Wisconsin, will talk about "Analysis and Synthesis in the Development of New Varieties of Plants." A field trip to Moscrip's Farm, Lake Elmo, to observe studies of pasture management, has been arranged for Tuesday afternoon. On Wednesday the section will cooperate with the Phytopathologists, Geneticists and Plant Physiologists in a field trip to observe the work of the divisions of agronomy and plant genetics and plant pathology and botany of the University of Minnesota at University Farm. Thursday morning will be devoted to a field trip to Lake Mille Lacs, with visits en route at the High-lime Peat Experimental Field at Coon Creek and the Low-lime Peat Experimental Field at Page, twelve miles south of Lake Mille Lacs.

The Section on Education (Q) will hold four sessions, on Thursday and Friday morning and afternoon, for the presentation of reports on research studies on (1) school administration, (2) the improving of learning, (3) understanding the young child and (4) higher education. On Thursday evening the section will participate in a dinner held under the auspices of Phi Delta Kappa and Pi Lambda Theta, at which Professor F. B. Knight (University of Iowa) and Professor John E. Anderson (University of Minnesota) will speak.

A DINNER DEMONSTRATION OF THRESHOLD DIFFERENCES IN TASTE AND SMELL

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MEAL-TIME is distinctly a time of taste and smell. However great may be the appeal to the eye or to the ear in the dinner accompaniments, the primary appeal of food is to the senses of gustation and olfaction. At meal-time one is most ready to try experiments that involve the senses associated with the consumption of our daily bread. The fact that at table the senses in question may be washed, as a slate, clean for a new test by so simple a procedure as a morsel of food and a drink of water is an added reason why a dinner offers a favorable opportunity for a demonstration of peculiarities in taste and smell.

The specific occasion about which the editor of SCIENCE has requested a brief account was the biologist's dinner at the Berkeley meeting of the A_3S this past June. The demonstration was made possible by the cooperation of the management of the International House, where the dinner was held, as well as by that of Dr. A. E. Clarke, who had charge of assembling and distributing the test material and of recording the reactions as expressed by a showing of hands. Since nearly 250 persons were present at the dinner it was not possible in the time available to obtain an accurate record in any instance and, in consequence, some of the estimates given below have been reached with the aid of tests made at other times. The showing of hands adequately fulfilled its chief purpose, however, which was to demonstrate how different people may be in their reactions to the same stimuli.

The first test was called a "preservative cocktail," which was sipped by the diners before they were served with a conventional fruit cup. It consisted of a 0.1 per cent. solution of benzoate of soda served in paper cups in lieu of wine glasses. This is the concentration used commercially in the preservation of food. The majority found it tasteless, but to over a quarter of those tested, however, it had a distinct taste which was described for the most part as sweet or bitter. A larger proportion are able to taste the dry powder, but this compound has been advertised as a tasteless substance, which it is to some, but not to others.

Following the fruit cup, each was given two glassine envelopes marked respectively 0.02 per cent. and 0.64 per cent. The first contained a slip of paper tape which had been dried after being passed through a 0.02 per cent. alcoholic solution of PTC (phenyl-thiocarbamide). The second paper had been treated with a 0.64 per cent. solution and was 32 times stronger. The first paper was without taste to the majority and tasted by only about a quarter of the people. The second stronger paper was tasted by the majority and was without taste to only about 15 per cent. This test was given to show that a substance must have a certain strength of concentration before it can be tasted and that this concentration is different for different people. In other words, people differ in their taste thresholds. They differ also in the kind of sensation which they appear to get from a substance which they taste. PTC, for example, is bitter to most tasters, but a considerable proportion of people report other tastes. In an exhibit at the American Museum of Natural History in connection with the Eugenics Congress in 1932, an opportunity was given for visitors to record on a voting machine what taste, if any, they got from paper impregnated with a medium concentration of PTC. Of the 6,377 who voted, 1,296, or 20.3 per cent., were non-tasters and 5,081, or 79.7 per cent., were tasters. The latter reported their tastes as follows:

Bitter	Sour	Sweet	Salty	Other tastes
4,168	346	134	309	124
(65.4 per cent.)	(5.4 per cent.)	(2.1 per cent.)	(4.8 per cent.)	(1.9 per cent.)

Among the other tastes reported were bitter almonds, camphor and sulfur, which are really odors.

Some of those who attributed sour, sweet or salty to PTC were tested and found able to recognize these tastes as well as bitter in test solutions of other substances. A considerable number of people, however, can not discriminate between some of the primary tastes. Many people, for example, get the same sensation from what most of us call bitter and sour.

It has been shown by others, as well as by the writer, that differences in ability to taste PTC are innate and hereditary. There is no reason to believe that differences in ability to taste other substances are not also innate and hereditary, although PTC is the only one so far tested genetically.

Following the soup, the tables were supplied with "tabloids" of the rare sugar mannose which had been prepared through the kindness of Dr. C. S. Leonard, director of the Burroughs Wellcome Research Laboratories. Each contained 5 mg mannose and 5 mg feculose, a tasteless starchy binder. About 15 per cent. found them entirely tasteless, 20 per cent. found them sweet only, 10 per cent. found them bitter only, while 55 per cent. got both a sweet and a bitter taste. To most of the latter the sweet comes first, but to some the bitter sensation preceded the sweet. To some who were negative to PTC, it was a satisfaction to find they could taste both the sweet and the bitter in mannose, while some of the tasters of PTC failed to perceive one or both of the two tastes of this peculiar sugar. There appears to be little correlation between a person's ability to taste two different kinds of bitter. If the tabloids had been made to contain a different proportion of mannose and feculose, the proportion of tasters and non-tasters would have been different as well as the proportion of those who tasted both the sweet and the bitter. Perception of sweet and bitter in mannose depends upon individual thresholds, which may be different for these two sensations.

Following the roast, instead of a taste test, which might have interfered with the succeeding test, there was interpolated, out of its logical sequence, an odor demonstration which will be discussed later.

The salad consisted of Globe artichokes with mayonnaise dressing and was a taste test in itself. After eating artichokes, 40 per cent. found that water was unchanged in taste, while 60 per cent. found water tasted different. To most, this taste was sweet. The taste reactions to water following artichokes were found to have no close relation to reactions to PTC or to mannose, which had been tried earlier in the meal. No response has yet come to the request that was made for information as to what the chemical substance might be in artichokes which was responsible for the after-taste of the water. There is some evidence suggesting that certain methods of cooking may prevent the reaction. Thus, Globe artichokes cooked with baking soda failed to elicit the reaction in a subject who is regularly positive, and negative reactions have been obtained from the preserved hearts of artichokes which are sold in bottles.

During the remainder of the dinner and after the coffee, demonstrations were given of differences in reactions to odors. Flowers of a cultivated variety of snapdragons (Antirrhinum) and of the Golden Gleam Nasturtium had been supplied as individual table decorations and provided objects more attractive to the eyes than they were to the noses of some of the diners. Each flower was graded according to the strength of its odor as odor absent, weak, medium or strong and in regard to the feelings which it aroused as pleasant, indifferent or unpleasant. About a quarter could detect no odor in the snapdragon and the rest found the odor weak or of only medium strength in contrast to the nasturtiums, which to most were strong or of medium strength, with only a few calling the odor weak. Connected probably with this difference in the strength of odor in the two flowers, a higher proportion of the people considered the odor of the snapdragon pleasant than the proportion which found the nasturtium fragrant and a larger number considered the odor of the latter disagreeable than found the snapdragon to be unpleasant. Certain other flowers[1] with which the writer has experimented appear better adapted to showing differences in smell reactions, but almost any flower with not too strong an odor will disclose some who can not smell it if enough people are tested. A person who is unable to detect fragrance in one kind of flower may be keen in detecting fragrance in other flowers.

Some peculiar reactions to certain natural odors have been reported. Thus, several persons have told the writer they could not smell the odor of skunk even when it appeared strong to others, in one case after running over the source of the odor. One person confessed that he really liked the odor when it was not too strong.

Better than flowers and natural odors for testing people are known chemical substances, the concentration of which can be controlled at least roughly. Folded pieces of filter paper are conveniently kept for several days in a sealed jar with a measured quantity of an alcoholic solution of the odorous substance and assembled in glassine envelopes shortly before the

[1] A. F. Blakeslee, *The Nat. Hort. Mag.*, 11: 211–212, July, 1932.

demonstration. Vanillin and synthetic musk retain their odor in the paper for a considerable time and by adjusting the concentration a group can be separated as desired into a large or into a small proportion of smellers as contrasted with non-smellers. It is readily shown that smell is like taste in that people differ greatly in respect to the threshold at which they can first detect the odorous substance. Smell differs from taste, however, in several respects. There are only a few fairly well-defined categories into which people can classify their tastes, but for their olfactory sensations clear-cut classification seems to be impossible. Odors, in consequence, are generally described in terms of other odors and even of tastes, such as sweet and sour.

Moreover, people differ greatly in the way in which they described a given odor when they compare it with known odorous substances. This is well shown by cuminol, which is variously described by different people as smelling like citrus rind, caraway seeds, crushed bugs, roses, perspiration and other things fragrant or otherwise. This wide range of reactions to cuminol was kindly pointed out to us by Mr. H. S. Redgrove, but caprillic alcohol has somewhat the same odor and we have found it to elicit similar reactions of nearly as wide a range. Many have difficulty in recognizing what kind of perfume they are smelling unless they see the name on the bottle or the flower from which the odor comes. Both cuminol and caprillic alcohol are good reagents also with which to show the differences between people in regard to their emotional response to an odor. The concentration of cuminol on the papers brought to Berkeley was such that about as many found the odor pleasant as those who found it unpleasant. By making the odor stronger or weaker in other demonstrations we have found a larger or smaller proportion who had unpleasant reactions. It was obvious that concentration of odor has much to do with our likes or dislikes. Strong odors are generally unpleasant but, since people differ in thresholds, what is strong to one is weak to another.

Odors are also tied up with associations that make them pleasant or unpleasant, apart from their strength. Associations, conscious or unconscious, probably are the most important factors in making an odor agreeable or disagreeable, as can be realized by one's reactions to odors that are purely personal.

Smell differs from taste again in that the olfactory powers appear dulled with age, and cases are not rare in which the sense of smell has become entirely lost. Several parents have told the writer that certain of their children when young, by smelling a handkerchief they had picked up, were able to tell to which member of the family it belonged, but that this ability had been lost after they had grown up. The writer knows a child personally who surprised his family by recognizing clothes as belonging to a playmate after they had been mixed up in the wash returned from the laundry, but his sense of smell is not unusually keen now in his early twenties. The organs of smell may be temporarily put out of commission by environmental factors, such as a cold in the head or olfactory fatigue. The taste reactions are probably more constant for a given individual, although recent studies indicate that taste acuity may change considerably from one time to another.[2]

Flavors are really odors and to be perceived must be volatile. Unlike the four primary tastes—bitter, sour, sweet and salt, flavors are supposed not to be perceived when the nose is closed. The diners were asked to hold the nose while putting into the mouth a pastille of Bittra chocolate and to note all the sensations resulting. To most, no taste of chocolate (really an odor) was evident until the nose was opened but, as is always the case in such demonstrations, a considerable number reported the chocolate flavor while the nose was still closed. Those with a low threshold (*i.e.*, acute tasters) for bitterness in chocolate could detect the bitter taste in the confection that was not evident to others. A further difference between people was disclosed by the fact that a considerable number could detect no sweetness while the nose was closed, but the sweetness was evident as soon as the nose was opened. The reason for this unexpected result is not yet clear. It has been of regular occurrence whenever groups of people have been tested with confections in this way. "Lifesaver" tablets are convenient objects with which to show different reactions to tastes, flavors and other sensations connected with eating. Sour as well as sweet can be differentiated as tastes in distinction to the flavor in orange or lemon lozenges, for example. Peppermint and wintergreen in addition to the flavor produce a sensation which is variously described as hot or cooling. This can be shown to be neither an odor nor a taste, if we limit this last term to the four primary tastes—bitter, sour, sweet and salt—as most authors believe we should. Hot tamales of our southern neighbors owe their hotness to red pepper, the heat of which is neither smelled nor tasted, properly speaking. Although we purchase pure tastes in the form of sugar, table salt, the acetic acid of vinegar and the bitter constituents of beer and some other drinks, most of the money spent to satisfy our appetites is expended for odors in the form of flavors and for other mouth sensations not properly classified in the category of taste.

Those who had seen how differently from themselves

[2] T. N. Salmon and A. F. Blakeslee, *Proc. Nat. Acad. Sci.*, 21: 78–83, Feb., 1935; A. F. Blakeslee and T. N. Salmon, *Proc. Nat. Acad. Sci.*, 21: 84–90, Feb., 1935.

others had reacted to the tests were perhaps a trifle more inclined to be tolerant of the opinions of other people. From the differences in taste and smell which they had seen in respect to a relatively few substances they could believe the statement that no two people are exactly alike in their sensory reactions and probably never have been. Training and other environmental factors do have an influence on human perceptions and behavior, but it is safe to say that judgments of drinkers regarding the taste of beer and judgments of the Supreme Court regarding issues of law can not help differing because men are born different.

SCIENTIFIC EVENTS

THE NORWICH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE annual meeting of the British Association for the Advancement of Science will be held at Norwich from September 4 to 11, under the presidency of Professor W. W. Watts. The only previous meeting of the British Association in the city of Norwich was in 1868 under the presidency of Dr. Joseph D. Hooker.

The inaugural general meeting will take place at 8:30 P. M. on Wednesday evening, September 4, when Professor Watts will deliver the presidential address, on "Form, Drift and Rhythm of the Continents."

The presidents of the sections and titles of their addresses are as follows:

Section A (Mathematical and Physical Sciences): Dr. F. W. Aston, "The Story of Isotopes."

Section B (Chemistry): Professor W. N. Haworth, subject to be announced.

Section C (Geology): Professor G. Hickling, "Some Aspects of Coal Research."

Section D (Zoology): Professor F. Balfour Browne, "The Species Problem."

Section E (Geography): Professor F. Debenham, "Some Aspects of the Polar Regions."

Section F (Economic Science and Statistics): Professor J. G. Smith, "Economic Nationalism and Foreign Trade."

Section G (Engineering): J. S. Wilson, "Stability of Structures."

Section H (Anthropology): Sir Arthur Smith Woodward, "Recent Progress in the Study of Early Man."

Section I (Physiology): Professor P. T. Herring, "The Pituitary Body and the Diencephalon."

Section J (Psychology): Dr. Ll. Wynn Jones, "Personality and Age."

Section K (Botany): F. T. Brooks, "Some Aspects of Plant Pathology."

Section L (Education): Dr. A. W. Pickard-Cambridge, "Education and Freedom."

Section M (Agriculture): Dr. J. A. Venn, "The Financial and Economic Results of State Control in Agriculture."

An evening discourse will be delivered on September 6, by Dr. S. J. Davies, dealing with "Diesel Engines in Relation to Coastwise Shipping." A second evening discourse will be delivered on September 10, by Dr. C. S. Myers, on "The Help of Psychology in the Choice of a Career."

The Lord Mayor of Norwich, P. W. Jewson, and the Lady Mayoress will give a reception in the Castle Museum on the evening of September 5, and a garden party at Crown Point will be given during the week by H. M. Lieutenant for Norfolk, Russell J. Colman, and Mrs. Colman.

September 7 has been reserved for general excursions to places of interest, schools and industrial firms in the neighborhood of Norwich. Preceding the meeting a geological excursion of four days' duration under the direction of Professor P. G. H. Boswell is being arranged to examine the coastal and inland sections in Norfolk from Hunstanton (Lower Greensand, Red Chalk, Lower Chalk) *via* Morston (purple boulder clay and raised beach) and Weybourne (Weybourne Crag) to Cromer and Bacton (Cromer Forest Beds, Scandinavian Drift and Chalky Boulder Clay).

The societies in correspondence with the association consist of (*a*) Affiliated Societies undertaking local scientific investigations and publishing the results; and (*b*) Associated Societies of at least three years' standing, and not fewer than fifty members, formed for the purpose of encouraging the study of science.

Delegates of the Corresponding Societies will meet on September 5 and 10 to discuss matters of common interest to the societies and the association. The presidential address, by Professor P. G. H. Boswell, will deal with town and country planning.

Future annual meetings will be held as follows: 1936, in Blackpool; 1937, in Nottingham; 1938, in Cambridge.

INTERNATIONAL BIOLOGICAL CONGRESSES

UNDER authorization of the national entomological societies and of Section F of the American Association for the Advancement of Science, arrangements have been made with certain steamship companies for the transportation of those going from America to the Entomological and Zoological Congresses. These arrangements and certain European tours in advance of the congresses are also open to those attending the other congresses, or their friends, or to the university public in general. The European excursions will be as follows: