Our results on this sample were 0.048 by the acetate method and 0.055 by the volumetric. By the combination method described above, which seems to exclude many of the chances of error which occur in either the acetate or molybdate method, we found 0.0538 per cent. phosphorus.

It will be noticed that the results obtained by the acetate method are lower than either of the others. This has been our experience repeatedly, when we have compared the three methods, the acetate giving invariably the lowest results.

We will not enter into a discussion in regard to the causes for this as they are many, and this is not the purpose of our paper, but in our opinion the proposed Committee on Standard Methods can do no greater benefit to the iron industry of our country than by a thorough investigation of the methods used for the determination of phosphorus in ores and finished products. From our personal observation we know that frequently injustice is done, and able chemists brought into disrepute, simply because their results have not agreed with those obtained by analytical chemists of wide reputation, whose methods have not told the whole truth.

ON THE QUALITATIVE DETERMINATION OF TANNING MATERIALS.[1]

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IT can hardly be said that any systematic attempt has been made to formulate a scheme for distinguishing the various tanning materials by their qualitative reactions, except perhaps a very slight table published by the writer, although, in view of the constantly increasing number of new tanning materials, and especially of new extracts which are offered to tanners, the matter has become one of considerable practical importance. The commercial value of an extract is dependent, not only on the percentage of tanning matter as determined by analysis, but on the nature of the tannin present, which influences the character of the leather produced.

It is, of course obvious, that, failing a clear knowledge of the

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[1] Read before the World's Congress of Chemists, August 25, 1893. Proof of this article was kindly read by Professor Henry Trimble.

tannins themselves any definite scheme of separation is for the present impossible; since, although we have good reason to believe that the tannins are a class, we are quite ignorant of their number, which may easily be a comparatively small one, as many members of the group which at present receive individual names are probably mere mixtures. What can be done is to separate the tanning materials into groups or individuals by reactions which have been empirically determined; of which in many cases we do not know the chemical significance, and which may possibly be often due to other constituents of the materials than the tannins themselves. The question is still further complicated by the fact that woods, barks, and fruit of the same tree often yield tannins of distinctly different character. In view of these facts, the group tables given must be only regarded as pointing out the general character of the material examined, and their indications must always be confirmed by direct comparison of *all* the reactions observed with those given by the material suspected. It must also be remembered that in some cases the group reactions are uncertain, or may be simulated by mixtures, which may often be determined by comparison of the results of the more special tests.

In this connection it may be noted that most of the reactions under the intermediate groups might be simulated by suitable mixtures of A and F; and that the inconstancy of the iron reaction in closely allied trees, points either to their containing mixtures of tannins, or to the existence of a very large number of closely allied tannins of very similar constitution. The point is one very difficult of decision, since we have no really reliable method for separating different members of the family.

It was thought that some information as to the meaning of the reactions employed might be obtained by examining the behavior of the simpler derivatives under the same circumstances, and the results are given in table X. It will be at once obvious that the blue-black reaction with iron is characteristic of the pyrogallol group; and the green-black equally so of the catechol derivatives, while phloroglucol, contrary to the statements of the text-books, gives no marked reaction with iron, but is alone characterized by the very delicate reaction with the vanillin present in deal. On the remaining reactions little light is thrown.

In qualitative work with tanning materials, a good deal depends on the strength of the solutions, and the way in which the tests are performed, and as the information in the Tables is necessarily very brief, a few preliminary words are desirable.

Infusions of tanning materials are understood to be of about the strength used by the writer in determinations by hide-powder, *viz.*, about 0.6 gram of dry soluble matter in 100 cc., but moderate divergencies from this do not influence results. Of course where reactions are feeble in any case, with very dilute solutions they may be imperceptible, and on the other hand, strong solutions will sometimes give precipitates where only colorations are noted with weak ones.

Bromine water reaction.—It is best to add the bromine water drop by drop to 2–3 cc. of the infusion in a test tube, until the solution smells strongly. In some cases the precipitate is slight, or forms slowly, and occasionally it is crystalline and on this account less conspicuous, but it is usually a distinct yellow or brown flocculent one. In most cases bromine precipitates such tannins as give a green-black with iron, and in general terms it may be said to be a reagent for the catechol tannins.

Nitrous acid reaction.—This reaction, which is believed to be a new one, is obtained by adding to a few cc. of the infusion in a porcelain basin a distinct excess of solution of sodium or potassium nitrite, and then 3–5 drops of decinormal sulphuric or hydrochloric acid. In typical cases the solution instantly turns pink or crimson, and slowly changes through purple to a deep indigo-blue, but in others, as sumach where the reaction is feeble, and masked by other changes, the final color is green or even brownish. In a large number of cases, nitrous acid produces a yellow or brown coloration or precipitate, but "reaction" in the Tables invariably means a series of color-changes as above described. Nothing can as yet be said on the nature of the chemical changes produced. The reaction is given by all tanning materials which yield ellagic acid or "bloom," but not by ellagic acid itself, nor by pure gallotannic acid. It is possibly a reaction of ellagitannic acid.

Ferric alum, Ammonio-ferric sulphate.—A one per cent. solution of this salt has been chosen as easily obtainable, neutral, and in a state of approximate purity. Ferric chloride, which is generally used, is almost invariably strongly acid, and of a very persistent yellow. Acid ferric chloride in excess will give a green-black reaction with gallotannic acid itself, and its results as a test are often very misleading. Ferric acetate, which has also been largely used gives heavy precipitates with most materials and is very strongly colored, so that it was found less convenient than the iron alum. As the colorations are generally very powerful, they are best seen by diluting the tannin infusion freely, and adding the iron solution very cautiously. In many cases the coloration first produced, and which is the characteristic one, rapidly fades to a dull olive or brown in presence of excess of iron, probably by oxidation and destruction of the tannin.

Cupric sulphate and ammonia.—When solution of cupric sulphate is added to a tanning material infusion, it sometimes gives a precipitate, and sometimes not. This is a useful indication in some cases, but must not be regarded as of first rate importance as the presence of any weak organic salt would in all cases cause a precipitate, by neutralizing the sulphuric acid of the sulphate. Cupric acetate produces a precipitate with all tannins so far as I have observed, and it is interesting to note that in this case, as in many others of a like character, the tannin combines with, and precipitates the salt as a whole. On the addition of ammonium carbonate, effervescence takes place, and the precipitate darkens, and becomes a true tannate.

When ammonia is added to the mixture of a tannin and cupric sulphate, a precipitate is invariably formed in the first instance, consisting of a tannate of copper with variable quantities of blue cupric hydroxide. With excess of ammonia, the whole of this precipitate is in many cases dissolved, while in others, an insoluble tannate remains. The latter is the case with all tannins derived from gallotannic acid and with many containing protocatechuic acid and forms a useful means of classification, though as yet the difference of structure to which it corresponds is unknown. The fact that hemlock and other pine barks, as well as cutch and gambier, yield cupric tannates soluble in ammonia is an instructive commentary on processes which have been proposed for quantitative estimation by precipitations by ammonio-cupric solutions.

Where the precipitate redissolves it generally does so with the production of either a greenish brown, or a purplish brown coloration, which in presence of a small amount of the blue ammonio-cupric sulphate, appears either as a green or a reddish violet, and is again a useful means of identification. It need hardly be pointed out that to see this coloration well, the copper should be in the least possible excess. Hence it is desirable to use a very weak copper solution, say at most one per cent.

Stannous chloride and hydrochloric acid.—This reagent, the application of which is here first published, consists in a strong solution of stannous chloride in concentrated hydrochloric acid. If about ten cc. of this are added to one cc. of the tanning material infusion, in a porcelain basin, and allowed to stand for ten minutes, coniferous tans, mimosas, and some others give a very marked pink coloration. This is specially distinct in the case of larch bark. If a small piece of larch-tanned leather be steeped in the reagent, the coloration appears very strongly.

Deal shaving and Hydrochloric acid.—A shaving or slip of any pine wood is moistened with the infusion, and then, either before or after drying, is again moistened with concentrated hydrochloric acid. In the case of cutch and gambier, and a few other materials, the spot becomes at once a bright red or violet, but in many cases the reaction is faint, and only appears after some hours. It probably always indicates the presence of phloroglucol.

Sodium Sulphite—This was mentioned in my previous manuscript on the subject, but the printer unfortunately substituted sodium sulphide, which does not answer in the laboratory.

In some cases these reactions will serve to determine the constituents of mixtures but in many cases this will continue impossible till further and more distinctive reactions are discovered.

They can of course be applied to the recognition of tannates. when excess is present in leather which can be dissolved out with water; but the effect of dilute alkalies and other solvents on the reactions is worth further experiment.

A few drops of the solution are placed in contact with a crystal of sulphite on a tile or in a basin. With valonia, a bright purplish pink is rapidly developed, apparently by oxidation. Many other tanning materials produce red or pink colorations, but in no case so marked a reaction as valonia.

Concentrated sulphuric acid.—A test tube is rinsed out with the infusion, and drained so that only about a drop remains, and concentrated acid is cautiously poured into the sloping tube, so as to form a layer underneath the tannin solution. The ring of color at the junction of the two liquids is noted, and then they are mixed by shaking, and diluted with water. About half the materials give a deep purplish crimson, called simply "crimson" in the Tables, and in many cases this is decidedly pink on dilution, while in other cases it is obscured by brown products formed by the heat of mixture. A large number of other materials give browns or yellows only, which when intense appear red, but dilute to yellows or yellow-browns.

Lime water is a most useful reagent, being very varied in the color of the precipitates it produces, and the changes they undergo by oxidation. The reaction is best seen in a shallow porcelain basin.

QUALITATIVE CLASSIFICATION OF TANNING MATERIALS. TABLE I.

Bromine water produces a precipitate.						Bromine water produces no precipitate.			
Nitrous acid gives no reaction or merely darkens.				Nitrous acid causes a red coloration, becoming violet and blue or green.		Nitrous acid gives no reaction or merely darkens.		Nitrous acid produces a red coloration changing to violet and blue or green.	
Iron alum green-black.			Iron alum blue-black.	Iron alum green-black.	Iron alum blue-black.	Iron alum green-black.	Iron alum blue-black.	Iron alum green-black.	Iron alum blue-black.
Copper sulphate followed by ammonia in excess.			Group B. Table V.	Group C. Table VI.	Group D. Table VII.	Group E. No members of this group known but *catechol and protocatechuic acid*, which are not tannins. See Table X.	Group F. Table VIII.	Group G. No members of this group known.	Group H. Table IX.
Precipitate redissolves with reddish violet coloration-Group A α. Table II.	Precipitate redissolves with green or olive brown coloration-Group A β. Table III.	Precipitate is insoluble in excess of ammonia-Group A γ. Table IV.							

TABLE II.

Group A *a*.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ + NH_4OH	$SnCl_2$ + HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.
Cutches from *Ac. catechu wood.*	Green-black.	pp.	No react. darkens.	pp. redissolves generally red-violet c'l'n.	No react.	Deep violet-red.	Reddens somewhat.	Red-brown coloration.	Reddish pp. slowly formed.
"Thann leaf" extract (*a cutch substitute*).	Olive-black pp.	pp.	No react. darkens.	pp. redissolves brownish coloration.	No react.	No react.	No react.	Crimson, pink on dilution.	No pp.
"Turwar" bark. (*Cassia auriculata.*)	Green-black.	pp.	No react. darkens.	pp. redissolves red-violet.	No react.	Trace.	Pink coloration.	Crimson.	Reddish pp.
"Gambene" extract (a gambier substitute).	Green-black coloration.	pp.	No react. darkens.	pp. redissolves red-violet.	No react.	No react.	Slight pink coloration.	Crimson-pink diluted.	Reddish pp.
"Tengah" bark (*Ceriops Candolleana*).	Green-black coloration.	pp.	No react. darkens pp.	pp. redissolves red-violet.	Pink coloration.	No react.	Pink coloration.	Crimson.	Bright red pp.
Bark (*Acacia leucophlœa*).	Green-black coloration.	pp.	No react.	pp. redissolves red-violet.	Pink coloration.	Slow violet react.	Pink coloration.	Crimson-pink diluted.	Dull brown pp.

TABLE III.

Group A. β.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4 + NH_4OH$.	$SnCl_2 + HCl$.	Deal Shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.
Gambier, (ext. of leaves of *Nauclea gambir*).	Deep green coloration	pp.	No react. darkens.	pp. redissolves olive-green.	Yellow.	Deep violet-red.	Yellow.	Crimson dilutes brown.	No pp.
(1) "Purim Bast." (leaves of *Colpoon* or *Osyris compressa*).	Green-black.	pp.	No react.	No pp. pp. redissolves green.	No react.	Pink.	Yellow.	Crimson dilutes brown.	Light yellow pp.
(2) "Koko" natal, (leaves of *Celastrus buxifolia*.)	Green-black.	pp.	No react.	No pp. pp. redissolves green.	No react.	No react.	Yellow.	Dark brown.	Bright yellow pp.
Larch bark (*Larix Europæa*).	Green-black coloration.	pp.	No react. darkens.	pp. redissolves olive-green.	Pink coloration.	No react.	No react. darkens.	Deep red-brown.	Rusty pp.
Hemlock bark (*Tsuga* or *Abies Canadensis*.)	Olive-green reddish pp.	pp.	No react. pink with $NaNO_2$	pp. redissolves neutral tint.	Pink coloration.	No react.	Reddens.	Crimson dilutes pinkish.	Red-brown pp.
"Larch" extract (*Abies excelsa*). (3)	Green-black or brown.	pp.	No react.	pp. redissolves olive-green coloration.	Pink coloration.	No react.	Darkens.	Deep red-brown.	Brown pp.

(1) Used at Cape of Good Hope as sumach.

(2) Used in Natal as sumach substitute.

(3) *Fichte*, *Rothtanne* Norway or common spruce. *Abies pectinata* the *Weiss or Edel-Tanne* or silver fir is said to give a blue-black with iron

TABLE IV.

Group A γ.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ + NH_4OH.	$SnCl_2$ + HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.
Willow bark. (Russian. Sp. unknown.)	Green-black.	pp.	No react.	Slight pp. — Dense pp.	No react.	Violet faint.	Pink coloration.	Red-brown not intense.	Slight greyish pp.
Acacia Angfica or Pepladenea macrocarpa.	Green-black.	pp.	No react.	Slight pp. — Dense choc'e pp.	Pink or violet color.	Violet faint.	Reddens somewhat.	Crimson dilutes pink.	Reddish pp.
Acacia catechu bark.	Green-black.	pp.	No react.	No pp. — Dense violet-bla'kpp	Possible trace.	Trace.	Pink color.	Red-brown.	Flesh color pp.
"Thorn tree" bark. (*Acacia horrida*) (Cape.)	Green-black.	pp.	No react. darkens.	No pp. — Dense pp.	No react.	Doubtful.	Pink color.	Dull crimson not intense.	No pp.
Mangrove bark extract. (*Rhizophora mangle.*)	Green-black.	pp.	No react.	No pp. — Reddish-black.	Slight reddening.	No react.	Slight reddening.	Red-brown.	Red pp. darkened by excess.
Quebracho wood extract. *Quebracho or* (*Loxopterygium Lorentzii.*)	Green-black coloration.	pp.	No react.	Slight pp. — Dense pp.	Pink color pp.	Trace.	Doubtful.	Crimson coloration dilutes pink.	Light brown pp.
"Sugar brush" bark. (Cape.) (*Protea mellifera.*)	Green-black.	pp.	No react. darkens.	No pp. — Dense pp.	No react.	Trace.	Doubtful.	Red.	Yellow-brown pp.
"Waagenboom" (Cape.) (*Protea grandiflora.*)	Green-black.	pp.	No react. darkens.	No pp. — Dense pp.	No react.	Trace.	Pink color.	Crimson dilutes pink.	Light yellow pp.
"Kruppelboom" (Cape.) (*Leucospermum conocarpum.*)	Green-black.	pp.	No react. darkens.	No pp. — Dense pp.	No react.	Violet distinct.	Pink color.	Crimson dilutes pink.	Slight greyish pp.
"Silver tree" (Cape.) (*Leucodendron argentea.*)	Green-black.	pp.	No react. darkens.	No pp. — Dense pp.	No react.	No react.	Pink coloration.	Crimson dilutes pink.	Flesh color pp.

TABLE V.

Group B.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ + NH_4OH.	$SnCl_2$ + HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.
"Skens," Cypress Sumach (possibly *Coriaria myrtifolia*).	Blue-black pp.	pp.	No react.	Slight pp. — Dark pp.	No react.	No react.	Yellow.	Yellow-brown.	Yellow pp. dark'ning
Kliphant bark (1) (*Rhus Thunbergii*).	Blue-black.	pp.	No react.	No pp. — Dense dark pp.	No react.	No react.	Pink.	Dull crimson dilutes orange.	Pinkish pp.
Canaigre (Root of *Rumex hymenosepalus*).	Blue-black. pp.	pp.	No react.	Slight pp. — Dense dark pp.	No react. clouds.	Trace violet.	Slight dark'ning	Yellow-brown.	Pink coloration greyish pp.
"Talwaan" or "Elandsbortjes" (Root *Elephantorrhiza Burchellii*).	Blue-black pp.	pp.	No react. darkens.	Slight pp. — Dense dark pp.	No react.	Trace violet.	Pink.	Red.	Reddish brown pp.
Mimosa or Wattle bark (Various Austral. Acacias).	Dirty violet pp.	pp.	No react.	Slight or no pp. — Dense purple brown pp.	Slight reddening	Sometim's trace.	Reddens.	Crimson dilutes pink.	Reddish or yellow-brown pp.
Babool bark. India. (*Acacia Arabica*).	Dirty violet pp.	pp.	No react.	Slight or no pp. — Dense dark pp.	Some trace.	Faint trace.	Slight dark'ning	Crimson dilutes orange.	Dark reddish brown pp.
Dark red Austr. bark (Probably an acacia).	Dirty violet pp.	pp. needle crystals.	No react.	Slight pp. — Deep violet pp.	No react.	Faint trace.	Orange-pink.	Crimson dilutes pink.	Bright violet pp.
"White bark" *Algaroba blanca* South America (A *prosopis* or *acacia*).	Dirty violet pp.	pp.	No react.	No pp. — Reddish black pp.	No react.	Violet.	Reddens strongly.	Crimson dilutes pink.	Red pp. turning violet.

(1) Used at Cape of Good Hope.

TABLE VI.

Group C.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ and ammonia.	$SnCl_2$ + HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.	
Cork bark (*Quercus suber*).	Green-black coloration	pp.	Reacts somewhat.	Slight pp. — Brown color.	No react.	No react.	Reddens.	Crimson dilutes pink.	Reddish brown pp.	
Green Oak (Ital.) (*Quercus Ilex*.).	Green-black coloration	pp.	Reacts faintly if at all.	Slight pp. — Brown color.	No react.	No react.	Reddens.	Crimson dilutes pink.	Reddish brown pp.	
Garouille, Root Bark of Kermes Oak (*Quercus Coccifera*).	Green-black coloration	pp.	Reacts	Slight pp. — Brown color.	No react.	No react.	Reddens.	Crimson dilutes pink.	Reddish brown pp.	
Quercitron Bark (*Quercus Tinctoria*).	Green-black coloration	pp.	Reacts somewhat.	Slight pp. — Brown color.	No react. Light green.	No react.	Doubtful.	Crimson dilutes pink.	Reddish brown pp.	Dyes yellow with Al. and Sn. mordants.
Chestnut Oak (*Quercus Castanea*).	Olive-green coloration	pp.	Reacts distinctly.	Decided pp. — Insol. in excess.	No react.	No react.	Reddens.	Crimson dilutes pinkish.	Reddish brown pp.	Infusions fluoresce especially with ammonia.

TABLE VII.

Group D.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ and ammonia.	$SnCl_2$ + HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.	
English Oak *Quercus Robur*.	Blue-black (green with excess).	pp.	Reacts somewhat.	Slight pp. — Dark brown pp.	No react.	Faint react.	Reddens.	Crimson dilutes pink.	Reddish brown pp.	
Jaft or Delicft. (1) Supposed oak product.	Blue-black pp.	pp.	Reacts red-blue.	Brown pp. — Dark brown pp.	No react. Dark brown pp.	Faint react.	Some dark'ning	Crimson dilutes pink.	Reddish brown pp.	Strong infusions dry whitish and iridescent

(1) A Persian product, dark scales very rich in tannin (about forty per cent).

TABLE VIII.

Group F.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ + NH_4OH	$SnCl_2$ + HCl	Deal shaving and HCl	Na_2SO_3	H_2SO_4	Lime water.	
Aleppo galls (*of Quercus infectoria*).	Blue-black pp.	No pp. slight scum.	Reacts red to blue.	G'nish pp. — Dark pp. insoluble.	Light yellow pp.	No react.	No react.	Greenish to dirty yellow.	Pale pp. turning bluish-green.	
Sumach (leaf of *Rhus coriaria*).	Blue-black pp.	No pp.	Reacts feebly.	G'nish pp. — D'k brown insol. pp.	No react.	No react.	No react.	Yellow.	Yellow pp. turning bright green.	Dyes yellow on Sn mordants.
Myrobalans (*Torminalia chebula*).	Blue-black pp.	No pp.	Reacts red to blue.	Yellow pp. — Dark insoluble pp.	No react.	No react.	Yellow.	Yellow.	Yellow pp. turning greenish.	Dyes yellow on Sn mordants.
Pomegranate rind (*Punica granatum*).	Blue-black pp.	No pp.	Reacts red to blue.	Brown pp. — D'k brown insol. pp.	No react.	No react.	No react.	Orange-brown.	Bright yellow pp. turning red with exc'ss	
Algarobilla (pod of *Caesalpinia brevifolia*).	Blue-black pp.	No pp.	Reacts red to blue.	S'ht g'n pp — Dense dark pp.	No react.	No react.	Deep yellow.	Deep yellow-brown.	Bright yellow pp. darkens somewhat.	
Divi-divi (pod of *Caesalpinia coriaria*).	Blue-black pp.	No pp.	Reacts red to blue.	S'ht g'n pp — Dense dark pp.	No react.	No react.	No react.	Crimson.	Yellow pp. turning red-purple.	(1)
Algarobo (probably pod of *Prosopis dulcis*).	Blue-black pp.	No pp.	Reacts red to olive.	S'ht g'n pp — Dense dark pp.	No react.	No react.	Yellow.	Yellow to olive.	Yellow pp. turning black.	
Valonia (Cup of *Quercus Aegilops*).	Blue-black pp.	No pp.	Reacts red to blue.	No pp. — Dark red'ish pp.	No react.	No react.	Purplish pink.	Deep yellow.	Yellow pp. turning red-purple.	
"Oakwood" extract (oak or chestnut wood).	Blue-black pp.	No pp.	Reacts red to blue.	Pale pp. — Purple brown pp.	No react.	No react.	Reddens.	Yellow-brown.	Yellow pp. turning red-purple.	(2)

(1) Moderately strong potassium nitrite solution precipitates divi, but not *dilute* oakwood solutions; pp. soluble in hot, or *much* cold water.

(2) *Crude* chestnut wood extract may be distinguished from oakwood by its violet-reaction with ammonium sulphide (see "*Gerber*" No. 261, p. 157).

TABLE IX.

Group H.	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ and ammonia.	$SnCl_2$ + HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.
Pure Gallotannic Acid.	Blue-black pp.	No pp.	No react.	No pp. — Dark pp.	No react.	No react.	No react.	Yellow.	Pale pp. turning blue.
Babool Pods. *Acacia Arabica.*	Blue-black.	No pp.	No react. darkens.	Slight pp. — Dark green color.	No react.	Faint violet.	No react.	Reddish violet.	Pink color. No pp.

TABLE X.

	Ferric alum.	Bromine water.	Nitrous acid.	$CuSO_4$ and ammonia.	$SnCl_2$ and HCl.	Deal shaving and HCl.	Na_2SO_3.	H_2SO_4.	Lime water.
Catechol.	Dark green coloration.	No pp.	Turns yellow.	No pp. — Green color.	No react.	No react.	No react.	Green coloration.	No pp.
Protocatechuic acid	Dark green coloration.	No pp.	Turns brown.	No pp. — No pp.	No react.	No react.	No react.	No react.	No pp.
Phloroglucol.	No react.	Bulky white pp.	Turns olive-green	No pp. — No pp.	No react	Red-violet coloration.	No react.	Slight yellow.	No pp.
Pyrogallol.	Blue-black turning green and brown.	No pp.	Turns yellow.	No pp. — Brown color.	No react.	No react.	No react.	Brown coloration.	Violet colora'n rapidly turning brown.
Gallic acid.	Blue-black coloration.	No pp.	Turns brown.	No pp. — Brown color.	No react.	No react.	No react.	No react.	White pp. rapidly turning blue.