and alkaline salts, (e. g. chlorides) without previously reporting the alkaloid, giving at least an approximate determination of the vegetable base. If free acid is present, this may also be determined in the same operation.

A PLAN FOR DETERMINING BY TITRATION BOTH ACID AND BASE IN BENZOATES OR SALICYLATES OF THE ALKALIES.

A. B. LYONS, M. D.

Dissolve 0.25 gm. of the salt (e. g. Sodium Benzoate) in 10 cc. of distilled water in a separator. Add 25 cc. of decinormal sulphuric acid. Shake out the benzoic acid with four successive portions of chloroform, which must be proved to be free from alkalnity or acidity. The chloroform must be drawn off each time into a second separator in which it is to be shaken with 20 cc. of distilled water, to wash out any sulphuric acid which may have accompanied the chloroform. After washing thus, transfer the chloroform to a suitable flask, in which the free acid is to be titrated with N/25 volumetric alkali (lime water answers well), using as indicator methyl red. The end point of the titration is indicated by the appearance of a yellow color in the aqueous stratum after shaking with the chloroform.

The water in separator No. 2 is to be transferred to separator No. 1 and the residual acid is to be determined by titration with N/25 volumetric alkali. This excess deducted from the volumetric sulphuric acid originally taken, gives a measure of the benzoic acid which has been extracted, and consequently of the base with which that acid was combined.

Evidently this second titration is all that is usually required, but the first serves as a check on the result obtained.

The method should be tried in comparison with that of the U. S. P. VIII to test the question which of the two is the more exact on the one hand, and the more rapidly executed in practice on the other.

NOTES ON CHEMICAL TESTS OF THE UNITED STATES PHARMACOPŒIA.*

CARL E. SMITH.

(Continued from page 301.)

ACONITINA.—Requires 26 to 28 parts of alcohol for solution ("22 parts." U. S. P.). The melting point is not a good criterion of purity, as the alkaloid decomposes and melts at temperatures varying with the rate of heating. About 0.2 gm. should leave no weighable residue on incineration. Not all solutions of aconitine are laevogyrate, as B. L. Murray has pointed out; alcohol-solutions are dextrogyrate, water-solutions inactive, and benzene-solutions laevogyrate. Market products are variable in composition, frequently not responding to the perman-

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*Analytical Laboratory of Powers-Weightman-Rosengarten Company.

ganate precipitation test, because of the presence of amorphous alkaloids, which may also be detected by a bitter taste of the weak solutions.

AETHER.—Determination of the specific gravity with results varying not more than two units in the fourth decimal place, has been described by G. D. Rosengarten (*Jour. Ind. & Eng. Chem.*, 1911, v. 3, p. 872) as follows: "A calibrated pyknometer of 25 cc. capacity is employed. To determine its volume the pyknometer is first weighed with water at 25° C., choosing a convenient mark on the stem, say 30 or 40, which may be the more convenient. The pyknometer is then filled with ether to a little above the mark at which the weight of water has been determined and placed in a 1000 cc. beaker containing water, which is carefully kept at 25° C. and constantly stirred with a thermometer. When the volume of ether becomes constant in the pyknometer the excess of ether is drawn off by means of a capillary pipette until the desired mark is exactly reached. The pyknometer is then quickly dried with soft flannel or filter paper and weighed. A capillary pipette for this purpose is easily made by drawing out an ordinary eye-dropper." Attempts to cause ether to boil in a test-tube by means of the warmth of the hand are seldom successful. This test should therefore be omitted and the boiling point determined in the regular manner. 25 cc. should leave no weighable residue on evaporation from a platinum or porcelain dish and drying the dish at 100°. The test for aldehyde should be made with exclusion of light. As peroxides are liable to form in ether on keeping, especially when exposed to light in partially filled containers, tests for these are important. Baskerville and Hamor recommend cadmium potassium iodide. The test may be made by shaking 10 cc. of ether with 1 cc. of a freshly made water-solution of cadmium potassium iodide (1 in 10), in a glass-stoppered tube, protected from light, occasionally during one hour. No color should develop in either liquid. Peroxides cause liberation of iodine. When cadmium potassium iodide is not available, a freshly made solution of potassium iodide U. S. P. (1 in 10) may be used with almost equally reliable results. For a full study of the tests of ether for anæsthesia, by Baskerville and Hamor, see *Jour Ind. & Eng. Chem.*, 1911, v. 3, p. 302.

AETHER ACETICUS.—It should not leave more than 0.01 per cent. of residue on evaporation. A more exact means than that given in the U. S. P. for determining the ethyl acetate contents is the following: About 4 cc. of acetic ether are weighed in a 100 cc. flask provided with a stopper of glass or rubber. A few cc. of water are added and free acetic acid neutralized with alkali hydroxide, with phenolphthalein as indicator. The neutralized liquid is then shaken briskly for a few minutes with 50 cc. of normal alkali, until the ester is dissolved. By shaking the mixture occasionally during 2 hours, the saponification will be completed without heating or it may be hastened by warming gently. If the reaction is incomplete, the unchanged ester may be detected by its odor, after cooling. The excess of alkali is titrated with normal acid. Each cc. of normal alkali ($O=16$) corresponds to 0.08806 gm. of ethyl acetate. The sulphuric acid test for carbonizable impurities is rather too exacting, particularly when the ester is kept in cork-stoppered containers. A slight color at the zone of contact should be allowed.

AETHYLIS CARBAMAS.—It should not leave more than 0.05 per cent. of residue on incineration. In addition to conforming to the U. S. P. requirements, it should stand the following tests: The water-solution (1 in 20) should be neutral to litmus, should not show more than slight traces of chloride with silver nitrate, and should show no nitrate by the ferrous sulphate test.

AETHYLIS CHLORIDUM.—The test for hydrochloric acid may be made more definite and practical by dissolving 1 cc. of ethyl chloride in 20 cc. of alcohol and adding a few drops of silver nitrate. No turbidity should be produced at once. This also serves as a test for ethyl bromide and iodide. The test of the last paragraph may be modified to advantage in this manner: On spontaneous evaporation of 10 cc. from a shallow dish no foreign odor should be noticeable while the last portions evaporate and no weighable residue should remain.

ALCOHOL.—Comments in pharmaceutical literature on the U. S. P. requirements indicate that these are fairly satisfactory. The chief criticisms have been that alcohol stored in wood-containers is excluded by the test for tannin and that the test for methyl alcohol is incapable of detecting smaller quantities than 2 per cent. As a result of experiments with various methods, J. Rosin proposes a modification of the present test, capable of detecting about 1 per cent. of methyl alcohol: 1 cc. of alcohol (95 per cent. by vol.) or a proportionately larger quantity of weaker alcohol is diluted to 10 cc. with water, in a 40 cc. test-tube. 0.5 cc. of sulphuric acid is added, the mixture cooled, and 5 cc. of a cold 15 per cent. water-solution of potassium permanganate added. After 2 minutes the precipitate produced is dissolved by addition of just enough sulphurous acid, and the liquid boiled until free from the odor of acetaldehyde. It is then cooled and 1 drop of a water-solution of resorcinol (1 in 200) added. A portion of this mixture is stratified over on equal volume of sulphuric acid. Not more than a light pink and no rose-red zone or whitish flakes near the zone should be produced. Legal's test for acetone is useful when adulteration with ordinary wood spirit containing acetone is suspected. It is conveniently applied as follows: To a mixture of 5 cc. of alcohol and 2 cc. of sodium hydroxide solution (5 p. c.) about 5 drops of a freshly made water-solution of sodium nitroprusside (1 in 50) are added, then acetic acid to a *slightly* acid reaction. No violet color should appear within 1 minute. For determining non-volatile matter platinum or porcelain dishes should be used instead of a glass vessel, as the U. S. P. directs, since glass loses appreciably in weight during contact with steam or hot water.

ALOIN.—According to J. M. Francis the product of the American market is *not* "chiefly prepared from Curaçao aloes," as stated by the U. S. P. He proposes that the vague requirements as to solubility and ash be replaced by the following: "Not more than 1.5 per cent. should be insoluble in either water, alcohol, or acetone. It should not leave more than 0.5 per cent. of residue on incineration." Of the identity tests given in last paragraph of the U. S. P., p. 36, only the first and the last are applicable to all permissible varieties of aloin. Solutions of aloin should be neutral or not more than faintly acid to litmus.

ALUMEN.—For identification as a potassium salt the test with sodium bitartrate is not conclusive, as ammonium alum also gives a precipitate with this reagent The flame test is more reliable. Arsenic is a probable impurity not provided for in the U. S. P. tests. The official Gutzeit and Bettendorf tests can be used. The U. S. P. tests are not sufficient to determine if the salt conforms to the "rubric" requirement of at least 99.5 per cent., as it may contain other impurities, such as ammonium, calcium, magnesium, chloride, and others. Quantitative determinations of aluminum and of potassium may be required in doubtful cases.

ALUMEN EXSICCATUM.—A literal interpretation of the requirements admits any dried alum, regardless of the amount of water it may have absorbed, provided it has a dry appearance and contains not more than 1 per cent. of impurities when in the anhydrous state. However, it was obviously not the intention of the Revision Committee to permit the presence of an indefinite amount of absorbed water, as the efficacy of the salt, for the purposes intended, decreases in proportion to th quantity of water it contains. As the salt is decidedly hygroscopic, a test defining a limit of water should be given. Foreign pharmacopœias allow 10 per cent.

ALUMINI SULPHAS.—This salt crystallizes with varying quantities of water under different conditions, the salt of the market sometimes containing more, sometimes less than 16 molecules. The German Pharmacopœia recognizes a salt containing 18 molecules. A salt containing only traces of free acid, as required by the U. S. P., cannot be expected to make a clear solution in water, because of hydrolytic dissociation. Excessive contamination with arsenic, for which no test is given, has sometimes been noted. The German Pharmacopœia directs the Bettendorf test. Determinations of aluminum and of water are required to ascertain if more than 0.5 per cent. of impurities are present.

AMMONII BENZOAS.—As Seidell and Menge have reported, neither the melting point nor the reaction to litmus paper is a satisfactory means of establishing purity. They recommend titration of the ammonia after distilling the salt with fixed alkali. For pharmacopœial purposes it is probably sufficient to titrate the free benzoic acid in a water-solution of the salt, with litmus as indicator. Pure ammonium benzoate is a little alkaline to litmus. Traces of chloride and sulphate should be allowed in this salt.

AMMONII BROMIDUM.—It does not volatilize "completely," but should not leave more than 0.05 per cent. o fresidue, when heated. A test for bromate is unnecessary, as it cannot exist in the salt when it has a slightly acid reaction. The standard of purity is now unnecessarily low, as the salt is readily obtained 99 per cent. pure, the chief impurity being ammonium chloride.

AMMONII CARBONAS.—Market products contain from 27 to 31 per cent. of ammonia; the U. S. P. standard of at least 31.58 per cent. is seldom reached. It should not contain more than 0.05 per cent. of non-volatile matter. The titration is made more conveniently with methyl orange as indicator without boiling.

AMMONII CHLORIDUM.—While nominally allowing 0.5 per cent. of impurities, the U. S. P. gives tests which exclude any salt less than 99.9 per cent. pure. As ammonium sulphate is the chief impurity in this salt, the requirement of almost entire absence of it is equivalent to requiring practically a chemically pure product.

AMMONII SALICYLAS.—The U. S. P. requires that a concentrated aqueous solution "should redden blue litmus paper." With much care a salt can be made having a slightly alkaline reaction, but unless perfectly dry and kept in full, tightly stoppered containers, it soon loses enough ammonia to acquire an acid reaction. Therefore, this requirement excludes a salt of the highest attainable purity, and places a premium on a product containing considerable quantities of free acid. Free salicylic acid, which is practically the only impurity this salt is likely to contain in excess of traces, is best determined as stated under *Ammonii Benzoas.* Non-volatile matter should not exceed 0.1 per cent.

AMYLIS NITRIS.—It should be required to distil completely at a temperature not exceeding 110°, to exclude objectionable impurities, such as amyl nitrate and nitropentane. In the assay it is advisable to use only half the volume of potassium iodide solution and of sulphuric acid directed, but both should be of double strength. This hastens the reaction and makes it more nearly complete.

ANTIMONII ET POTASSII TARTRAS.—The limit of arsenic, which was changed in 1907, is by some critics considered too lenient. This impurity is found to be difficult to remove, and involves methods of purification that cause partial oxidation of the antimony, which would require lowering the percentage of pure salt in the product from 99.5 per cent. to 98.5 or 98 per cent. The tests for sulphate, heavy metals, and potassium bitartrate hardly show "absence" of these impurities as stated, but are sufficiently sensitive for practical purposes.

ANTIPYRINA.—The melting point as given by various authorities, including the more important recent pharmacopœias, varies from 109° (Danish Pharmacopœia) to 114° (French Pharmacopœia). Market samples examined during two years past, while otherwise conforming to all U. S. P. requirements, had melting points ranging between 105° and 113°, the entire melting intervals being included in these figures. The difficulty of obtaining products having uniform melting points has also been noted by Lefelt and others. Ash should not exceed 0.1 per cent. The U. S. P. test for acetanilide cannot be used, as pure antipyrine also responds to the iso-nitrile reaction, but complete solubility in 1 part of cold water excludes this adulterant, as well as phenacetine, sufficiently well.

APOMORPHINAE HYDROCHLORIDUM.—The salt of commerce, as furnished for medicinal purposes, is not anhydrous as the U. S. P. formula indicates, but contains ½ molecule (2.89 per cent.) of crystal-water, which it loses over sulphuric acid and regains on exposure to the air. About 0.2 gm. should leave no weighable residue on incineration. A test for decomposition products given by recent pharmacopœias consists in shaking about 0.1 gm. with 10 cc. of ether, when the latter should not become more than slightly reddish. Fresh stock, under these conditions, gives no color whatever. Frerich's test for other alkaloids including by-products of the manufacture of apomorphine, consists in placing about 0.1 gm. of the salt on a dry filter and washing it with a cold mixture of 1 cc. of hydrochloric acid, U. S. P., and 4 cc. of water. The washings may become turbid, but should yield no precipitate at once on the addition of Mayer's reagent. The test is based on the sparing solubility of apomorphine hydrochloride in diluted hydrochloric acid.

AQUA AMMONIA.—Non-volatile matter is more accurately and conveniently determined by evaporating a measured quantity without previous neutralization. Because of the solvent action of ammonia solutions on glass, 0.02 per cent. should be allowed in 10 per cent. and 0.05 per cent. in 28 per cent. solutions, although when freshly bottled they contain much less than this. Appreciable amounts of ammonia will be volatilized and results found too low, when the U. S. P. directions for the assay are followed. It is more practical to weigh the sample in a flask containing either volumetric acid or sufficient water to prevent volatilization.

AQUA HYDROGENII DIOXIDI.—Determination of acidity by direct titration, which is directed by most foreign pharmacopœias and sometimes recommended by writers in American journals is not reliable, as part of the alkali forms a combination with hydrogen peroxide which gives no color with phenolphthalein, according to Endemann and others. The U. S. P. method is to be preferred. The test for hydrofluoric acid is not delicate enough to prove "absence," but is sufficiently so to exclude objectionable quantities.

ARGENTI NITRAS.—In the test for lead the mixture with sulphuric acid must be kept hot to prevent crystallization of silver sulphate, which may be mistaken for lead sulphate. The test for foreign salts may give misleading results, unless several precautions are taken, which are not mentioned in the U. S. P. Hydrochloric acid should be added only in slight excess, to a hot solution of the salt, and the mixture allowed to stand until the liquid is clear. A little silver chloride still remains in solution, as a rule, and may be removed by evaporating the filtrate to dryness on a water-bath and taking up the residue with water and a few drops of diluted hydrochloric acid. Any insoluble matter should be filtered out and the filtrate evaporated. This test is superfluous, as the same impurities will be shown by the titration, when this is made with sufficient care to obtain results within 0.1 per cent.

ARSENI TRIOXIDUM.—It should not contain more than 0.1 per cent. of non-volatile matter. Commercial products often contain over 1 per cent. To dissolve arsenic trioxide in sodium bicarbonate solution for titration, there is no objection to boiling in order to hasten solutions. The statement sometimes made that normal sodium carbonate, which is formed by heating, decolorizes iodine under the conditions of the assay, has been found erroneous. It is more convenient, however, to dissolve the sample in caustic alkali, neutralize, and add sodium bicarbonate, as proposed by Caspari, but presence of caustic alkali favors atmospheric oxidation and the solution should be neutralized without delay. Not less than 0.2 gm. should be taken for an assay, for accurate results.

ATROPINA.—The melting point of a considerable number of commercial samples were found to vary between 113° and 116°, the upper figure, together with other tests, indicating total absence of hyoscyamine in a number of cases. About 0.5 gm. should leave no weighable residue on incineration. About 0.1 gm. should dissolve in about 2 cc. of sulphuric acid without imparting to it more than slight yellow color and this color should not be more than slightly increased on addition of about 0.1 cc. of nitric acid. Entirely colorless solutions, as demanded by the U. S. P., are not obtained with any product of the market. A test for apoatropine and belladonnine, required by the more recently published pharmacopœias, consists in adding 2 cc. of ammonia water to 5 cc. of a water-solution of atropine (1 in 60) made with a slight excess of diluted sulphuric acid. No turbidity should be produced at once.

ATROPINAE SULPHAS.—The salt furnished to the trade contains about 1 molecule (2.59 per cent) of crystal-water and is somewhat efflorescent (the U. S. P. formula is that of the anhydrous salt, stated to be permanent in air). The melting point varies greatly with the rate of heating. According to Riedel the pure salt can be melted at 180° by slow heating and at 190° by rapid heating. Other pharmacopœias give melting points ranging from 180° to 184°. In other respects the remarks under ATROPINA apply also to this salt. The presence of hyoscyamine in atropine and its salts is best determined with a polariscope.

AURI ET SODII CHLORIDUM.—To be certain of complete precipitation of gold, in the assay, it is advisable to add a second portion of a few cc. of hydrogen peroxide solution about half an hour after adding the first portion. The same volume of liquid should be maintained during the period of heating, by addition of water if necessary. The precipitation is best made in a small, well-glazed, covered porcelain casserole.

BENZALDEHYDUM.—It is colorless only when freshly distilled and becomes yellowish on keeping a short time. A test for nitrobenzol is given in the Belgian and German pharmacopœias. It has been found satisfactory when made as follows: About 1 gm. of benzaldehyde is dissolved in 20 cc. of alcohol and enough water added to produce a slight turbidity. A brisk evolution of hydrogen is maintained in the solution for 1 hour by additions of zinc and diluted sulphuric acid. It is then filtered and evaporated to about 20 cc. On boiling this with 2 drops of potassium dichromate test solution no violet color (indicating presence of aniline) should be produced. The U. S. P. assay method, according to various analysts, does not give even approximate results. A sample, recently examined by H. C. Frey and the writer, in which no impurities other than about 5 per cent. of benzoic acid could be detected, assayed 51 per cent. by this method. No satisfactory method is at present known. An adaptation of the U. S. P. (Blank and Finkenbeiner) method for formaldehyde gave with the same sample 94.5 per cent., but several days were required for complete reaction. The U. S. P. tests, including specific gravity and boiling point, a test for nitrobenzol, and determination of benzoic acid (by titration in alcohol-solution, with phenolphthalein as indicator) should be sufficient to limit impurities, exclude adulterants, and define approximately the percentage of actual benzaldehyde.

BENZOSULPHINIDUM.—Described as "nearly odorless." It is odorless when pure, but usually has a faint aromatic odor. The melting point is given as 224° for the pure substance by some authorities, also for the medicinal substance by several pharmacopœias. Para-sulphamine-benzoic acid, often present as an impurity, melts at 280° to 283° and may raise the melting point of saccharin considerably. Market samples have been found to melt between 215° and 225°. Residue on incineration should not exceed 0.5 per cent. A series of 13 samples yielded from 0.13 to 0.33 per cent., chiefly sodium sulphate. A water solution should have a distinctly sweet taste in a dilution of 1 in 10,000.

BETANAPHTHOL.—The melting point of acceptable market samples varies from 119° to 123°. Other pharmacopœias give from 120° to 123°. Non-volatile matter should not exceed 0.05 per cent. The tests for alphanaphthol should be made in cold, saturated solutions.

BISMUTHI CITRAS.—A pure salt theoretically contains bismuth corresponding to 58.44 per cent. of bismuth oxide, which would be excluded by the present limit of 56 to 58 per cent. As stated in the Brit. Pharm. Codex, the salt usually contains 2 to 3 per cent. of absorbed water, allowance for which should be made in an assay.

BISMUTHI SUBCARBONAS.—In the test for alkalies and alkali earths a limit of 0.2 per cent. should be allowed.

BROMOFORMUM.—A product containing only 1 per cent. of alcohol decomposes rapidly. The German and Belgian pharmacopœias require 4 per cent., with a view to better keeping qualities. Bromoform of the latter composition congeals at 5° to 6°, boils at 144° to 150°, and has a specific gravity of 2.829 to 2,833 at 15°/15°, according to the German Pharmacopœia. It should be free from suffocating odor (carbon oxybromide).

BROMUM.—The U. S. P. tests are not sufficient to determine if the limit of 3 per cent. of impurities is exceeded, no provision being made for the limitation of chlorine, which is the principal impurity, always present to some extent in bromine of commerce. A simple test to show approximately how much is present, proposed by the German Pharmacopœial Commission, is as follows: "1 cc, of a solution of 1 gm. of bromine in 29 gm. of water is diluted with water to 10 cc., 3 cc. of ammonium carbonate solution (1 part ammonium carbonate, 3 parts water, 1 part 10 p. c.-ammonia water) are added, then 5 cc. of n/10 silver nitrate. The mixture is shaken briskly and filtered, then acidulated with nitric acid of about 25 per cent. A very slight opalescence and no formation of a deposit in 1 hour indicates presence of about 1 per cent. of chlorine; a moderate opalescence and a deposit after half an our about 2 per cent.; a decided opalescence, but still translucent liquid and a deposit of flakes after 2 or 3 minutes about 3 per cent.; an opaque mixture, beginning to form flakes at once, 4 per cent. or more." The test should be made in tubes of about 2 cm. diameter. An improvement of the iodate method for exact determination of chlorine in presence of bromine is given by L. W. Andrews in *Jour. Am. Chem. Soc.*, v. 25, p. 756.

CAFFEINA.—Products of representative sources do not contain more than 0.1 per cent. of non-volatile matter. The requirement that caffeine should produce colorless solutions with concentrated sulphuric or nitric acid, is hypercritical, but about 0.5 gm. should dissolve in 5 cc. of either sulphuric or nitric acid without producing more than a slight yellowish color.

CAFFEINA CITRATA.—Several additional tests are required to establish purity and correct composition. Residue on incineration should not exceed 0.1 per cent. A saturated water-solution should stand the U. S. P. time-limit test for heavy metals. A 1 per cent. water-solution should remain clear 5 minutes after addition of barium chloride. It should not yield less than 49 per cent. of anhydrous caffeine by the following test: About 0.5 gm., dried to a constant weight at 80° before weighing, is dissolved in 10 cc. of warm water, an excess of caustic soda solution added and the cooled mixture shaken with 3 portions of 20, 10, and 5 cc., respectively, of chloroform. The combined chloroform extracts are evaporated to dryness and the residue dried to a constant weight at 80°. In the U. S. P. solubility test (2d paragraph of small type) separation usually does not take place for several hours after dilution with 5 parts of water, unless the liquid is cooled to a low temperature.

CAFFEINA CITRATA EFFERVESCENS.—It should yield not less than 1.95 per cent. of anhydrous caffeine, when about 5 gm. are assayed by the method given above.

CALCII BROMIDUM.—The U. S. P. tests are not sufficient to determine if the salt contains the required 97 per cent. of $Ca\ Br_2$. Among impurities not provided for, it may contain much chloride, a little sulphate, and also magnesium and alkali salts. For an exact determination of the actual $Ca\ Br_2$ contents quantitative determination of calcium and of bromine would be required, but for practical purposes it is usually sufficiently exact to determine the chloride, after the salt has been rendered anhydrous at about 180°, by precipitating bromide and chloride together as silver salts, then making an approximate separation of the two by means of a limited quantity of ammonium carbonate solution (see test for chlorides under ACIDUM HYDROBROMICUM, U. S. P., p. 13). The impurities in the products of reputable makers are usually so well within the U. S. P. limits, that quantitative determinations are not required.

CALCII CARBONAS PRAECIPITATUS.—The test for "limit" of iron, aluminum, and phosphates practically requires *total absence* of these impurities. Additional tests are needed to ascertain presence of the required 99 per cent. of $CaCO_3$, as the salt may contain chloride, sulphate, magnesium and alkali salts. A volumetric determination of calcium is readily made by dissolving the salt in hydrochloric acid, expelling carbon dioxide by boiling, then adding an excess of ammonia water and precipitating with volumetric oxalic acid. The excess of oxalic acid is titrated in an aliquot part of the filtrate with permanganate (for details see Fresenius, Quant. Anal.). In doubtful cases, e. g., when a considerable quantity of calcium sulphate or chloride is present, a carbon dioxide determination may be necessary.

CALCII CHLORIDUM.—When "rendered anhydrous by fusion," as specified by the U. S. P., the salt undergoes decomposition sufficiently to acquire an alkaline reaction, while it is required to be "strictly neutral." A nearly anhydrous, neutral salt is made at a lower temperature in granular form. A limit of 0.1 per cent. of magnesium and alkalies is equivalent to requiring a purity of practically 99.9 per cent., instead of 99 per cent. as specified, as magnesium is the chief impurity in calcium compounds not readily removed. Determination of calcium (by the method indicated above or other suitable method) would make a test for magnesium and alkalies superfluous.

CALCII HYPOPHOSPHIS.—The test for "absence" of phosphate and sulphate will not detect traces of these, nor can absence of phosphate be demanded in a salt that is subject to atmospheric oxidation with formation of phosphite and phosphate. No method is provided to determine presence of 98 per cent. of $Ca\ (PH_2O_2)_2$. The permanganate method of the U. S. P. of 1890 has been criticised as being unreliable because of interference of sulphites, thiosulphates, phosphites and phosphates. Although theoretically the presence of these substances should cause the results to be too high, experience has shown the tendency of the method towards too low results. Sulphites and thiosulphates are not now found in the commercial product and all except traces of phosphite and phosphate may be eliminated by adding an excess of lime water to a water-solution of the salt and applying the permanganate method to the filtrate. For more exact determinations it is preferable to precipitate phosphite and phosphate with lead acetate, oxidize the hypophosphite in the filtrate with nitric acid and determine it by the usual methods as phosphate.

CALCII PHOSPHAS.—The test for barium, as given, is far from being sensitive enough to prove "absence" of it. Strong acidulation with nitric acid effectually prevents precipitation of decided traces of barium sulphate. A better way would be to use barely enough nitric acid to bring the salt in solution, add the potassium sulphate, and let the mixture stand for some hours. If a precipitate is formed, it should be readily and completely dissolved by further addition of nitric acid. Some specimens of this salt have been found to respond to the U. S. P. test for excessive quantities of arsenic, when actually the arsenic present was well within U. S. P. limits. The samples, when boiled with silver nitrate solution, gave evidence of containing traces of some impurity capable of reducing silver, assumed to be phosphite, which, on conversion to phosphine during the test for arsenic, would produce a yellow spot similar to that produced by arsine. After a preliminary treatment with nitric acid, as directed in the U. S. P. for hypophosphites, no reactions for arsenic were obtained. When the salt contains more than traces of magnesium or of sulphate, quantitative determinations of either calcium or phosphoric acid, or of both, may be required, to ascertain if a minimum of 99 per cent. of $Ca_3(PO_4)_2$ is present.

CALX CHLORINATA.—A committee on Standard Specifications of the *Am. Chem. Soc.* proposes requirements as follows: It must be white, fresh, and dry, must contain not less than 31 per cent. of available chlorine, and must settle readily and completely when mixed with water; if lumps are present, they must break down and leave no core. Analyses are to be made by Penot's method, by adding an excess of n/10 sodium arsenite and titrating excess with n/10 iodine (Sutton's *Volumetric Analysis*, 10th ed., p. 177). Further details are given in *Jour. Ind. & Eng. Chem.*, 1911, v. 33, p. 861. The U. S. P. method of assay has the defect that any chlorate present is included in the determination. By acidulation with acetic acid, according to Bunsen, instead of hydrochloric acid, more accurate results may be obtained by the U. S. P. method.

CALX SULPHURATA. The semi-quantitative test intended to show presence of at least 55 per cent. of calcium sulphide has been found by J. Rosin to give results much too low, chiefly because of interaction between the sulphide and sulphite, which is always present. By methods involving removal of sulphite before determination of the sulphide, a recent sample was found to contain 58.5 per cent. of Ca S., when the U. S. P. test indicated presence of less than 55 per cent.

CAMPHORA.—No pharmacopœia, so far as the writer is aware, has as yet admitted synthetic camphor, although it is claimed in various quarters to be therapeutically equivalent to the natural product. Borisch's test, as given in the Swiss Pharmacopœia, to distinguish natural from artificial camphor, is based on the presence of some characteristic impurity in the former. About 0.01 gm. of camphor is stirred with a few drops of a 1 per cent. solution of vanillin in concentrated sulphuric acid. Natural camphor gives a yellow color, changing to red, violet, and blue. Synthetic camphor gives no colors. The German Pharmacopœia states the specific rotatory power of a 20 per cent. solution of pure natural camphor in absolute alcohol to be +44.22° at 20°. A specimen of a synthetic product was recently found to have a specific rotation of about +15°. It is usually stated that synthetic camphor is optically inactive. According to the French Pharmacopœia camphor should make a clear solution in benzene, to show absence of more than traces of water. The test also shows presence of inorganic impurities of various kinds. Non-volatile matter should not exceed 0.05 per cent.

CAMPHORA MONOBROMATA.—While this substance dissolves in concentrated sulphuric acid without decomposition, as stated, the solution has a decidedly yellow color, which is not stated. This color may be erroneously considered to indicate presence of impurities. It disappears when the solution is poured into water. G. A. Menge reported 5 commercial specimens to melt between 74.8° and 76.2°. On the basis of examination of 36 samples adoption of a melting range of 74° to 77° seems advisable. Non-volatile matter should not exceed 0.05 per cent. It should be nearly free from water-soluble halogen compounds, as shown by shaking about 0.5 gm. of the powdered substance with 10 cc. of water. The filtered liquid should be neutral to litmus and show not more than a slight opalescence on addition of silver nitrate.

CARBO ANIMALIS PURIFICATUS.—The test for limit of ash should be made with the dried substance or the calculation made on the basis of the dried substance. It should not lose more than 5 per cent. in weight when dried 2 hours at 100°. No limit of moisture is now required. The following additional tests are also recommended: When boiled with 100 parts of water, 10 cc. portions of the filtered water should not be made turbid at once by barium chloride or silver nitrate. On heating to boiling about 1 gm. with 20 cc. of water and 1 cc. of diluted hydrochloric acid, the filtered solution should not respond to thte U. S. P. time-limit test for heavy metals.

CARBO LIGNI.—In addition to the U. S. P. requirements, it should meet the following: Dried 2 hours at 100° it should not lose more than 5 per cent. in weight. When dry, it should burn without a luminous flame and leave not more than 5 per cent. of ash.

CHLORALUM HYDRATUM.—Much confusion exists as to the melting point, which is an important test of purity. This is illustrated by the figures of several pharmacopœias and other authorities: 58° (French, Japanese, Austrian); about 58° (U. S., Belgian); 53° (Swiss); 47° (Spanish); softens at 49°, completely melted at 53° (German); 51°, when pure (P. Siedler); 49° to 51°, when pure (M. Lefeldt). Formerly the products in this market melted at 58° or a few degrees lower, but more recently most samples tested have melted at 53° or but little higher. A commercial sample recently examined, after drying over sulphuric acid, softened at 49°, began to melt at 50°, and was completely melted at 53°. It conformed in other respects to the U. S. P. standard, stood the former U. S. P. nitric acid test, as well as the iodoform test, for alcoholate, and assayed 99.9 per cent. by a method described below. The same sample, when recrystallized from benzene, softened at 49°, began to melt at 50°, and was completely melted at 51°, corroborating the figures given by Siedler and Lefeldt. A melting point higher than 51° is probably due chiefly to presence of butyl-chloral hydrate (m. p. 78°). The U. S. P. requires a freshly prepared water-solution of chloral hydrate to be neutral to litmus, but it was pointed out by Schering many years ago that such solutions always have a slightly acid reaction. This has often been verified since then. The test for chloride is faulty, as the pure substance very soon liberates hydrochloric acid in water-solution, but an alcohol-solution (1 in 20) should not at once redden moistened blue litmus paper nor should it become opalescent at once on addition of silver nitrate. Non-volatile matter should not exceed 0.05 per cent. The U. S. P. has no test for alcoholate, that with nitric acid, given in the first printing in 1905, having been cancelled in 1907. This test is now official in several of the important, more recently published pharmacopœias. Statements have been made that the nitric acid test is misleading and unnecessary, as the presence of alcoholate would be shown by the melting point, but it appears that the correct melting point of chloral alcoholate has not yet been definitely ascertained and the publishd figures for it are rather near to that of chloral hydrate itself, being 56° (Jungfleisch) and 46° (Lieben), as quoted by Beilstein. The writer can find no fault with the nitric acid test as it was given originally in the U. S. P., VIII, as follows: If 1 gm. of Hydrated Chloral be placed in a porcelain dish and covered with 1 cc. of nitric acid (sp. gr. 1.38), no yellowish coloration of the mixture should be produced at ordinary temperature, or even after warming the mixture 3 or 4 minutes, nor should yellowish fumes be produced after 10 minutes' warming. The Swiss Pharmacopœia requires a purity of 99.5 per cent., by the following method: About 4 gm., accurately weighed, are dissolved in 10 cc. of water, then 30 cc. of n/1 caustic alkali added and the mixture allowed to stand exactly 2 minutes. The excess of alkali is at once titrated with n/1 acid, with phenolphthalein as indicator. Each cc. of n/1 alkali (O = 16) consumed corresponds to 0.1654 gm. of CCl_3COH+H_2O. Market products at the present time test from 99.5 to 100 per cent. by this method. It is important to adhere closely to the specified conditions of time and concentration for reliable results. It should be taken into consideration also, that the impurities most likely to be present also neutralize alkalies under the conditions of the method, and that, therefore, the results are of value only for corroboration of the results of other tests and for detecting excessive quantities of water.

CHLOROFORMUM.—The specific gravity (1.476 at 25°/25°) does not accurately correspond to a maximum alcohol content of 1 per cent., as intended. It corresponds more closely to the minimum content of 0.6 per cent. To insure presence of alcohol within these limits, the specific gravity at 25°/25° should be not less than 1.473 nor more than 1.477. A higher specific gravity may indicate either that alcohol is not present in sufficient quantity for effectual preservation or that a liquid having a higher specific gravity than chloroform, such as carbon tetrachloride, is present. Determinations should be made with a pyknometer of verified accuracy, of the type described under AETHER. A boiling point determination is of little value for ascertaining the purity of chloroform. A few tests in addition to those of the U. S. P. may be of value. No weighable residue should remain on evaporation of 20 cc. from a platinum or porcelain dish and drying the dish at 100°. Presence of carbon oxychloride would be shown, according to various foreign pharmacopœias, by a suffocating odor of the sample. However, it is never found in chloroform that stands the U. S. P. sulphuric acid and silver nitrate tests. The barium hydroxide test, U. S. P., 1890, was directed principally against this impurity, but was dropped at the last revision because of its unreliability, 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—

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