liability, pure products often failing to comply with it. It has lately been proposed again by C. Baskerville. As carbon tetrachloride has for some years been a source of manufacture of chloroform, contamination of the product with this is possible. No reliable simple test for it has yet been devised, but determination of the specific gravity, after removal of alcohol and water, should show its presence. To remove alcohol, about 50 cc. of chloroform should be shaken with successive portions of 10 cc., 10 cc., and 5 cc. of concentrated sulphuric acid, the chloroform then neutralized by shaking with a solution of alkali carbonate, then dehydrated by shaking occasionally for half an hour with about 5 gm. of anhydrous potassium carbonate or calcium chloride, decanted and distilled. The first portion of distillate should be perfectly clear to show that water was completely removed. The specific gravity of the distillate should not be higher than 1.4848 at 25°/25°. That of carbon tetrachloride is about 1.60. Chloroform of U. S. P. standard, after removal of alcohol and water, had a specific gravity of 1.4846. Another portion of the same specimen, to which 2% by volume of carbon tetrachloride was added, and which was then treated for removal of alcohol and water, had a specific gravity of 1.4858. A test for acetone in chloroform is desirable. A reliable and sensitive test consists in shaking 5 cc. of chloroform with 5 cc. of water. To the separated water 2 cc. of sodium hydroxide solution (5 p. c.) and 5 drops of a freshly made water-solution of sodium nitroprusside (1 in 50) are added and the mixture made slightly acid with acetic acid. No violet tint should appear.

CHROMII TRIOXIDUM.—The U. S. P. requires that when it is decomposed by heat, the residue obtained "should yield nothing soluble in water." This is too exacting, as other pharmacopœias allow from 0.5 to 1 per cent. of alkali chromate. The test for sulphuric acid does not show "absence" of it, even when no turbidity is produced after long standing. Not only the dilution, but also addition of "a few cc." of hydrochloric acid prevent detection of traces, but the test is quite delicate enough for detction of objectionable quantities of sulphuric acid. Enough hydrochloric acid should be added to prevent precipitation of barium chromate.

(To be continued.)

THE ART OF FLAVORING.*

JAMES CROMBIE, PH. C.

I fear that the title of this paper is somewhat misleading. It is not my intention to enumerate the main flavoring agents and to show you how such may be applied individually or in combination to form pleasing and palatable preparations of things that are otherwise, but rather to advance a suggestion or theory whereby flavoring as an art may be better understood, and some system devised which will guide us in our selection of flavors and in the making of flavor combinations. Not only has your several discussions on the flavor or aroma of B. P. waters suggested the subject to my mind, but the many very fine flavored preparations—

*Read before the Pharmaceutical Society of Great Britain, at Edinburgh, March 20, 1912. Reprinted from *The Pharmaceutical Journal and Pharmacist.*

often of proprietary origin—which are finding much favor, both with prescribers as well as patients, have awakened the need there is on the part of the individual pharmacist to cultivate the art of flavoring on some system rather than on the present rule-of-thumb methods which, to say the least concerning them, are too haphazard. To understand the matter fully it is necessary to introduce an aspect of the subject which at first sight may seem foreign to this paper, but which, in a fuller light, I feel sure, will prove an essential, viz.: The physiology of taste and smell. You will here note that taste and smell are two distinct senses, the one felt in the mouth by the tongue and the other in the nose by the olfactory epithelium. But most physiologists give flavor as simply smell, and describe it entirely apart from taste. While this may be perfectly correct physiologically, we cannot, from a pharmaceutical point of view, entirely separate the two. To illustrate, we would never think of supplying a sour taste with the same flavor as we might a sweet taste. A lemon flavor would run with an acid, while a cinnamon would be more agreeable to a sweet. While making this proviso, allow me to return to the physiology of the subject. First in a general way, and secondly with more particular attention to the organs under review. *General.*—Any cause that provokes a nerve to action is called a stimulus, and the evidence of that stimulation may be felt as a sensation either pleasing or otherwise. All appreciable qualities of objects in the surrounding world are natural stimuli at the sensory periphery, and these natural stimuli are the physical qualities of objects that excite, as smell, sight, hearing, taste, etc. *Particular.*—The principal nerve of taste is the glosso-pharyngeal, which supplies the posterior part of the tongue—*i. e.*, that portion of the buccal surface which most contributes to taste. Two other nerves also take part in taste. These are the so-called gustatory branch of the fifth, which is a common sensory nerve, and the chorda tympani of the seventh. The nerve ends by which taste excitation are considered to be received are the taste bulbs. Each taste bulb is an oval body formed of long fusiform cells arranged in cortical and medullary groups. Tastes may be classified into (1) sweet, (2) bitter, (3) acid or sour, (4) salt. It has not been decided whether alkaline and metallic tastes are elementary. The substance to be tasted must be dissolved; here there is a striking contrast to the sense of smell: flavor is really odor. Further, the solutions to be tasted should be about the temperature of the body, as then the sensation is more readily felt—on an average in about one-fifth of a second. It would seem that specific tastes have specific nerves, for different parts of the tongue are more sensitive to certain tastes than others; the back to bitter, the tip to sweet and salt, the sides to acid, the middle to hardly any. Cocaine applied to the tongue in increasing doses is said to abolish sensation of all kinds in the following order: General sensibility and pain, bitter taste, sweet taste, salt taste, acid taste, tactile sensations. When diluted sweet and salt solutions are simultaneously applied to the tongue, they tend to neutralize one another, but a true and definite point is difficult to reach. Sweet and bitter, sweet and acid liquids are antagonistic to a similar but less perfect extent. The delicacy of the sense of taste is shown by the power to detect one part of sulphuric acid in 1000 of water. Quinine, common salt, and sugar are less easily detected, but in the order given. Chewing the leaves of an Indian plant, *Gymnema Sylvestre,* destroys the sensibility to bitter and sweet, but leaves

the power to discern acids and saline bodies. The union of taste and smell is said by one writer on the subject to give rise to the composite sensation termed the flavor of a substance, while all the others consulted entirely separate taste from flavor, and describe the latter under smell. This may be the true philosophy of the subject, but, as already noted, it is impossible for us, as pharmacists, to separate the two entirely. The manner in which smell is conveyed is variously described. One writer says: "Odoriferous particles carried in the inspired air into the lower nasal passages pass by diffusion into the upper chambers, and, coming into contact with the olfactory epithelium, give rise to the sensation of smell." Another states that it is necessary that odorous substances should be in a gaseous state in order to act on the olfactory epithelium. A third, Ramsay, has advanced the theory that the sense of smell is excited by vibrations of a lower order than those which give rise to the sense of light or heat, and he points out a series of important facts in support of this view. He states that to produce the sensation of smell a substance must have a molecular weight at least fifteen times that of hydrogen. For instance, the specific gravity of marsh gas is eight—no smell; of ethane, fifteen—faint smell; of propane, twenty-two—distinct smell. Haycraft, assuming the correctness of Ramsay's hypothesis—that smell depends on the vibratory motion of odorous particles—has endeavored to show that the quality of the sensation depends on the kind of vibration producing it. He has also traced a correspondence between the character of the smell and the position of the body producing it in the groups in which Mendelejeff has arranged the elements to illustrate the periodic law. When we remember that smells can be filtered through cotton wool without loss of pungency, the theory of odoriferous particles exciting the nerves falls somewhat short. And, again, that odorous matters of animal effluvia, etc., are of a higher specific gravity than the air, and do not readily diffuse, upsets the general application of the gaseous theory. Here we are left with the vibratory theory of Ramsay, which may be applied without exception to all emanations. And it becomes the more likely when we think how the forces sound, light, and heat are transmitted. This, then, brings me to my theory, or suggestion, for a better understanding of smell or flavor. Having admitted that the sense of smell is conveyed by vibration, it appears quite feasible to draw a parallel between smell and sound. If certain sound waves produce certain notes, then certain smell waves must produce certain odors. In music we have scales of notes, in which every musical sound has a place, and to the trained ear of a musician very fine gradations of sound may be determined. Why, then, should we not have an odorous or flavoring scale drawn up and clearly defined, to which all odors may be compared? Again, we might learn, as in music, that certain notes or flavors may not run together, in other words, will not harmonize, but will produce discords. Another way it might be shown that, as in music, all flavor combinations must be on the same key. One might well imagine such flavors as liquorice giving low notes on the scale, while higher up might be placed cinnamon, almonds, nutmegs, and still higher eucalyptus, thymol, menthol, etc.; and perhaps at the top ethereal flavors, as pineapple, pear, raspberry, etc. One difficulty suggests itself—*i. e.*, the selecting of simple or elementary flavors to form notes on the scale, most flavors, even those derived from a single source, being of a composite nature. The foregoing and many other

similes might be drawn between music and flavor by those better versed in the theory of music. There is one point of special importance to pharmacists, that which might be termed the psychology of flavoring. If a preparation has a pleasing appearance, the person taking it may be predisposed towards it, and will naturally seek for a pleasant flavor, and, if present, will appreciate it to a greater extent than he would if it looked dull and uninviting. Just fancy a connoisseur of good wine seeking to roll upon his tongue a wine of miserable color and muddy appearance! This, then, forms my theory or fantasy on flavoring, and though it may be more in the nature of a dream than a reality, still I hope it may serve the purpose of awakening in some greater mind the possibility of some system which will guide us in the art or science of flavoring.

DISCUSSION.

Mr. Boa said this was a very suggestive paper. It was well to have some definite principle to go upon in flavoring. In regard to perfumery it was interesting to note that if, for example, they put a drop of oil of eucalyptus on blotting paper and shook it, they would observe a series of different odors coming off in stages, thus indicating that all essential oils were a complex combination of different odors. Again, it would be found that if two perfumes, having nothing in common, were mixed, the result would not be agreeable. Another point to be observed was, and he thought this a principal consideration in the building up of perfumes, that odors diffused at different rates. If they put a few drops of one perfume at the corner of a room, for example, the odor would be perceptible at the other extreme much earlier than in the case of some other perfume placed in the same position at the same time. This had to be borne in mind when, in blending perfumes, they were endeavoring to back up one by the addition of another. In such cases it was necessary to select perfumes which diffused at the same rate. Culinary flavors, such as lemon, orange, or vanilla, were generally of a simpler nature than those found in perfumes. The sense of taste and the sense of smell seemed to be closely related. He knew a man engaged in the drapery trade who was accustomed to buy and sell perfumes, but he was almost destitute of the sense of smell. Nevertheless, he could select perfumes by the curious method of allowing a little to trickle down the throat. He thought Mr. Crombie should follow up the interesting suggestions he had made, and embody the results in a future communication. It seemed not unlikely that, as the result of experience, and probably unconsciously, those accustomed to obtain any desired flavor, really did so by proceeding on such lines as Mr. Crombie indicated.

Mr. Henry said he had noticed that in the B. P. Codex, an otherwise excellent publication, the formulæ seemed frequently to fail, because of the flavor being unsatisfactory. In the case, for example, of the syrup of glycerophosphates, it is spoilt by the harshness of the taste. In this respect it differed from the proprietary articles. Possibly, this might be due to the fact that the B. P. Codex preparation contained a larger proportion of glycerphosphates. He thought Mr. Crombie had done the craft a service by this ingenious suggestion.

Mr. Merson said those who had experience in the making of palatable preparations, had been accustomed to reach a result by a rule-of-thumb method, and it would be an advantage to have some definite system instead.

Mr. Somerville said the question of flavoring with certain medicaments was important. He had often heard it said that a mixture containing quinine flavored with syrup of orange was a fraud. The agreeable odor of the orange, and the sweetness of the sugar were speedily replaced by the bitterness of the quinine. If they could hit upon a flavor which would mask the quinine bitterness in the pleasing odor and sweet taste of the sugar, it would be an advantage. It was often said by those who took Gregory's Powder, that if it was mixed and handed to them by another person, it was more easily taken, because they had not time to perceive the nauseous odor which was so evident when they had themselves to mix it with water.

Mr. MacPherson said he thought Mr. Crombie had omitted the chief point suggested by his paper, namely, a definite scale for flavors. His recollection was, that this was an idea that was made much of by Mr. Piesse, and Mr. Crombie might get some useful hints from his published book on perfumery.

Mr. Rowland said it would not be so easy to get a scale of odors from natural products, each of which represented rather a chromatic scale. A better plan would be to begin with some of the coal tar products which could be separated by fractionation, as was done even already in the case of many of the essential oils. By collecting these fractions together, they might be able to hit upon a scale.

Mr. Hill said the title of Mr. Crombie's paper would have been more accurate if he had called it not "The Art of Flavoring," but the "Science on which the Art of Flavoring is Based." What he had said was suggestive, but only preliminary, and he hoped Mr. Crombie

would follow the matter up and give a subsequent communication setting up something like a definite practical scale.

Mr. Tait said, taking the analogy of music, a novice could play a scale on a piano, but it would be destitute of that quality which would be imparted to it by a highly trained pianist. The same was even more noticeable in the production of a vocal scale. In the same way they might draw up a scale of flavors according to the science of flavoring, but the art of flavoring was something more that could only be reached by training and experience.

Mr. Crombie, in replying, said it was difficult to draw up a scale, and, certainly they would have to begin with some of the elementary odors. In the case of a preparation like cod-liver oil emulsion they might have two classes of flavors, the ethereal odor being the first perceptible, and some heavier odor towards the last, so as to mask the flavor of the cod-liver oil. With regard to distinguishing perfumes by swallowing them, it had been stated that the nostrils could be filled full of such a thing as eau de Cologne without perceiving any odor, but if air bubbles were admitted the odor was immediately perceptible. This seemed to suggest that in order to produce the sense of smell the substance must be in a gaseous or suspended form. Flavoring was very frequently completely overdone, and he thought that in this country we were much behind. The Americans excelled in giving just that amount necessary and no more. In preparations such as cod-liver oil emulsion he sometimes found as much as a drachm of oil of almond or oil of cinnamon to a gallon of emulsion, which was quite excessive. Six drops to the gallon was ample for flavoring purposes. Recently he had been asked by a hairdresser to supply him with something possessing the distinctive odor of a hair preparation. At first he was puzzled, and then imagined that he had tasted the same odor. On reflection, he remembered that his impression was associated with some liquorice pastilles which he had tasted, and, when tasting, had perceived the odor. Syrup of orange was quite insufficient as a flavoring agent for covering the taste of quinine. They required something very much heavier, such as liquorice. In regard to taking Gregory's Powder, it was well known that by simply holding the nose a person would find the swallowing of Gregory's Powder quite an easy matter.

THE INFLUENCE OF HYDROGEN PEROXIDE ON THE AROMATIC COMPONENTS OF MOUTH-WASHES.

(Notes from the Laboratory of E. Sachsse & Co., Leipzig.)

As hydrogen peroxide has, besides disinfecting, very vigorous oxidizing propensities, it is obvious that it has a deteriorating influence on all essential oils, etc., which have easily oxidizable constituents, such as alcohols, aldehydes, etc.

It is, therefore, of importance to every manufacturer of dental and similar preparations to know which essential oils and other aromatic products are influenced by hydrogen peroxide, and which remain unchanged.

The table below will show this.

The hydrogen peroxide solutions used were made as follows: 0.05 oz. aromatic substance (essential oil or chemical) were mixed with 40 ozs. alcohol 55 overproof, 30 ozs. water, and 25 ozs. of a 12 percent solution of hydrogen peroxide. These mixtures were left two months in stoppered brown bottles, and then compared with similar freshly-prepared mixtures.

The Aromatic Substance Employed.	*Remarks on the Taste and Character of the Solutions after two months.*
Oil of almonds freed of prussic acid	Turned entirely to benzoic acid
Anethol Oil of aniseed tsf. "Sachsse" Oil of star aniseed tsf. "Sachsse"	Unchanged
Bornylacetate	Unchanged
Carvacrol	Weaker than the fresh solution
Cinnamic aldehyde	Entirely oxidized, insipid taste, not a trace of cinnamon flavor left
Oil of cloves tsf. "Sachsse" Eugenol	Slightly changed—the taste of the fresh solution is more agreeable.
Oil of caraway seed tsf. "Sachsse" Carvol	Unchanged, only slightly weaker