

Photos by Frank Ross

Monkey gets vitamin pill in a study of the effects of malnutrition on taste.

PHYSIOLOGY

The orphan senses

The chemical senses, taste and smell, are coming out of a dark age of scientific investigation

by Christopher Weathersbee

For some reason the allied chemical senses, taste and smell, are the poor cousins among the pathways by which information reaches the brain. Painters please the eye, composers the ear, and both are acclaimed as artists. The craftsman who pleases the nose and the tongue is called a cook and rarely achieves fame.

Likewise in the sciences, there is a comparatively great amount of research in vision and hearing. But the few researchers working in chemical senses are much overlooked, scattered and sporadically funded. Most of the people in the field, highly competent though they may be, got there by wandering there. Only a minute number actually trained for the discipline.

The Monell Chemical Senses Center may be part of the answer to this vacuum of interest and organization in such a potentially fruitful field. Formed early in 1968 at the University of Pennsylvania in Philadelphia, the unique center will have the dual mission of doing integrated basic research in taste and smell and of training new workers in the field.

Basic though the planned studies may be, however, the field is so little covered that applications lie close to the surface. Many is the industry which would like to be scientific about how to make its products smell appealing

and/or taste good. Dr. Morley Kare, the center's recently appointed director, gets calls and letters almost daily from industry representatives offering help and asking to be kept posted.

More important applications than such things as good-smelling dog food are involved. One of them was pointed out by Dr. Luther Terry, former Surgeon General of the U.S. Public Health Service and chairman of the center's advisory council, when he announced Dr. Kare's appointment.

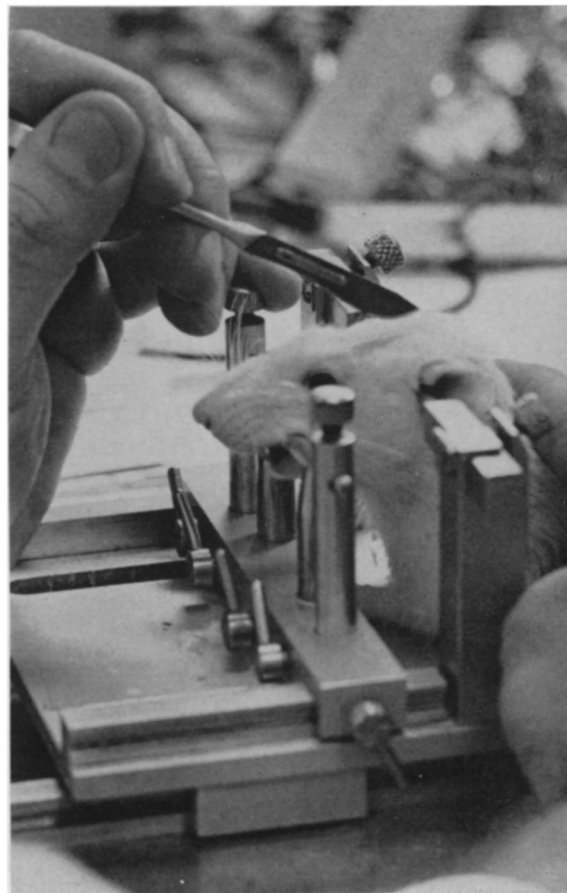
Animals, Dr. Terry notes, as a rule depend far more on their chemical senses to survive than does man. Many animals hunt, evade predators and locate mates by smell, and differentiate food from poisons by taste. Generally speaking, the farther down the pyramid of life one goes the more important are chemical senses, so that the whole ecology of the planet rests on animals which are quite sensitive to the taste and smell of their environment.

The rub, Dr. Terry and many others agree, is that man is changing the odor and taste of the environment, both with his pollutants and with the substances he adds to make life easier for himself.

Organisms lower on the pyramid which depend for survival to a large extent on the taste and smell of their environment thus may find that man has changed it and made it unrecogniz-



Obesity may be result of sense loss.



Brain studies of rats reveal sense data.

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Dr. Morley Kare heads new senses center at the University of Pennsylvania.

able. Deprived of meaningful information about their surroundings they may die out. Should this occur on a large enough scale the biosphere itself might not survive the upheaval.

Total extinction of life is the most extreme extrapolation of man's careless chemical meddling with his environment. But it is possible, and the fact of possibility illustrates the need for knowledge in the chemical senses.

The center was made possible by a million-dollar grant from the Ambrose Monell Foundation, matching funds from the Veterans Administration, and support from other branches of Government and private industry.

What was sought in a site was a combination of a research-oriented dental school, essential for assistance in an oral physiology program; a veterinary medicine school to cooperate in comparative studies between animals and humans, and a medical school to provide opportunity to work with humans. In addition to possessing these qualifications, the University of Pennsylvania has established itself as a leader in research in the physiology and behavior of feeding.

The center, housed at the moment in some vacated cancer research laboratories, will have its own five-story building on campus, to be ready for occupancy next December. Plans call for a staff of 50 by the time the move comes. This will include 12 professors, 20 graduate students and 18 technicians and laboratory assistants.

Disciplines represented will include ecology, ethology, biochemistry, biophysics, physiology, neurophysiology, physiological psychology, electrophysiology, anatomy, nutrition and experimental surgery. It is hoped later, as other staff positions become available, to add such disciplines as entomology.

Though open only a few months, the

center already has produced some startling results. It has been found, for instance, that rats fed radio-labeled sugar show radioactivity in the brain less than 60 seconds after ingestion (SN: 9/28, p. 314). This would indicate that the radioactive sugar has passed from the mouth directly to the brain by some unknown pathway.

In the studies the esophagi of rats were tied off, then the labeled sugar placed in the animals' mouths. Within 60 seconds the rats were killed and frozen in liquid nitrogen. Subsequently lengthwise microtome slices were made of the rat bodies to show the organs outlined in their proper positions. Autoradiographs of the slices showed radioactivity throughout the head, including the brain. Dr. Kare says this rapid transport of sugar may have some relationship to the rapid regulation of appetite.

Other work is being done in chemical communication between primates. Monkeys have a gland which apparently produces a pheromone—a broadcast chemical sex attractant—which is important in mating and in marking off territory. Studies are being made of the biochemical nature of the gland and of the behavior the pheromone produces.

Other areas of research include:

- The function of the chemical senses in regulating feeding behavior. For instance, if an animal's system is loaded with carbohydrate, does its degree of enthusiasm for certain foods change, and if so, how?

- The regulation of digestive secretions by stimulation of the taste sense. The commonest example of this is mouth-watering (saliva contains the digestive enzyme diastase). But a strong taste stimulus also is able to stimulate pancreatic secretions.

- The effect of malnutrition and undernutrition on the taste sense. Already

it has been found that undernutrition results in vitamin deficiencies which dull the sense of taste. On the other end of the scale, just after hunger is satisfied the sense of taste also is less acute. The kind of malnutrition which leads to obesity may involve a breakdown of this last phenomenon.

- The chemical nature of the taste and smell receptors.
- The coding of sensory information in the central nervous system.
- The role in regulating populations of wild species that is played by their senses of taste and smell.

In connection with the last field of study, Dr. Kare notes that it is silly to try to pretend that other animals share the human set of taste preferences. To humans both saccharine and sucrose taste sweet. To some animals neither tastes sweet; to some one but not the other tastes sweet.

"Even a superficial observer," Dr. Kare says, "must have some doubts that a coprophagous dog or mouse-eating cat is moved by 'home-style' or 'country-flavor' and other qualities designed to appeal to the human palate."

Another difference is that many animals can taste water, the domestic dog and cat included. To man water is tasteless. This problem incidentally complicates research, since experimental taste stimulants are commonly given in aqueous solution.

Applications of research at the center can be expected almost immediately. For instance, a better understanding of the taste world of cattle is needed to help meet the world protein shortage. Animal husbandrymen are attempting to feed beef cattle such unappetizing fare as ground wood and newsprint (SN: 8/31, p. 218). At the moment cattle raising is a luxury because of the degrees of food competition between cows and men. But in order to get good growth on urea and last week's daily paper, the mixture must be made a lot more palatable.

Much work already has been done on an empirical basis on controlling insect populations by manipulating the odor of their environment. Sex and food smells are sprayed around in an effort to abort mating attempts or lure the insects to poisons. It is hoped that a better theoretical basis for this approach to insect control can be worked out at Monell.

"We have a mandate to hire the brightest guys available," Dr. Kare says, "and get them together where they can interact." So far, he says, while work in the field has often been outstanding, it has been diffuse, with people working alone without benefit of instant cross-checking with others. ◇