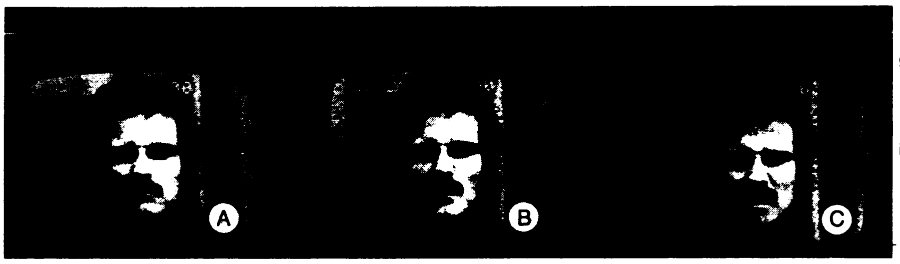
How emotions affect involuntary nerves



Involuntary nerves turn off in response to expression of disgust.

An unlikely collaboration between scientists and actors has bolstered a hypothesis that has been building for some years now. It's that the human body's involuntary nervous system reacts specifically to various emotions rather than in the same way.

The study, reported in the Sept. 16 SCIENCE by Paul Ekman and Wallace V. Friesen of the University of California School of Medicine at San Francisco and by Robert W. Levenson of Indiana University in Bloomington, also revealed that facial expression alone can stimulate physiologic response in the expresser.

Ten or so studies over the past few years have found that the involuntary nervous system reacts specifically to various emotions. The studies have had some drawbacks, though. None compared the physiological responses of the involuntary nervous system to more than two or three emotions. Also, researchers doing the studies attempted to induce certain emotions in subjects by showing them pictures or films; as a result, the researchers couldn't be certain that the subjects truly felt the desired emotions.

Ekman and his co-workers, in contrast, designed their study so that if it wasn't superior to previous ones in approach, at least it provided a broader and fresher perspective on the subject. They studied the response of the involuntary nervous system to six emotions. They also attempted to induce these emotions in subjects by having them form facial expressions for the emotions that are universal across human cultures. Such an induction, they reasoned, might prove to be a more accurate yardstick of specific emotions than simply showing subjects pictures or films. And it was precisely because of their intent to obtain facial expressions that were truly indicative of the six emotions that they used actors as their subjects.

Indeed, as the researchers expected, their subjects' involuntary nervous systems reacted to the emotionally representative facial expressions which they assumed. "This is the first evidence that anyone has ever reported that a voluntary facial muscle movement can change the involuntary nervous system," Ekman told SCIENCE NEWS. But also, as the investigators expected, the subjects' involuntary nervous systems reacted differently to the assumption of facial expressions representing various emotions. In fact, there were even different responses within the involuntary nervous system to a single emotion.

For instance, subjects' heart rates—one measure of involuntary nervous system reactivity—increased considerably in response to facial expressions of anger, fear and sadness while they rose only a little in response to happy and surprised demeanors and actually fell somewhat in reply to an outward appearance of disgust. Finger temperature—another index of involuntary nervous system reactivity—soared in response to anger, increased a little in response to happiness and sadness and dropped somewhat in reply to fear, surprise and disgust. —*J. A. Treichel*

Global study probes lower atmosphere dynamics, composition

We live, work, play and breathe in the troposphere, but precious little is known about its nature or how it works. This lowest layer of the earth's atmosphere is critical to chemical reactions in the upper layer — the stratosphere — and like the stratosphere, it is changing. NASA is exploring tropospheric chemistry and developing instruments that will allow precise and reliable measurements of the lower atmosphere's trace gases.

NASA has devoted much attention to the stratosphere in recent years, partly due to the concern that the sensitive ozone layer may be depleted through reactions with gases such as chlorofluorocarbons (CFCs). "We have become increasingly aware that in order to understand the stratosphere, we have got to understand at least some of the key issues in the global troposphere," says Robert J. McNeal of NASA. "The troposphere ultimately is the source and sink for everything that takes place in the stratosphere."

A series of chemicals could decrease stratospheric ozone while at the same time, another series of chemicals and processes could increase ozone in the troposphere. Ozone will be examined along with carbon monoxide (CO), hydroxyl radical (OH), and nitrous oxide (NO), but McNeal says it is ozone that is the key to understanding atmospheric chemistry because so many chemical reactions in the atmosphere either produce ozone or destroy it.

The first phase of the project involves development of instruments so sensitive that they can detect nitrous oxide in concentrations of one part per trillion, or the OH radical at one part per quadrillion. "We're trying to convince ourselves that we know how to do this, and to convince the rest of the scientific community that we know how to do it," McNeal says.

Toward this end, a series of ground-based experiments was performed at Wallops Island, Va., in July. Test flights from Barbados in November will expose the instruments to a tropical marine environment, which is important for studies of OH, NO, and ozone. Finally, flights in April from NASA's Ames Research Center in Moffett Field, Calif., will look at the meteorological conditions that occur during a tropopause folding event, in which the boundary between the stratosphere and the troposphere dips steeply toward the ground (SN: 9/3/83, p. 151). If satisfied that the data and the instruments are reliable, scientists from 16 research organizations will procede with the program on a global basis.

In addition to the propensity of trace gases to react with each other and with water vapor, many of them are greenhouse gases, enhancing the warming effect expected to result from the recorded increase in carbon dioxide (CO_2). When researchers at NASA's Goddard Space Flight Center in New York calculated measured increases from 1970 to 1980 of two CFCs, N_2O and methane, they found that these four trace gases alone contributed 70 percent as much to the calculated warming over that 10-year period as did CO_2. Scientists also are studying the biological sources of gases such as methane, which by some reports is increasing at a rate of two percent per year (SN: 12/11/82, p. 375). At a rate of increase of even 1.5 percent per year, 60 million metric tons of methane are entering the atmosphere and not being consumed, says Ralph Cicerone of the National Center for Atmospheric Research in Boulder, Colo. "We don't know why any of the methane sources would be that far out of balance."

As scientists learn more about the chemistry and dynamics of the troposphere, their findings may break what McNeal calls the "molecule of the month syndrome," in which new, significant measurements transform the scientific perception of the troposphere. The way out, he says, is to do a "systematic, careful study of the global troposphere over a period of enough years that we can begin to understand what's going on."

— *C. Simon*