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On certain Properties of Rosewood and some other Hard Woods. By A. GALLETTY, Museum of Science and Art, Edinburgh.

(Read 11th February 1886.)

Brazilian rosewood appears to have been used in Europe for making furniture for more than 200 years. For that purpose it long stood next to mahogany in importance, but though still much used, other woods have now an almost equal hold on public favour. From an official return it would seem that the quantity annually exported from Brazil had increased from 560 tons in 1839 to 4700 tons in 1874, the value of the latter being about £70,000. In a book published in 1876 by the Government of Brazil, for the purpose of giving reliable information respecting the resources of the country, it is stated that rosewood exists in great abundance in the forests of Pernambuco, Alagoas, Bahia, Espirito Santo, Rio de Janeiro, and Minas Geraes. This official account of the plentiful supply of rosewood does not, however, agree with the reports about it which sometimes appear in English trade journals. But it is probable that one species of tree furnishes the rosewood usually sent from Brazil to England, while the statement in the volume above-mentioned may refer to woods more or less resembling each other from several species. However this may be, it is very strange that the species of tree which yields the Brazilian rosewood of commerce is not known to European botanists. It is doubtful, indeed, if even the genus has been correctly ascertained. We are equally ignorant respecting a rosewood imported from Honduras. Perhaps there is not another vegetable product, of the same importance commercially, the source of which has remained so long unknown to botanists. Many years ago Dr Lindley considered the tree to be a species of *Mimosa*, and subsequently believed it to belong to the genus *Triptolomea*. At one time it had been called, apparently on some authority, *Mimosa jacarandá*. It has been commonly stated in English works on economic botany that the commercial name for rosewood in Brazil is "jacarandá;" but this name appears to be applied in that

country to the wood of several distinctly different trees. Some of the more important woods of Brazil are enumerated in the official book already referred to, and among these are noted the black, the purple, the violet, the white, and the thorny jacarandás, all of which have different specific names and three of them belong to the genus *Machaerium*. In this genus is also placed what in the same list is called the rose jacarandá, though curiously enough its specific name is not given.

It seems that the leaves of the Brazilian rosewood tree, or of one of the trees so-called, are in the Kew Herbarium, and judging by them and the appearance of the wood, Mr Bentham assigned this tree to the genus *Dalbergia*. The species, however, is still unknown at Kew.

The appearance of Brazilian rosewood is familiar to every one from its frequent use in furniture. It is called rosewood because, when fresh, it has a faint smell of roses, but apparently it soon loses this distinctive odour. Many experienced cabinetmakers assert that this wood changes in colour before it is many years old, its rich reddish or purplish brown colour becoming an iron grey. There appears, however, to be some doubt about the accuracy of this observation, owing probably to the fact that it is customary to stain the wood when made up into furniture, and therefore it may only be the stain that is fugitive. As will presently be seen, rosewood is remarkable for the large quantity of resinous colouring matter in its composition. It is sent to this country in half-round fitches, because "heartshake," or hollowness at the centre, generally extends far up the trees. This necessitates the cutting of the logs down the middle longitudinally, hence the notion among cabinetmakers that all rosewood trees have a rotten side.

Thinking it would be interesting to ascertain to some extent what chemical properties are peculiar to Brazilian rosewood, what to some East Indian woods from known species of *Dalbergia*, and what to a few other well-known woods, I have, with the assistance of one or two chemists, got an examination made of a small number of specimens of these.

The chemical examination of the woods referred to in

what follows was made by treating them with the ordinary solvents used for this purpose.

First, as to the rosewoods. The specimen to be treated was reduced to fine sawdust, and allowed to digest in twice its bulk of shale naphtha at a temperature of about 150° F. (65·50 C.). The naphtha, after twenty-four hours, was drawn off, and the sawdust thrown on a filter and washed with more hot naphtha till nothing further would dissolve. The naphtha solution had a pale colour, and on evaporation left a yellowish resin.

After leaving the sawdust for a time in a warm place to get entirely rid of the naphtha, it was next treated in a similar manner with ether, until everything which it would dissolve was extracted. The evaporation of the ether gave a second resin of generally a very dark colour.

By a similar process a third extract was made with methylated spirit (alcohol), the solution being very dark coloured and on evaporation giving a resinous body of an extremely dark, almost black colour.

The relative proportions of these extracts varied in the different rosewoods examined, as will be seen from the following table:—

Kind of Wood.	Treated with	Quantity of Extract.
Rio de Janeiro Rosewood, <i>Dalbergia</i> sp.? Specific gravity, '932,	{ Naphtha, Ether, Alcohol,	1·527 per cent. 2·746 " 15·704 "
Bahia Rosewood, <i>Dalbergia</i> sp.? Specific gravity, '953,	{ Naphtha, Ether, Alcohol,	1·432 " 5·771 " 13·178 "
Honduras* Rosewood, Specific gravity, '670,	{ Naphtha, Ether, Alcohol,	1·390 " 0·524 " 8·549 "
East Indian Rosewood, <i>Dalbergia latifolia</i> . Specific gravity, '825,	{ Naphtha, Ether, Alcohol,	1·555 " 3·981 " 11·234 "
Sissoo (East Indian wood), <i>Dalbergia Sissoo</i> . Specific gravity, '910,	{ Naphtha, Ether, Alcohol,	3·800 " 3·760 " 10·000 "

The naphtha extracts have the ready solubility in

* The specific gravity of the specimen of Honduras rosewood operated upon appears to be exceptionally low.

naphthas and spirit of wine, characteristic of the ordinary pine resins. Like the latter, they also creep up the sides of the evaporating basin into globules, and when heated on a spatula give the characteristic pine resin odour. Some at least of these naphtha extracts become much deepened in colour by standing for days in an open porcelain basin occasionally wetted with methylated spirit.

Compared with alcohol, ether takes out a small proportion of resinous matter, but both extracts are highly coloured. The probability is that the natural process of oxidation converts the one into the other, and that if the ether extracts were exposed for a sufficient time to the action of the atmosphere it would have the same properties as the alcoholic extract. Resinous colouring matters generally are liable to oxidation, causing slight alterations in their properties.

The alcoholic extract, which is of the same character in all the rosewoods, is the most important, the relative proportion of it being high compared with the naphtha and ether extracts. When the last traces of the spirit are evaporated it is a dark, brittle substance, which easily scales off the evaporating basin. This substance has been tested with the solvents usually employed for dissolving resins, colouring matters as well as fatty and waxy bodies, and its behaviour in this respect is quite peculiar. It is—

1. Insoluble in benzole.
2. Insoluble in bisulphide of carbon.
3. Insoluble in spirit of turpentine.
4. Insoluble in warm olive oil.
5. Slightly soluble in hot acetic acid.
6. Soluble in chloroform.
7. Very soluble in acetone.

[The ether extract has the same characters.]

The properties of this rosewood extract, as shown by its different solubilities, distinguish it, so far as is known, from that of other woods, although mahogany extract in some points resemble it. It is rare to find any substance, belonging to the class of bodies just mentioned, so entirely insoluble in some of these solvents and so readily soluble in others. Substances of a resinous character generally,

whether colouring matters or not, are compounds of carbon, hydrogen, and oxygen—nitrogen being absent. Rosewood extract was also found, after testing, not to contain nitrogen. A striking peculiarity of this extract is its strong tinctorial power, 1 part in 100,000 parts of alcohol showing a distinct colour in an ordinary test tube. It does not appear to have the qualities of a weak organic acid. It may also be mentioned that this spirit extract gives to paper a colour very much like that produced by nitrate of silver.

The Sissoo wood differs chiefly in its naphtha extract. The proportion of this is much larger than in any of the other rosewoods examined, and it appears to have some peculiarities requiring further examination. One of these, however, is worthy of particular notice. If, before it is more than a couple of days old, it is dissolved in alcohol, it communicates a deep and splendid purple colour to that liquid. It appears, however, to lose this property very soon, probably by oxidation.

Two examples of mahogany operated upon gave the following results:—

Kind of Wood.	Treated with	Quantity of Extract.
Spanish or Cuba Mahogany, <i>Swietenia Mahogani</i> . Specific gravity, .840,	{ Naphtha, Ether, Alcohol,	1·338 per cent. 2·843 " 12·292 "
Honduras or Bay Mahogany. <i>Swietenia Mahogani</i> . Specific gravity, .420,	{ Naphtha, Ether, Alcohol,	0·864 " 0·292 " 3·145 "

A comparison of the tables shows that Spanish mahogany, which was treated in the same manner as the rosewoods, gave nearly the same percentages of the various extracts. But the naphtha extract of mahogany has not the pine resin odour when heated on a spatula, and its ether and alcohol extracts have only a light pinkish colour in the solid state, and have hardly any tinctorial power in solution. The spirit extract has one property remarkably different from any noticed in the alcoholic extract of rosewood. When dry, it is brittle and very friable on being rubbed between the fingers; but when heated up with turpentine to a temperature nearly at

its boiling point, it suddenly swells to many times its volume, becoming transparent and of a fine claret colour. This extract behaves in a somewhat similar manner with olive oil. Of all the extracts examined, which include those of greenheart and teak as well as the rosewoods, this is the only one which has shown this peculiarity.

The alcoholic extract of mahogany is—

1. Insoluble in benzole.
2. Insoluble in bisulphide of carbon.
3. Insoluble in turpentine, but when heated it suddenly swells to many times its original volume.
4. Insoluble in warm olive oil, but swells.
5. Soluble in hot acetic acid.
6. Insoluble in chloroform.
7. Readily soluble in acetone.

[The ether extract of mahogany has nearly the same characters.]

It will be noticed that the sample of "Spanish" mahogany used had twice the density of the Honduras specimen, and that the extracts from the latter are much smaller in amount than those obtained from the former. Honduras mahogany is generally a much lighter wood than that imported from Cuba.

The wood of greenheart, *Nectandra Rodiei*, specific gravity .991, treated in the same way as the above, gave—

With naphtha,	1.99 per cent.
With ether,	0.18 „
With alcohol,	3.20 „

These extracts have the following solubilities :—

Naphtha Extract.

1. Soluble in bisulphide of carbon.
2. Soluble in ether and alcohol.
3. Insoluble in acetic acid.
4. Soluble in acetone, but not readily.

This is more a vegetable fat than a resin. It has not the characteristic resinous odour even when fused, and its alcoholic solution gives a precipitate with acetate of lead, corresponding with fatty bodies generally. It does not

dry up, on the water bath, to a brittle substance, but remains greasy—thus differing completely from the pine resin character of the rosewoods.

Alcoholic Extract.

1. Slightly soluble in benzole.
2. Slightly soluble in bisulphide of carbon.
3. Insoluble in turpentine.
4. Soluble in hot acetic acid.
5. Readily soluble in acetone.

Ether Extract.

1. Readily soluble in bisulphide of carbon.
2. Soluble in benzole.
3. Insoluble in acetic acid.
4. Insoluble in acetone.

None of the solutions possess the strong tinctorial power of the rosewood extracts.

A specimen of teak, *Tectona grandis*, specific gravity '660, also treated in the same way, gave—

With naphtha,	3·56 per cent.
With ether,	0·42 „
With alcohol,	3·54 „

And the solubilities of these are :—

Naphtha Extract.

1. Soluble in benzole, but not readily.
2. Almost insoluble in alcohol.
3. Almost insoluble in ether.
4. Soluble in turpentine.

Ether Extract (soft and almost greasy).

1. Soluble in benzole.
2. Soluble in bisulphide of carbon.
3. Soluble in turpentine.
4. Slightly soluble in hot olive oil.
5. Insoluble in hot acetic acid.
6. Soluble in chloroform.
7. Soluble in acetone, but much less so than is the case with ether extracts of the rosewoods or mahogany.

Alcoholic Extract.

1. Insoluble in benzole.
2. Insoluble in bisulphide of carbon.
3. Insoluble in turpentine.
4. Insoluble in hot olive oil.
5. Slightly soluble in hot acetic acid.
6. Slightly soluble in chloroform.
7. Readily soluble in acetone.

It is necessary to state that the specimen of teak operated upon had a specific gravity considerably less than what is usual with this wood.

The naphtha extract of teak, which is proportionally large, is a waxy substance, of a green colour, and very sticky, even when long heated on the bath. It does not become brittle when cold. At the temperature of boiling water, or at least when very close upon it, it is a highly viscid body, proving the absence of any fatty oils in the wood. These oils, being all freely soluble in warm naphtha, would have given this extract a greasy character in place of its strong sticky nature. The absence of any kind of a fatty oil in this wood is confirmed by the insolubility of the extract in ether or alcohol.

The solubilities of the ether and alcoholic extracts of teak are remarkably different from those of the rosewoods and of the mahogany, which have been given. A comparison of the tables will show that they are almost reversed.

I am indebted to the following chemists for conducting most of the above experiments:—Mr William Baxter, formerly of the Bathgate Chemical Works; Mr David Brown, of the firm of Messrs J. F. Macfarlan & Co., Edinburgh; and Mr John Galletly, Addiewell Chemical Works, West Calder.