are likely to be most effective, given that resources are scarce.

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Parasites penetrate the skin of anyone in contact with water



Doctoral student Liang Song (second from left), now graduated doctoral student Don Maszle (right), and colleagues from China use GPS to locate a study site."

FIGHTING PARASITIC DISEASE

from cover

The collaboration of the two teams has taken on a new dimension and a new urgency now that work has begun on the massive Three Gorges Dam on the Yangtze River, which will cause ecological changes that are not yet well defined. SIPD has been studying the new dam's potential impact on the spread of schistosomiasis.

The researchers are building a mathematical model for designing intervention programs for areas that are at high risk for schistosomiasis transmission. The model integrates site-specific field data collected from 1987 to the present in Sichuan. With the help of sophisticated global positioning system (GPS) technology, the team is matching information about geography and habitat from the field studies—a ditch system, for example—with satellite photos of the same area to learn what ecological conditions support the snail populations.



Spear in the Xichang laboratory


The researchers recently tested a method of predicting snail habitat from Landsat satellite images, and found that it worked.

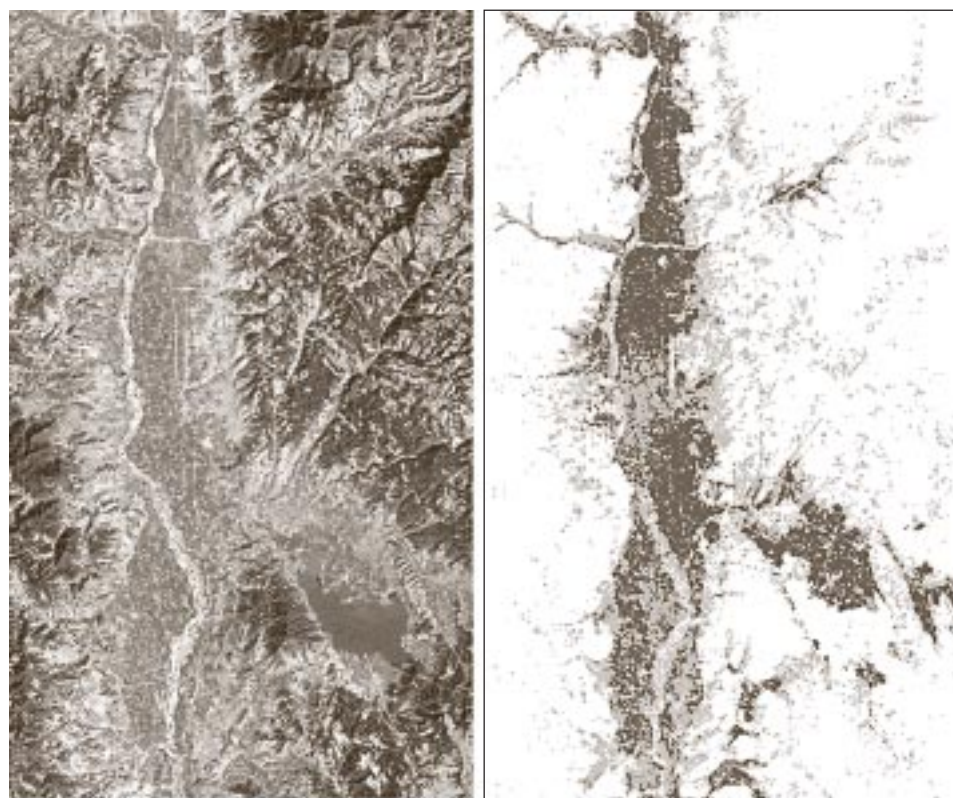
“We believe we can identify environments where snails can exist,” said Spear. “Then, in areas that do not currently have snails, you can use a ground-based surveillance program to try to prevent the populations from being established.”

As a next step, the researchers would like to learn if certain features of the landscape will determine the extent of disease transmission in areas where snails exist.

“We’re trying to integrate a great variety of spatial and historical data into our model,” Spear said. “The question is whether we can do this well enough to use the model as a test bed for simulating intervention strategies and predicting which might be the most effective. In the long haul, we hope to use the predictive capability of computer models to fight this disease.”

Spear anticipates that it will take five more years to know if the modeling process will work. “If we succeed, we will have paved the way for coupling a mathematical model to local data as a way to design customized prevention strategies.”

The UC Berkeley team includes researcher Edmund Seto, who works on remote sensing, statistician Alan Hubbard, and doctoral students Song Liang and Bing Xu. The collaborators at SIPD are directed by Professors Xueguang Gu and Dongchuan Qiu. 



Based on a satellite image of the Anning River Valley (left), the computer model (right) identifies potential snail habitat (dark areas)



Anning River Valley

Using Models to Track the Spread of Waterborne Disease

As public health becomes increasingly interdisciplinary, COEH is welcoming affiliates who bring new perspectives to problem solving.

Bioengineer Joseph Eisenberg, adjunct assistant professor in the School of Public Health at UC Berkeley, uses mathematical models to explore how infectious diseases are transmitted. His models provide insights that policy makers can use to understand transmission pathways, assess exposure risk, explore different scenarios for intervention, and understand the implications of the choices they can make.

Much of his research involves modeling how waterborne pathogens, such as the protozoan of the genus *Cryptosporidium*, are transmitted.

When 400,000 people in the city of Milwaukee became ill with cryptosporidiosis in 1993—the largest such outbreak in U.S. history—Eisenberg and his colleagues examined how the disease could have come through the water system and into people’s homes. He has also been following the impact of drinking water on people whose immune system is compromised—for example, people with HIV, for whom the disease can be life threatening.

Eisenberg is particularly interested in exploring how epidemiological modeling and traditional epidemiological studies can work together. To learn more about traditional data collection and epidemiological approaches, he is directing a federally-funded study headed by epidemiologist and COEH faculty member Jack Colford of UC Berkeley’s School of Public Health to assess the impact of the quality of drinking water within sensitive population groups such as the elderly.

The mathematical model he will develop in conjunction with this study will draw upon historical field data, information in the research literature, and findings from other water quality trials that the Berkeley team is conducting in an attempt to understand more broadly how waterborne diseases are transmitted. Ultimately, he hopes his model will provide more general insights for risk assessment and decision making.

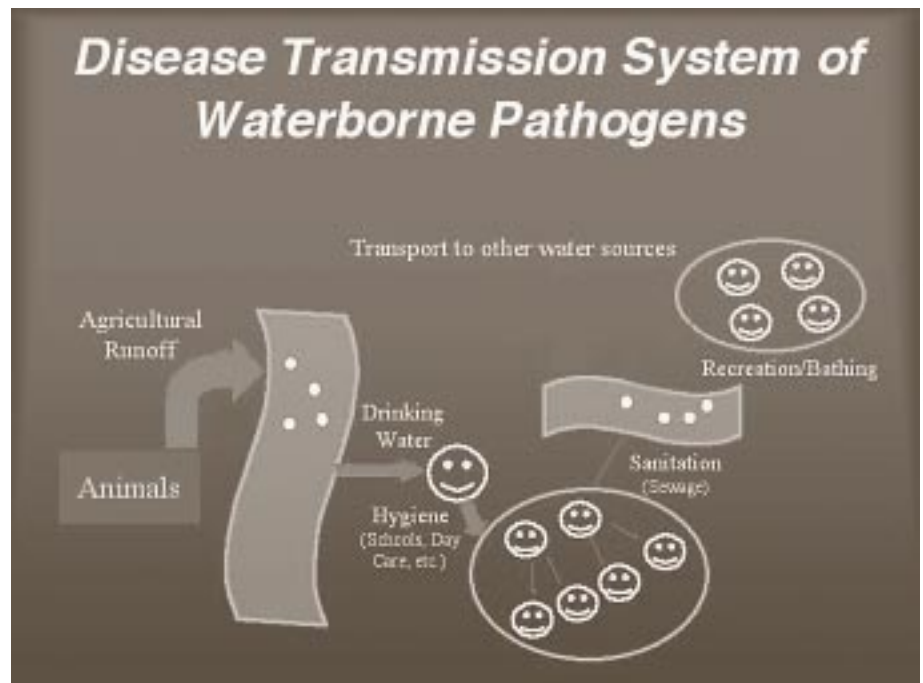
“Since the pathways that can make a person sick are interdependent, mathematical modeling helps us to understand how various factors play into a given result and how important those factors are. The model can tell us whether we know enough to draw a certain conclusion and what the implications of various policy choices would be,” Eisenberg explained.

In the coming years, Eisenberg hopes to use modeling to understand more about how waterborne pathogens move from host to host in developing countries. 🌐



Photo by Suzanne Llewellyn

Joseph Eisenberg



Graphic by Joe Eisenberg

Standing at Work May Clog Carotids

A study of middle-aged working men has associated standing on the job with progressive clogging of the carotid arteries and has shown that men who already have arterial narrowing or heart disease are especially at risk.

The carotids are the big arteries on either side of the neck that carry blood to the brain. Narrowing of these arteries inhibits blood flow, which can lead to reduced mental functioning, memory loss, and stroke.

Using highly sensitive ultrasound instruments to measure thickening of the inner walls of the carotid arteries, COEH faculty member Niklas Krause and collaborators from Ann Arbor, Michigan, and Kuopio, Finland, studied nearly 600 men participating in the Kuopio Ischemic Heart Disease Risk Factor Study in Finland. Krause conducted the study while at the Public Health Institute in Berkeley. He has since joined the Department of Medicine at UC San Francisco.

The study tested the hypothesis that long-term standing at work is a potential risk factor for atherosclerosis, a disease that causes arteries to stiffen, their inner walls to thicken, and their interior passageways to narrow. Standing causes blood to pool in the lower ex-

tremities, which makes the heart pump faster and changes the characteristics of blood flow and wall shear stress inside the arteries, leading to arterial wall injury and causing a narrowing of the arteries. These changes can lead to heart attacks or stroke.

The researchers measured the change in the thickness of the inner layer of the artery walls over four years, and found that men who stood the most had a

significantly greater progression of thickening (.33 mm) compared to those who reported standing a lot (.28 mm), little (.25mm) or not at all (.24).

“The numbers seem small, but a .1 millimeter change in artery wall thickness is huge,” Krause explained. “Each .1 millimeter represents about a 10 percent increase in the risk of a heart attack.”

For the men in the study who had heart disease, the progression of atherosclerosis was nine times greater if they stood very much at work than if they did not stand (.75mm v. .08 mm). For men with prior narrowing of the carotid artery, the progression was three times greater if they stood very much than if they did not stand (.45mm. v. .14mm.).

The study, published in the Scandinavian Journal of Work and Environmental Health 2000, vol. 26, no. 3, included men from all walks of life and took into account more than 25 potentially confounding factors, including age, income, smoking, blood pressure, obesity, medications, blood lipids, alcohol consumption, leisure time activities, physical job demands, job stress, and cardiorespiratory fitness.

“In some occupations, people are not permitted to sit,” Krause said. “Our results suggest that changing tasks, work stations, and schedules to allow for varied work postures may reduce the risk of carotid atherosclerosis. The findings are particularly important for workers who already have heart problems. For example, we might need to consider how we are counseling such workers during vocational rehabilitation.”

Krause hopes to continue his research with a 10-year follow-up study examining the association of standing at work with cardiovascular diseases and strokes. 🔄



Photo by Janice Crooks

Krause's study associates standing on the job with progressive clogging of the carotid arteries.

Studying Pesticide Exposure in Costa Rica

Researchers at UC Davis are exploring whether Costa Rican farm workers exposed over time to low levels of the herbicide, paraquat, may be at increased risk for lung injury and disease.

More than 300 workers from coffee, banana, and palm oil farms throughout Costa Rica are being recruited for the study. The workers will complete a work history questionnaire and undergo pulmonary function and exercise testing.

Paraquat is used in more than 130 countries for weed control. Valued for its effectiveness, rapid decomposition in soil, and lack of a toxic residue, it is commonly used in California. It is also heavily used in Latin America, where the tropical climate intensifies the need for a quick-acting herbicide. In the United States, only certified applicators are permitted to use paraquat. Several countries, including Finland, Sweden, and Austria, ban its use completely. In Costa Rica, however, no restrictions exist, and people can purchase paraquat for their own gardens.

Case reports of accidental poisonings and suicide attempts have shown that, at high doses and without immediate

medical treatment, paraquat causes severe lung damage and respiratory failure; however, the health effects of chronic low-level exposure are not well understood.

COEH faculty members Marc Schenker, chair of the Department of Epidemiology and Preventive Medicine, and Kiyong Lee, an exposure assessment specialist, are addressing this question with Laurel Beckett, professor of epidemiology and preventive medicine, and Bruce Hammock, professor of entomology in the College of Agriculture.

“This study is one of the largest and most intensive to be conducted in this population,” said Schenker, a physician known internationally for his work on improving the working conditions of agricultural laborers. “We hope these studies provide a more definitive answer to the question about the safety of chronic low-level paraquat exposure.”

Schenker and his co-investigators hope to have preliminary results in 2002. For more details about the study visit <http://www-epm.ucdavis.edu/www/Projects/salud/Intro.htm>



Photo by Rafael Lupercio

Killing weeds with paraquat.

AIHA Honors Nicas

The American Industrial Hygiene Association (AIHA) is honoring COEH faculty member Mark Nicas with the 2001 Edward J. Baier Technical Achievement Award for his “comprehensive contributions to the profession.”

Nicas, adjunct associate professor of environmental health sciences in the School of Public Health at UC Berkeley, will receive the award at the annual

conference of the AIHA, this month, in New Orleans. The award includes a \$1,000 honorarium from the award sponsor, Clayton Environmental Consultants.

Nicas’s research interests include mathematical exposure modeling, tuberculosis transmission risk, statistical sampling strategies, and respirator performance.



Photo by Peg Skorpinski

Mark Nicas

Lessons Learned from Evacuating the Capitol

Never has COEH alumna Jennifer Hatfield's training in occupational health nursing been tested more keenly than it has in the past six months, as legislators and the staff of the state Capitol have wrestled with solving the state's energy crisis against the backdrop of a bizarre workplace disaster that took one life and disrupted the lives of hundreds of others. Here is her experience.

January 16, 2001. The speaker of the Assembly had just tapped his gavel, wrapping up the Assembly session for the night, when an explosion on the opposite side of the building rocked the



Photo courtesy of *The Sacramento Bee*, Bryan Patrick.

room. In her office, Occupational Health Nurse Jennifer Hatfield, MS '98, UC San Francisco, heard a loud thud, and her TV rattled.

"I thought it was the janitors dropping a heavy desk above me," she recalled. Moments later the fire alarm sounded. A big rig, its horn blaring, had barreled up the sidewalk, rammed the south side of the state Capitol just under the Senate chambers, and burst into flame, destroying a granite portico and setting an unoccupied Senate committee hearing room ablaze. The driver, a man with a history of mental illness, died instantly.

"It looked like a war scene," Hatfield said. "It was very upsetting, but every-

one knew how to evacuate the building properly, and we got everyone out in a calm and orderly fashion."

Once outside, however, the evacuation procedure frayed slightly around the edges.

"People didn't know their designated safety areas," Hatfield said, "and, despite the best efforts of the California Highway Patrol to keep gawkers away from the scene of the crash, it was amazing that a few people got safely out of the building only to circle back over there, even while the truck was still burning!"

In the months ahead, she and her colleagues would take steps to ensure that people knew their safety stations and would designate more people to direct the way to these stations, but, for the moment, Hatfield had to focus on immediate health and safety needs. One woman needed emergency care for smoke inhalation. Two people sprained their ankles running around in the dark looking for co-workers. And one man became distressed, because the fire reminded him of losing his house twice in fires.

"Most companies would have closed their doors the next day, but the Rules Committees wanted to show the public that we wouldn't be deterred—plus we were right in the middle of the electricity crisis (still are!) and were under tremendous pressure. I slept maybe four hours that night and the following nights, and some of the top managers didn't sleep at all for over two days. We were in constant surveillance making sure the building was safe."

The next morning, as legislators and staff returned to the damaged building, Hatfield and her co-worker called upon psychologists specially trained in post-traumatic crisis counseling to help anyone who felt the need to talk.

"The counselors explained that, immediately after a disaster like this, people become very task oriented. They suggested that we keep monitoring for a week or so, because that's when people become sad and weepy. I did find this to be the case. We're a big

family, here, and I wanted to make sure that people who needed to grieve could do so. It was also very important to show everyone that our upper management cared and were providing support for them. Bringing in counselors immediately was one way to show they did care.”

As the smoke residue and the odor of the disaster lingered, Hatfield treated people for nosebleeds and dryness in their throat and eyes and helped them relocate to other offices, if needed.

In the aftermath of the fire, water from the sprinkler system seeped into the basement, carrying diesel fuel with it. The basement had to be closed for three months so that sheet rock and carpeting that had soaked up the fuel could be replaced and the basement monitored for toxic mold.

“Industrial hygienists came in every morning before work hours and tested the building,” she said. “To allay everyone’s fears about exposures, we held meetings where employees could hear what was being done from the hygienists and the contractors. Occasionally, my co-worker and I brought the hygienists in to talk with people who were especially fearful that their office wasn’t being taken care of properly. Communication with employees was very important, and we did not take it lightly. I felt it helped tremendously in getting everyone back to business quickly.”

Assuaging fears was Hatfield’s biggest challenge. “We were starting the cold and flu season, and, when people came in worried about smoke exposure, I had to gently assess what was going on. Mostly, we used “tender loving care” and educated them about the different symptoms for allergies, colds, and smoke inhalation. If they felt they were having an allergic reaction related to the odors, we sent them to their physician.”

Hatfield learned that getting through the disaster itself “wasn’t nearly as tough as putting out the ‘fires’ after the fire.”

“It’s amazing how long it takes to get things back to normal. It will take over a year to restore our Capitol, and I don’t


think it will ever be the same,” she said.

Analyzing what went right about the Capitol’s response to the disaster, Hatfield said, “Our highest priority was communication. We needed to coordinate our command structure with the Fire Department, and it worked as it had in our drills. The CHP called the evacuation. Our Assembly and Senate sergeants evacuated the building, quickly set up a command post, and then worked closely with the Fire Department when they arrived. Communication was a major key in keeping this disaster from turning into chaos.”

To make disaster response even more effective in the future, Hatfield and her colleagues have placed vests and emergency kits for first responders at all the fire hoses in the Capitol so that, if another evacuation is ever called, volunteers designated to search offices and direct people out of the building will know exactly where to find vests and equipment. They are also planning better ways to get people to designated safety areas, especially in the dark.

“We don’t have a perfect answer, because this is a public building, open to visitors, but we know that our system for room by room checks works, and we’re improving our capacity to move people to safety fast,” she said.

In recent months, with legislators and staff under continuing pressure to solve California’s energy problems, symptoms related to stress and overwork from that effort have claimed most of Hatfield’s attention.

“Indigestion, chest pains, headaches—sometimes we just need to tell people to stop working and go to lunch!” she laughed. 



Located on the Berkeley, San Francisco and Davis campuses of the University of California, COEH trains occupational and environmental health specialists in medicine, nursing, toxicology, epidemiology, policy, ergonomics and occupational hygiene. It also conducts research and facilitates exchange of information and experience among labor, industry, and the academic community to better serve the working population. In 1982, it was designated an Education and Research Center (ERC) of the National Institute for Occupational Safety and Health (NIOSH). COEH *Bridges* is published quarterly and made available at no charge.

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Losing Your Job Can Make You Ill, Researchers Find

Losing your job can be harmful to your health, according to COEH's newest affiliate, Edward Yelin, adjunct professor of medicine and health policy at UC San Francisco and an expert in the social and economic impact of chronic disease.

Yelin has devoted his career to learning how changes in the nature of work affect people with health problems such as arthritis, asthma, and musculoskeletal disorders. He has also studied how economic patterns affect people's ability to work. In the last few years, he has expanded his focus, asking what happens to healthy people when they lose their job or find themselves in new working conditions. He has learned that poor health is both a cause and a consequence of employment problems.

With funding from the California Wellness Foundation, Yelin, co-investigator Laura Trupin of the Institute for Health Policy Studies and the Department of Medicine, Irene Yen of the Institute for Health and Aging at UC San Francisco, and collaborators on other campuses and in community organizations have been building a statewide data base for analyzing work-related health issues. Since 1998, they have conducted interviews that track changes in people's health and their work situation—integrating information that traditionally has been surveyed and analyzed separately.

Their findings, based on phone interviews conducted in 1998, 1999, and 2000 as part of the California Work and Health Survey, have shown that healthy people who lose their jobs are more than three times as likely to report a worsening of their health from one year to the next, and more depression as well.

One of the most profound changes that Yelin and his colleagues have found in the California labor market over the past few years is the loss of job security.

"People are changing jobs much more frequently," Yelin said. "It's very striking that the amount of time people spent in jobs fell during the boom times of recent years, which suggests that shorter longevity on the job is not just a phenomenon that occurs when the economy is contracting but is something coursing throughout the economy."

Another change is that fewer employers are providing a full range of benefits.

"Workers are being asked to take more risk," Yelin said. "In addition, the nature of work is changing with the emergence of high tech. Put this all together and you find that, even in good times, people's job security is eroding, which takes a toll on health."

The surveys also revealed that California workers in fair or poor health are twice as likely to lose their jobs from one year to the next than are those in better health.

Results of the California Work and Health Survey for 2000 revealed that, using conservative assumptions, about 1.6 million California adults who were not employed were available to work. Contrary to the stereotype of the young, inexperienced, or unskilled worker, many of those surveyed had been to college and had worked within the past five years.

"Since many of the Californians we interviewed had a long work history and recent involvement in the workplace, we couldn't help wondering why employers weren't making more of an effort to upgrade U.S. workers rather than pushing for visas for people from other countries," Yelin said.

The survey also found that working Latinos and African Americans—almost one-third of California's working population—are more likely than working whites to have lower incomes, to lack pension plans, to lack health insurance coverage, and to have poorer health, even when key labor market




Photo by Richard Kite

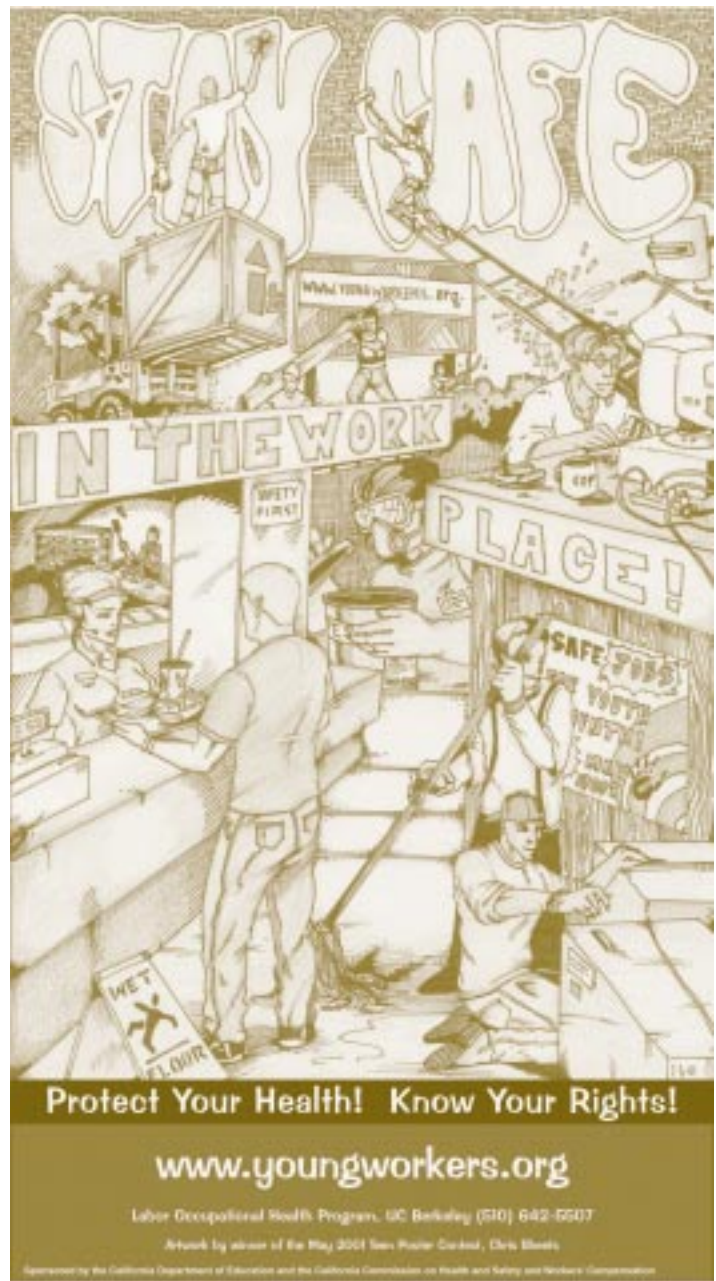
Edward Yelin

and health determinants such as age, sex, and educational level are taken into account.

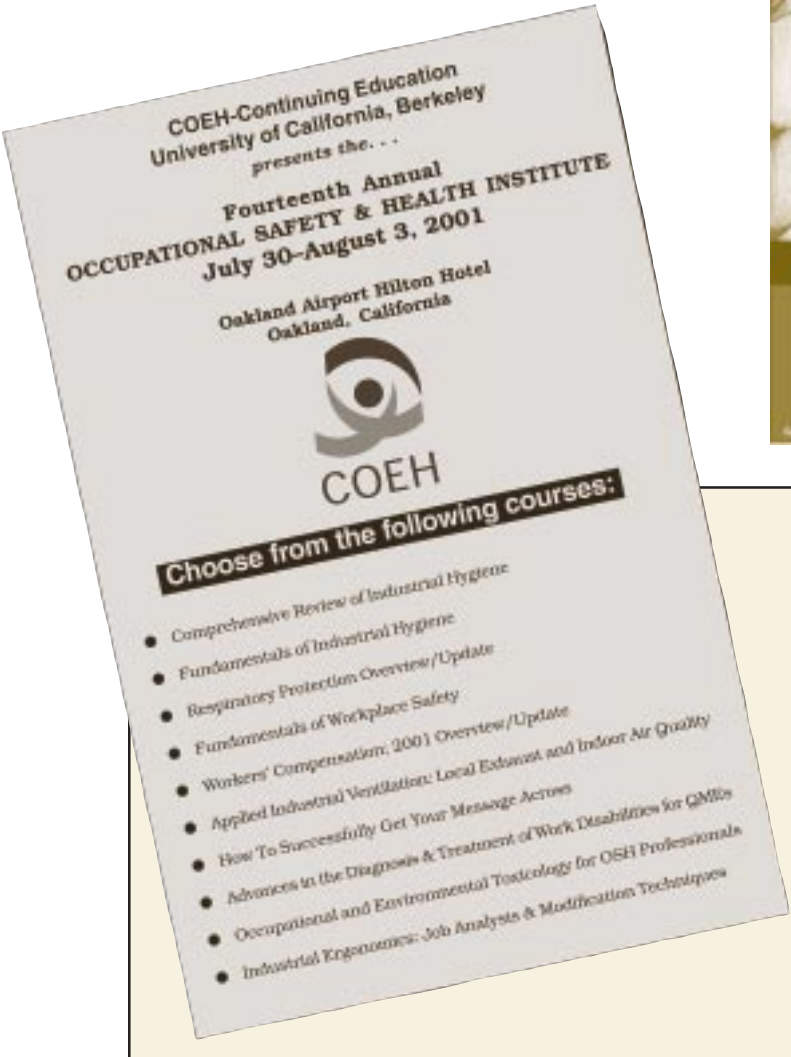
The team's latest results indicate that the median retirement age for Californians is the late 50s, many years earlier than the age at which people are entitled to Social Security benefits (62).

"Contrary to the myth of the rich dotcommer running along the beach, many of these people have retired because of health problems, and the family income is suffering," Yelin said.

The researchers have reported their results to the state legislature and have disseminated them through the media. His work to date notwithstanding, Yelin considers that he has "barely begun to scratch the surface of the data we've collected," and he is looking forward to joining other COEH faculty to learn more about how working conditions are affecting people's health. 



Artist Chris Sheets



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Symposium Spotlights Asthma and the Environment



Photo by Janice Crooks

Scott Weiss

COEH hosts a spring symposium each year to address issues of concern in occupational and environmental health. This year's symposium on asthma and the environment brought together more than 120 faculty members, students, alumni, and government officials to hear from researchers and share information. COEH Director John Balmes discusses highlights of the symposium below. For more information, see our Web site: <http://ehs.sph.berkeley.edu/coeh/>.

Keynote speaker Scott Weiss opened our March symposium on the "Impact of the Environment on Asthma" with a call for more research to learn whether factors such as obesity, ethnic background, and living in a city may put people at greater risk for asthma.


Weiss, professor of Medicine and Public Health at Harvard and an internationally recognized expert in the epidemiology of asthma, noted that asthma is a disease of the developed world. For example, while African-American children have a relatively high risk of asthma, there is little asthma in rural Africa.

Arguing that traditional epidemiological studies (exposure-response relationships) are unlikely to provide "break-through" information that can be used to reduce the burden of asthma, Weiss said genetic epidemiological studies in appropriately recruited populations are much more likely to improve our understanding of asthma and to have a substantial impact on public health.

Michael Lipsett of the Office of Environmental Health Hazard Assessment, co-investigator of a study of environmental pesticide exposure in children of Latina mothers, reviewed what is currently known about pesticide exposure and asthma and dis-

cussed the biologic plausibility of low-dose organophosphate pesticide exposure as a risk factor for asthma.

Rob McConnell of the Children's Health Study (CHS) research team at the University of Southern California reported that children exposed to fine particles and nitrogen dioxide (NO₂) exhibit impaired growth of lung function and that asthmatic children have increased symptoms of bronchitis when they are exposed to fine particles and NO₂. The study has not found a connection between ozone exposure and growth of lung function, but it has found that exposure to ozone is more strongly associated with school absences due to respiratory illness than are the other pollutants.

Traditionally, scientists have tried to learn whether environmental pollutants affect lung function by studying rodents. But rodents have pulmonary systems that are not at all like ours, and they react differently to atmospheric toxins. Now, Charles Plopper, chair of the Department of Anatomy, Physiology, and Cell Biology in the School of Veterinary Medicine at UC Davis, and an interdisciplinary team of researchers have developed a rhesus monkey model of allergic airway disease that appears virtually identical to human asthma. Discussing this pioneering model, Plopper said that, when young monkeys were exposed to ozone and house dust mite antigen, this combined exposure altered the structure of their lungs and led to greater asthma-like features than exposure to house dust mite alone. This research suggests that children prone to asthma who are exposed to ozone and allergens at an early age might also develop abnormal airway remodeling that could affect the long-term growth of their lungs and their susceptibility to asthma (see accompanying story). 

Ozone, Dust Mite Allergens Can Impair Lungs, Cause Asthma in Monkeys

A study of baby monkeys by researchers at the California Regional Primate Research Center, UC Davis, suggests that breathing air polluted with ozone can impair the structure, development, and function of the lungs and make them susceptible to asthma.

Presenting the study at COEH's recent symposium on asthma and the environment, Professor Charles Plopper, who chairs the Department of Anatomy, Physiology, and Cell Biology in the School of Veterinary Medicine and leads the Primate Center's Respiratory Diseases Unit, said that, by the time the monkeys were six months old—the equivalent of about three years old in a human child—those that had been exposed to ozone and dust mite allergens had lost half of their conducting airways. The lungs of rhesus monkeys normally have 14 branches. Those monkeys exposed to ozone and allergens had an average of eight.

Since the respiratory systems of rhesus monkeys and humans are very similar, the research team's startling findings imply that exposure to ozone and dust mite allergens in the atmosphere may impair normal lung development in young children and pave the way for asthma.

The work of Plopper and his colleagues is of particular interest because the incidence of asthma in the United States has risen dramatically in recent years. In California alone, more than 2 million people—including an estimated .5 million children—suffer from the disease.

The UC Davis research is the first to show that environmental pollutants can compromise post-natal lung growth in primates. Among the most dramatic results, Plopper and his team found that exposure to ozone and allergens:

- thickened the smooth muscle that controls the diameter of the airways, causing more resistance to airflow
- increased the mucous cells inside the airways, producing more mucous

than normal

- decreased the elasticity of the tissues, making it harder for them to expand and contract
- changed the nerves associated with respiratory function in both the lungs and the brain, making the brain hypersensitive and hyper-reactive to allergens and exacerbating an asthmatic response

The team's work underscores with biological evidence studies such as those done by COEH faculty members John Balmes of UC San Francisco and Ira Tager of UC Berkeley that have found reduced lung function in young people raised in smoggy parts of California.

The UC Davis team exposed the monkeys to ozone levels comparable to those in Mexico City on a high pollution day. In future work, the researchers plan to study whether ozone levels closer to those in major U.S. urban areas have similar effects and whether or not the damage caused by ozone and allergen exposure is reversible when the exposure is eliminated.

"As we gain more knowledge about the biological impact of these exposures, we can begin to develop preventive measures and therapies for very young kids," Plopper said. "We will also know from a mechanistic point of view the critical points at which intervention will help." 🧐



Charles Plopper

Abnormal lung development and ozone

The lungs of baby rhesus monkeys develop abnormally when exposed to ozone pollution. Many of these abnormalities are similar to those in the symptoms of asthma. As with infant monkeys, human babies are born with lungs that are still developing.

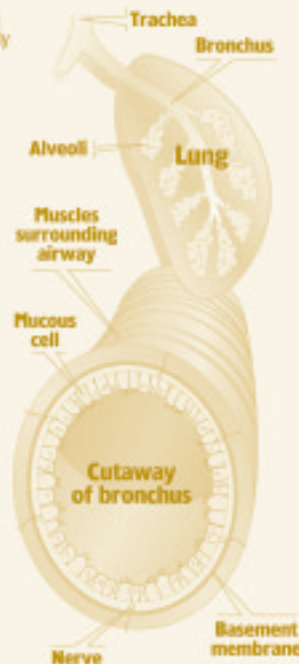
The lungs have fewer branches. In a normal young monkey there are 14, but only an average of eight in ones exposed to ozone.

There are more mucous cells. They secrete extraordinarily high levels of mucous, blocking airways.

Muscles surrounding the airways thicken and change shape. When the muscle contracts in reaction to an irritant it causes greater restriction than normal to breathing.

Basement membrane thickens. This layer, composed of connective tissue, becomes less flexible.

Nerves are more sensitive to irritants. The nerves that detect irritants, such as allergens and pollutants, are much more sensitive and trigger reactions more easily. This overstimulation, in turn, makes the brain hypersensitive.



Source: UC Davis

Boe/Sheldon Carpenter

Graphic by Sheldon Carpenter, Courtesy of The Sacramento Bee



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