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THE

TECHNOLOGIST.

A MONTHLY RECORD OF

Science Applied to Art, Manufacture, and Culture.

EDITED BY

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Author of "The Commercial Products of the Vegetable Kingdom," "A Dictionary of Trade Products," "The Curiosities of Food," "Waste Products and Undeveloped Substances," &c. &c. &c.

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THE TECHNOLOGIST.

NOTES ON THE VEGETABLE PRODUCTS OF TASMANIA, AT THE INTERNATIONAL EXHIBITION OF 1862.

BY WILLIAM ARCHER, F.L.S.

The principal timber trees of Tasmania, such as the blue gum, stringy bark, white gum, or gum-topped stringy bark, swamp gum, and peppermint tree, furnish a hard, close-grained, and strong timber, which is used in ship-building and house-building, and generally for all the purposes to which oak is applied in England. Huon pine is very durable, and is employed for boat-building, for which it is peculiarly adapted, and for house-fittings, &c. Blackwood makes excellent naves and spokes, cask staves, &c. Native myrtle is valuable for house-fittings. Swamp gum yields the finest palings and other split-stuff in the world. Sassafras affords timber for house-fittings, bench-screws, lasts, &c. Celery-topped pine is chiefly used for masts and ship's spars. The different kinds of timber in the following list are arranged according to their value. The diameter of the trees is measured at the height of 4 feet from the ground.

Blue Gum (*Eucalyptus globulus*, Lab.)—The common name is derived from the bluish-grey colour of the young plants. Diameter, 5 to 30 feet; average of those felled for use, 6 feet. Height, 150 to 350 feet; sp. grav. about ·945 to 1·055. Abundant in the southern and south-western parts of the island. Cut for house-building, it sells at 8s. to 10s. per 100 superficial feet—for ship-building, at 12s. to 14s.

Stringy Bark (*Eucalyptus gigantea*, Hooker, fils.)—Common name taken from the coarse fibrous bark. Diameter, 4 to 24 feet; average of sawn about 5½ feet. Height, 150 to 300 feet; sp. grav. about ·905. Abundant everywhere upon hilly ground. Price, the same as that of blue gum.

Swamp Gum.—White Gum (*Eucalyptus viminalis*, Lab.)—Common names, from its growing to perfection in humid situations, and from its gigantic white trunk. Diameter, 4 to 18 feet; average, about 5½ feet.

Height, 150 to 300 feet ; sp. grav. about ·885. Growing in forests with other kinds of *Eucalyptus*, in rather humid localities. A small variety, called the manna tree, grows abundantly about Hobart Town and in other places, on dry ground. Price, for general purposes, the same as that of blue-gum ; 5-feet palings, 6s. to 8s. per 100.

Gum-topped Stringy Bark, sometimes called White Gum (*Eucalyptus gigantea, var.*)—A tree resembling the blue gum in foliage, with rough bark similar to stringy bark towards the stem. It has been found recently that this wood possesses nearly all the properties of strength, solidity, and durability of the blue gum—whilst, being straight-grained, it is much easier to work. It is very abundant about D'Entrecasteaux Channel. An old plank from the Hobart Town Wharf, which has been twenty years in use, may be seen in the timber trophy. Price, about the same as blue gum.

Peppermint Tree (*Eucalyptus amygdalina*, Lab.)—Common name, from the odour of the leaves. Diameter, 3 to 8 feet ; average, about 4 feet. Height, 100 to 150 feet ; sp. grav. about ·895. The peppermint tree abounds throughout the island, on gravelly and other poor soil. Price, about the same as that of swamp gum.

Huon Pine (*Dacrydium Franklinii*, Hooker, fils.)—So called, because it was first discovered on the banks of the Huon river. Diameter, 3 to 8 feet ; average, about 4½ feet. Height, 50 to 120 feet ; sp. grav. about ·650. Abundant in portions of the south-western part of the island. Price, about 16s. per 100 superficial feet, in the log.

Blackwood (*Acacia melanoxylon*, Br.)—So called from the dark-brown colour of the mature wood, which becomes black when washed with lime-water. In moist, shaded localities the trees grow more rapidly, and the wood is of a much lighter colour. Hence this variety is called "Lightwood" (in Hobart Town), to distinguish it from the other. Diameter, 1½ to 4 feet ; average, about 2¼ feet. Height, 60 to 130 feet. Sp. grav. about ·885. Found throughout the island, but not abundantly in any one locality. Price, about 12s. to 14s. per 100 feet superficial, in the log.

Native Myrtle (*Fagus Cunninghamii*, Hook.)—Common name, from the fancied resemblance of its dark-green leaves to those of the myrtle. Diameter, 2 to 9 feet ; average, about 3½ feet. Height, 60 to 180 feet. Sp. grav. about ·795. The native myrtle exists in great abundance throughout the western half of the island, growing in forests to a great size, in humid situations. Price, about 16s. per 100 feet superficial, in the log.

Celery-topped Pine (*Phillocladus rhomboidalis*, Rich.)—So called from the fancied similarity in form of the upper part of the branchlets to celery. Diameter, 1¼ to 2 feet ; average, about 1½ feet. Height, 60 to 150 feet. Sp. grav. about ·655. Rather common in damp forests in the southern parts of the island, and in some sub-alpine localities.

ORNAMENTAL WOODS.—The different kinds of wood included in the following list are all in constant use for cabinet and fancy work. They are arranged according to their value. The finest specimens of native myrtle, musk-wood, Huon pine, and black-wood, exhibit qualities of the highest excellence, both in tint and variety of venation.

NATIVE MYRTLE (*Fagus Cunninghamii*, Hook).

MUSK-WOOD (*Eurybia Argophylla*, Cass.)—Named from the musky odour of the plant. Diameter, 6 to 15 inches—the butt enlarging towards the ground to 1½, and even 2½ feet. Height, 15 to 30 feet. Spec. grav. about ·685. Abundant throughout the island in damp localities.

HUON PINE (*Dacrydium Franklinii*, Hook, fils.)

BLACK-WOOD (*Acacia melanoxylon*, Br.)

SHE-OAK (*Casuarina quadrivalvis*, Lab.)—A portion of the common name is evidently derived from the resemblance of the markings to those of oak. Diameter, 1 to 1½ foot. Height, 20 to 30 feet. Spec. grav. about ·845. Very common on dry stony hills, except in the north-western districts.

HE-OAK (*Casuarina suberosa*, Otto.)—Diameter, 9 to 15 inches. Height, 20 to 25 feet. Spec. grav. about ·855. Common on stony hills.

HONEYSUCKLE TREE (*Banksia Australis*, Br.) — Named from the large quantity of honey in the flowers. Diameter, 1½ to 2½ feet. Height, 20 to 40 feet. Sp. grav. about ·645. Abundant on sandy soil.

DOGWOOD.—(*Bedfordia salicina*, D.C.)—Diameter, 6 to 16 inches. Height, 15 to 25 feet. Sp. grav. about ·985. Common of small size, but rare of large proportions.

NATIVE LAUREL.—(*Anopterus glandulosus*, Lab.)—So named from its laurel-like leaves. Diameter, 6 to 10 inches. Height, 15 to 22 feet. Sp. grav. about ·675. Tolerably abundant in some sub-alpine localities.

BLUE GUM (*Eucalyptus globulus*, Lab.)—Curly-grained variety.

PEPPERMINT (*Eucalyptus amygdalina*, Lab.)—Some specimens of this timber have a fine wavy marking.

USEFUL WOODS.—SILVER WATTLE (*Acacia dealbata*, Lindl.)—So called from the whiteness of the trunk, and the silvery green of the foliage. Used for cask staves and treenails. Diameter, 1½ to 2½ feet. Height, 60 to 120 feet. Sp. grav. about ·795. Very common.

IRON WOOD (Tasmanian).—(*Notelœa ligustrina*, Vent.)—An exceedingly hard, close-grained wood, used for mallets, sheaves of blocks, turnery, &c. Diameter, 9 to 18 inches. Height, 20 to 35 feet. Sp. grav. about ·965. Not uncommon.

SWAMP TEA-TREE (*Melaleuca ericifolia*, Sm.)—So called, probably, because the leaves of an allied plant (*Leptospermum lanigeram*, Sm.) with similar bark, are said to have been used as a substitute for tea. Diameter, 9 to 20 inches. Height, 20 to 60 feet. Sp. grav. about ·824. Used for turnery chiefly.

NATIVE CHERRY (*Exocarpus cupressiformis*, Lab.)—So named because

the colour of the fruit is similar to that of a Kentish cherry. Diameter, 9 to 15 inches. Height, 20 to 30 feet. Sp. grav. about ·785. Used for tool handles, spokes, gun-stocks, &c.

White-wood (*Pittosporum bicolor*, Hook.)—Wood white. Diameter, 8 to 13 inches. Height, 20 to 35 feet. Sp. grav. about ·875. Used in turnery. Probably fit for wood engraving.

Native Box (*Bursaria spinosa*, Cav.)—The leaves are somewhat like those of the English box. Diameter, 8 to 12 inches. Height, 15 to 25 feet. Sp. grav. about ·825. Used for turnery.

Pink-wood (*Beyeria viscosa.—Croton viscosum*, Lab.)—Diameter, 6 to 10 inches. Height, 15 to 25 feet. Sp. grav. about ·815. Used for sheaves of blocks, and for turnery.

Native Pear (*Hakea lissosperma*, Br.)—The woody seed-vessel is somewhat pear-shaped. Diameter, 8 to 12 inches. Height, 29 to 30 feet. Sp. gravity about ·675. Fit for turnery.

Scented Woods.—Tonga Bean Wood (*Alyxia buxifolia*, Br.)—The odour is similar to that of the tonquin bean (*Dipteryx odorata*). A straggling sea-side shrub, 3 to 5 inches in diameter.

Native Box (*Bursaria spinosa*, Cav.)—The scent is pleasant, but fleeting.

Tanning Barks.—Wattle Bark.—The bark of the black wattle (*Acacia mollissima*, Wild.), the silver wattle (*Acacia dealbata*, Lindl.), and the blackwood tree (*Acacia melanoxylon*, Br.) The first-named yields the most valuable bark, and is common on dry stony hills.

Fibres.—Currajong (*Plagianthus sidoides*, Hook.)—The fibres of the bark are very strong. It is a large shrub, found chiefly on the southern side of the island, in ravines and shady places, and grows rapidly.

Lyonsia (*Lyonsia straminea*, Br.)—Fibres of the bark fine and strong. The lyonsia is met with, rather sparingly, in dense thickets, with its stems hanging like ropes among the trees.

Blue Gum (*Eucalyptus globulus*, Lab.)—The bark of this immense tree yields a fibre which may, probably, be found available for making the coarser kinds of paper.

Stringy Bark (*Eucalyptus gigantea*, Hook. fils.)—The fibres of the bark are similar to those of the blue-gum bark, but are not so strong, or so fine.

Fibrous Grass (*Stipa semi-barbata*, Br.)—After the seed has ripened the upper part of the stem breaks up into fibre, which curls loosely and hangs down, waving in the wind. The condition of the fibre at this time is undoubtedly far inferior to what it would be if rightly prepared. Common in some localities.

Gums.—Kino.—This gum, which seems to have similar properties to those of the East Indian "kino," exudes from the woods of all the Tasmanian species of *Eucalyptus*.

Wattle Gum, the gum of the Silver Wattle (*Acacia dealbata*, Lindl.),

is exceedingly viscous, and, probably, quite as useful as gum arabic. The gum of the black wattle (*Acacia mollissima*, Willd.), which is often mixed with the other, is very inferior to it, being far less viscous.

SUNDRY PRODUCTS.—PRICKLY FERN TREE (*Alsophila Australis*, Br.)—This very handsome fern tree occasionally attains a height of 30 feet. It is not, by any means, so common a fern tree as *Dicksonia antartica* (Lab.)

PITH OF RUSHES.—This is the pith of the largest Tasmanian rush (*Juncus vaginatus*, Br.) It is not rare. The pith is made up, in Hobart Town, into head-dresses, of which specimens are shown.

GELATINOUS SEAWEED (*Gracilaria sp.*)—This alga, which may, perhaps, be regarded as a variety of *G. confervoides* (Grev.), is occasionally used for making jelly. It abounds on the shores of Sloping (or Slopen) Islands, in Frederick Hendrick Bay.

NATIVE BREAD (*Mylitta Australis*, Berk.)—An insipid, under-ground fungus, which sends up no stem, and is generally met with by accident When growing rapidly it sometimes causes the ground to crack, and may thus be discovered by a careful observer, as it probably was by the Aborigines, who used it as food.

NOTE ON THE SILKWORM.

BY JAMES MORRIS.

I beg to append the following few lines, in the shape of a note, to the short article on the silkworm which appeared in the TECHNOLOGIST of last month. At a late meeting of the *Académie des Sciences*, M. Brouzet communicated the very beneficial results which he had obtained in arresting the contagious maladies of the silkworm, by the employment in his silkworm sheds of pine-wood injected with sulphate of copper. M. Brouzet was a large proprietor in the Cévennes, and he had the misfortune to see his crop of silkworms perish successively from the year 1853 to 1858. He then determined to renew the whole of the woodwork of his silkworm houses, and for this purpose he employed pine wood recently cut. This produced a satisfactory result, though it was sufficiently clear that many of those diseases to which the silkworm is so liable were again in operation. It appears that in 1860 M. Brouzet was charged by the Government to furnish a certain quantity of poles for the telegraphic wires over which it had control. M. Brouzet injected these poles, according to the process adopted by Dr. Boucherie. The thought occurred to him that a similar process might be advantageously adopted in the wood work of his silkworm houses. He accordingly employed the sulphate of copper, and the health of the silkworms not only visibly

improved, but none of them were attacked by those diseases which had caused such havoc among them in preceding years. Those worms, on the contrary, though of similar origin and placed in the same locality, but which were in houses built of non-injected wood, were attacked by the ordinary diseases, and gave results far inferior to those which had been otherwise treated. It is, therefore, clear that an advantageous antiseptic result was produced by the employment of the sulphate of copper as a wood-injection; and this idea is worthy of the notice of all those who are interested in the care of these worms, which are now assuming an importance which they never had so extensively before.

With regard to the diseases of the silkworm in France, it is satisfactory to know that they are now considerably on the decline. In a communication to the *Académie des Sciences*, by M. Guérin-Méneville, on the 25th of June, that indefatigable investigator remarked, that the character of the epidemic which had previously attacked the silkworms had become considerably modified—a sign that it had entered upon its period of decline. Referring to his previous labours in this department, and particularly those of 1849 and 1853, M. Guérin-Méneville maintains his previous opinion, that the cause of the first epidemic among the silkworms originated in a diseased state of the mulberry trees. This explanation agrees better with the great mass of facts which have been observed in the cultivation of the mulberry tree on a large scale; for others besides M. Guérin-Méneville had remarked the various phases of disease which the mulberry trees assumed, being sometimes numerous spots; at other times, the falling off of the fruit before it had reached a period of maturity, whilst the leaves could not be preserved in the usual manner without fading away and rapidly fermenting. M. Moglia de Orsinovi, who distilled the mulberry for the purpose of obtaining an alcohol, lately communicated to his friends a fact no less conclusive than characteristic, that of late years the mulberry fruit, instead of yielding him an alcohol as usual, only gave him after distillation a species of aromatic oil. On this point M. Guérin-Méneville observes:

"This circumstance recalled to me at once that in my communications in the year 1849 on the changes in the blood of diseased silkworms, I had drawn attention to the vibrating corpuscles and the crystals as the principal characteristics of the disease, and that these discoveries had been the starting-point of more recent observers in the same field, whose observations had been considered as new. A scientific man, whilst discovering my already-discovered *hema* tozoa, to which he simply gave another name, concluded, as I had previously done, that the silkworm disease was the result of some essential alteration in nutrition; but, instead of admitting with me, as was most natural in such a case, that such alteration in nutrition had its cause in a vitiated nourishment supplied to the worms, this party endeavoured to discover something extremely vague, which he no doubt considered more scientific, remarking that this essential

alteration in nutrition was produced by some miasmatic or contagious element. M. Chavannes, who had also studied my vibrating corpuscles and the blood-crystals, and had noticed that this fluid in the healthy caterpillar in the wild state contained none of them, concluded that the normal state of these silkworms might be brought back, by cultivating them in the same way as nature does with respect to the wild caterpillar—that is, in the open air. Though such conclusions are, no doubt, sound, there is still nothing to prove that such amelioration in the silkworm did not rather arise from the employment of healthy leaves during many generations."

After the notices on this subject which have already appeared in the TECHNOLOGIST, and particularly after the able and elaborate paper on the silk-producing insects of India, &c., by Mr. Frederic Moore, in the July number of this journal, it is to be hoped that some fresh impulse will be given to the silkworm culture, and to ailanticulture especially, so that a new industry may be organised in England.

THE MANUFACTURE OF LEATHER CLOTH.

The manufacture of leather cloth as a substitute for Morocco leather, was commenced in the year 1849, in the city of Newark, U. S. The first specimen of it seen in this country, was exhibited in 1851. The Americans have had the merit of producing many labour-saving machines and articles of domestic convenience, and many of them are becoming increasingly known and extensively adopted in this country. It is certain that this article of leather cloth has superseded the use of leather for many purposes to which the old material has hitherto been applied, besides being put to uses for which leather is wholly unsuitable. Messrs. Crockett, the inventors and patentees commenced the manufacture of leather cloth in England in 1855, and their factory was an old workhouse, situated in one of those dreary, unpicturesque marshes at West Ham, in Essex, a locality somewhat famous for its insalubrious manufactures. The firm was known as the "Crockett International Leather Cloth Company." In 1857 Messrs. Crockett surrendered their business to a company formed under the title of "The Leather Cloth Company, Limited," which purchased the entire European business.

The new company, with a paid up capital of 90,000*l.*, and having Mr. A. Lorsont as their managing director, began the enterprise with great energy. They erected substantial and extensive premises, which cover ten acres of ground, employing upwards of 200 men. They produce daily 1,000 pieces of 12 yards long and 1½ yards wide, or 15,000 square yards; sufficient if laid end to end to reach from their factory to the warehouse in Cannon street west—a distance of seven miles.

It will be evident that an article intended to resemble leather should be pliant, supple, and not liable to peel off or crack. These excellencies are to be attained by the peculiar ingredients of the composition with which the cloth is covered, and the method of applying it. On entering the factory our attention was first directed to the boiling room, in which there are 12 furnaces, with a large cauldron over each for boiling linseed oil. This process is attended with considerable danger from the liability of the boiling oil to generate gas and explode ; hence, a man is stationed at each cauldron stirring gently the boiling mass and watching a thermometer inserted in it, and which at the time of our visit stood at 580°. The oil is supplied to the boiling house by pipes from an adjoining building, where there is a huge tank with nine compartments containing 3,200 gallons each, or 28,800 altogether, amounting to 122 tons of oil. The boiling oil being allowed to cool is conveyed on a tramway to the mixing-house, where, in a puddling machine, it receives several other ingredients, the principal ones being lampblack and turpentine, which being mixed into a composition is ready for use.

The cloth to which this composition is applied is known by the name of "grey," or unbleached cotton. It is of a peculiar manufacture, and made expressly for the company. The store room is a spacious building and will contain an immense stock ; at present it has 25,000 pieces, or 300,000 yards. Here the cloth is calendered, and cut into lengths of twelve yards. The two ends of each length are sewn together to make it endless ; two sewing machines are in constant operation at this work. The pieces are then removed to the "milling" rooms, so called because they contain the mills in which the cloth receives the composition. These mills are rough looking wooden structures, having a drum at one end and a roller at the other, over which the cloth is passed, and then tightened by a crank and wheel at one end. A large frame knife or scraper, is then dropped down close to the cloth, a measured quantity of composition being laid on the cloth along the edge of the knife, the mill revolves, and the cloth receives as much of the composition as can pass under the edge of the knife. The piece is then carried to the heating room adjoining, and hung up on the rack to dry till next morning.

There are on the premises six milling rooms, with three mills in each, and having three men attendant upon each mill. The adjoining rooms for drying are heated by three rows of pipes laid along the wall. These pipes during the day are at a temperature of about 130°. The temperature is then increased towards the evening, and during the night to 160°, and it is the duty of the watchman to open the doors for ventilation and cooling, preparatory to the men resuming their work for the next coating.

Of course, in a building so greatly heated, and having so much inflammable material within it, the danger of fire is imminent, but every precaution has been taken which prudence could dictate. The building

is fire-proof, the floors are of metallic lava, and the roof, which is flat, is of the same material. A large pipe runs up the outside wall by the partition which divides the drying rooms, into each of which runs a branch pipe with a valve, which can be worked from the outside. A deluge of steam can by these means be poured into the rooms in a few minutes, by day or night. There are fourteen fire-plugs around the buildings, on the main of the East London Water Works, with hose and turncocks at hand, so that ample means of extinguishing fire exist on the premises.

But to return to the manufacture. The coating being thoroughly dry, the cloth is then taken to the "rubbers," whose business it is to remove all inequalities from the surface, and make it perfectly smooth. This is done by the "rolling machine" (an ingenious contrivance of Mr. Eagles, the manager,) by which the cloth is made to pass between two rollers, revolving in opposite directions. These rollers are covered with pumice stone, and do the work completely and expeditiously, which, till lately, was done by hand at great expense of labour. The "coating" and the "rubbing" being repeated four, and, in the case of heavy goods, five times, the cloth is ready for the "painters." The "painting rooms" contain machines similar to the "mills;" but instead of the drum they have a roller at each end, over which the cloth passes slowly, and a man at each side supplies the paint, meeting each other half way. Dependant partly on the colours, and partly on the article to be produced, is the number of coats of paint to be applied. Sometimes two will be sufficient, at other times four are necessary. The last coat receives several applications of a peculiar elastic enamel, composed chiefly of copal varnish, to protect it from the action of the atmosphere.

At this stage of the process the edges of the cloth are rough and have to be trimmed, and the seam by which the ends are sown together has to be cut. This is done by a machine called the "Guillotine," and we now follow the cloth to the "grainer." This latter, and to the ordinary leather cloth, finishing process, is done by a remarkably beautiful iron machine, having two rollers, the upper one being of polished iron cut obliquely on the surface, the other one of paper. Between these two rollers the cloth passes twice and receives its external resemblance to morocco leather. There are six machines used for this finishing process, and others for embossing, from the small diamond to the large mediæval pattern. The latter consumes much more time in passing through the machines. The cloth is now stamped with the trade-mark, labelled, and rolled up ready for transmission to the warehouse in Cannon street west.

On looking at the pieces when finished, one is struck by the extreme cleanness of the inner side after passing through so many soiling operations; this is owing to the practical skill with which the men handle the cloth, and to the agility with which they remove it from the several

machines, and carry it to the drying-rooms. While watching the process, we thought that in many respects, it was similar to the tanning with sumach, from the leaves and stalks of the *Rhus coriaria*, by means of which skins are made into morocco leather. As the leather cloth can be made permanently soft and elastic by the oily matter combining with the texture of the cloth, as it does with the fibres of the skin, the imitation is complete and successful.

There is another room in this establishment, especially interesting to the artist, where the cloth is printed in gold and colours, in designs which are really chaste and beautiful, and which, when used for the furniture and hangings, adorn rooms with something of oriental splendour. Here, too, there are table-covers with floral borders, rich in colour and choice in grouping, with centre pieces, which, as specimens of decorative art, are very effective. Many of these are displayed at the International Exhibition, and, we doubt not, excite both surprise and admiration.

The mixing room is a kind of *sanctum* of the manager's, and we suppose that from the skill with which the colours are prepared arises much of the excellence of the company's manufacture. In a room adjoining there are sixteen colour-grinding mills, constructed on the American principle, and worked by machinery, as in, indeed, almost everything on the premises seems to be. The machine which sets all in motion is a high pressure double-cylinder engine of 50-horse power, made by Woods, of Halifax. There are three immense Cornish boilers by Hill, of Heywood, which have been tested to a water pressure of 130 lbs. to the square inch, and represented 60-horse power. One of these is sufficient to work the engine by day and heat the drying rooms by night. We observed that, by the generosity of the company, a part of their premises had been given for the use of the 5th Essex Rifle Volunteers ; the drill room and armoury are magnificent apartments, such as are seldom seen devoted to such a purpose.

A writer in a very useful work on the "Manufactures of Great Britain," asks somewhat triumphantly, "What substitute could be found for leather?—a substance at once durable and elastic, affording protection from wet and cold, capable of being formed into innumerable useful articles, and susceptible of a high degree of ornament, and supplying lining to our carriages and covers to our books." This book was published in 1848, under the direction of the "Committee of General Literature and Education," and now in 1862, we have a substitute answering all the requirements here specified.

As to protection from wet and cold, the whole American army is equipped with leather cloth in the shape of capes, leggings, and knapsacks, our upholsterers can vouch for its durability and elasticity. The useful articles into which it can be made, and the degree of ornamentation it can receive, are becoming every day more manifest. We line our

railway, street carriages, and our hats with it; and as to our books, if they are not covered with it they ought to be. Truly our progress in art and science is defying all prediction as to what we may not accomplish, and rendering obsolete many of our familiar proverbs, and none more strikingly so than that "there is nothing like leather."—'Mechanics' Magazine.'

ESSENTIAL OILS FROM THE GENERA EUCALYPTUS AND MELALEUCA, SUITABLE FOR GENERAL APPLICATION IN THE ARTS.

These oils, consisting of nineteen varieties, have properties which fit them for the manufacture of varnishes and for illuminating purposes, and the trees and shrubs from which they are derived are so widely distributed, and obtainable in such quantities, as to render it probable that the oils can be produced at a cost enabling them to compete commercially with similar products of other countries.

Eucalyptus amygdalina (Tasmanian Peppermint, Dandenong Bastard Peppermint).—The tree, from the leaves of which this oil is obtained, occurs chiefly in the southern districts of the Colony of Victoria, and is common in Tasmania; it occupies open and undulating forest land, and is always interspersed with other trees, and is one of the least valuable of the Eucalypti, considered in reference to its timber. On the other hand, its yield of essential oil is astonishingly plentiful, 100 lbs. of the freshly-gathered leaves, inclusive of the small branchlets to which they are attached, giving upwards of three pints, imperial measure. The oil exists ready formed in the leaf, and the cells containing it may be seen in great numbers on examination by transmitted light.

This oil is a thin transparent fluid of a pale yellow colour, possessed of a pungent odour, resembling that of oil of lemons, but coarser and stronger; its taste is rather mild and cooling, producing an after sensation in the mouth resembling camphor, with something of its bitterness. Its specific gravity at 60° F. is 0·881. It boils freely at 330°; but as the evaporation proceeds, the mercury rises rapidly to 370°, where it remains almost stationary. Cooled to 0° F., it at first becomes turbid, and then clearing, deposits a white flocculent substance, which melts at + 27° F. Suffered to evaporate spontaneously, it proves to be somewhat less volatile than oil of turpentine. Like other essential oils, it leaves no stain on paper, and in shallow vessels it absorbs oxygen, giving rise to a residual resinous matter. When brought in contact with iodine no explosion ensues, even when the temperature is raised; but a dark-coloured solution is created, which, when heated, emits peculiar variegated

vapours, in which the colours yellow, red, violet, green, and blue are very beautifully visible, particularly in bright sunlight.

The essential oil of *E. amygdalina* is soluble in all proportions in turpentine, both fat and drying oils, benzine, naphtha, ether, chloroform, and absolute alcohol. Spirits of wine also dissolves it pretty freely; and water, on being agitated with an excess, takes up 1·1 per cent. by weight, or two drachms to the imperial pint.

This oil, when exposed in a shallow vessel, is ignited with great difficulty, by means of a burning match of wood or paper: in this way it cannot be made to take fire by contact with a flame until it has become quite hot. When it does burn under these circumstances, it produces a bright flame, with much smoke. When burned in a kerosene lamp, it gives a flame very nearly as luminous as that from American kerosene, but somewhat yellower, and inclined to smoke: a slight addition to the height of the chimney obviates this defect. The solvent powers of this and other oils from the genera Eucalyptus and Melaleuca constitute one of their most important characteristics, which will, doubtless, be turned to account in the preparation of varnishes and lacquers, provided the cost of production does not exclude their use for such purposes.

To enable manufacturers and technical men to estimate the capabilities of this as compared with the liquids usually employed for dissolving resinous substances, an extended series of experiments have been undertaken, the results of which are embodied in the subjoined table. In reference to this table, it is necessary to state that the exact saturating quantity of some of the substances there specified is obtained with much difficulty and loss of time, because the solution gradually increases in viscidity, while the solvent power of the oil proportionally diminishes; but in every case the resin undergoing investigation was added until a portion of it remained for two three days unacted upon. It will also be seen that the solutions were effected at ordinary temperatures, and the results produced by the action of different degrees of heat are not included in the category of facts, because to have done so would have extended this portion of the inquiry beyond all reasonable limits. Those persons who are conversant with this subject will, it is believed, be able to deduce from what is here stated the information they require. In those cases in which only part of a resin is taken up by the essential oil, the determination of the quantity dissolved has been made by evaporating carefully a measured portion of the solution to dryness, and weighing the residue, after heating it until decomposition had just commenced.

Mr. Hugh Gray, of Ballaarat, exhibits an oil distilled by him from one of the Eucalypti, which Dr. Mueller believes to be the *E. amygdalina*, judging from leaves of the tree forwarded to him. In yield this tree is very inferior to that which has just been described, 100 lbs. of the leaves

in the dry state giving 31 ounces 2 drachms of oil; in other respects being a close resemblance to it. The specific gravity of this sample is 0·907; it boils at 320°, the mercury rising to 385°. A comparison of this with the preceding oil suggests the idea that a portion of the volatile contents of the leaves may have been lost by the drying process to which they were subjected.

TABLE SHOWING THE SOLUBILITY OF RESINOUS SUBSTANCES, AT ORDINARY TEMPERATURES, IN THE ESSENTIAL OIL OF *Eucalyptus amygdalina.*

Name of Resinous Substance.	Number of ounces avoirdupois soluble in 1 imperial pint.	Remarks.
Camphor	23·3	Thin, transparent, almost colourless; solution perfectly saturated at about 70° F.
Rosin	20·3	Oily solution.
Mastic	17·5	Perfect solution, very viscid.
Victorian Sandarac (from the *Callitris verucosa*)	11·6	Beautiful clear yellow solution, very viscid.
Elemi	10·2	Oily solution.
Sandarac (ordinary) .	7·3	Fine viscid solution.
Kaurie Gum (from New Zealand)	7·3	Beautiful clear solution, exceedingly viscid. This resin dissolves with great readiness in the essential oil.
Dammar (ordinary) .	7·3	Fine solution, as thick as castor oil.
Asphalt	5·8	Perfect solution, almost opaque, and very thick.
Grass-tree Gum (from Victoria)	5·2	This resin is not completely soluble in *amygdalina;* to obtain a saturated solution, it must be used greatly in excess. The solution is oily, and of a beautiful transparent red colour.
Dragon's blood . . .	4·3	Beautiful solution, obtained by using a moderate excess of the resin.
Benzoin	2·8	A portion only soluble; the concentrated solution is obtained by treating a large excess; yellowish oily liquid, very clear.
Copal (Sample No. 1)	1·94	Clear, viscid, colourless solution, some samples more soluble than others; in all cases, a few clear gelatinous particles sink to the bottom, and remain undissolved even on dilution. The solution takes place very rapidly.
Ditto (Sample No. 2)	1·33	

SOLUBILITY OF RESINOUS SUBSTANCES—*Continued.*

Name of Resinous Substance.	Number of ounces avoirdupois soluble in 1 imperial pint.	Remarks.
Amber	1·74	About one quarter of the amber soluble ; it must be used in excess to obtain a concentrated solution.
Anime	1·45	This resin is soluble only in part, (about 67 per cent.), the remainder gelatinizes and remains for a long time in suspension. These particles, although they swell very much, do not lose their granular form nearly so much as those which form the insoluble portion of copal.
Shellac	1·16	Obtained by digesting a very large excess, reduced to a fine powder ; a small portion only of the lac being soluble, and that with great difficulty. The colour of the solution is pale orange.
Caoutchouc	0·73	A perfect solution, but very viscid.
Beeswax	0·73	Slightly turbid. The essential oil is capable of liquifying many times this quantity, but the turbidity of the solution increases very much, and it becomes thicker, ultimately refusing to flow.
Gutta Percha . . .	0·0	Digestion for several days produced no effect.

Eucalyptus oleosa (Mallee Scrub).—This species of Eucalyptus furnishes an essential oil which undoubtedly ranks first in importance amongst those submitted to the jurors. The interest which attaches to it, arises from the fact that greater facilities are offered for collecting the leaves from which it is distilled than is the case with those furnishing the other oils forwarded to the Exhibition.

The *E. oleosa* covers the greater part of the vast tracts of level country towards the north-west of Victoria, forming, with the species *E. dumoso* (Cunn.), and *E. socialis* (F. Mueller), the dense masses of vegetation known as Mallee Scrub. Its dimensions require it to be ranked as a shrub, as it rarely exceeds twelve feet in height; but from the circumstance that the individuals of the species are clothed with foliage to the ground, and often grow so closely together as to form impenetrable masses of vegetation, an exceedingly large quantity of the leaves can be procured in a short space of time, without moving far from one localit-

in search of them; and this supply could be maintained from day to day, as required for distillation, almost without limit.

Besides the favourable influence which the shrubby character of this plant exerts upon the cost of the raw material, the manufacturer of this oil upon a large scale would derive great benefit from the water-carriage which the River Murray furnishes for the transport of produce, and the constant and peculiarly abundant supply of water indispensable for purposes connected with the distillation and refrigeration of the oil.

The River Murray, in Victoria alone, is for about 270 miles of its course covered on its southern bank with Mallee Scrub, receding in some cases to a short distance inland, whilst in others it comes down to the water's edge. Under conditions so favourable, it is certain that the oil can be produced at a very inconsiderable cost.

The physical and chemical properties of the essential oil of *E. oleosa*, do not differ materially from the preceding. It is a thin mobile liquid of a pale yellow colour; mild in taste as compared with others of this class, the flavour being camphoraceous, and also suggestive of oil of turpentine in a slight degree.

Its odour, which is distinctly mint-like, is not so agreeable as that of *E. amygdalina*. The yield of the shrub, though inferior to that of the Dandenog Peppermint is still very large, 100 lbs. of the green leaves and branches giving 20 ounces of oil. Its specific gravity is 0·911, and it boils freely at 320°, and temperature gradually increasing until it remains stationary at 350°.

Burned in a kerosene lamp, this volatile fluid produces a fine luminous flame, superior in colour to that emitted by the preceding oil under similar circumstances, and totally devoid of smoke or smell. It is an excellent solvent for resins, but accurate determinations of the quantities of such substances taken up by it have not been made.

Its habitat extends from the Murray to the south of Lake Hindmarsh, and to Spencer and St. Vincent's Gulfs, in South Australia; it also occurs in the vicinity of Lake Torrens, and in the neighbourhood of the Darling and Murrumbidgee. It is essentially a desert species, and is not found in Tasmania.

Eucalyptus sideroxlyon (Ironbark).—In productiveness this tree ranks next in the series, 16 ounces 7 drachms having been obtained from 100 lbs. of the leaves alone. This amount should be taken as only approximate, for the green material, closely packed, having to be transported for a considerable distance, had suffered fermentation, and, owing to the heat evolved, to an extent certain to have acted disadvantageously upon the yield of oil.

The specific gravity of iron bark oil is 0.923; it boils at 310°, the mercury afterwards rising to 352°. In taste and smell it closely resembles that from mallee scrub. It is a thin, limpid, very pale yellow

fluid, igniting with great difficulty in open vessels, but burning well and with a dense white luminous flame in the lamp. The ironbark tree occurs on barren ranges, and is frequent in the vicinity of the gold-fields.

Eucalyptus goniocalyx (one of the White Gums).—The yield from the leaves of this tree is not so copious as that from *E. amygdalina*, although still very considerable ; 100 lbs. of fresh leaves give a product measuring 16 ounces. This oil is of a very pale yellow colour, with a pungent penetrating odour, rather disagreeable ; its taste is diffusible, strong, and exceedingly unpleasant. Its specific gravity is 0·918 ; it boils at 306°, after which the mercury rises to 346°. For illuminating purposes this oil is admirably adaped ; it produces a brilliant white flame, superior in intensity and colour to that from the best American kerosene ; its consumption in one of these lamps does not cause any smoke or smell. This tree is scattered over the mountain ranges of Victoria, but is not known in Tasmania. It is in some places rather abundant, being found from the Buffalo Ranges to the Mitchell River, in Gipps Land ; also in the district of the Upper Yarra.

Eucalyptus globulus (Blue Gum).—Two specimens of this volatile oil are shown in the Exhibition ; No. 1 is from the leaves of young trees, and No. 2 from those advanced in growth. The oil cells in the younger leaves are remarkable for their size, but a larger yield of oil is obtainable from those more perfectly matured ; this amounts to 12½ fluid ounces from 100 lbs. of freshly-gathered material. The essential oil from the blue gum must be regarded as one of the most important of this series, on account of its solvent and illuminating properties, and also in consequence of the large demand for blue gum timber, which occasions the felling of many trees of this kind, so that in some localities leaves of the *E. globulus*, which are utterly wasted at present, are to be had in great abundance. This oil is a thin limpid fluid, of a very pale yellow tint, almost colourless in the case of the sample from the young leaves ; its odour is like that of cajeput, to which all the oils from the Victorian Eucalypti have more or less resemblance. In *E. globulus* the camphor-like smell predominates ; its taste is not so disagreeable as the preceding, and more cooling and mint-like.

The specific gravity of this oil is 0·917 ; it boils more readily than the *E. amygdalina*—viz., at 300°, the mercury rising only to 350°. The sample from the young leaves differs slightly in these respects. Reduced in temperature to 0° F., it remained clear, and deposited no solid matter. In contact with iodine, this oil acts like *amygdalina*, and it is equally difficult to ignite in open vessels. In a lamp it gives a dense white flame, superior to kerosene, without smoke or smell. Its solvent capabilities are detailed in the following table. It is worthy of remark, that it dissolves grass-tree resin perfectly, in which it differs materially from *E. amygdalina*.

TABLE SHOWING THE SOLUBILITY OF RESINOUS SUBSTANCES AT ORDINARY TEMPERATURES, IN ESSENTIAL OIL OF *Eucalyptus globulus.*

Name of Resinous Substance.	Number of ounces avoirdupois soluble in 1 imperial pint.	Remarks.
Camphor	14·5	Thin solution, perfectly saturated at about 70° F.
Mastic	12·7	Fine solution, easily effected, of the consistency of honey.
Kaurie Gum (from New Zealand)	8·0	This resin dissolves with great readiness; the solution is very viscid, flowing with difficulty.
Sandarac (ordinary) .	7·3	Oily solution. This resin is taken up more slowly than the preceding.
Grass-tree	6·5	This gum completely dissolves, giving a deep red viscid liquid, almost opaque.
Asphalt	6·5	A thick opaque solution. It is very probable that the oil would take a greater quantity than that here given, but it is not possible to see when the asphalt ceases to dissolve.
Copal (sample No. 2) .	1·02	The resin in this case must be used in excess. The soluble part of it gives, with the oil, a perfectly colourless oily solution. By continued digestion for several weeks, so considerable a portion of the gelatinized residue is taken up, beyond the amount given in the table, as to make *E. globulus* appears to be the best solvent of copal.
Anime	0·81	This resin behaves in a manner somewhat resembling that just described save that the gelatinized insoluble portion retains its pulverulent form, although very much swelled and softened. About 55 per cent. of anime is dissolved in this volatile oil.
Shell-lac	0·13	Pale, bright, amber-coloured solution, very thin; it can only be obtained by digesting a large excess of the finely-powdered resin.
Gutta Percha . . .	0·0	No solvent action.

Eucalyptus corymbosa (Bloodwood).—The leaves from which this sample of essential oil was produced had suffered decay to even a

greater extent than those used in the preparation of the oil of the Ironbark tree, and it is believed that this circumstance gave rise to the formation of certain resinous matters which passed over the products of distillation, increasing in the form of minute grains, the bulk of the oil. The yield from 100 lbs. of leaves was therefore as follows:—pure limpid oil 9 ounces 3 drachms, oil containing resinous matter in suspension 6 ounces 2 drachms; of the latter fifty per cent. of its volume may be estimated as consisting of solid matter, upon which assumption the total yield may be approximatively stated as 12 ounces 4 drachms.

In odour this sample of oil differs greatly from all the oils of this class, so much so that it could hardly be recognised as of Eucalyptine origin. Its smell in relation to the others is much fainter and milder, and while partaking slightly of the lemon odour of the *E. amygdalina*, combined with a trace of attar of rose, it wants altogether the characteristic pungency and freshness of its congeners.

The taste of this oil is slightly bitter, producing the usual after-taste of peppermint, and irritating the throat; but it is not so pungent and diffusible as many others. It is a colourless and limpid fluid, and its specific gravity, which is below the average, is 0·881 at 60° F. It is found along the North-eastern boundary line of this colony and extends thence into New South Wales.

Eucalyptus fabrorum (Stringybark).—What has been said of the facilities offered for obtaining leaves from the Blue Gum is equally applicable to those from the Stringybark; the cost of such would not be great if the apparatus for distillation were erected in the vicinity of saw mills or where the wood splitter prosecutes his business. The Stringybark has a much wider range than many of the Australian Eucalypti, and is moreover quite gregarious, forming the main bulk of the timber in the barren mountainous districts; it is known from Spencer's Gulf to New South Wales, and extends also into Tasmania.

The essential oil from *E. fabrorum* is a transparent reddish-yellow fluid of a mild odour, as compared with *goniocalyx* and *globulus*, and much less disagreeable. In taste it resembles the other Eucalyptine oils, but is rather more irritating in the mouth, and also distinctly bitter though less unpleasant. Its specific gravity is 0·899, and its boiling points are respectively 340° and 382°; cooled to 0° F. it becomes turbid and opalescent. It will be perceived that this phenomenon, which also takes place with *E. amygdalina*, harmonises with the high boiling points which they both possess, whilst globulus which boils as low as 300° does not separate any frozen portion when cooled to zero.

With iodine this oil behaves as does amygdalina. In the lamp it gives a fine flame, but one not quite so white as that from *E. goniocalyx* and *E. globulus*. 100 lbs. of freshly-gathered leaves from the stringybark

tree yields 8 ounces of oil. Its solvent properties, with a selection of resinous bodies, will be found noted in the subjoined table:

TABLE SHOWING THE SOLUBILITY OF RESINOUS SUBSTANCES AT ORDINARY TEMPERATURES, IN ESSENTIAL OIL OF *Eucalyptus fabrorum.*

Name of Resinous Substance.	Number of ounces avoirdupois soluble in 1 imperial pint.	Remarks.
Camphor	21·8	A perfectly saturated solution, thin and clear; temperature about 70°.
Mastic	16·4	Pale yellow solution, clear and bright, of the consistence of oil.
Sandarac (ordinary) .	10·9	Rather more viscid than preceding.
Kaurie Gum (from New Zealand)	10·2	Beautiful transparent solution, exceedingly viscid.
Grass-tree	7·6	This resin is totally soluble in the essential oil of *E. fabrorum*, producing a liquid of a deep red colour, almost black.
Anime	1·09	Golden yellow solution, a portion only of the resin being soluble (about 75 per cent.), the insoluble being much swelled and gelatinized.
Shell-lac	0·98	Dark amber-coloured liquid, only obtained when a large excess of the resin is employed. The undissolved portion softens and aglutinates together, adhering fast to the sides of the vessel used for the digestion.
Copal (sample No. 2) .	0·76	This resin behaves as anime does; about 50 per cent. is soluble in the volatile oil.
Gutta Percha . . .	0·0	No solvent action.

Eucalyptus fissilis (Messmate).—This oil bears a strong resemblance to the preceding; its yield is the same—viz., 8 ounces from 100 lbs. of leaves. Its colour is a pale reddish yellow, and its smell is mild and rather agreeable, like fabrorum. In taste it is also very similar, attacking the throat. Its specific gravity is 0·903 at 60° F., and it boils at 350°, the temperature rising until it reaches 386°.

The essential oil of *E. fissilis* is a good solvent for resins, but no exact quantative determinations have been made with it. The messmate tree occurs under the same conditions as stringybark.

Eucalyptus odorata (Peppermint).—The peppermint tree extends from

New England through Australia Felix as far as Spencer's Gulf, is not known in Tasmania, forms in open reaches park-like scenery; but, contrary to what might have been anticipated, the quantity of oil furnished by the leaves of this species of the Eucalyptus is not large; the two samples forwarded differ so much in this and other respects, that a brief description of each will be necessary. The specific gravity of the oil marked No. 1 is only 0·889, and its boiling points are respectively 335° and 390; its consumption in a lamp does not give rise to quite so brilliant and white a flame as that from good kerosene. The yield is small, being only 5½ drachms from 100 lbs. of the fresh leaves, while in the case of No. 2, a similar quantity of leaves yielded 4 ounces 1⅓ drachms. This discrepancy is not easily accounted for, and is possibly due to accidental circumstances. Both samples of oil have a pale yellowish colour, inclining slightly to green; they are limpid fluids, and diffuse an aromatic smell in which one resembling that of camphor predominates. The taste is like that of *fabrorum*, but milder. The specific gravity of the sample No. 2 of this essential oil is 0·922. It boils at 315°, and as the evaporation proceeds the temperature rises to 356°. It is acted upon by iodine in a manner similar to *amygdalina*. In a kerosene lamp it gives a very brilliant white light, and burns exceedingly well.

Eucalyptus Woollsii (Woollybut).—The tree, from the leaves of which this oil is distilled, has but a limited range in Victoria; it is met with in the north-eastern portion of Gipps Land, and accompanies the blood-wood into New South Wales. The sample of oil submitted to the Jurors exhibits the remarkable property of imparting an indelible transparent stain to paper, indicating that a resin is probably held by it in solution. This opinion is strengthened by the unusually high specific gravity which it possesses—namely, 0·940; and by the fact that its boiling points are also much above the average, being 380° and 420° respectively. The taste of this essential oil is aromatic, and cooling, with but little pungency; it has a fragrant camphoraceous odour, and an oily consistency. The yield from 100 lbs. of leaves (those used having suffered slightly from close packing) is 3 ounces 3¼ drachms. In a kerosene lamp this fluid gives a good bright clear flame, but somewhat inferior to kerosene in intensity.

Eucalyptus rostrata (Red Gum).—Like that from the Peppermint, this oil is represented by two samples, which differ chiefly in colour; that of No. 1 being pale yellow, while No. 2 is of a reddish-amber tint. In smell it is hardly distinguishable from odorata, and the same may be said of its taste. The yield from 100 lbs. fresh leaves of the red gum is not large, as compared with many of the oils above described, amounting to 1 ounce 4½ drachms. The specific gravity of this oil is 0·918; its boiling point is the lowest of any, being 280°, the mercury afterwards became stationary at 358°. A portion which had been rapidly evapo-

rated to about one-fourth its bulk, almost gelatinised when reduced to zero, without losing its transparency. This oil burns very well.

The red gum has a wider range than any other of the Australian timber trees, being equally common within and beyond the tropics, and is usually found on the banks of rivers ; it does not occur in Tasmania.

Eucalyptus viminalis (Manna Gum).—A pale yellowish-green oil, the smell of which is disagreeable, but not very strong or penetrating. In taste it resembles *odorata*. Its specific gravity is 0·921, and its boiling points 318° and 360°. The yield is the least of any, being only $5\frac{1}{7}$ drachms from 100 lbs. fresh leaves. It burns very well in a lamp.

This Eucalyptus is to be met with on grassy reaches, often interspersed with *odorata ;* it is found also in New South Wales, South Australia, and Tasmania.

Melaleuca linarifolia.—The extraordinary large yield of oil which the leaves of this shrub supply, as compared with the quantities obtainable from others of the tea-tree genus, naturally places it at the head of the list ; 100 lbs. of fresh branchlets and leaves giving a product measuring 28 fluid ounces. It presents the appearance of a very light straw-coloured mobile fluid, of rather a pleasant odour resembling the oil of cajeput, but less aromatic and pungent, and possessed of a singularly agreeable taste—in which respect it differs from most of the other oils—strongly suggestive of both mace and nutmeg, followed by the usual mint-like aftertaste, common in a greater or less degree to the mrytaceous oils. The specific gravity of the liquid under consideration is 0·903, the lower of its two boiling points is unusually high, being 348°, while the interval between it and the temperature at which the mercury ceases to rise, is very much narrower than the average, comprising only 21°.

This essential oil burns well in the lamp, as far as colour is concerned, but its illuminating powers appear to be slightly inferior to good kerosene. This shrub is restricted to East Gipps Land and New South Wales, where it forms large bushes along some of the rivers.

Melaleuca curvifolia.—The product obtained from the distillation of the leaves and branchlets of this plant is of an oily consistency, and amber colour ; and, like *E. Woollsii*, leaves a transparent stain on paper, which peculiarity is probably due to a similar cause. Its specific gravity is considerable, being 0·938 ; it boils at 364° and 508°, which are remarkably high, being each of them upwards of 40° above the average boiling points of the eucalyptine oils, thus maintaining its similarity to the *E. Woollsii.* The yield from 100 lbs. freshly-gathered material is 5 ounces $7\frac{1}{5}$ drachms. The taste of this oil is not disagreeable, and resembles cajuput very closely. It is a good solvent for resins.

This species of tea-tree is found on the coast of Victoria, where it sometimes forms fine umbrageous trees ; it also grows in desert regions, where it is of a scrubby habit. It seems to prefer a saline soil.

Melaleuca erisifolia (Common Tea-tree of the Colonists).—The shrub

from which this oil is extracted is very plentiful, and widely distributed. It inhabits vast tracts of swampy and often sub-saline country, and gives rise to the term "Tea-tree Swamp;" it is remarkable for growing actually in water. It is also found in Tasmania and New South Wales, seldom exceeding the size of bushes, and penetrates along the watercourses into the ranges. It could be collected in very large quantities without difficulty. The minuteness of its leaves renders it necessary to introduce the smaller branches with them into the still, so that the yield of oil, which amounted to 5 ounces from 100 lbs. of fresh material, is, therefore, much less than it would be, could the leaves be operated on alone, as they do not constitute more than about a fourth of the weight of the whole. This remark is true of many of the plants of this genus, but more especially so of the *ericifolia*, as its leaves are smaller than those of any other, samples of the oil of which have been forwarded to the Exhibition; it may also help to account for the very great difference in the quantity obtained by each of the exhibitors.

The oil bears a striking resemblance to the cajeput of commerce, obtained from the *Melaleuca leucadendron* of the Moluccas. The colour of the product from this species of tea-tree is a very pale yellow; its smell is like cajeput, but somewhat less agreeable; its taste is bitter and camphoraceous, followed by a cool sensation, like that produced by peppermint, but the similarity to camphor is less perceptible, both in smell and taste, than it is in cajeput. This volatile oil is thin, but not as mobile as others; its specific gravity is 0·899 to 0·902, at 60° F., and it boils freely at about 300°, the mercury rising to 362°. In shallow vessels it is as difficult to ignite as any of the preceding oils from the genus Eucalyptus, but in a common kerosene lamp it burns very well, with a dense white flame, giving rise to neither smoke nor smell.

When iodine is brought into contact with it, at ordinary temperatures, reddish fumes are perceptible, without any explosion; by raising the temperature, variegated vapours are emitted similar to those already described.

It is worthy of remark, that the distillation of cajeput from the leaves of the *Melaleuca leucadendron* is conducted in a manner differing from that which has been pursued in the production of the Victorian oils, as in that case the leaves of the plant are allowed to heat in sacks, and are subsequently macerated in water, and fermented for a short time before the distillation is commenced. The object of this treatment is probably to increase the yield, and facilitate the escape of the oil; but it should be remembered that the productiveness of the *M. leucadendron* is not large—viz., scarcely three drachms from two sacks full of leaves; while the yield from *M. ericifolia*, and one or two other species, must be at least from twenty to one hundred times as great. It will be seen from

the following table that this oil is not inferior to any of the preceding as a solvent of resinous substances.

TABLE SHOWING THE SOLUBILITY OF RESINOUS SUBSTANCES AT ORDINARY TEMPERATURES, IN ESSENTIAL OIL OF *Melaleuca ericifolia.*

Name of Resinous Substance.	Number of ounces avoirdupois soluble in 1 imperial pint.	Remarks.
Camphor	18·9	Thin limpid solution, perfectly saturated at about 70°.
Mastic	15·3	Very soluble, forming a viscid, clear solution.
Kauri (from New Zealand)	10·2	This resin dissolves with readiness; its solution is very viscid, and of a pale, clear, reddish-yellow colour.
Sandarac (ordinary) .	8·7	Perfect solution, somewhat thinner than the preceding, but thicker than that of mastic.
Grass-tree	6·5	This resin is totally soluble in the oil of *M. ericifolia*, giving rise to a liquid of a very deep red colour, thicker than oil.
Anime	1·02	This resin is not totally soluble at ordinary temperatures; a little more than half of the quantity used was taken up to produce a solution of the strength indicated. The undissolved portion passes into a very bulky gelatinous state.
Shell-lac	0·95	The portion of shell-lac which is taken up by this solvent forms with it a transparent, deep amber-coloured fluid, of the consistence of oil; to obtain it, the resin must be used in excess, and in a finely divided state.
Copal (Sample No. 2)	0·82	Gum copal is rapidly acted upon by this volatile oil, but only a portion enters into perfect solution (about 56 per cent.), the remainder remains suspended in a very gelatinous, transparent state.
Gutta Percha . . .	0·0	No solvent action.

Melaleuca Wilsonii.—The productiveness of this shrub is tolerably great, bearing in mind the fact already stated, that a large portion of the material weighed into the still consists of stems and twigs, which, although they appear to contain a little oil, as is the case with all the

plants of this genus, must yet be regarded as relatively unproductive material. From 100 lbs. of the fresh green material four ounces of a pale yellow oil are obtained. In smell it is like *curvifolia;* its taste is very diffusible and pungent. Its specific gravity is 0·925.

This plant has been found hitherto only in the vicinity of Lake Hindmarsh, and the Tatiara country, and the River Wimmera. It is a desert species.

Melaleuca uncinata.—This plant is essentially a desert species; it ranges from Victoria across the continent to Western Australia, and forms a slender and graceful shrub. The colour of its essential oil is green, being in this respect exactly similar to cajeput, but in taste it resembles more the Eucalypti. In smell it is like *M. ericifolia*, with an addition of peppermint. The yield from 100 lbs. of the plant is approximately 1 ounce 6 drachms.

Melaleuca genistifolia.—100 lbs. of this shrub yield 1 ounce 2 drachms of a pale greenish yellow oil, mild in odour and taste; but both characteristic of the tea-tree oils. The quantity submitted for investigation was not sufficiently large to admit of determining its specific gravity and boiling points. The *M. genistifolia* accompanies the *M. linarifolia*, but is rare in Victoria.

Melaleuca squarrosa.—This oil is also coloured green. It resembles that of *uncinata* and *ericifolia*, but its taste is disagreeable; and, while it retains in this respect the character peculiar to the tea-tree oils, its flavour is somewhat vapid. The yield from *M. squarrosa* is small, being only 5 drachms from 100 lbs. of the shrub.

This is one of the most common of the tea-tree shrubs, being frequently found with *ericifolia* in tea-tree swamps, though, unlike it, it assumes in deep forest dells the dimensions of a large tree.

Before passing from the consideration of the essential oils of this class, it is desirable to make some observations bearing upon their technical importance and general characteristics.

The similarity in the properties of the oils which have been described is so great, that the investigations made respecting them have failed to establish individual peculiarities, sufficiently marked to enable the chemist to distinguish with certainty between them, and tell by the examinrtion of a sample the source from which it was obtained. In a practical point of view this want will be little felt, as for the manufacture of varnishes, the dissolving of india-rubber, or for illuminating purposes, they are almost equally valuable. The behaviour of these substances when subjected to the action of re-agents may be shortly stated as follows:

With sulphuric acid at ordinary temperatures a gradual darkening in colour is perceptible, the tint varying slightly according to the oil operated upon, but the final result is in all cases a deep brown. When heat is employed, these changes are rapidly brought about; the acid is decomposed, giving rise to sulphurous acid gas, and the oil is con-

verted into a charred mass, a part of which is dissolved by water, producing a liquid so dark as to be almost black.

Nitric acid acts but slowly in the cold ; it gives rise when much concentrated to numerous shades of brown, olive, purple, violet, and grey ; but when an addition of oil of vitriol is made, or when the nitric acid is employed at a temperature near its boiling point, the action is exceedingly violent ; nitrous acid fumes are given off in great abundance, and the oil is converted into a brown resinous body of a pungent odour, hard and brittle, yet becoming plastic like pitch ; soluble in alcohol and ether ; fusing at a moderate heat and inflammable, and possessed of marked acid properties, as it forms coloured salts with the bases, and reddens litmus, in its alcoholic solution.

Hydrochloric acid does not give rise to very marked results on being simply added to one of these oils ; but the effects produced by this reagent have not as yet been studied to the extent they deserve. Iodine has been already referred to. What has been said of *E. amygdalina*, as to its solubility in various liquids, is true of the whole series.

If a piece of the metal sodium be introduced into one of these volatile oils, an evolution of gas instantly begins upon its surface, and this action is much aided by heat ; it is not under any circumstances as energetic as that caused by the same treatment of some other essential oils, such as oil of cloves. The soda formed is taken up by the oil, giving rise to a dark brown liquid, from which water abstracts the colour, and acquires alkaline properties. Solid potash aided by heat, and a solution of potash in alcohol, act very similarly as far as the change in colour is concerned.

From what has been said it would appear probable that these volatile fluids must be regarded as oxygenated oils of very similar constitution, holding a camphor, or possibly a liquid carbo-hydrogen in solution, the proportion of which differs in the several varieties. The adoption of such theory helps at least to explain the differences which exist, in bodies otherwise so similar in their boiling points, the separation of solid matter at low temperatures, and above all in the varying purity of colour with which they burn in a lamp supplied with a constant amount of atmospheric air.

The following summary will be found to give concise information respecting some of the properties of these oils, and the circumstances under which they were produced.

E. amygdalina (Dandenong Peppermint).—Gathered in September ; yield from 100 lbs., 60·50 oz. ; specific gravity at 60° F., 0·881 ; boiling temperatures, 330° to 370° ; relative illuminating power, the flame of kerosene = 1·000, 0·849 ; colour of flame, that of kerosene being white, yellow. This yield is estimated from fresh leaves and branchlets together ; the flame has a tendency to smoke.

E. amygdalina, from Ballaarat.—Yield from 100 lbs., 31·25 oz. ; specific gravity at 60° F., 0·907 ; boiling temperatures, 320° to 385° ;

relative illuminating power, the flame of kerosene = 1·000, 1·028; colour of flame, that of kerosene being white, white. Yield estimated from leaves only which had been dried in the shade.

E. oleosa (Mallee Scrub) from Murray District.—Gathered in January; yield from 100 lbs., 20·00; specific gravity at 60° F., 0·911; boiling temperatures, 322° to 350°; relative illuminating power, the flame of kerosene = 1·000, 1·080; colour of flame, that of kerosene being white, white. Freshly gathered leaves and branchlets, brought a considerable distance, but in excellent condition.

E. sideroxylon (Ironbark), from Bendigo.—Gathered in December; yield from 100 lbs, 16·88; specific gravity at 60° F., 0·923; boiling temperatures, 310° to 352°; relative illuminating power the flame of kerosene = 1·000, 1·090; colour of flame, that of kerosene being white, very white. From leaves only which had undergone fermentation.

E. goniocalyx (White Gum), from Dandenong.—Gathered in November; yield from 100 lbs., 16·00 oz.; specific gravity at 60° F., 0·920; boiling temperatures, 306° to 346°; relative illuminating power, the flame of kerosene = 1·000, 1·098; colour of flame, that of kerosene being white, very white. From fresh leaves and branchlets.

E. globulus (Blue Gum) No. 1, from Port Phillip.—Gathered in March; specific gravity at 60° F., 0·919; boiling temperatures, 295° to 346°; relative illuminating power, the flame of kerosene = 1·000, 1·086; colour of flame, that of kerosene being white, very white. From fresh leaves only.

E. globulus (Blue Gum) No. 2, from the Botanical Gardens, Melbourne. Gathered in April; yield from 100 lbs., 12·50 oz.; specific gravity at 60° F., 0·917; boiling temperatures, 300° to 350°; relative illuminating power, the flame of kerosene = 1·000, 1·048; colour of flame, that of kerosene being white, very white. From fresh leaves only.

E. corymbosa (Bloodwood), from East Gipps Land.—Gathered in December; yield from 100 lbs., 12·50 oz.; specific gravity at 60° F., 0·881; relative illuminating power, the flame of kerosene = 1·004; colour of flame, that of kerosene being white, yellow. Leaves and branchlets which had undergone partial decay; the flame has a slight tendency to smoke.

E. fabrorum (Stringybark), from Dandenong.—Gathered in September; yield from 100 lbs., 8·00 oz.; specific gravity at 60° F., 0·890; boiling temperatures, 340° to 382°; relative illuminating power, the flame of fierosene = 1·000, 0·870; colour of flame, that of kerosene being white, yellow. From fresh leaves only; the flame has a tendency to spread and smoke.

E. fissilis (Messmate), from Dandenong.—Gathered in September; yield from 100 lbs., 8·00 oz.; specific gravity at 60° F., 0·903; boiling temperatures, 335° to 386°; relative illuminating power, the flame of kerosene = 1·000, 0·908; colour of flame, that of kerosene being white-yellowish. From fresh leaves only.

E. odorata (Peppermint) No. 1, from Port Phillip.—Gathered in August; yield from 100 lbs., 0·69 oz.; specific gravity at 60° F., 0·889; boiling temperatures, 335° to 390°; relative illuminating power, the flame of kerosene = 1·000, 0·850; colour of flame, that of kerosene being white, yellow. Yield estimated from fresh leaves only.

E. odorata (Peppermint), No. 2, from Port Phillip.—Gathered in August; yield from 100 lbs., 4·17; specific gravity at 60° F., 0·922; boiling temperatures, 315° to 356°; relative illuminating power, the flame of kerosene = 1·000, 1·158; colour of flame, that of kerosene being white, very white. Yield estimated from fresh leaves only.

E. Woollsii (Woollybut), from East Gipps Land. — Gathered in January; yield from 100 lbs., 3·40 oz.; specific gravity at 60° F., 0·940; boiling temperatures, 380° to 420°; relative illuminating power, the flame of kerosene = 1·000, 0·967; colour of flame, that of kerosene being white, white. Yield estimated from leaves only which had suffered slight injury from close packing.

E. rostrata (Red Gum), No. 1, from Port Phillip.—Gathered in July; yield from 100 lbs., 1·04 oz.; specific gravity at 60° F., 0·918; relative illuminating power, the flame of kerosene = 1·000, 0·985; colour of flame, that of kerosene being white, very white. Yield estimated from fresh leaves only.

E. rostrata (Red Gum), No. 2, from Port Phillip.—Gathered in July; yield from 100 lbs., 1·56 oz.; specific gravity at 60° F., 0·918; boiling temperatures, 280° to 358°; relative illuminating power, the flame of kerosene = 1·000, 0·942; colour of flame, that of kerosene being white, yellowish. Yield estimated from fresh leaves only.

E. viminalis (Manna gum), from Port Phillip.—Gathered in August; yield from 100 lbs., 0·65 oz.; specific gravity at 60° F., 0·921; boiling temperatures, 318° to 360°; relative illuminating power, the flame of kerosene = 1·000, 1·082; colour of flame, that of kerosene being white, white. Yield estimated from fresh leaves and branchlets.

M. linarifolia (Tea-tree), from Botanical gardens, Melbourne.—Gathered in January; yield from 100 lbs., 28·00 oz.; specific gravity at 60° F., 0·903; boiling temperatures, 348° to 369°; relative illuminating power, the flame of kerosene = 1·000, 0·982; colour of flame, that of kerosene being white, white. Yield estimated from fresh leaves and branchlets brought a considerable distance.

M. curvifolia (Tea-tree), from Port Phillip Heads.—Gathered in November; yield from 100 lbs., 5·90 oz.; specific gravity at 60° F., 0·938; boiling temperatures, 364° to 408°; relative illuminating power, the flame of kerosene = 1·000, 1·031; colour of flame, that of kerosene being white, white. Yield estimated from fresh leaves and branchlets.

M. ericifolia (common tea-tree), from Port Phillip.—Gathered in October; yield from 100 lbs., 5·00 oz.; specific gravity at 60° F., 0·902; boiling temperatures, 300° to 362°; relative illuminating power, the

flame of kerosene = 1·000, 1·017; colour of flame, that of kerosene being white, white. Yield estimated from fresh leaves and branchlets.

M. ericifolia, from Port Phillip.—Gathered in October; yield from 100 lbs., 1·37 oz.; specific gravity at 60° F., 0·899; boiling temperatures, 310° to 350°; relative illuminating power, the flame of kerosene = 1·000, 1·076; colour of flame, that of kerosene being white, white. Yield estimated from fresh leaves and branchlets.

M. Wilsonii (Tea-tree), from Wimmera.—Gathered in December; yield from 100 lbs., 4·00 oz.; specific gravity at 60° F., 0·925; relative illuminating power, the flame of kerosene = 1·000, 1·094: colour of flame, that of kerosene being white, very white. Yield estimated from fresh leaves and branchlets brought from a long distance.

M. uncinata (Tea-tree), from Botanical Gardens, Melbourne.—Gathered in November; yield from 100 lbs., 1·75 oz.; specific gravity at 60 F., 0·920; relative illuminating power, the flame of kerosene = 1·000, 1.075; colour of flame, that of kerosene being white, very white. Yield estimated from fresh leaves and branchlets.

M. genistifolia (Tea-tree), from Botanical Gardens, Melbourne.—Gathered in January; yield from 100 lbs., 1·25 oz. Yield from fresh leaves and branchlets.

M. squarrosa (Tea-tree), from Gipps Land.—Gathered in December; yield from 100 lbs., 0·63 oz. Yield from dried leaves and branchlets.

Averages of Eucalyptus oils obtained from the species *amygdalina*, *oleosa*, *sideroxylon*, *goniocalyx*, *globulus*, and *fabrorum:* Yield from 100 lbs., 22·31 oz.; specific gravity at 60° F., 0·908; boiling temperatures, 317° to 359°; relative illuminating power, the flame of kerosene = 1·000, 1·006. Average interval between lower and higher boiling points, 42° F.

Averages of Melaleuca oils obtained from all the species: specific gravity at 60° F., 0·915; boiling temperatures, 331° to 372°: relative illuminating power, the flame of kerosene = 1·000, 1·046. Average interval between lower and higher boiling points 41° F.

With reference to the yield given, it should be borne in mind, that although the quantity obtained from each species has been determined with considerably accuracy, such results cannot be regarded as absolutely constant under all circumstances; for there can be little doubt that marked variations will be perceptible in the producing powers of oil-bearing trees, due to differences in age, in the localities where they grow, whether on high or low, moist or dry ground, in the time of year when the leaves are gathered, and in climatic influences generally. In addition to these, a direct cause of variableness is to be found in the proportion of branchlets introduced with the leaves into the still, or included in the calculation.

These are the causes which may have given rise to occasional anomalies, of which one or two instances will be found in the preceding

summary statement; but the manufacturer on the large scale will find that under like conditions the quantity he obtains may often exceed the yield as stated, but will very rarely fall below it.

The averages appended have been furnished solely for practical purposes; those belonging to the Eucalypti have been derived from the most common and important trees of that genus. In the case of the tea-tree oils the yield has been omitted, in consequence of the great disparity which the species of that genus manifest in this respect, and from the fact that the species *ericifolia* exists in much greater profusion, and covers larger tracts of country than all the others taken together.

To enable a comparison to be made between the productiveness of Victorian plants supplying essential oils, and those of other countries, which are frequently dried before subjecting them to distillation, the following determinations of the loss in weight by drying Eucalyptus leaves in the shade have been made, and may be depended upon for their accuracy:—

E. amygdalina (Dandenong peppermint)	loses 50	per cent.
E. globulus (blue gum)	50	„
E. viminalis (manna gum) . . .	41	„
E. rostrata (red gum) . . .	58	„
Average loss by drying in the shade .	50	per cent.

The photometric values of the flames produced by the combustion of these indigenous products have been obtained by comparing them with a kerosene lamp with a flat wick $\frac{5}{8}$ inch wide, and burning 318 grains per hour of kerosene of the best quality imported from America.

It is evident that such of the oils as give a yellow or yellowish light may be made perfect in colour by a judicious admixture with others, giving a purer flame, or by an alteration in the form of the lamp, and that consumed under such modified circumstances they would also emit a greater amount of light.

Regarding the suitability of these substances for illuminating purposes there can be no question, as they are possessed of all the valuable properties required for the economic production of artificial light. In efficiency and safety they equal the best kerosene, their odour being at the same time more agreeable, while unlike it they leave no stain upon paper or clothing. Endowed with so many advantages, their general adoption in place of lamp oil, kerosene, naphtha, and camphine, will depend solely upon the cost of their production; and without venturing to express a decided opinion upon a question of such difficulty, the successful solution of which depends upon an intimate knowledge of local circumstances, the jurors offer the following data, in addition to the information already given, with the view of enabling those who desire to pursue this subject further, to make the calculation of cost for themselves.

The apparatus required would consist of a still of large dimensions, which might be constructed of sheet iron, with a stout plate at bottom to resist the action of fire. Adapted to this a worm of very moderate size would be found sufficient, as the oils are easily condensed, and for refrigerating purposes a supply of cold water must be available, a small quantity being also necessary for the still. The price at which green leaves, which could be collected by women and young persons, can be delivered at the manufactory, constitutes the chief item in the calculation of expense. To facilitate its estimation the following weights may be stated as the results of actual experience: — a sack, capable of containing 200 lbs. of flour, when closely packed with fresh green leaves only, weighs from 90 to 100 lbs., with Eucalyptus leaves and branchlets together from 50 to 60 lbs. Of the freshly gathered material used for the production of two of the tea-tree oils (*linarifolia* and *genistifolia*), the leaves alone amounted in weight respectively to 41 and 48 per cent. of the whole, the stems making up the rest; from 70 to 80 per cent. may be received as equally applicable to Eucalyptus leaves and branchlets, without involving an important error. The question of cost will be also materially affected, should the residual decoction remaining in the still, after the expulsion of the volatile contents of the leaves, be applicable to some useful purpose. The liquid referred to contains a very considerable quantity of extractive and astringent matter in solution, which might be turned into account in a variety of ways; but until more is known of its constituents and properties, it would be premature to bring its value into calculation.

The approximate extent of country covered by the several descriptions of vegetation in Victoria is, according to A. J. Skene, Esq., of the Survey Department, morasses, lakes, and lagoons, 402,000 acres; dense mallee scrub, 5,560,000 acres; mountain ranges densely wooded with gum, 6,225,000 acres; open timbered country, 38,922,000 acres; open plains devoid of timber, including heaths, 4,470,000 acres; tea-tree scrub, 65,000 acres—Total, 55,644,000 acres.

From the foregoing figures it will be seen that about 12,000,000 acres of land, namely the mountainous tracts, and those covered with mallee and tea-tree scrub, are densely clothed with myrtaceous vegetation, in the foliage of which enormous quantities of valuable volatile oils are stored.

The suitability of these substances for the manufacture of varnishes has been frequently referred to already; in addition it may be remarked, that most, if not all, of the refractory resins which are but little acted on by them at ordinary temperatures yield to their solvent action, when previously fused in the manner commonly practised by varnish makers.

Gutta percha, which is not affected by a lengthy digestion in the cold, is easily taken up when the temperature is raised, although a large portion appears to be again deposited when the liquid has cooled and

remained for some time in a state of rest. The most exceptional and important property which the Victorian oils exhibit in their relations with resinous substances, is the power they possess of dissolving the fossil Kauri Gum (*Dammara Australis*) of New Zealand. This substance can be obtained at a very low price, from 10*l.* to 12*l.* per ton; but the difficulty of bringing it into perfect solution, has hitherto retarded its exportation in large quantities. The solution of the above named resin, bears dilution with very strong alcohol, ether, and chloroform to any extent, and about 30 per cent. of turpentine may be added with safety; but 50 per cent. of that solvent throws down the resin as does spirits of wine, benzine, linseed oil, and coal oil (kerosene). The solution of sandarac may be diluted with strong alcohol; but turpentine and linseed oil cause the deposition of the resin. Asphaltum is thrown down by the absolute alcohol; but turpentine may be added with impurity. Grass-tree resin on the contrary is held in solution by alcohol, but will not bear dilution with turpentine or linseed oil. Mastic may be diluted with all the ordinary solvents, but alcohol in quantity appears to precipitate a portion giving rise to a milky appearance.

With a view of testing the durability of varnishes prepared with essentials oils of the genera Eucalyptus and Melaleuca, many experiments have been undertaken; numerous surfaces coated with them, and with varnishes of established reputation, have been placed in sheltered and exposed situations, and the effects of sun and moisture, and of shade, compared and noted from time to time; but the results obtained are as yet too imperfect to admit of their embodiment in the present report, investigations of this kind requiring much time for their satisfactory completion.

DESCRIPTION OF THE CHIEF FOREST TREES OF UPPER CANADA.

BY DR. HURLBERT.

The samples of wood about to be described, sent to the International Exhibition, have been collected from the extreme eastern and western, and central parts of Upper Canada, for the purpose of showing the extent of country over which the most valuable timbers grow.

1. The most important collection is in the form of planks, twelve feet long and four inches thick, with the bark on both edges. Of these (sixty in number), there are superb samples of white oak, four feet wide; white wood, black cherry, black walnut, button-wood, white ash, sugar maple and soft maple, from three to four feet wide; one plank of pine, from the township of Bayham, twelve feet long (and it could have

been cut fifty feet long) and fifty inches wide, without a knot, sawn from a tree 22 feet in circumference and 120 feet to the first limb ; the first four logs, twelve feet long, making 8,000 feet of lumber after being squared.

2. The second class of woods are sections of the trunks of the chief of the valuable timbers, with the bark on, taken from the three divisions of the Province above named. Of these there are thirty-four.

3. The third are neatly planed and polished specimens of all our chief woods—one side varnished, the other plain—veneers of the plain wood, of crotches, of roots, &c., of the most choice varieties. Of these there are two collections, each of 73 specimens, with some smaller ones ; in all, about 250.

4. The fourth class consists of the sections of the trunks (from three to six inches in diameter), one foot on, with the bark on, so cut as to show the grain of the wood and the polish it will take, accompanied with twigs, leaves, and flowers of the trees. In this class are five valuable collections, from the distans parts of Upper Canada, of some 90 distinct kinds of native woods and shrubs. Of these there are 203 pieces.

The common and scientific names of all the woods are given, with the size and height of the trees, the specific gravity of the wood, its weight compared with shell-bark hickory (which, being the heaviest of all our woods, is taken as the standard), its uses, prices, at the lake ports, and at Quebec, &c.

5. The fifth class contains samples of tool-handles, shafts, and poles of carriages, spokes, naves, &c., showing the common purposes for which the woods are best adapted and most used.

From a pamphlet issued from the Bureau of Agriculture, at Quebec, we learn that Canada exports annually about 30,000,000 cubic feet of timber in the rough state, and about 400,000,000 feet board measure, of sawn timber. The revenue derived by the province, during the year 1860, for timber cut in the forests, amounted to about 500,000 dols. Of the sixty or seventy varieties of woods in our forests, there are usually only five or six kinds which go to make up these exports so vast in quantity ; the remaining fifty or sixty timber trees are left to perish, or are burned as a nuisance, to get them out of the way. By showing, in the markets of the world, that we have these valuable woods, and can furnish them at such unprecedentedly low prices, we shall secure additional purchasers. The collections here named were made chiefly in reference to this point, and are, in their nature and in their intrisic value, it is believed, well adapted foı that purpose.

In extent, in the variety and value of its woods, the great forests of deciduous trees of North America surpass all others ; and the most remarkable of this great mixed forest is that growing in the valley of the St. Lawrence. The Western coasts of both continents, in high latitudes, furnish only or chiefly the Coniferæ. The high summer temperatures

and abundant summer rains are, unquestionably, those conditions of climate necessary to produce these peculiar forest trees. The western coasts of both continents, in high latitudes, have the necessary moisture, but not the high summer temperature; the western prairies, east of the Mississippi, and the vast deserts west of it, have the summer heat but not the moisture; hence the absence of all trees in the one region, and of the deciduous trees in the other.

1. White Pine (*Pinus strobus*).—Grows in all parts of Canada in extensive groves, or scattered amongst the deciduous forests. Average height, 140 to 160 feet; average diameter, 3 and 4 feet; but common at 5 and 6 feet in diameter and 200 feet high, especially near the shores of Lake Erie. Trees of 22 feet in circumference and 220 feet in height and 120 to first limb, are sometimes found. The trunk is perfectly straight. The wood is soft-grained, easily wrought, and durable; used in immense quantities in architecture. The large trunks are particularly sought for masts of ships. Largely exported to England, where it is called "Weymouth pine." Specific gravity, 0·46; weight of cubic foot, 29 lbs.

2. Red Pine (*Pinus resinosa*).—Found in dry soils and in the cooler latitudes of Canada, and attains the height of 80 feet, with a trunk 2 feet in diameter, very straight and uniform. It affords a fine grained, resinous timber, of much strength and durability, and highly valued in architecture Specific gravity, 0·66; weight of cubic foot, 40 lbs.

3. Yellow Pine (*P. mitis*).—Grows in dry and sandy soils, common in all parts of the country; attains the height of 60 feet; wood close, fine grained, durable, and moderately resinous, and much used for ship building and all kinds of architecture. Specific gravity, 0·52; weight of cubic foot, 30lbs.

4. White Oak (*Quercus alba*).—Widely distributed throughout Canada in all rich soils. Average height, 130 feet; height to first limb, 70 feet; diameter, 30 inches, and quite common, 60 inches in diameter, found 84 inches in diameter in the western parts of Upper Canada. Of the twenty varieties of oaks in North America, the white is the most valuable. The wood is of great strength and durability, and extensively used in ship-building, for staves of casks, spokes and naves of waggon wheels, railway ties, &c.; bark useful in tanning and in medicine. The timber is largely exported to England and the West Indies, and can be furnished in the remotest parts of Upper Canada at 40*l.* sterling per 1,000 cubic feet; freight to Quebec about 11*l.* sterling per 1,000 cubic feet. Specific gravity, 0.84; weight of cubic foot fully seasoned, 50 lbs. Potash obtained from outer wood, 13·41, and from heart wood, 9·68 per cent.; value for heating purposes, 81 (shell-bark hickory being 100).

5. Black Oak (*Quercus tinctoria*).—One of the largest trees of our forest, 100 to 130 feet in height, and 4, 5, and 6 feet in diameter. Not

so common or so valuable as white oak. The bark used in tanning, and for obtaining *quercitron*, used in dyeing.

6. Red Oak (*Quercus rubra*).—Grows extensively throughout Canada, is a lofty, wide-spreading tree, of an average height of 130 feet, and of 70 feet to the first limb, and common at 30 inches in diameter. Makes best casks for oils and molasses. Too little sought after, because of the great abundance and greater value of white oak. Can be furnished in the remote parts of Western Canada at 35*l.* sterling per 1,000 cubic feet; freight to Quebec about 10*l.* sterling; specific gravity, 0.675; weight of cubic foot, 40 lbs.; value for heating purposes, 69; outside wood yields 20·5 per cent., and the inside 14·79 per cent. of potash.

7. Swamp Oak (*Q. prinus*, var. *discolor*).—A beautiful tree, widely diffused, attaining the height of 70 to 90 feet. Grows in swampy alluvial grounds; timber preferred to that of the red oak, resembling more the white oak, and called also swamp white oak. The specific name *discolor* or *bicolor* is derived from its rich and luxuriant foliage. Specific gravity, 0·675; weight of cubic foot, 40 lbs; value for heating purposes, 68.

8. Chesnut (*Castanea vesca*).—Grows only in the western parts of Upper Canada, and on rocky or hilly lands; a large tree, 80 to 100 feet in height and 36 inches in diameter. The timber is coarse grained, strong, elastic, light, and very durable; posts of chesnut have been known to stand in the ground for forty years. The young wood is very elastic, and is used for rings of ship masts, hoops for tubs, &c. Chesnut is distinguishable from oak in having no large transverse septa, though in every other respect the two woods are remarkably similar in texture and colour. The nuts are much esteemed, and sweeter than those of the European variety (the Spanish chesnuts). Outside wood contains 4·56 per cent. of potash; inside 2·73 per cent. Specific gravity, 0·5; weight of cubic foot, 32 lbs.; value for heating purposes, 52.

9. Black Walnut (*Juglans nigra*).—Grows abundantly on the rich soils of the western and south-western parts of Upper Canada, of an average height of 120 feet, 70 feet to the first limbs, and 36 inches in diameter. Sections of the wood 6 feet in diameter are not uncommon. The wood is compact, strong and tough, of a deep violet colour, surrounded by a white alburnum. It is used extensively for building, for furniture, and in the form of veneers. It can be furnished along the line of the Great Western Railway, or at the lake ports, for 60*l.* sterling per 1,000 cubic feet; freight thence to Quebec, about 11*l.* per 1,000 cubic feet. Specific gravity, 0·5; weight of cubic foot, 30 lbs., well seasoned; value for heating purposes, 65.

10. Butternut (*Juglans cinerea*).—A large forest tree of an average height of 100 feet, 65 feet to the first limb, and 24 to 30 inches in diameter, found over extensive areas in Canada on elevated river banks and on cold, uneven rocky soils. The wood is of a reddish hue, lighter

than the black walnut, shrinks but little, and is used in panneling, in ornamental work, and for furniture. The bark is used in dyeing, and from it is extracted an excellent cathartic. Specific gravity, 0·426 ; weight of cubic foot, 26 lbs. ; outside wood contains 4·42 per cent. potash ; inside, 1·42 per cent.

11. Shell-bark Hickory (*Carya alba*).—A tall and slender forest tree, of an average height of 110 feet, 50 feet to the first limb, and 18 inches in diameter. The fruit is covered with a very thick epicarp, separating into four parts, and containing a thin-shelled, highly-flavoured kernel. The tree is covered with shaggy bark, consisting of long, narrow plates loosely adhering by the middle ; hence called shell or shaggy-bark hickory. It is also called walnut in parts of the country where the black walnut does not grow. It is the heaviest of all Canadian woods, strong, compact, and elastic, and much used where these qualities are required, as for the handles of all kinds of tools, and spokes of carriage wheels, shafts and poles of carriages, hoops, whip stalks, hand-spikes, &c. From the bark is extracted a yellow dye. Specific gravity, 0·929 ; weight of cubic foot, 58 lbs. ; value for heating purposes, 100* (the best of all Canadian woods) ; inside wood contains 20 per cent. of potash ; outside, 7·5 per cent.

12. Smooth-bark Hickory (*Carya glabra*).—Nearly all the remarks made in reference to the shell-bark hickory apply to this species, and the wood is used for the same purposes, although it is not quite so highly esteemed. The bark of the tree is smooth, and the kernel of the nut very bitter in contrast with the other or sweet nut hickory.

13 and 14. Sugar or Hard Maple and Bird's-Eye Maple (*Acer saccharinum*) and Red or Swamp Maple (*A. rubrum*).—Found abundantly throughout Canada in all rich soils, and attains a height of 130 feet and 12 feet in circumference. From its beauty and abundance in Canada, the leaf of the maple has been adopted as the national emblem. The timber is very beautiful, and is distinguished as bird's-eye maple and mottled or curly maple (*Acer rubrum*), and is much used for picture frames and in furniture ; the less ornamental portions of the timber are much used for house carpentery and furniture. When well seasoned it is one of the hardest kinds of wood ; carriage and waggon-makers prize it highly for axles and for purposes where great strength and the least deflection are required. Its value for heating purposes is unsurpassed. It is from this maple that so much sugar is made. This and the soft maple (*Acer dasycarpum*) are most planted for ornamental and shade trees in lawns and gardens. The wood can be furnished at Quebec at about 45*l.* sterling per 1,000 cubic feet. Potash in the outer wood, 8·77 ; in the inner, 4·21 per cent. Specific gravity, 0·6 ; weight of cubic foot,

* In estimating the value of the several kinds of wood for fuel, the shell-bark hickory is made the standard, and called 100.

38 lbs.; value for heating purposes, 80, but mostly used for fuel, and generally preferred to all other woods.

15. Soft or White Maple (*Acer dasycarpum*).—This species much resembles the last, but its leaves are larger, and its winged fruit larger. It is common in all low, damp, rich soils; sometimes attains a diameter of 4 feet, and a height of 80 feet. Not so abundant as the hard maple, nor so valuable; the wood is white and soft; the bark is used for dyeing. As an ornamental tree, it is preferred to the hard maple, as having a denser foliage, and being of more rapid growth.

16. White Ash (*Fraxinus Americana*).—Grows abundantly throughout Canada, and attains an average height of 110 feet, and 60 feet to the first limb, and 26 to 36 inches in diameter. The timber is much valued for its toughness and elasticity; excellent for works exposed to sudden shocks and strains, as the frames of machines, wheel carriages, agricultural implements, the felloes of wheels, &c., handles of implements, and for numerous similar purposes. The young branches serve for hoops of ships' masts, tubs, for coarse basket work, &c. It grows rapidly, and the young or *second growth* wood is more valuable than that of the old trees. Can be furnished in almost every part of Canada for 35*l.* sterling per 1,000 cubic feet, and at Quebec for about 45*l.* Specific gravity, 0·616; weight of cubic foot, 40 lbs.; value for heating purposes, 70.

17. Red Ash (*Fraxinus pubescens*).—A smaller tree than the white ash, of much rarer occurrence, and not so valuable, but still a very valuable timber, resembling very much the white ash, and often confounded with it. The wood is also used for the same purposes. Specific gravity, 0·7; weight of cubic foot, 40 lbs.

18. Black Ash (*Fraxinus sambucifolia*).—Found in moist woods and swamps, grows to the height of 60 to 70 feet, with a diameter of 2 feet; the wood is tough and elastic, but much less durable than white ash; the young saplings are in great requisition for hoops, and mature trunks for baskets. The timber is very durable under water. Specific gravity, 0·7; weight of cubic foot, 40 lbs.

19. Rim Ash (*Celtis occidentalis*).—Grows to the height of 30 to 40 feet, and 1 foot in diameter. The trunk has a rough but unbroken bark. The wood is very tough, and used for hoops of barrels.

20. Rock Elm (*Ulmus racemosa*).—Found in most parts of Canada, and grows very large in the western counties, averaging 150 feet in height, and 80 to the first limb, with a diameter of 22 inches. Is abundant in the western part of Upper Canada; preferred to even white ash by some carriage and waggon makers for the poles and shafts of carriages and sleighs. The wood bears the driving of bolts and nails better than any other timber, and is exceedingly durable when continuously wet: it is, therefore, much used for the keels of vessels, water-works, piles, pumps, boards for coffins, and all wet foundations requiring wood. On account of its toughness, it is selected for the naves of wheels, shells

for tackle-blocks, and sometimes for gunwales of ships. It can be laid on board of vessels at the ports of the lakes for 40*l.* sterling per 1,000 cubic feet; freight to Quebec about 11*l.* Specific gravity, 0·59; weight of cubic foot, 36·75 lbs.

22. American or White Elm (*Ulmus Americana*).—A majestic tree, attaining a diameter of 60 inches in some of the western counties of Upper Canada, and of great height, with wide spreading branches. Grows in most woods and along rivers, in rich soils. The wood is tough and strong, used for the naves of wheels, and preferred by wheelwrights to the English elms. Can be furnished at the same price as the rock elm.

23. White Beech (*Fagus sylvestris*).—Grows in almost every part of Canada, of an average height of 110 feet; height to the first limbs 50 feet, and diameter 18 inches. It is distinguished from the red beech by its size, the lighter colour of the bark and wood; it is also of more difficult cleavage, of greater compactness and strength, and is much used for planes and other tools of carpenters; also for lathe-chucks, keys and cogs of machinery, shoe-lasts, toys, brushes, handles, &c.; in architecture, for in-door work; common bedsteads and furniture; for carved moulds, for picture frames, and large letters used in printing; it is easily worked and may be brought to a very smooth surface. Vast quantities of it is used for firewood. Specific gravity, 0·672; weight of cubic foot, 41 lbs.; outside wood contains 12 per cent., inside 4 per cent., of potash. Value for heating, 65.

24. Red Beech (*Fagus ferrruginia*).—The red beech is regarded by many as only a variety of the beech, with the wood softer and of more easy cleavage than the white, with also a slight difference in foliage. The timber is not so valuable as that of the white beech, but used for the same purposes. It is also abundant throughout Canada. The nuts of both kinds are small, two together in the four-lobed burr, oily, sweet and nutritious.

25. Blue Beech (*Carpinus Americana*).—Common along streams; grows 10 to 20 feet high, with ridged trunk; an exceedingly hard, whitish wood; excellent for cogs of wheels and for purposes requiring extreme hardness. The trunk is also made into brooms by being peeled by a knife, and is the most durable and soft of the splint brooms. Specific gravity, 0·79; weight of cubic foot, 47 lbs.; value for heating, 6·5.

26. White Birch (*Betula alba*).—Grows on the hill-sides and the banks of rivers; a slender and beautiful tree of from one to two feet in diameter and 50 feet high, but usually not so large. The trunk is covered with a tough cuticle, consisting of numerous laminæ, the outer of which is snow-white. The wood is of a fine compact texture, tough but not durable, and is used in turning and furniture. Specific gravity, 0·5; weight of cubic foot, 32; value for heating, 48.

27. Paper Birch, White Birch (*B. papyracea*).—A large tree, with

fine grained wood, and a very tough, durable bark, splitting into paper-like layers. It is of the bark of this birch that the Indians make their canoes ; hence the name, Canoe Birch. The wood is very similar to the last, and used for similar purposes. There is also a dwarf mountain variety.

28. Black Birch (*Betula lenta*).—The largest of the birches, two to three feet in diameter, and 60 to 70 feet in height ; found over an extensive area, but more abundant in Lower than in Upper Canada. The trunk is covered with a dark brown or reddish bark, which becomes rough in old trees, and has a very agreeable aromatic flavour. The wood is of a reddish colour, strong, compact, and takes a high polish ; much used in furniture, and almost as handsomely figured as Honduras mahogany, and, when coloured, and varnished, is not easily distinguished from it. It is used, also, by carriage builders, and in frames of ships. and parts under water ; it is more prized as it becomes better known, as no wood sustains shocks and friction better than birch. A good deal of it is exported to Europe. The bark is harder than the wood, and used by Indians and backwoodsmen for shoes, hats, tiles of roofs, canoes, &c. Specific gravity, 0·65 ; weight of cubic foot, 46 lbs. ; value for heating, 65.

29. Yellow Birch (*B. excelsa*).—A lofty, beautiful, slender tree, of 80 feet in height and 10 inches in diameter, with a thin, yellowish cuticle. Not very abundant ; used for much the same purposes as the black and white birches, and valuable for fuel.

30. Wild Black Cherry (*Cerasus serotina*).—Grows to an average height of 120 feet, with trunk of uniform size, and undivided to the height of 70 feet in the forests, of an average diameter of 24 inches, not uncommonly 36 inches, and found 48 inches in diameter. Not very abundant, but found over extensive areas, not in groves, but in single trees interspersed in the forests of deciduous trees, and springs up freely and grows rapidly after the primal forests are cleared off. The timber, of a pale red brown, is compact, fine, close-grained, receives a high polish, and is extensively used in cabinet work. The bark has a strong bitter taste, and is used in medicine as a tonic. The fruit, black when mature, is pleasant to the taste. The timber can be furnished in the western part of Canada at 60*l.* sterling per 1,000 cubic feet ; freight to Quebec about 11*l.* Specific gravity, 0·56 ; weight of cubic foot, 34 lbs.

31. Wild Red Cherry (*Cerasus Pennsylvanica*).—Much smaller tree than the black cherry, of rapid growth, and found mostly succeeding the original forests, attains 40 to 50 feet in height, and 12 to 15 inches in diameter. The flowers are white, the fruit red and very acid.

32. Basswood (*Tilia Americana*).—Common forest tree throughout Canada, of an average height of 110 feet, height to first limbs, 65 feet, and diameter, 24 to 30 inches ; often much larger. The wood is white, oft, close-grained, and not liable to warp or split, much used in cabinet

work and furniture, in pianofortes and musical instruments, for cutting-boards for curriers, shoemakers, &c., as it does not bias the knife in the direction of the grain; it turns cleanly, and is much used in manufacturing bowls, pails, shovels, &c. Cost, at the ports of the lakes, 37*l.* sterling per 1,000 cubic feet; freight to Quebec, 7*l.* Specific gravity, 0·48; weight of cubic foot, 26 lbs. Of the same genus as the lime or linden in England.

33. White Wood (*Liriodendron tulipifera*).—Grows only in the western parts of Upper Canada, and attains a height of 130 feet, 70 feet to the first limb, and 36 inches in diameter, and not uncommon 60 inches in diameter. Very abundant in the south-western counties of Canada, and can be furnished at 35*l.* sterling per 1,000 cubic feet; freight to Quebec, 8*l.* It is called also the tulip tree; and in some localities, erroneously, yellow poplar. The wood is extensively used as a substitute for pine for building and cabinet purposes. It is easily wrought, durable, and susceptible of a fine polish. Specific gravity, 0·5; weight of cubic foot, 30 lbs.

34. Buttonwood (*Platanus occidentalis*).—Called also plane-tree, and, improperly, sycamore. It is very abundant in the western and south-western parts of Canada, attaining an average height of 120 feet, 60 feet to first limbs, and 30 inches in diameter, and not uncommon at 60 inches in diameter. It yields a clean wood, softer than beech, very difficult, almost impossible, to split. Sometimes mottled, used in furniture, chiefly for bedsteads, pianofortes, and harps, for screws, presses, windlasses, wheels, blocks, &c., and immense quantities exported to Virginia for tobacco boxes. Prices and freight same as for white wood. Specific gravity, 0·5.

35. Poplar (*Populus monilifera*)—Called also cotton wood. A large forest tree occurring on the margins of lakes and rivers. The timber is soft, light, easy to work, suited for carving, common turning, and works not exposed to much wear. The wooden polishing wheels of glass grinders are made of horizontal sections of the entire tree. The seeds are clothed in white cotton-like down, hence the name. Specific gravity, 0·4.

36. Balsam Poplar (*Populus balsamifera*).—Also a large tree, growing in wet, low lands; wood resembling the previous. None of the poplars are used as large timbers.

37. White Willow (*Salix alba*).—A familiar tree of rapid growth, attaining a height of 50 to 80 feet; originally from Europe. The timber is the softest and lightest of all our woods. The colour is whitish, inclining to yellowish grey. It is planed into chips for hat-boxes, baskets, &c. Attempts have been made to use it in the manufacture of paper; small branches are used for hoops for tubs, &c.: the larger wood for cricket bats, boxes for druggists, perfumers, &c. Specific gravity, 0·4; weight of cubic foot, 24 lbs.

38. Iron-wood (*Ostrya virginica*).—A small, slender tree, 40 to 50 feet in height, and 8 to 10 inches in diameter. The bark remarkable for its fine, narrow, longitudinal divisions, and of a brownish colour. The wood hard, strong, and heavy; used for hand-spikes and levers, hence the name lever wood; it is also called hop hornbeam. Found only sparsely scattered through the forests of deciduous trees. Specific gravity, 0·76; weight of cubic foot, 47·5 lbs.; much prized for fuel.

39. White Thorn (*Cratægus punctata*).—A common shrub or small tree, 15 to 20 feet high, and 6 inches in diameter, found in thickets on dry rocky lands. Thorns stout, rigid, sharp, and a little recurved, 1½ inches long. Flowers white, fruit bright purple, and some varieties white. The wood extremely hard, used by wood engravers, for mallets, &c. Specific gravity, 0·75; weight of cubic foot, 46 lbs.

40. Black Thorn (*Cratægus tomentosa*).—A large shrub or small tree, 12 to 15 feet high, thorns 1 to 2 inches long, found in thickets and hedges. Flowers large, fragrant, and white; fruit, orange red; wood hard, like white thorn.

41. Wild Apple Tree (*Pyrus coronaria*).—A small tree, 15 to 20 feet high, common in the western part of Upper Canada. Wood hard, like the thorn; flowers large, rose-coloured; fruit one inch in diameter, yellowish, hard, and sour, but esteemed for preserves.

42. Pepperidge (*Nyssa multiflora*).—Found only in the western part of Upper Canada, and of an average height of 100 feet, of 60 feet to the first limb, and of 12 to 18 inches in diameter; scarce. The bark light grey, similar to that of the white oak, and broken into hexigons. The wood is white, fine-grained, soft, the texture consisting of interwoven fibres, rendering it very difficult to split. It is, therefore, useful for beetles, naves of wheels, and for purposes requiring the toughest timber.

43. Dogwood (*Cornus florida*).—Common in Upper Canada, grows 20 to 30 feet high, and 8 inches in diameter. The wood is very hard and compact, and hence the name *Cornel* from the Latin *Cornu*, a horn; used for mallets, and is well adapted for the same purposes as box-wood. It is so remarkably free from silex, that splinters of the wood are used by watchmakers for cleaning the pivot-holes of watches, and by the optician for removing the dust from small lenses. The bark is rough, extremely bitter, and used in medicine as a tonic. Specific gravity, 0·78; weight of cubic foot, 50 lbs.

44. White Cedar (*Thuja occidentalis*).—Found extensively over Canada on the rocky borders of streams and lakes, and in swamps. It grows to the height of 60 to 70 feet, rapidly diminishing in size, throwing out branches from base to summit. The wood is light, soft, coarse-grained, and very durable; much used in frame work of buildings and for the upper timbers of ships, as posts for fences, gates, &c. It is one of the most durable of Canadian woods; much esteemed also for making

split laths, known as cyprus laths. Specific gravity, 0·45 ; weight of cubic foot, 26 lbs.

45. Red Cedar (*Juniperus Virginiana*).—Grows in many parts of Canada in dry rocky situations. It sometimes attains the size of 24 inches in diameter, but mostly smaller. Leaves are dark green, the younger ones small, ovate, acute, scale-like, overlying each other. The wood is fine-grained, compact, of a reddish hue, very light and durable. It is used for fences, aqueducts, tubs and pails, and as cases for drawing pencils—hence called pencil cedar.

46. Hemlock (*Abies Canadensis*).—Common in the hilly, rocky lands of Canada, attaining the height of 80 feet, and 3 feet in diameter. The timber is soft, elastic, of a coarse, loose texture, not much used, but sometimes substituted for pine ; resists well the effects of moisture, and for this reason is used for railway ties. The bark is extensively used in tanning. Specific gravity, 0·45.

47. Black Spruce (*A. nigra*).—This fine tree abounds in the higher and mountainous land of Canada, attains a height of 80 feet. The timber is light, strong, and elastic, and, though inferior to white pine, is still valuable. From the young twigs spruce beer is made.

48. White Spruce (*A. alba*).—A smaller tree than the black spruce, but attains a height of 50 feet. Trunk from 12 to 18 inches in diameter. Timber much the same as that of the black spruce.

49. Canada Balsam. Balsam Fir (*Abies balsamea*).—Common in humid grounds in the cooler latitudes of Canada, and attains a height of 30 to 40 feet. The bark is smooth, abounding in reservoirs filled with a resin or balsam, which is considered valuable in medicine.

50. Balsam Fir (*A. Fraseri*).—A smaller tree than the last. A highly ornamental shade tree.

51. Tamarac (*Larix Americana*).—A tall, slender tree, rising to the height of 80 to 100 feet, abundant in Canada in low wet lands. The wood is considered very valuable, being heavy, strong, and durable. Called also American larch, and hackmatac. It has recently come into great demand for ship building and railway ties, for which latter purpose it is found to be well adapted, and very durable. The best oak is superior to it only for the outside work of a ship. For knees, bends, garlands, &c., of a ship, no wood is better. It is remarkably distinguished from the pines by its deciduous leaves, being bare nearly half the year. It is found up to a very high latitude, even in Hudson's Bay. Specific gravity, 0·6.

52. Sassafras (*Sassafras officinale*).—Found only in the western part of Upper Canada ; grows to the height of 50 to 60 feet, and 15 inches in diameter. The timber is of little value, but used for light ornamental purposes on account of the fragrant odour. Every part of the tree has a pleasant fragrance and an aromatic taste, strongest in the

bark of the root, from which an essential oil is distilled highly valued in medicine. Specific gravity, 0·6.

53. Sumac (*Rhus typhina*).—Common on rocky, poor soils throughout Canada, and readily springs up on neglected lands after the primal forests are cleared off; attains a height of 20 feet, and 8 inches in diameter; the wood is soft, aromatic, of sulphur yellow, makes beautiful veneers, and is used in dyeing. The bark of this and the other varieties is also used in dyeing and tanning.

THE FISHES OF PRINCE EDWARD ISLAND.

BY THE REV. GEO. SUTHERLAND.

Prince Edward Island rises in the midst of waters long famed for the abundance and fine quality of their fish. Although not so plentiful as in years long gone by, they still frequent our shores in vast shoals; many of them pass up and down our rivers and streams; and afford a healthy occupation and a valuable means of subsistence to a large number of our population. They include many of the richest and most palatable fish to be found in any quarter of the globe.

Fishes are vertebrate animals, with gills fitted for breathing under water—of cold red blood—and with fins and extremities fitted for swimming. They are divided into two great classes:—1. Those with a skeleton of cartilage and with bony points or plates on the skin. And—2. Those with a skeleton of bone and with horny scales. The second class is by far the most useful and important, as well as the most numerous. It is the highest type of fish.

I.—Fish of Cartilage Skeleton.

Five kinds are met with on our coasts, viz: the Skate, the Dogfish, the Thresher, the Shark, and the Sturgeon.

1. The Skate or Ray. Two or three species of Skate are found. These fish are flat, with broad pectoral fins. Their eyes are above the mouth, their nostrils below it. They are characterised by a long slender tail. In one species, the Sting Ray or Skate, the tail is armed with a sharp bone with which it inflicts wounds. The pectoral fins or wings are sometimes used as food, but the fish is little prized.

2. The Dog-fish is a small, active, voracious fish about the size of a salmon, and allied to the shark, which it greatly resembles. It has a projecting snout, is tenacious of life, drives off the herring and destroys

nets. It is not used for food, but the oil is valuable—and the body is sometimes dried for feeding pigs.

3. The Thresher is bold, active, and powerful—a member of the shark family. It is found from eight to twelve feet in length. It pursues and destroys the mackarel, shad, &c. It boldly attacks the small whales of our Gulf, violently threshing them with its tail and inflicting great pain as the movements of the whale indicate.

4. The Shark is a well-known, large, powerful, and voracious fish. It has a long, tapering body, with projecting snout on the under side of which are the nostrils. Its tail is peculiar, the upper part of it being much longer than the lower, enabling the fish to throw itself rapidly on its side to seize its prey. Its mouth is armed with formidable teeth, and is situated in the lower side of the body and posterior to the snout. Sharks are often seen on the north coast of the island. The family name of the three last mentioned fishes is the *Squalidæ*.

5. The Sturgeon is caught from two to eight feet in length. In shape it is almost pentagonal. The back of the head is depressed and flattened. Both head and sides are covered with bony plates. Its colour above is dull grey, and beneath white. The flesh is coarse. It was once numerous on our coasts, and might yet be caught in some of our large bays.

2. Fish of Bony Skeleton and Horny Scales.

The most valuable families of this class are the Salmon, Mackarel, and Cod families ; other species are of less consequence.

1. The Salmon. This valuable fish is well known. When fresh, it is beyond comparison the best fish in our waters. In the spring, great numbers of them find their way into our gulf, but as our rivers are poorly adapted for the deposit of their spawn, they spread along the coasts of Nova Scotia and New Brunswick, pressing specially into the Bay Chaleur and up the Restigouche river. At one time they were abundant in the East River, and in several other rivers of the island ; now they are almost confined to St. Peter's Bay, and the Morrell river which flows into it.

2. The Trout. There is scarcely a stream on the Island in which some species of trout may not be found. In some rivers they are very fine. The salt-water trout, of grey appearance, sometimes called the Salmon-trout, is caught in the harbours in spring ; at a later period, it ascends the rivers. The fresh-water Trout is brighter and more florid. When in good condition, its spots bright and flesh firm, it is much more highly flavoured than the other. When in cold water, and having the range of a flowing stream, they are always best.

3. The Smelt, a small fish, is very abundant at certain seasons of the year. In winter it is best, and may be obtained by a hook or spear through the ice along the shore, or on the flats. About the last of April

it ascends the brooks, and may be caught in vast quantities by a scoop-net.

4. The Capelin resembles the Smelt, but is more slender. It seldom strikes our shores, preferring the colder waters around the coast of Newfoundland. Occasionally it is found on the north coast. It is superior to the smelt, and when salted and dried has a fine flavour. The salmon, trout, smelt, and capelin, are classed under one genus—the *Salmonidæ.*

5. The Mackarel is a member belonging to the albecore or horse mackarel, the Sword-fish and others. The mackarel is a finely-shaped fish, and when just taken out of the water has a bright and beautiful appearance. This valuable and much prized fish ranges round our island, lying off and on its shores according to the prevailing winds from July to November.—Occasionally it enters the harbours. Large quanties are annually caught off the north and east coasts by Yankee fishermen fitted out for the purpose.

6. The Albecore is occasionally seen on the north coast. It pursues the herring on which it preys. It resembles a monster mackarel, and is seen from five to eight feet in length. Its flesh is much superior to that of the sturgeon. The family is called the Scombridae.

7. The Herring. Vast shoals of herring swarm on all the shores of the Gulf in the early part of summer. About the first of May they strike the shores of the Island, and are often caught in great quantities. They are, however, lean at that season. Those caught in autumn are much superior.

8. The Gasperaux resemble herring, but are generally shorter and stiffer. They are later in their arrival than the herring. The first taken are the best. When salted they are inferior to the herring. They force their way with great perseverance into the ponds and brooks, and are easily caught.

9. The Shad is a very valuable fish, and occasionally ascends some of our large rivers, though not in abundance. It is greatly larger than the gasperaux—and its flesh is almost equal to Mackarel. The herring gasperaux and shad belong to one family called the *Clupeidae.*

10. The Cod is too well known to need any description, and is found in all parts of the Gulf. They are most abundant on the north shore of the Island. When dried, they are generally prized as an article of food. —A valuable oil is obtained from their livers.

11. The Hake differs slightly from the cod. It is generally three feet in length, prefers muddy bottoms, and is often caught at night. Its mouth is armed with teeth which will soon cut off a hook, if the line is not protected. It sometimes receives the name of "Ling."

12. The Torsk much resembles the cod, but its tail-fin is rounded, with a blue and white edge. It has a barbule on the chin. The back-

fin stretches to the tail. It is more rare than the cod, and its flesh is much finer.

13. The Haddock is found on our shores at certain seasons. It is much smaller than the full grown cod. When fresh it is good. If slightly salted and smoked, it is much better than if cured as codfish.

14. The Frost Fish, or Tom Cod. This small fish may be caught in many parts of the island. Its flesh is white and soft, and is but little prized. It attains its name from the time of the year in which it makes its appearance in creeks—generally after the *frost* has set in in the month of December. The cod, the hake, the torsk, the haddock, and the frost fish belong to one family, the cod family, called the *Gadidae.*

15. The Bass, so easily known by its stripes, once abounded in all our harbours. It, like other valuable fish, has become scarce. It is still occasionally found in the harbours, especially on the north side, where it may be caught with nets or taken by the hook.

16. The Perch. The perch is remarkable for its sharp and strong fins. Two species are to be found, the yellow perch and the blue perch. The yellow perch, sometimes called the cunner or sea-perch, is much esteemed as food—the other is little prized. The bass and the perch belong to one family, the *Percidae.*

17. The Flounder is found in all the creeks of the island. It is a small flat fish, often seen moving slowly along a sandy or muddy shore in search of food. It may be eaten when fresh fish are scarce, but it is very bony and not very palatable.

18. The Halibut is a very large flat fish, weighing sometimes from 200 to 300 lbs. It is not very frequently caught on the Island coasts. When fresh and in good condition, its flesh is prized. Portions of it are sometimes dried and smoked, after being slightly salted.

The flounder and the halibut belong to one family, called the *Pleuronectidæ.*

19. There are other fishes of less note, such as the Sculpin, with a large depressed head, armed with spines, and a small tapering body, found about the wharves and rocks ; the Mummachog, a small fish which swims about ponds and rivulets and the mouth of creeks, and sometimes used as bait ; and the very small Pin-fish, armed with a spine on the back and on the sides.

20. Eels of the finest quality abound on the muddy bottoms of the harbours, rivers, and mill-dams. They are of two species, the common eel and the sea eel. They may be caught by a trap made of rods, but are generally speared, either through the ice, or on the flats by torchlight. The sea eels are the best. Both species are very voracious.

ON THE ANTIDOTE CACOON (*FEUILLŒA CORDIFOLIA*) —NATURAL ORDER *CUCURBITACECE*, OR CUCUMBER ALLIANCE.

[Named in honour of LEWIS FEUILLEE, a French Physician-Monk, who travelled in Peru.]

The antidote cacoon is a scandent plant (perennial), climbling on the highest trees, and very common here (Jamaica). The pericarp resembles a small calabash packed singularly, with seeds eight to twelve in number ; albuminæ very oily and bitter, used by negroes as an antidote for poisonous stings and foul ulcers, &c. I have used it with good effect to cattle suspected of having eaten a poisonous herb.

Long, p. 718, says the seeds are extremely bitter, and when grated and infused in rum or other spirits, a small dose opens the body and produces an appetite. The infusion is also made in Madeira wine, and taken to relieve pains in the stomach. The oil gives a clear, fine light when burnt in lamps, and emits no disagreeable smell.

Dancer says the kernel sliced and infused with orange-peel and a little wild cinnamon (*Canella alba*) in rum, forms an excellent bitter and opening medicine ; infused in water and rum, good in all cold poisons.

Piso says that he has seen whole families in Brazil that have had violent aches and pains, got by the night air, who have been cured with the oil of these nuts, which they may easily have growing in great plenty in most parts of America. It cannot be used in victuals, being so excessively bitter.

Barham remarks—" A French gentleman some years past brought me from Peru some of these nuts, and asked me if I knew what they were. I did not satisfy him whether I knew them, but asked him what the Spaniards called them, and what use they put them to. He told me the Spaniards called them Avilla, and that they were worth their weight in gold to expel poison, and wished I could find them growing in Jamaica, which they do in great plenty, and the negroes I employed to get them for me called them sabo (p. 113).

These seeds are said to be good for a person going into a dropsy, or a swelling of the face and feet, &c., and the following is the receipt :— Take eight or ten of the kernels, scrape and bruise them fine in a mortar ; put the same into a bottle, pouring thereon a pint of old rum or brandy and the like quantity of water ; let it remain in the bottle two or three days, shaking the bottle frequently. Take a wineglassful every morning fasting, and use moderate exercise before breakfast.

An anonymous writer in the 'Columbian Magazine' for July, 1798, who gives the foregoing receipt, states that "a young girl had been pronounced by the medical gentlemen in Spanish-town in a dropsical state, and everything administered as they thought necessary in such a case,

but all in vain ; for, on my subsequent removal to Kingston, I found the swelling much increased in her face, legs, and thighs, with a puffiness in her belly. A planter from above Rocks breakfasted with me; I called the girl to get some water ; he was alarmed on seeing her condition, and advised the use of the cacoon, or antidote, observing that he had made a perfect cure of a girl in the same state. I proceeded according to his directions, and with the like success. It is now eighteen months since, and, thanks be to God, she is now in perfect health. I therefore think myself in duty bound to publish the same for the benefit of my fellow-creatures." Ignorance alone could only raise a doubt.

This plant could be freely cultivated in this island to any extent. The range of mountain land is very great, and scarcely serviceable for other plants occupied by limited means.

N. WILSON.

The oily seeds of this West Indian shrub are said by Lindley to be intensely bitter, and act virtually both as emetics and purgatives. The seeds of *Feuillala triobata* yield a fatty oil, used instead of ointment in pains of the joints. The Americans employ the oil of both species for lamps. In Brazil the seeds are considered an effectual remedy against the bites of poisonous serpents, and particularly as an antidote to the poison of *Rhus toxicodendron*, *Mancenilla*, and *Spigelia*, when fresh, and bruised in water. The leaves of *F. cordifolia* are said to possess the same properties.

Scientific Notes.

THE EDIBLE BIRDS' NESTS OF THE EAST.—The eminent naturalist, M. Moquin-Tandon, lately presented to the Académie des Sciences a carefully written paper by M. P. Bories, of the Island of Réunion, "On the Nests of the 'Salanganes' (*Hirundo esculenta*) and the Japan Moss." Ornithologists recognise five species of salanganes, nearly all of which are found in the Indian Archipelago. A single species exists in the Island of Réunion, and it is to the study of this bird's nest that M. Bories has given considerable attention. He found it to be composed of a species of lichen (*Alectoria luteola*) which grows abundantly on the trees of that island, and of a variable quantity of mucus secreted by the salivary glands of this bird. M. Bories caught one of them carrying in its beak filaments of the *Alectoria*. This is what, no doubt, gave rise to the circumstance mentioned by Buffon, that it was supposed in the Malayan peninsula that these nests were partly made by the birds from the fry of a certain fish abundant along the

coasts, which they carried away in their beaks. These nests of the *Hirundo esculenta* are the results of a number of successive generations; those introduced into commerce are the portions secreted by the birds carefully separated from the lichen. M. Bories also remarks that the Japan moss of commerce is not prepared with the nests of these salanganes, but with an alga of the genus *gelidium*. F. M.

Ool-a-Chan Oil.—Among the new animal oils shown in the International Exhibition is one in the Vancouver's Island Court which has not been before seen here, and termed Ool-a-Chan oil. We have been favoured with the following brief account of it by a physician long resident in the island, who is probably better acquainted with it than any one else there:—The Ool-a-chan fish much resembles the smelt both in size and transparency. It visits the coast about the month of May, appearing upon the same day every year, and mounts the streams by myriads to spawn. This fish is of a very rich flavour, and is a favourite article of food. Some are salted and smoked, or dried for winter use, being universally prized. By warming over a slow fire, or by heating in water, an oil is abundantly obtained, which is used for the same purposes as cod liver oil, and with as much, if not greater benefit. The oil when cold is of the consistence of thick cream, white in colour, with but little odour, and by no means unpleasant to the taste—in fact, those who use it very quickly acquire a partiality for it. The Indians make large quantities every season, and with them it supplies the place of butter. They cannot live without it, and it forms a great article of trade. They prefer it rancid. It is a notorious fact, that the Indians are subject to spitting of blood and consumption; they suffer theuroptysis for years, but still live to a great age? How much has the ool-a-chan to do with the prolongation of their days. A vast quantity of this oil could be obtained, were it found desirable for medicinal use.

THE TECHNOLOGIST.

NOTES ON APPARENTLY USEFUL WOODS HITHERTO LITTLE KNOWN.

BY JOHN R. JACKSON.

If it were attempted to divide or classify the products of the vegetable kingdom according to their sphere of usefulness, we should find no part of greater importance, if we exclude cereals, or requiring greater investigation, than the woods. Our knowledge of the source of many of our most beautiful woods which lend their aid to minister to our daily requirements and luxuries, are but imperfectly known, and our knowledge on this point has certainly not advanced much of late; nor will it, until we can receive authentic specimens of the foliage and flowers of each tree. Timber merchants and manufacturers are content to receive the woods under the commercial name, and purchasers of the manufactured articles are generally easily satisfied by obtaining such articles in the most beautiful woods irrespective of their names; so that until buyers persist in requiring the scientific names of the woods from the manufacturers, who could with a little trouble obtain them, there is little hope of the sources of some of our best timbers being known, although many great and satisfactory results will undoubtedly accrue from the vast accumulation from all parts of the globe now under inspection at South Kensington. These large collections are not brought together simply to show us the extent of our knowledge, but they tend to teach us how much, as well as how little, we know of the application of art and science to these productions. Doubtless, then, much will be added to our store of knowledge in this as in every other branch of science, at the close of this great show. The value and importance of this section of economic botany cannot be misunderstood. Timber is certainly one of the most essential requisites in the Arts and Manufactures, and though in these days iron has superseded wood for ship-building

and for various other purposes, yet it never can be entirely supplanted by its formidable rival. Timber has held its place in the estimation of men of all ages, both of civilised and uncivilised nations. In every country where it is found mankind has abundance of application for it. The vast collection of woods furnished by our Colonial possessions to the International Exhibition have undoubtedly never before been equalled in point of magnitude and numbers, and the appearance of many of them seem to stamp them as likely to be of value for cabinet and ornamental purposes. It has, therefore, occurred to me that a few remarks upon some of the woods more especially adapted to furniture and cabinet work would not be out of place, but, on the contrary, rather appropriate at this time when most if not all mentioned in this paper can be seen by those interested in this branch of industry, and, indeed, may perhaps be the means of bringing some of them having greater claims to attention under the notice of those by whom alone they can be brought into repute—our timber merchants and manufacturers. Of course the great bulk of the woods exhibited by our Colonies are not new to us in point of name, for they have held a place in our museums for some years; but the collections here shown are unique in regard to their great size and also their extreme beauty. There have been lists published of the woods known in commerce arranged both alphabetically and also geographically; but I have in the following enumeration grouped them according to their colours, thinking that such an arrangement will facilitate reference both to the manufacturer and also for the purpose of identification. In this grouping, however, some difficulty has to be contended with, owing to the great variety of shades which merge into one another.

Light Coloured Yellow Woods.

Dacrydium Franklinii, Hook fil. (Huon Pine.)—This perhaps is the most beautiful of all the light-coloured woods, and certainly the most beautiful in point of delicate marking of all the Tasmanian woods. The tree is very abundant and often attains a height of 100 feet. The wood is exceedingly durable, and is used for ship and house-building, machinery, &c., as well as being much esteemed for cabinet work and furniture. Excrescences or burrs are very abundant upon the trees, and the appearance of these, when cut and polished, are most beautiful, the ground being of a yellowish colour somewhat resembling satin wood thickly studded with dark knots, each of which is surrounded with a silvery lustre. There is as great a difference between the appearance of the wood cut from the trunk and burr of this tree, as that produced by the walnut. Very beautiful specimens of burrs of this wood are made up into articles of furniture, and may be seen in the Tasmanian trophy in the International Exhibition, where slabs from the trunk may likewise be seen. That this wood has not been brought into use in England

seems rather surprising, as it is well adapted for some articles of furniture, and for the larger kinds of inlaying and marqueterie work.

Pittosporum undulatum, Vent. (Wallandundeyren.)—This wood has nearly the same tint as the Huon pine, with dark wavy markings, and when polished makes a very fine appearance. It is very close grained and hard, and would afford handsome veneers for cabinet work. After careful seasoning it becomes exceedingly firm and close, for which reason it has been suggested as a substitute for box wood in wood engraving. The tree grows to a height of about 90 feet, and is very common in many parts of New South Wales.

P. bicolor and *P. crassifolium* have also close-grained light-coloured woods like the preceding, and are natives of the same country.

Acronychia laurina, Muell .(Yandermanna.)—Also a native of New South Wales, where it forms a handsome tree about 70 feet high, producing a very close-grained and light-coloured wood, much resembling the wood of the orange, to which family it belongs.

Achras Australis, R. Br. (Jerra wawak.)—Called in New South Wales the Brush Apple, or Wild Plum, is a large tree frequently attaining 100 feet in height. The wood is yellow about the same tint as the former, but prettily marked with darkish wavy lines, very close grained and firm, suitable for cabinet work and inlaying. In the New South Wales catalogue of the Paris Exhibition, 1855, one tree is mentioned as standing at Brisbane Water which measured 10 feet 6 inches in girth.

Polyosma Cunninghami, R. Br. (Yeralla.)—A light-coloured even-grained wood, probably useful for some kinds of furniture and inlaying, where a plain light-coloured wood is required. Care must be taken in drying or it is apt to split, but when properly dried it is hard and durable. Like the former, it is a native of New South Wales, attaining a height of from 30 to 40 feet.

Bursaria spinosa, Cav.—A native of Tasmania and many parts of New Holland; is a small tree not more than 30 feet high. The wood is very close and even-grained, of a yellowish colour, unmarked and very much like our Box wood; indeed its vernacular name is the Tasmanian Box wood; it has the appearance of being well adapted for wood engraving, and no doubt would be found useful for inlaying.

Toddalia lanceolata, Lam.—A South African tree; furnishes a wood very much like the foregoing, but rather of a darker yellow, and the annual rings more developed, but without any other markings. The wood which is very tough, and is called White Iron Wood, is much used at the Cape in the construction of waggons, ploughs, &c., on account of its great strength.

Celastrus rhombifolius, Eckl. et Z. (Pendoorn.)—Is another of the dense hard, and heavy Box-like woods of the Cape. It is a small tree or shrub; but the wood is very much prized amongst musical instrument

makers, especially for clarionets, flutes, &c. It is also largely used in turnery.

Cassine Maurocenia, L.—Much like the former and used at the Cape for the same purposes as well as for all kinds of fancy cabinet work.

Elæodendron Australe, Vent. (Courari-ou.)—A New South Wales tree, slender; but growing to a height of about 40 feet, produces a close-grained, firm wood of a lightish yellow colour with darker, wavy, and eccentric markings, very beautiful when polished, and adapted for furniture and turnery purposes.

Duboisia Myoporoides, R. Br. (Cork wood.)—A small tree of New South Wales, growing from 15 to 30 feet high. The wood is of a very light colour; almost as light as the wood of the Lime; very close grained and firm, but easily cut. It is adapted for some kinds of cabinet work, but more especially for wood carving.

Schotia latifolia, Jacq. (Bosck Bœrboon.)—A native of South Africa; is a small tree with a hard, tough, and durable wood, of a plain yellowish colour. It is used at the Cape for posts, &c.; but might be useful also for inlaying, being too small for cabinet work.

Nyssa multiflora, Walt. (Pepperidge, or Tupelo.)—A native of North America, where it grows to a large-sized tree. The wood is very light, much resembling Sycamore, and is said to offer great resistance to splitting owing to the manner in which the fibres are interwoven.

Zieria lanceolata, R. Br.—(A native of New South Wales.)—A tolerably-sized tree attaining a height of about 80 feet, with a diameter of from 2 to 3 feet. It has a clear light-coloured wood, close and prettily grained, somewhat soft, but nevertheless takes a good polish, and might be found useful for the more ornamental parts of cabinet work.

Sideroxylon inerme, L. (Milkwood of the Cape.)—A small tree about 8 or 10 feet high, producing a close, hard, and very durable wood, not affected by damp. It is in great repute at the Cape for boat-building, bridges, &c., and is of a plain yellow colour looking well when polished.

Halleria elliptica, Thbg. (Oudehout)—Is also a native of the Cape, growing 6 to 10 feet high, producing a yellowish wood, tough, and even grained, used at the Cape for plough beams, &c., though perhaps worthier of better application.

Halleria lucida, L. (Witte Olyve.)—A small tree of the Cape 6 or 8 feet high, has a wood somewhat resembling Beech, but more yellow, and a much finer grain. It is hard and durable, and is much used in carpentry and in the manufacture of planes and other tools.

Eckebergia Capensis, Sparrm. (Cape Ash.)—Attains a height of 30 or 40 feet. The wood is very close and tough, with a silvery grain, having a pretty and delicate appearance when polished. It is much used at the Cape for various purposes, but well adapted for inlaying, cabinet work, &c.

Byrsonima coriacea, Sw. (Lotus berry), native of Jamaica, where it is a very common and beautiful tree. The timber is fine, close, and even grained, of a light colour with a pinkish tinge. Might be found useful for the more ordinary kinds of cabinet work, possessing no great beauty, but is a clear light coloured wood.

Badiera diversifolia, Dc. (Bastard lignum-vitæ.) — Is a small tree growing abundantly in many parts of Jamaica, producing a hard, compact, and fine-grained wood, apparently very durable, being nearly as heavy as the true lignum-vitæ. It is of a lightish colour, having a pinkish tinge without any markings.

Citrus aurantium, L. (The Orange.)—This well-known tree is now cultivated in every tropical or subtropical country, though more especially in Southern Europe and the Canary Islands. The wood is very close, even grained, and of a clear yellow colour. It is sometimes used for making walking-sticks, &c., but is seldom obtained large enough for cabinet work, though it might be employed more extensively than it is for turnery or inlaying.

Niebuhria caffra, Dc. (Witbosch-hout.)—A South African tree growing about 20 feet high, with a diameter of 10 to 15 inches; produces a hard, tough, and durable wood, of a clear light colour, much used at the Cape for some articles of furniture and for various other purposes.

Atherosperma moschata, Lab. (Tasmanian Sassafras.)—Is a large tree attaining a height of 150 feet. The wood is unmarked, somewhat resembling our Deal, but of greater strength, and much yellower when polished. It is extensively used in Tasmania for house flooring, and in the construction of carpenters' tools.

Dovyalis zizyphoides, E. Mey.—This tree is very common in the woods in the neighbourhood of the Cape of Good Hope, where it grows to 30 or 40 feet in height. The timber is of a citron yellow colour, close grained, hard and compact. It is used chiefly in waggon work and for other purposes where strength is required, although its appearance when polished ought to secure it a place amongst the ornamental woods.

Myrsine variabilis, R. Br.—A good-sized tree about 50 feet in height, growing in New Holland. The wood is of a lightish colour, prettily marked, close and even grained.

Genipa Americana, L., Lana of British Guiana, where it forms a lofty tree, the timber frequently squaring from 14 to 18 inches; very close grained, hard, and durable, and of a yellow colour, without any markings or figure.

Pennantia acuta, Planch. (Balim bowlimba.)—A large tree native of New South Wales. The wood of which appears to be well adapted for the more ordinary kinds of cabinet work, and for inlaying where a light-coloured wood is required. It is even grained, and takes a good polish.

Hymenanthera dentata, R. Br. — Is but a small Australian tree or

shrub, not usually exceeding 20 feet in height, nevertheless the wood is tolerably hard, takes a good polish of a fine grain, with light silvery and dark alternating markings.

Liriodendron tulipifera, L.—(The Tulip tree, white wood, or yellow Poplar of North America.) It grows to a large size and produces a wood of nearly the same colour and density as Ash, but with a silvery grey grain. It takes an excellent polish.

Tilia Americana, L. (Bass wood.) — A native of North America. It is about as strong as the common Lime, but a much more beautiful wood, being very even grained, with alternating silvery and dark transverse lines, changing in position with the rays of light. This would make a beautiful wood for inlaying and also for panelling.

Acer saccharinum, L. (The Sugar Maple of North America.)—Has wood very much like the last, both in appearance and apparent strength.

Tetranthera ferruginea, R. Br.—A tree of New South Wales, where it grows to a height of about 80 feet. It has not a very dense wood, but apparently tough, and even grained, of a light colour, the annual rings being developed in darker stripes.

Podocarpus Thunbergii, Hook. (Cape Yellow Wood.)—Is as its name indicates, a native of the Cape of Good Hope. It does not grow to any great height, but slabs can be obtained from it from 10 to 15 inches across. The wood is of a clear yellow colour, with an even grain, but is not so durable as that of

Podocarpus elongatus, L'Herit, is a much larger tree, commonly 70 feet in height, close grained, something resembling deal, and perhaps of a more yellowish colour. It is very commonly used at the Cape for all sorts of purposes, both useful and ornamental.

Maba Guineensis.—Supposed to be the source of the wood known as Bahama Satin Wood, or, as it is called in its native country, Yellow Wood. It grows abundantly and to a large size on Andros and the adjacent islands. The wood is of a close fine grain, having a pretty wavy pattern, which looks remarkably well when polished. It is imported into this country in small quantities, and is sometimes confounded with the Indian Satin Wood, to which it bears some resemblance.

Ostrya Virginica, Lam. (Iron Wood of North America.)—A tree growing from 40 to 50 feet high, and 8 to 10 inches in diameter. It is very close and even grained, of a clear light colour somewhat like Ash.

Araucaria Cunninghami, Ait, called the Moreton Bay Pine, from its abundance at that place; is also found in other parts of New South Wales. It grows to a height of from 200 to 300 feet, and produces an even-grained wood something like deal, but much finer both in grain and also in the general appearance of the wood which is of a clear yellow colour.

Michelia Champaca, L. (Sappoo.)—A tree of the East Indian Penin-

sula and Ceylon, where it grows 30 or 40 feet high, producing a firm and durable wood of a brownish yellow tint with silvery shading. It is used in Ceylon chiefly for carriages and house-building.

Exocarpus cupressiformis, Lab. (Native cherry.)—An Australian tree growing to a height of about 50 feet and 1 to 2 feet in diameter. The timber is very closed grained, of a light and even colour, and might probably be found of service for turnery purposes. It is apt to split unless care is taken in drying.

Acacia Farnesiana, Willd.—A small tree growing in India, St. Domingo, the South of Europe, &c., producing a hard and tough wood of an even grain, and a clear yellow colour. It is much used in India for tent pegs, the knees of ships, &c.

Icica altissima, Aubl. (Red or White Cedar of British Guiana.)—Where the tree grows to a height of about 100 feet, the wood squaring from 1 to 3 feet. It is of a dingy yellow colour, rather open grained, but takes a good polish. It is easily worked and not liable to split. A strong aromatic odour is contained in the wood, which effectually keeps away insects, and adapts it for cabinets, wardrobes, &c. As a proof of the durability of this wood it may be stated that one of the canoes that accompanied Sir R. Schomburgk in his expedition into the interior, was simply a hollowed trunk of this tree, which, after four years' hard service was found to be perfectly sound.

Darkish Yellow Woods.

Pithecolobium pruinosum, Bth. (Meroan gangne.)—A common tree at Illawarra, in New South Wales, growing to a height of about 60 feet, with a diameter of from 1 to 2 feet. The wood is of a deep yellow colour covered with dark wavy lines and knots ; well adapted for all kinds of cabinet work.

Fagarastrum capense, Don. (Knobhout, of the Cape of Good Hope.)—Tree about 10 feet high. The timber is firm and close grained, of a beautiful dark silvery yellow, the annual rings distinct in fine dark parallel lines running transversely. Slabs of nearly 18 inches in breadth may be obtained from this tree.

Podocarpus spinulosus, Spr. (White Pine of New South Wales).—A large tree frequently attaining a height of 120 feet. The wood is close but easily worked ; some specimens are very beautifully figured with dark markings. It has been suggested that this wood might prove valuable for the sounding boards of musical instruments.

Cupania Australis, A. Cunn. (Tamarind tree of New South Wales.)—It grows to about 90 feet high, producing a firm, close-grained wood, with dark, cloudy markings running transversely. This wood appears well adapted for panelling and some of the larger kinds of cabinet work.

Callistemon pallidum, Dc. (Broad-leaved Tea tree.)—Also a native of

New South Wales, growing to about 50 or 60 feet in height. The wood is hard and very close grained, of a dusky brownish yellow colour; it requires careful drying or is apt to split.

Ceratopetalum apetalum, Don. (Light Wood of New South Wales.)—Produces a fine-grained wood easily worked, has a light-coloured ground with dark stripes, and looks well when polished. It is a large tree attaining a height of 130 feet, from which slabs can be procured 3 or 4 feet in breadth.

Oxleya Xanthoxyla, Cunn. (Yellow Wood.)—Is also a native of Australia, where it is used for boat-building; a dye is also obtained from it, hence its vernacular name. The wood is hard and close-grained, of a deepish yellow colour with a silvery tinge, and looks well when polished. It is a large tree growing 100 feet high.

Caryocar tomentosum, Willd. (Souari Wood of British Guiana.)—It is a dense heavy wood, of a deep yellow colour, with a brownish tinge, and is said to excel for ship-building, besides being used for various other purposes. It may be obtained 40 feet in length, squaring 16 to 20 inches.

Erythrina Corallodendron L. (Barracara.)—This likewise is one of the hard heavy woods of British Guiana. It is even grained, of a brownish yellow colour without markings.

Gymnocladus Canadensis, Lam.—A native of North America, growing to a height of about 30 or 40 feet. The wood is of a darkish silvery yellow, with light brown stripes, tolerably firm, and close grained; looks well when polished.

Gleditschia triacanthos, L. (Honey Locust tree of North America.)—Growing 30 or 40 feet high. The wood of this tree somewhat resembles the last, being of a silvery yellow, with darkish stripes, though not quite so dark on the whole.

Acacia julibrissin, Willd. (A native of the Levant and the East Indies.)—The tree attains a height of about 30 or 40 feet, producing a close and even-grained wood, of a deep silvery yellow, variegated with narrow brown stripes.

Olinia Capensis, Klotz. (Hardpeer.)—A native of the Cape of Good Hope, growing about 16 or 18 feet high, with a diameter of 10 to 12 inches. The wood is hard, compact and heavy, of a brownish yellow colour. It is much used for picture frames, various fancy purposes, and for the axles of waggons, &c.

Cryptocarya glaucescens, R. Br. (Oorawang, or Laurel of New South Wales.)—Where the tree attains a height of 120 feet and a diameter of 2 to 4 feet. The wood is rather soft, but might be found useful for many purposes, being of a clear darkish yellow, taking a good polish.

Eupomatia laurina, R. Br. (Balwarra.)—A New South Wales tree growing 20 or 30 feet high, and having a diameter of 8 to 16 inches;

produces a somewhat softish wood, which nevertheless might be found useful. It is of a silvery yellow colour with a brownish transparent appearance, and looks well when polished.

Phoberos Mundtii, W. Arn. (Klipdoorn.)—A native of the Cape of Good Hope, producing a clear, brownish yellow, hard and close-grained wood, much used by builders, as also in the construction of carriages and waggons. It can be obtained 20 to 30 feet long, with a diameter of about 3 feet.

Erythroxylon Coca, Lam. (Native of Peru, but found also in Africa.—It is a tree growing 20 or 30 feet high, and produces a close, even grained, compact wood; the sap wood being of a lightish tinge, while the heart wood has a tendency to a pinkish brown.

Koelreuteria paniculata, Lamx.—A small tree not more than 20 feet high, native of China, producing a wood of a silvery yellow, with darkish stripes, something like the wood of *Gymnodadus Canadensis*, but not quite so dark.

Geigera multiflora, Muell. (Kaligneen.)—A New South Wales tree, attaining a height of about 90 feet, with a diameter of 1 to 2 feet; very abundant at Illawarra. The wood is very hard, close grained and firm, of a rich deepish yellow with dark wavings.

Xanthoxylum Clava Hercules, L. (Hercules club, or Prickly Yellow Wood of Jamaica.)—The tree grows to a height of 50 or 60 feet, producing a rather coarse grained, but solid and heavy wood, of a brownish yellow colour, used in Jamaica for furniture, inlaying, and also for flooring.

Piscidia erythrina, L. (White Dogwood.)—Also a native of Jamaica; produces a hard and heavy wood, of a dull brownish yellow colour, much valued for its durability. The tree grows to a height of about 30 feet, and is common in Jamaica, the Bahamas, Antigua, &c.

Piscidia Carthaginensis, L. (Bitch Wood, or Black Dogwood of Jamaica.)—Is considered by some as only a variety of the former species. The woods are much alike, both in grain and colour. This is largely used in Jamaica for wheels and carriages.

Eucalyptus globulus, Labil. (Blue gum.)—A very large Tasmanian tree, where it grows to over 300 feet in height. The wood is very tough and durable, of a dull brownish yellow colour, without any great beauty; but takes a good polish. It is much used for ship and house-building bridges, &c. Very many of the *Eucalypti* (the Gum trees of Australia,) produce very tough and durable woods of a large size; but the species are so numerous and so imperfectly known, that it is impossible to give detailed account of their value with accuracy.

Eugenia Zeyheri, Harv. Wilde Jambos of the Cape of Good Hope, where it grows to a height of from 15 to 20 feet, and a breadth of 9 to 12 inches, producing a timber, very compact and close-grained, of a brownish yellow colour.

Myrtus trinervis, (Dthalandoon).—Native of New South Wales, growing about 70 feet high, with a diameter of 10 to 24 inches. The wood is even-grained, close, and firm, of a darkish yellow colour.

Acmena floribunda, Dc. (Tdjerail.)—Native, like the last, of New South Wales, where it produces an even-grained and compact wood, of a brownish yellow, taking a good polish. It grows to a height of 60 or 80 feet, and a diameter of 1 to 2 feet.

Cathartocarpus fistula, Pers.—The wood of this tree is of a close, even grained nature, and a plain yellow colour, without any distinct markings. It is a middling-sized tree, but does not produce timber of any size, though large enough for the construction of spars for the native Indian craft. It is a native of the East Indies, but naturalised in the West, and South America.

Prosopis spicigera, L.—An East Indian tree, growing to a height of 40 or 50 feet, producing a hard, even-grained, and very strong wood, of a darkish yellow colour, without any distinct markings.

Eucalyptus gigantea, Hook. fil. (Stringy Bark of Tasmania), where it is one of the largest forest trees, attaining a height of 250 to 300 feet. It is a very strong and durable wood, something like teak, but not so dark in colour, and is in great demand in its native country for house and shipbuilding, as well as for various other purposes.

Eurybia argophylla, Cass. (Musk Wood of New South Wales).—So named on account of the leaves and young shoots having an odour of musk. It is a forest tree, growing 20 or 30 feet high, producing a tolerably hard and durable wood, of a dusky yellow colour, very beautifully covered with darkish wavy lines and knots. This is a very handsome wood, and is used in New South Wales for furniture and cabinet work. It takes a capital polish.

Trochocarpa laurina, R. Br. (Beech or Brush Cherry).—A native of New Holland, growing to the height of 30 or 40 feet. The timber is firm and close, of a brownish yellow, with a silvery shade, some specimens being very prettily marked, and well adapted for cabinet work.

Dark Woods of a Brownish Colour.

Grewia tilæfolia, Vahl. (Damin-na).—A small tree, native of the East Indies and Ceylon, produces a close-grained tolerably heavy wood, of a dull brownish colour.

Lophira alata.—A tree of West Tropical Africa, growing from 80 to 100 feet high, has a hard and very heavy wood, rather coarse-grained, of a dark brown colour.

Mammea Americana, L. (Mammee Apple).—A tall handsome tree, growing in the West Indian Islands. The wood is of a rich brown colour, sometimes of a wavy appearance. It is hard, heavy, and very durable, and takes a good polish.

Thespesia populnea, Corr.—A native of the East Indies and Australia,

and naturalised in the West Indies. It is a tree attaining a height of 40 or 50 feet in Ceylon, where it is known by the name of "Sooriya," and is used for a variety of purposes, as carriage wheels, buildings, &c. In India it is in very general use where strength and durability are required, being used for rollers, gun-stocks, &c. It is very close-grained, of a clear brown colour, with occasional dark stripes.

Calophyllum Inophyllum, L.—A native of the East Indies, Ceylon, and the Pacific Islands, attaining a height of about 90 feet, and producing a tolerably close and even grained wood, much used in Ceylon for masts and spars for boats, &c. It is of a lightish brown colour, with a silvery shade, and takes a good polish.

Moschoxylum Swartzii, Juss. (Musk Wood of Jamaica).—So called from the strong odour of musk contained in the leaves. It is a tree about 20 or 30 feet high. The wood is close and heavy, of a silvery brown colour, with fine dark lines.

Zanthoxylum aromaticum, Willd.—A native of the West Indian Islands. It is a tree about 20 feet high, growing abundantly in all the woods. The timber is very close, and fine-grained, the sapwood of a pinkish brown, the heart wood much darker.

Gomphia Guianensis, Rich. (Candlewood of Jamaica).—It is a small tree, producing a firm close-grained wood, of a dull brown colour, with a pinkish tinge.

Dalbergia lanceolaria, L. fil.—A native of the East Indies, where the tree grows to about 30 or 40 feet high, producing a hard heavy wood, of a dull brownish colour, much employed in Ceylon for housebuilding and other purposes.

Dipteryx odorata, Willd. Cumaroo of British Guiana, where it grows to a height of 60 or 70 feet, from which timber may be obtained from one to two feet square. It is a hard, heavy, tough, and very durable wood, used for shafts, mill wheels, and cogs. The colour is of a yellowish brown, with dark stripes. This tree produces the Tonquin bean.

Hymenæa Courbaril, L. (Locust Tree).—Grows abundantly, and to a great size, in the forests of South America, frequently attaining 60 or 80 feet before any branches are given off, and having a diameter of eight to nine feet. The wood is exceedingly hard, compact, and close-grained, in colour of a lightish brown, with dark streaks, but sometimes varying to a dark mahogany colour. It is used for engine work, planking of vessels, &c., is susceptible of a high polish, and might be employed for furniture.

Wormia triquetra, Rottb.—This is a native of Ceylon, where it grows to a height of 20 or 30 feet. The wood is tolerably close-grained, of a pinkish brown colour, with dark variegated stripes, commonly used in Ceylon for various purposes.

Wormia retusa, Hf. and T., (Godeparre).—This also is a native of Ceylon, growing in the woods to about 30 feet high. The timber resembles

the last in grain, but rather a duller brown colour, much used for roofs of houses, &c.

Bauhinia grandiflora, Juss.—A small tree, native of Peru, produces an apparently durable close-grained wood, of a silvery brown, with dark stripes, having a very rich appearance when polished.

Copaifera officinalis Jacq. (Balsam of Copaiva).—A large tree, native of the West Indian Islands. The wood is close and heavy, in colour of a dusky brown, with dark stripes. Takes a good polish.

Acacia verticillata, Willd. Prickly Mimosa of Tasmania, where it grows to a height of 20 or 30 feet, and eight inches to one foot in diameter. The wood appears tolerably close-grained and hard, of a lightish colour, with dark brown markings.

Acacia Cunninghami, Hook.—Also an Australian tree, producing a fine-grained, close, and compact wood, of a light brown colour, with dark stripes.

Pimenta vulgaris, W. A.—A native of the West Indian Islands, a common tree, growing to a height of 30 or 40 feet, producing a close-grained wood, of a dusky brown colour, with dark stripes.

Monotoca elliptica, R. Br. (Beech of New South Wales), but belonging to the *Epacris* family. It is a small tree, from 10 to 20 feet high, and 6 to 12 inches in diameter, producing a very fine close-grained wood, of a yellowish brown colour, much used for making handles for mallets and other tools.

Tecoma undulata, Don.—A native of India, where it grows to a height of 20 or 30 feet, and produces a hard and close-grained wood, of a lightish brown colour.

Persea gratissima, Gærtn. (Avocado Pear).—A native of Jamaica, but naturalized in all the West Indian islands, and also in Madeira. It grows to a large size, and produces a rather softish wood, of a brown colour, very prettily marked, with a silvery lustre, making a fine appearance when polished.

Casuarina leptoclada, Miq. (River or White Oak of New South Wales), where it frequently grows to 120 feet high and 2 to 5 feet in diameter. The timber is very strong, but will not bear exposure to the weather. The colour is of a clear brown, with dark markings, taking a good polish.

Dark Woods of a Reddish Brown Colour.

Platymiscium polystachium, Bth. (Roble of Trinidad).—A fine tree, native of the West Indian Islands and Panama, producing a tough wood of a light mahogany colour, with dark stripes, and a silvery transparent grain.

Copaifera bracteata.—A large tree of British Guiana, the wood of which is very close-grained and compact, and has been suggested as a substitute for rosewood in the fitting up of ships' cabins.

Mora excelsa, Bth.—This wood is produced by another of the magnificent trees of British Guiana, and is one of the strongest and most durable, being recognised at Lloyds as equal if not superior to oak. It is of a reddish brown colour, and takes a good polish.

Acacia dealbata, Link. (Silver Wattle).—A Tasmanian tree, growing from 60 to 120 feet high, with a diameter of from 1 to 3 feet. The timber is strong and tough, very prettily marked with streaks and knots of a deepish red colour, with a silvery grain. It is much used by native coopers.

Acacia decurrens, Willd.—Also a native of Tasmania, attaining a height of 40 or 60 feet, and a diameter of 12 to 18 inches. It is a close, even-grained wood, of a light reddish brown colour, with a silvery lustre, taking a good polish.

Acacia falcata, Willd. (Wee-tjellan, or Lignum Vitæ of New South Wales) is a small tree, not more than 20 or 30 feet high, with a diameter of from 8 to 16 inches. The wood is close, even-grained, and hard, of a rich reddish brown, and prettily marked, looking well when polished.

Acacia mollissima, Willd. (Black Wattle of Tasmania).—A tree growing to a height of 50 or 80 feet, with a diameter of 1 to 3 feet, producing a close-grained tolerably hard wood, of a light red colour, with dark stripes, used in Tasmania for tree nails, and when split for making hats and baskets.

Acacia glaucescens, Willd. (Karreewan).—A native of Australia, where it grows 20 or 30 feet high, with a diameter of from 1 to 2 feet. The wood is hard, close, and fine-grained, of a rich reddish brown colour, and takes a good polish.

Acacia Arabica, Willd.—Native of India, Egypt, Senegal, &c.; furnishes a strong, close-grained, durable wood, very much resembling the lighter kinds of mahogany when polished.

Trichilia glandulosa, Sm. (Rosewood of New South Wales), where it grows to about 80 feet in height. The colour of this wood is of a deep reddish brown, something like mahogany, to which family it belongs. It is close and even grained, and is very applicable to the manufacture of cabinets, bedsteads, &c., as insects are effectually kept away, owing to the presence of an essential oil. The sawdust has the peculiar effect of blistering the skin.

Carapa Guianensis, Aubl. (Carapa, or Crab Wood), is, as the specific name indicates, a native of British Guiana, where it grows in the forests to a height of 60 or 70 feet. The wood is hard and heavy, about the same colour as Honduras mahogany, though quite unmarked. It takes a good polish.

Curtisia faginea, Ait. (Hassagay Wood of the Cape of Good Hope), where the tree attains a height of from 20 to 40 feet, but is generally felled when at the former height. The wood is very heavy, tough, and

close-grained, of a colour resembling plain mahogany. It is highly prized at the Cape for furniture, tools, &c., but particulary for carriages and waggons.

Hartogia Capensis, Thbg. (Smalblad, or Lepelhout).—This is also a native of the Cape, and grows to a height of 12 or 15 feet, with a diameter of 1½ feet. The wood is firm, fine-grained, and tough, and when polished is equal to some of the finer kinds of mahogany, both in colour and texture. It is much used at the Cape for veneering superior articles of furniture, and also for the manufacture of musical instruments.

Berrya Amonille, Roxb. (Halmililo).—A native of the Moluccas and Ceylon, where the tree attains a height of 30 or 40 feet. The wood in colour somewhat resembles pencil cedar, but is much harder, closer, and finer grained, taking a good polish. It is considered the best timber in Ceylon for casks, tubs, waggons, &c.

Elæodendron croceum, Dc. (Saffron-wood of the Cape of Good Hope), growing to about 40 feet high, with a diameter of two to four feet. The timber is close, fine, even-grained, and very tough ; the colour is of a lightish red-brown, and looks well when polished. It has an infinite variety of uses in its native country, being employed for cabinet-work, furniture, building purposes, and also for carriage and waggon work.

Zizyphus jujuba, Lam.—A native of India, but growing also in China. It is a small tree, about 16 to 20 feet high, producing a wood of a fine reddish-brown colour, equal in appearance to fine mahogany ; it is very close and even-grained, compact, and heavy. From this wood the native Indian sandals are chiefly made.

Comocladia integrifolia, Jacq. (Maiden Plum of Jamaica), where it is a common tree, growing 20 to 30 feet high. It has a very heavy, dense, and even-grained wood, of a clear, dark, mahogany colour, and is used in Jamaica for furniture and cabinet work.

Pistacia Lentiscus, L.—This tree is a native of the south of Europe and the northern parts of Africa. It is known to us as being one of the trees from which the gum mastich of commerce is obtained, and grows to about 20 or 30 feet high, producing a close-grained, hard wood, of a dark reddish-brown colour, beautifully marked with dark stripes.

Odina Wodier, Roxb. A large tree, native of the East Indies. The heart wood of the old tree is hard, and close grained, of a reddish-brown mahogany colour, taking a good polish. It is used in India for various purposes, amongst others, for sheaths for swords, &c.

Azedarachta Indica, Juss.—A tree 20 to 30 feet high, native of the East Indies, producing a hard, close grained, and durable wood, of a reddish-brown colour, with dark variegated markings. It is much used for shipbuilding, carts, and various other purposes.

Eperua falcata, Aubl. (Wallaba of British Guiana.) Where it grows very abundantly, and produces a close, even grained wood, very strong and durable, of a deep reddish colour. It is largely employed in house

building, for posts, and other purposes where strength is required; and can be obtained 30 or 40 feet long by 15 to 20 inches diameter.

Mesua ferrea, L.—Iron wood of the East Indies, and is a native also of Java, growing about 40 or 50 feet high. The wood is hard, and close grained, of a deep reddish-brown colour; looks well when polished, and is used in Ceylon for bridges, roofs, &c.

Alphitonia excelsa, Reiss. (Red Ash, Coopers' Wood, or Leather Jacket, of New South Wales.)—It is a fine tree, growing from 50 to 100 feet high, with a diameter of 2 to 3 feet. The wood is very sound and close grained. The heart wood is of a light colour, something like Honduras mahogany, and takes a good polish.

Copaifera pubiflora, Bth.—Purple heart of British Guiana, where it grows very abundantly, and to a large size, producing a timber of very great strength and durability. The colour varies much in different specimens, some being of a deepish red brown, but the most beautiful is of a clear reddish purple, exceedingly handsome when polished.

Baphia nitida, Lodd. (Barwood, or Camwood of Commerce).—A tree 50 or 60 feet high, native of the West Coast of Africa. It is well known in this country as a dye-wood; and is imported in logs from 4 to 5 feet long, and about a foot in width. The wood is tolerably close grained, of a deep reddish brown colour, and is occasionally used for turning.

Ceratonia Siliqua, L. (Carob).—A tree 40 or 50 feet high, native of the South of Europe and the Levant. The wood is rather coarse grained, but of a fine reddish brown colour. This is the tree which produces the Carob bean, or St. John's bread.

Prosopis julliflora, Dc. (Cashaw.)—A native of Jamaica; growing to the height of 30 or 40 feet. The wood is hard, close, and even grained; the heart wood of a lightish mahogany colour, the sap wood yellowish. It is much used for shipbuilding in Jamaica.

Detarium senegalense, (Gmel.)—A large tree, growing on the Gambia, where it is called "Dattock;" producing a hard and compact timber, of a deep reddish brown colour, apparently very durable.

Adenanthera pavonina, L. (Rukta chundun.)—A large East Indian tree, growing 100 feet high; found abundantly in all the forests. The wood is very hard and durable, of a deep red colour, which is extracted by the Brahmins for staining their foreheads after bathing.

Acacia arborea, Willd.—Wild Tamarind of Jamaica, where it grows to a height of 40 or 50 feet, producing a close compact wood, strong and durable; heart wood of a light reddish brown, the sap wood yellow.

Cerasus serotina, Lois. (American Bird Cherry.)—Growing in many parts of North America; frequently attaining 120 feet in height and 4 feet in diameter. The wood is very fine, even grained, and hard; of a very clear mahogany colour, without any markings, and susceptible of a

high polish. It is much used in North America for all kinds of cabinet work.

Cerasus Mahaleb, Mill.—A native of the South of Europe. A small tree, about 20 or 25 feet high, producing a very hard, close grained and fragrant wood ; much esteemed by the French for furniture and cabinet work. The colour is of a rich reddish brown, with a satiny lustre, and dark stripes.

Melaleuca uncinata, R. Br. (Yang-árra, or Common Tea Tree.)—A large Australian tree, from 40 to 80 feet high, and having a diameter of from 2 to 4 feet. It affords a very hard, close grained and durable wood ; excellent for underground work, but liable to split if care is not taken in the drying. The colour is of a reddish brown, with a silvery transparent shade.

Eucalyptus amygdalina, Lab. (Mokarago, or Narrow-leaved Iron bark of New South Wales,)—Where it grows to a height of 50 to 90 feet, with a diameter of 2 to 4 feet. This wood, like most of the *Eucalypti* is very dense, hard, and durable ; the colour reddish brown with dark stripes, looking well when polished.

Eucalyptus paniculata, Sm. (Mannen or Blood tree.)—A large tree from 60 to 120 feet high, and 3 to 4 or even 5 feet in diameter. The wood is not durable when exposed to the weather; but answers well for other purposes, as cabinet work, &c., for which the colour recommends it, being of a pretty reddish brown, with dark stripes, and taking a good polish.

Lecythis grandiflora, Aubl. (Monkey-pot tree.)—A native of British Guiana, growing to a large size. The timber is very close grained and hard. The heart wood of a lightish red colour, takes a good polish, and is much used in its native country for furniture as well as for the staves of casks.

Cunonia capensis, L. (Rood Els.—A small tree from 20 to 25 feet high, with a diameter of from 1 to 2 feet, native of the Cape of Good Hope. The wood is close and even-grained, very durable in moist situations, and much used for turnery and furniture. The colour is of a clear reddish brown, susceptible of a high polish.

Bassia longifolia, L. (Mee.)—A tree about 40 feet high, native of Ceylon, Malabar, Coromandel, &c. It is a heavy and very dense wood, said to be as durable as teak, but more difficult to be worked. The colour is of a dull red brown, much used in Ceylon for house buildings, bridges, and various other purposes.

Bassia Parkii, Don. (Shea butter tree.) A large African tree 40 or 50 feet high, producing a very heavy and close-grained wood. The colour of the heart wood is of a deep reddish brown much like the former species, and takes a good polish.

Sapota Achras, Mill. (Sapodilla.)—A native of Trinidad, Jamaica,

St. Vincent, &c. sometimes growing 50 feet high. The wood is of very fine even grain, somewhat resembling mahogany in colour but with deeper markings.

Sapota sideroxylon, Gr.—One of the most lofty trees of Jamaica, where it is much esteemed for its very strong and durable timber, of a clear reddish brown colour, capable of taking a high polish.

Coccoloba uvifera, Jacq. (Sea Side Grape of Jamaica,)—Where it is native, as well as in other of the West Indian Islands. It affords a close-grained timber, but appears liable to split. It is of a clear reddish brown colour, and is used in Jamaica for furniture and cabinet work.

Grevillea robusta, Cunn. (Silky oak.)—An Australian tree, attaining a height of 50 or 60 feet, and a diameter of 12 to 18 inches. The wood is hard and close grained, of a dark reddish-brown, with dark stripes; takes a good polish, and is used in its native country for furniture work.

Artocarpus integrifolia, L. (Jack Tree).—A large tree, common in Southern Asia and the Indian islands. It affords a tolerably close-grained wood, of a pale colour when young, but becoming by age of a rich mahogany colour. It is much used in India for furniture, cabinet work, frames, &c., and is capable of taking an excellent polish.

Casuarina quadrivalvis, Lab. (She Oak).—A Tasmanian tree, growing 20 or 30 feet high, and about 1 foot in diameter, producing a dense and very hard wood, of a reddish-brown colour, with dark stripes. It is used in Tasmania for picture frames as well as for cabinet work.

Xylomelum pyriforme, Sm. (Native or Wooden Pear).—So named from the shape of its fruit. This, like the last, is a native of Australia, where the tree grows 40 or 50 feet high. The wood of this tree is very much like the last, both as to grain and colour. All the Proteaceous woods are very beautifully marked, and when polished have a very handsome appearance.

Stenocarpus salignus, R. Br. (Beef Wood of New South Wales).—This tree frequently attains 100 feet in height, with a diameter of from 1 to 3 feet, affording a firm and durable wood, of a dull reddish-brown colour, but very beautifully marked, and having a fine satiny lustre. It is capable of taking a very high polish, and would make a handsome wood for some kinds of furniture or cabinet work.

Banksia serrata, L. fil. (Honeysuckle of Australia).—A tree growing 20 or 30 feet high, and having a diameter of 1 to 2 feet. The wood is rather coarse-grained, but handsome, of a dull reddish-brown colour, very prettily marked with dark stripes.

Artocarpus hirsuta, Lam.—A native of the East Indies, where it grows to a large size, producing a timber known as Angely wood, which is rather coarse-grained; in colour, of a dull reddish-brown. It is much used for ship and house building, as well as for various other purposes.

Casuarina stricta, Ait. (He Oak).—Likewise a native of Tasmania, attaining a height of 20 or 30 feet, and a diameter of 1 to 2 feet. The

wood is hard and compact, of a dark reddish-brown colour, with dark stripes, and silvery shaded knots; used for cabinet work, picture frames, &c.

Highly-Variegated Woods of a Brown or Reddish-Brown Colour.

Cedrela Australis, R. Br. (Polai, or Cedar, of New South Wales).—This is a magnificent tree, growing from 80 to 150 feet high, with a diameter of 3 to 4 feet. It is a most valuable wood, strong and durable, of a very deep, rich, reddish-brown colour, beautifully figured with dark variegated markings, looking very handsome when polished.

Cedrela odorata, L., a native of Jamaica and the West Indian Islands, is another lofty tree, producing a rich coloured, variegated wood, but not so deep in colour as the former. The colour of the wood appears to be influenced by the place of growth, that from Cuba being the lightest, and that from Jamaica of the darkest brown.

Pterocarpus erinaceus, Lam. (African Rosewood).—A native of the West Coast of Africa, and growing abundantly on the Gambia, produces a very close-grained, dense wood, of a deep, rich brown colour. It takes an excellent polish, and would look well made up into articles of furniture, &c.

Amygdalus communis, L. (Almond).—A native of the shores of the Mediterranean, but growing in the north of Africa, Persia, Spain, Italy, &c. The tree grows about 20 feet high, producing a wood of a fine, even grain, and a rich crimson brown colour. It is a very beautiful wood, and takes a high polish.

Fagus Cunninghami, Hook. (Tasmanian Myrtle).—Growing abundantly in nearly all the Tasmanian forests, attaining 150 to 200 feet high, with a diameter of 10 to 15 feet. The wood is very hard and durable, of the most beautiful appearance when polished, being of a deep reddish-brown colour, thickly studded with knots and wavy lines of a much darker tint. It is much used in Tasmania for furniture, picture frames, &c.

Cercis siliquastrum, L. (Judas tree).—A native of France, Italy, Spain, &c., growing to a height of 20 or 30 feet, produces a firm, even-grained wood, of a rich dark colour, streaked with deep brown markings. It takes an excellent polish, and might be useful for many purposes.

Melanoxylon Brauna, Schott. Brauna of Brazil, where it grows to a good sized tree. The wood is hard, close-grained, and firm, of a rich, deep colour, somewhat resembling rosewood, but rather darker. It is capable of taking a high polish.

Albizzia Lebbek.—A tree 20 or 30 feet high, growing in both the East and West Indies, North of Africa, &c., affords a close-grained hard wood of a yellowish-brown colour, beautifully variegated with markings passing from a mellow tint to a deep rich brown.

Eucalyptus acervula, Sieb.—A native of New Holland, where it grows to a good sized tree, and produces a very close-grained and hard wood,

very rich in colour, of a deep brown, with dark stripes, taking an excellent polish.

Careya arborea, Roxb.—A tolerably sized tree, native of the East Indies, Ceylon, &c. The wood is neither very hard nor heavy, and will not stand damp, but is pretty durable in dry situations. It is of a brownish colour, with dark stripes, and is much used for various purposes, especially for hoops, on account of its elasticity.

Olea laurifolia, Lam. Black Iron Wood of the Cape of Good Hope, where it attains 12 or 15 feet in height, with a diameter of 1 to 2 feet, affording a very hard, close-grained wood of a very dark colour, beautifully marked, somewhat resembling walnut. It is much used at the Cape for furniture and cabinet work.

Olea verrucosa, Link. (Olyvenhout). Also a native of the Cape, growing about 8 or 10 feet high, and a diameter of 8 to 12 inches. The wood is very dense and hard, and one of the most useful in the colony, both on account of its strength, and also for its handsome appearance, being in colour of a deep rich brown, with dark markings, very handsome when polished.

Cordia Gerascanthus, Jacq. (Spanish Elm).—A native of Jamaica and the West Indian Islands, where it grows about 30 feet high, producing a hard, close-grained timber of a dark brown colour, with deep coloured markings—a beautiful wood, taking a good polish, much used in Jamaica for cart bodies and for various other purposes.

Oreodaphne bullata, Neis. ab. E. (Stinkwood).—This is a native of the Cape of Good Hope, and grows 20 or 35 feet high, with a diameter of 3 to 5 feet. The wood is tolerably hard, close grained, and durable, of a deep brown colour, taking a good polish. It has a very disagreeable smell when cut ; hence its vernacular name ; and might probably be employed for cabinets for natural history collections, as it is not infested by insects. It is very extensively used in the colony for various purposes.

Oreodaphne fœtens Neis.—A tree growing 70 to 100 feet high, native of the Madeira and Canary Islands. The timber is very dense and heavy, of a dark-brown colour, with still darker stripes.

Endiandra glauca, R. Br., Teak wood of New South Wales, where it grows to a very large size, frequently attaining a height of 100 to 140 feet, and a diameter of from 3 to 5 feet, producing a hard and close-grained timber. The heart wood is of a very beautiful rich brown colour, with silvery transverse markings, and dark lines running longitudinally. It is capable of taking a high polish, and has every appearance of being a valuable wood.

Alyxia buxifolia, R. Br. (Scent-wood of Tasmania).—This is a small tree or shrub, and consequently does not produce wood of any great size, but it is firm and close-grained, of a lightish-brown mottled appearance, and has an odour resembling that of the Tonquin bean.

Bedfordia salicina, Dc. (Dogwood).—Also a native of Tasmania, growing about 20 or 30 feet high, but swelling to such an extent near the root as to enable boards 3 feet by 1½ feet to be cut from it. The wood has a most beautiful appearance when polished, being of a light brown colour, richly marked with knots and wavy lines. From its appearance, it seems well adapted for cabinet work.

Tetranthera apetula, Roxb.—A tolerably sized tree, growing in many parts of India, producing a hard and close-grained timber, of a light brown colour, beautifully variegated with dark markings.

Bridelia retusa, Spr.—A large tree, growing in many parts of India, Ceylon, &c. The wood is close-grained and heavy, of a deep brown colour with dark stripes, and takes a good polish.

Myrica Faya, Ait.—A native of Madeira, the Canary Islands, Spain, &c. It attains a height of 20 to 25 feet, and produces a very fine-grained compact wood, of a brownish colour, with a reddish tinge and dark stripes, taking an excellent polish.

Phœbe Barbusana, Webb.—Also a native of Madeira and the Canary Islands, where it attains to about 60 feet in height, producing a close-grained tough wood, of a deep, rich, reddish-brown colour, looking well when polished.

Pistacia terebinthus, L.—This is a native of the south of Europe and the northern parts of Africa, growing about 20 or 30 feet high, producing a hard, compact, and close-grained wood, in colour somewhat resembling walnut, but not so beautifully marked. From this tree the Venetian or Chian turpentine is procured.

Dalbergia latifolia, Roxb. Black Wood of India, where it is abundant in the forests, the tree growing to a large size, so as to furnish planks four feet wide, after the removal of the sap wood. This is one of the most valuable of the Indian woods, and when polished much resembles rosewood. It is largely used in India for all kinds of furniture.

Dalbergia Sissoo, Roxb.—This is the tree from which the Sissoo wood of the East Indies is produced. It is in colour somewhat like rosewood, but of a lighter tint, very tough and close grained, and is used in India for a variety of purposes, such as carts, gun-carriages, ship-building, &c. The tree grows to about 50 feet high.

Acacia melanoxylon, R. Br. (Myall of New South Wales).—This wood is of a very deep brown colour, with darkish stripes, having, when freshly cut, a strong odour of violets. The tree grows to a height of about 40 feet. The black wood, or light wood, of Tasmania, is said to be produced by this tree, but the wood has not so great a depth of colour, being lighter and more beautifully veined with a fine silvery lustre. Some confusion probably exists in the identification of the species from which these woods are produced.

Kew, 1862.

ON THE MEDICINAL PROPERTIES OF THE RED GUM OF AUSTRALIA.

BY JAMES SUTHERLAND, M.D.

The accompanying gum, a most invaluable medicine in certain disorders, is the produce of the *Eucalyptus rostrata*, a tree of frequent occurrence in the colony of Victoria and many parts of Australia. It exudes in a fluid state from the bark, and in many instances between the different layers of the wood, in the months of November, December, January, February, and March, and by the evaporation of the watery particles by which it is held in solution; it concretes into a beautiful ruby-coloured gum which, when exposed for a length of time to the air and the sun, assumes a black colour from an imperfect oxidation, losing at the same time its astringency. It is the only known vegetable astringent with the exception of the wattle gum which exudes in this state —for the kino and catechu, though called gums, are really extracts, being obtained by evaporating a decoction of the smaller twigs and branches of the *Acacia Catechu*, and the *Pterocarpus Erinacea*, and possess no mucilaginous properties. The S. G. varies from 1·25 to 1·35. It has a highly astringent taste, much more so than tannin or gallic acid. It is soluble in water almost in any quantity, for when added greatly in excess to that fluid it softens, and forms a semifluid mass of the consistence of honey, or thick mucilage. It is also soluble in alcohol, though not to the same extent as in water. When digested in sulphuric ether for some days a small quantity is dissolved, forming a deep red solution. According to my experiments one fluid ounce of ether dissolves six grains. It dissolves speedily in nitric ether, forming a beautiful dark-red tincture, though its astringency is rather impaired in this menstruum. It is altogether insoluble in chloroform, in which it floats upon the surface, and is neither softened by nor miscible with it. It strikes a deep black colour with the tincture of steel and sulphate of iron, and causes white flocculent precipitates, with solutions of animal gelatine, albumen, alum, sulphate of zinc, corrosive sublimate, muriate of morphia, sulphate of copper, hydrodate of potash, and carbonate of soda. With the bichromate of potash it yields a copious dark-brown, curdy precipitate, quite different from that occasioned by tannin. Nitrate of silver occasions a dark precipitate almost approaching to black. When treated with lime water, it assumes a dark hue, and gradually a pale-brown, gelatinous precipitate ensues. With the caustic alkalies it forms dark yellow solutions, and an orange-coloured solution with the tincture of iodine. Sulphuric acid throws down a brown-coloured, flocculent precipitate—nitric acid has no perceptible action at all—while the muriatic precipitates only a few and new coloured flocculi.

These experiments show that this gum is an original astringent prin-

ciple analogous in some respects to tannin, the basis of the other vegetable astringents, but by no means identical with that compound. Its properties are sufficiently distinct and characteristic to entitle it to be considered an astringent substance *sui generis*, which might with propriety be designated *eucalyptine*. My first impression was that it was composed of tannin, red colouring matter, and ordinary gum; but subsequent experiments failed to verify this theory.

As a medicine, it is a more powerful astringent than any in our pharmacopœas, and justly merits a place among the legitimate articles of the *Materia Medica* in these publications. In the year 1853, I collected a large quantity of this gum on the Black Hill, Ballarat, and made a variety of experiments on myself, taking it internally in doses varying from one to thirty grains, in order to ascertain if it could be safely administered as an internal medicine, and finding that it possessed no poisonous properties, I ventured to prescribe it in a variety of disorders in which astringents are indicated, and found it peculiarly serviceable in certain stages of diarrhœa and dysentery, in passive hæmorrhage, as an injection in leucorrhœa, gonorrhœa, and gleet, in scurvy of the gums, in *cyanche tonsillaris*, as a gargle when the acute symptoms have subsided, in relaxation of the uvula, and in hæmorrhoids, in the form of an ointment made by dissolving a drachm of the gum in a teaspoonful of water, and when intimately mixed, rubbing it up with an ounce of lard. The dose for internal administration varies from one or two grains to twenty, dissolved in water.

Ballarat, East Victoria.

ON THE TOBACCO TRADE AND CULTIVATION OF THE DISTRICT OF CAVALLA, TURKEY.

BY MR. MALING, BRITISH VICE CONSUL.

Tobacco is the staple article of production and industry of the sanjack of Drama, which forms the vice-consular district of Cavalla. The plant has been cultivated in the district from a remote period, but the general extension of its cultivation in all parts of the sanjack does not date, perhaps, more than twenty years back.

The area of all the arable lands in the sanjack of Drama is roughly estimated to be 500,000 acres, of which 35,000 acres are exclusively devoted to the culture of tobacco. A comparative statement of the areas under different sorts of culture would afford, however, a very imperfect idea of the relative importance of tobacco as a branch of the local in-

dustry and trade. This can be justly appreciated only when the time, labour, and capital employed in producing tobacco have been taken into account, together with the relative values of the exported produce. In a population of 250,000 souls, there is scarcely a family in the district whose livelihood does not, at this day, depend more or less on the production and trade of tobacco.

In the sanjack of Drama, as throughout Turkey generally, the land is for the most part owned by the tillers of the soil. Each peasant is absolute owner of his five or ten-acre freehold, and the village community of which he is a member constitutes a sort of small commonwealth of peasant proprietors, bound together for the defence of common rights and interests, and for the performance of their duties as subjects of the State. Although estates of several thousand acres in extent are occasionally to be met, they occupy in the aggregate but a small portion of the total surface. Small freeholds, independent of the village communities, are rare, and only to be found in the vicinity of towns.

The peasant freeholder cultivates his patch of ground with the assistance of his family, and seldom resorts to the aid of hired labour. There are peasants, however, who hold much larger areas of land, to the extent of fifty, or even a hundred acres, requiring the employment of hired labourers for their cultivation. The large owners utilize their properties after the following system. The landlord stocks the farm, provides agricultural implements, and defrays at his own cost the preliminary expenses of tilling and preparing the ground for seed. Each peasant does all else that may be needed on his particular allotment by means of his own labour and that of his family, or by hired hands, in tending and securing the produce. The crop, after deduction of the tithes, is then divided in equal proportions between landlord and cultivator.

Under such a system, stimulating enterprize and exertion so slightly on either hand, and with a languid administration, allowing almost unlimited powers of oppression to the landlord, it is not surprising that the peasantry on the large properties should be in a most wretched condition; nor, that with an unrivalled climate and soil to favour him, a resident landlord rarely derives seven or eight per cent. return on the fee-simple of his estate, and the absentee a much smaller income. In some rare instances proprietors let farms on the English system of a fixed rent in money; but tenant-farmers, as a class, in the English acceptation of the term, are unknown.

The growing importance of the trade, consequent on the steadily increasing demand for this species of tobacco in the home and foreign markets, is the cause that fresh land is yearly brought under this kind of husbandry, to a degree indeed which has rendered cereal and cotton cultivations quite subordinate to this more lucrative investment for capital and labour. Its culture may be extended almost unlimitedly

without encroaching on lands required for other produce, as there is a vast surface of reclaimable waste lands.

The present average annual yield of the district is about eighteen million pounds. The following is a statement of the weight of crops for sixteen years, going back to the earliest period whence any reliable statistics are procurable :—

Annual Weight of Tobacco Crops.

Years.	Weight. lbs.	Years.	Weight. lbs.
1844	9,310,000	1852	11,250,000
1845	8,580,000	1853	13,750,000
1846	8,610,000	1854	16,000,000
1847	10,410,000	1855	18,250,000
1848	9,450,000	1856	19,500,000
1849	9,800,000	1857	22,000,000
1850	10,250,000	1858	19,000,000
1851	9,700,000	1859	18,500,000

The rate of production, it is thus seen, has more than doubled within the last sixteen years.

The tobacco plant of this district, though all produced from the same seed, and belonging to the same species, is classed into two comprehensive varieties : the one known as the "Drama leaf," the other, of greater fame, as the "Yenidgeh leaf." The former is the larger and stouter leaf, and possesses more potent narcotic qualities. Its colour is generally of a deep reddish brown. The "Yenidgeh leaf" is smaller and of a slighter texture. The better sorts are of a rich yellow colour, hence its designation "golden leaved." It has a peculiarly delicate aroma, and is less narcotic in its properties.

The "Drama leaf" is principally grown in the western parts of the sanjack, and from this class the European market is exclusively supplied.

The production of these distinctly marked classes seems to be due to some inherent principle in the soil, for the modes of culture and of curing are identical, and there is no perceptible difference in the climate of the respective districts. The seed of the "golden leaf," if transplanted to the western districts, may succeed the first year in producing something analogous to its parent, the Yenidgeh tobacco, but the succeeding year it invariably degenerates. The soil is evidently the predisposing element in the change, although even the character of the earths does not seem to vary essentially. Quartz is the basis of the geological structure of the country, and the rich alluvial soils partake strongly of the siliceous character.

As the two great classes of leaf are further subdivided in the trade with reference to their peculiar properties and value, the particular production of each separate locality requires some description.

The district of Drama Proper comprises both plain and hill culti-

vation. The soils are light ferruginous loams. The plain produces annually about 4,500,000 lbs. to 5,000,000 lbs. The produce is known by the local denomination of "bashi-baghli," or "head tied," on account of the tobacco, when packed, being tied together by the stalk in bundles of ten or fifteen leaves. These are of the character known in botany as "petiolate," from having "petioles," or footstalks. The little bundles are called "manoks," and correspond to the "handwork" of American tobaccos. The best leaves, distinguished by a stronger and more substantial texture and a dark red hue, are reserved for the Constantinople market. The less substantial and lighter coloured find a sale in Russia. The value is from 4½d. to 7½d. per lb., and some of the finest sort even fetches 1s. to 1s. 4d. per lb. The mountain tobacco is much inferior in quality to the above. The annual yield is about 1,700,000 lbs. About one-half of the leaf is made up in the form of "bashi-baghli," or "head tied," the other half is known as "bassma" pressed, that is to say, the leaves being "sessile," or without petioles (footstalks), do not admit of being tied together, and consequently the "manoks" or "hands" consist simply of several leaves pressed together. Mountain "bashi-baghli" and "bassma" are both exported to Europe. Value, 2½d. to 6d. per lb.

The Vale of Pravista.—The growth is known by the name of "Demirli" (ferruginous), the village which introduced the cultivation into the district. The upper extremity alone of the valley is planted with tobacco. The soil is a light ferruginous loam, inferior in richness, to that of Drama. Annual production, 1,700,000 lbs., exported principally to Europe in the form of "head tied" or "bashi-baghli." Quality inferior, unsubstantial, and dark-coloured leaf. Value, 2d. to 3½d. per lb.

Cavalla.—In this locality, from the close vicinity of the hills, the gravelly element in the soils greatly predominates. Production yearly 600,000 lbs. Form chiefly bashi-baghli. Quality inferior, principally consumed by home markets. Value, 2d. to 4d. per lb., and some of the finer 7d. per lb. The produce of the above localities is shipped at Cavalla.

Sarishaban.—This district produces annually 2,250,000 lbs., of which seven-eighths is "bashi-baghli," or "head tied." Plain, hill, and mountain are alike cultivated. The produce of the hill and plain is called "Ghynbek" (navel), and is packed in small parcels of 30 lbs to 50 lbs. each, called "boghchas." These "boghchas" are distinguished into two classes, the finest as "béyaz" (white), so called from the white cotton wrappers in which they are made up; and the secondary as "kenavir" (canvas), from their coarse linen coverings. These are the golden-leafed tobaccos so highly prized in Turkey. The finest, consisting of about 600,000 lbs., are produced from the rising grounds. The crop raised on the plain comes next in estimation. With the exception

of 30,000 lbs, or 40,000 lbs. sent annually to Austria, all the finest qualities go to Constantinople, and the secondary to Smyrna and other home markets. Value, from 1s. to 4s. per lb.

The mountain crop (5,000,000 lbs.) goes almost entirely to Austria and France. This is of a darker colour, and is worth no more than 2½d. to 4d. per lb. The exportation to Europe is conducted through the port of Cavalla; the home or Turkish trade through the port of Karaghatch (Lagos).

Yenidgeh.—This locality also comprises plain, hill, and mountain culture. The greater proportion of the produce is made up into "bassma," whilst a portion only of the mountain growth becomes "bashi-baghli." In respect of quality, value, and mode of packing, this is the same class of tobacco as the Sarishaban. "Yenidgeh" is the generic designation for all the produce of the "golden leaf." The low lands produce 4,200,000 lbs., the high lands 1,500,000 lbs. The finer crop of the plain is sent to Constantinople and to Russia; the inferior to various parts of Turkey, and to the Danubian Principalities. Of the mountain tobacco about 500,000 lbs. go to Austria.

Ghiumirgina and Sultan-Yeri.—The cultivation in these districts dates only five or six years back. The tobacco is of the class "Drama," but rather inferior to it. Ghiumirgina produces about 420,000 lbs. "bassma," of a dark coloured leaf, worth from 2½d. to 4d. per lb., which is taken up by home markets. Sultan-Yeri yields 560,000 lbs., "bashi-baghli," of a still darker shade, worth from 2d. to 4d. per lb., of which the best is sent to Constantinople, and the inferior to the Principalities. These tobaccos, with those of Yenidgeh, are exported through Port Lagos.

Culture.—Experience, as derived from local cultivation, would seem to prove that the tobacco plant thrives best in an alluvial soil, composed of an equal mixture of clay and sand. In the low clay lands of Ghiumirgina, where clay predominates, the plant is far from arriving at perfection. On the higher levels, at the bases of hills, and on the gently rising uplands, the soil is most congenial to its wants; while on the mountain, where there is an excess of sand and quartzose detritus, the plant degenerates.

In tobacco-planting, the same land is cropped over and over again from year to year, and is never allowed to lie in fallow or under other crops. Constant applications of manure maintain the fertility of the rich soil, and prevent its exhaustion under this trying process. In common with every other branch of agriculture, the tobacco-lands are tilled entirely by the plough; spade husbandry is unknown. Men, women, and children, all contribute their labour.

The *Nicotiana rustica*, like the other species of the herbaceous annual Nicotiana cultivated in Europe, is not considered to be indigenous, but an exotic introduced from the New World. Some authorities are of

opinion that the plant cultivated in Turkey belongs to the species *Nicotiana macrophylla* (Orinoco tobacco), particularly the somewhat elongated Drama leaf; but there can be no doubt that the *Nicotiana rustica*, modified by climate and soil, is the parent of the tobacco which flourishes in this district. The variety grown here is paniculated or panicled (*Nicotiana paniculata*), the botanical term descriptive of the peculiar form of its inflorescence.

The ground is prepared for its culture in two ways—firstly, for the germination of the seeds ; and, secondly, for maturing the transplanted shoots. The seed is sown in beds or small plots of ground, set apart in the plantation, and proportioned in dimensions and number to its extent. The soil of these nurseries, previously highly impregnated with manure—sheep or goats' dung being preferred—is well trenched with an implement having two iron prongs, about nine inches long, set at an acute angle to a short wooden shaft, and employed after the manner of a pickaxe in breaking up and loosening the earth, and is brought to the condition of rich garden mould. The fatigue of using this "digger" is excessive, the shortness of the shaft obliging the husbandman to stoop in a constrained position ; and it is a curious fact, that a people who so much dislike hard labour have not yet devised an implement, like the spade, to render their toil less irksome, and more expeditious.

The beds are sown in February or March, and are afterwards covered with a thick layer of sheep or goats' dung. The shoots appear above ground in the course of a few days, and the precaution is then taken of laying brushwood over them to preserve them against the frosts. Towards the end of May the young plants are fit for setting in the fields.

During winter the fields have been well manured with horse or cattle dung, and repeatedly ploughed up. But still the ground is very imperfectly tilled to what it could be by means of less primitive agricultural implements than are in use in this country. The plough is a piece of crooked wood with one stilt, the share is only occasionally tipped with iron, and it has no coulter. The slow-draft ox is the only help to man's labour in the field. The harrow, roller, tormentor, &c., are unknown. By such rude and imperfect appliances, the surface soil is barely indented, and the rich sub-soils are never disturbed.

During the first half of May, sheep or goats are folded on the fields for the sake of their liquid manure, on a profuse application of which to the soil depends the perfection of the growth. In the course of time the soil of tobacco plantations consequently becomes highly impregnated with ammonia and nitrate of potass, both of which are absorbed by the plant ; the former influencing in a great measure, it is thought, the aroma. Owing to the great absorption of the nitrate of potash by the leaves, the tobacco, when ignited in the pipe, crackles and sparkles as if containing gunpowder, and even bursts into flame when a strong inhalation is taken. Minute crystals of this salt can be perceived on the surface of the dried leaf.

Transplanting is effected when the shoots are about six inches long, and have put forth three or four leaves. They are dug from the nursery beds with the double-pronged "digger," placed in a tub or basket for removal to the field, and put into the ground in rows by the aid of a dibble, or solely by the labourer's fingers, the earth being well pressed round the roots. No drills are made by the plough, but the rows are laid out with some regularity in the course of dibbling the single plants. The distance left between each row and between the plants themselves varies in different localities. At Drama, one foot; and in the "golden-leafed" district one foot-and-a-half's interval is observed; at Cavalla, about six inches space only is left between the rows, and the same interval between the plants. As soon as transplanted, the young plants are watered by hand. Irrigation is not resorted to, although it would be of service in dry seasons. The shoots are generally so vigorous that they rarely fail to strike root and thrive with a single watering in ordinary seasons. Reserved plants, however, are always kept in the nurseries to replace such as die off. A mean between a wet and a dry season is the most favourable to tobacco planting. Excessive moisture causes, it is true, a greater development of stalk and leaf, but the increase in bulk is more than counterbalanced by deterioration in quality. Drought, on the other hand, deprives the plant of its proper nourishment. Extremes equally weaken the leaf's substance, and lessen its oily richness of flavour.

Greater pains are bestowed on this culture than on other descriptions of local husbandry. The plant is carefully tended during growth, lateral shoots or suckers are removed, and the growth concentrated in one upright stem; hand-hoeing is vigorously practised, weeds eradicated, and the earth stirred up about the roots; but some important details are lost sight of. The stem is never topped, as it might be most judiciously, in rainy seasons; leaves, blighted or injured by grubs are allowed to remain; the lower leaves, which in the end are withered, soiled, and valueless, are not removed, and the juices are thus diverted from nourishing the more precious parts.

A well and full grown plant has a strong, upright stem, about four feet high and three-fourths of an inch in diameter, its skin somewhat hairy and sticky to the touch. The foliage is handsome. Each plant bears from ten to twenty green succulent leaves, ovate in form, and in some plants "petiolate," that is to say, having an intervening "petiole," or footstalk, by which they are attached to the stem; and in others "sessile," or sitting immediately on or clasping as it were the stem without any supporting footstalk. The leaves grow in clusters of three or four at intervals. The leaf of the Drama class is from seven to ten inches long; the Yenidgeh five to six inches, and often less. In rainy seasons the plant reaches six feet in height, and the leaves are larger and more numerous, but bulk is obtained at the cost of quality.

The flowers grow in clusters at the top of the stalk. The peduncles

or footstalks are variously sub-divided, whence the name of the variety, "panicled" or "paniculated." The inflorescence is white externally, and of a delicate red or yellow within, the edges, when full-blown, inclining to purple. To it succeed kidney-shaped seed-pods of a brownish colour, of the size of a large pea, filled with numerous and very minute grains of a dusky red hue. Thirty, forty, and even a hundred of these capsules are borne by a plant.

Curing.—About the end of July the lower leaves begin to lose their lively green appearance, and assume a yellowish tint. They also become thickened, roughish, and slightly brittle to the touch, and exude a clammy oily matter. The time for gathering has arrived. The lower leaves are first taken. This is done by the husbandman in person, and the morning, when the dew has evaporated, is the usual time selected. The lowest leaves are of little or no value, and it would have been more judicious to have removed them at an earlier period. They are known by the name of "deeb," or "dib," meaning "low" (or the "foot" of a plant or tree). By some planters they are even at this stage thrown away; others preserve them to form the outsides of the bales.

After ten days the next lowest cluster of leaves is taken; and so on, at from ten to twenty days interval, the successive clusters, until the topmost ones are reached, which are of little value. The different clusters in an ascending scale are called "Orta," middling; "Ana," mother; "Kuchuk Ana," little mother; "Utch Alti," three sixes, &c. The "Ana" are the best, and the next the "Kuchuk Ana." The leaves are largest at the bottom of the stalk, and diminish in size as they ascend. The gathering terminates towards the end of September.

As fast as gathered, the leaves are removed in baskets to the homestead, and placed under a shed. This is a building enclosed on three sides, the south being left open. Here they remain two or three days, until somewhat faded. The husbandman, his wife, and children, then with large needles string the leaves on to a piece of packthread, passing it through the thick ends of the stalks. Each string of leaves, ten or fifteen feet in length, is attached by the extremities and centre to a pole of corresponding length, and is placed in the sun, supported horizontally on trestles, where it remains so long as the leaves retain any moisture. Care is taken to remove the leaves into the shed on the approach of rain or heavy dews. They are finally hung up under the roof for the winter. The stalks are left standing in the field and are ultimately ploughed down as manure; a few tops being first secured for seed.

Combined with the sun's action, the free circulation of the air among the suspended leaves effects all that is required in the first stage of the curing process. Recourse is never had to artificial slow heat for drying them. After hanging in the shed the whole winter, the tobacco becomes thoroughly dry, and so excessively brittle, that if handled, it crumbles into dust. The next stage is to prepare it for carriage to the markets

of shipping ports. To effect this, advantage is taken of the first change from the dry frosty atmosphere of winter to the moist air which accompanies the return of spring, when the leaves, losing their crispness, are removed from the strings and made up into little bundles of ten or fifteen leaves, called "manoks," or "hands." The "bashi-baghli' are tied together by the foot-stalks ; the "bassma," having no petioles, are simply laid on each other. The sheds are not boarded, and as any prolonged contact with the air imparts a bad flavour to the produce, loose boards are temporarily laid down, and on these a double row of "manoks" is disposed, the tips of the leaves facing, or overlapping, and the stalks outwards. Other layers of "manoks" are successively laid on in like order, with such pressure as the labourer's muscles merely can apply, until the heap of "manoks" becomes a bale, two feet and a half or hree feet long, by two feet high and a foot and a half thick. It is then wrapped in strong hair-cloth and matting, and tightly corded. In this state the bale is ready for carriage. The Drama tobaccos are packed in the above way ; the Yenidgeh are made up originally in somewhat larger packages, and the bale is secured by a board at top and bottom, and bound with cords. Mechanical pressure is not applied to the tobacco until it arrives in the merchant's store, where it undergoes its preparation for shipment.

The production of a given area varies according to the mode of planting practised in the different localities. In the Drama district, where close setting is preferred, the yield is from 700 lbs. to 900 lbs. per acre. In the "golden-leafed" plantations the maximum return is 400 lbs. to an acre. The cost of production and the profit vary considerably.

The produce is carried to the shipping ports chiefly during the months between April and September. The tobacco shipped at Cavalla having to cross a mountain ridge, can only be transported on horse or mule's back, in bales of one hundred weight or one and a half hundred weight each. The 'Yenidgeh' being the produce of a plain bordering on the sea, with easy access throughout to Port Lagos, is carried in waggons.

Until recently, the only storeroom at Cavalla for the large trade carried on was to be found in the numerous 'Khans,' or native inns, in whose large stables the tobaccos used to be warehoused. Less appropriate stores for the preservation and seasoning of such a delicate article could scarcely be selected, for the floors are unboarded and the roofs by no means impervious to rain. And for such wretched accommodation the owners used to exact an exorbitant rent. New stores have recently been erected ; amongst others a very extensive and handsome range of warehouses, on the construction of which Messrs. Abbott, Brothers, of Salonica, the principal exporters to England, have expended 15,000*l.*

When the bales reach the stores at the shipping ports, they are arranged in two tiers on the ground floor, which ought properly to be,

and is now invariably, protected from damp by a wooden flooring. The bales are shifted from the upper to the lower tier at intervals of four or five days during a whole month. In this manner the tobacco undergoes the process called 'sweating,' which is in fact a partial fermentation. It sometimes happens that the store is too dry ; in that case water is from time to time, sprinkled on the floor between the rows of bales to hasten the sweating. The bales are then opened, examined, and sorted, and the soiled and inferior leaves, and those heated during the sweating, being rejected, the bales are made up to their proper weight and then pressed. Layers of inferior leaves are placed at the top and bottom of the bale. The presses in use are exceedingly rude, being nothing else than two stout planks connected by a couple of wooden screws worked by levers and manual power. The utmost power that can be exerted is not very great, as may be supposed, but experience (probably mere prejudice) is against pressing the leaf very strongly as it is supposed to injure it. The bales are finally dressed in a wrapper of hair-cloth which protects the flats and edges of the leaves ; the ends where the stalks are exposed are covered with a strip of matting. The bales are now ready for shipment and, unless immediately required, are removed to the upper floor to make room for the sweating and manipulation of other bales arriving in store.

The process, of sweating, sorting, and pressing, occupies the merchant until the end of June. It is thus seen that from seed time in March until July of the following year, fully sixteen months are required to bring the tobacco into a fit state for shipment, and, including the delay of shipping and the voyage, from eighteen to nineteen months before it can appear in the English market. Tobaccos for the British trade are usually made up in bales weighing, on an average, 127 lbs. each, and measuring six or seven cubic feet. However, a late shipment was made of bales weighing as much as 450 lbs. each. For France and Austria the bales do not exceed 110 lbs. In the home trade the bales vary from 100 lbs. to 200 lbs. weight, but the fine Yenidgeh tobacco is invariably made up as before mentioned in 'Boghchas' weighing 30 lbs. to 50 lbs.

In the first years of the trade with England the tobacco was packed in the same manner as American or West India produce, in wooden cases containing, *ad mininum*, 300 lbs., in conformity to the British Customs regulations of that time ; but in 1851 the Lords Commissioners of Her Majesty's Treasury, taking into their favourable consideration a memorial of the merchants, issued a minute to the effect that Turkey tobacco should thenceforward be imported on the same footing as East India produce, that is to say, in packages or bales weighing not less than 100 lbs. each ; but it must not be imported in vessels under the burden of 120 tons register.

'Strip-leaf,' a form of American tobacco in which the stalk or

principal fibre has been torn or stripped from the leaf, is not seen here; it is not usual to remove the stalk in this country when the leaf is cut up or manufactured.

The charges incurred on tobacco, from the time it leaves the grower's hands until it is stowed on board ship, include carriage from the country, brokerage, sorting, pressing, packing, weighing, porterage, lighterage, custom's duties, warehouse rent, and commission, and amount in the aggregate to about 1½d. to 3d. per pound on the Drama class of tobaccos, and from 4d. to 6d. per pound on the Yenidgeh. This estimate is irrespective of the loss of weight consequent on the drying and manipulation, which varies from two to five per cent., nor does it comprise the still larger deficiency resulting from sorting, which amounts to ten or twenty per cent., and in some unusually bad years to as much as thirty or forty per cent. of rejected tobacco. This 'Refuso,' or waste tobacco, is for the most part consumed in Egypt.

The quantity of tobacco shipped from the Cavalla district to different home and foreign markets in 1859 was 18,667,676 lbs., of which 14,100,000 lbs. went to the Turkish Empire, 2,691,228 lbs. to France, about 450,000 lbs. each to Austria, Greece, and Russia, 297,040 lbs. to Great Britain, and 224,000 lbs. to Sardinia. The trade with the Russian ports in the Black Sea, being carried on chiefly through Constantinople, its amount cannot be stated with any great degree of accuracy; and under the head of Greece is, no doubt, included a good deal of tobacco only nominally cleared out for that country.

NEW ICE MACHINE.

All the means hitherto employed for the manufacture of ice commercially have left much to desire; some with regard to the character of the ice obtained, others with respect to the construction of the machines or the fittings; others also on account of the quality of the ice made, which is sometimes of too small density, rendering the preservation of it difficult, or else of such an aspect and odour as to make its use almost impossible.

A new inventor has just discovered and patented a system which has no longer the faults, the inconvenience and the danger of others, but offers, on the contrary, immense advantages in its construction, and in the quantity of ice it produces. That inventor is M. Lespine, who has succeeded, after many years of persevering labour, in furnishing for use machines of a rare perfection, of a simple and easy construction, always certain and regular in their action, liable to no explosion or derange-

ment, and producing much more ice than any other system in use up to this time. The price of a machine capable of producing every hour—

20 kilogrammes	of ice is	. .	4,000 francs.
40 „	„	. . .	8,000 „
60 „	„	. . .	12,000 „
80 „	„	. . .	16,000 „
100 „	„	. . .	18,000 „

The profit (at Paris) on the rough ice is guaranteed by M. Lespine at three centimes the kilogramme. The ingenious construction of these machines offers, in addition to the advantages enumerated above, that of answering all the various purposes for which cold is required, without introducing any modification into its machinery.

The production of cold graduated at pleasure between zero and 30 degrees centigrade below zero, adapts these machines for scientific as well as commercial purposes. The different ways in which cold is used, may be classed into three divisions: the 1st comprising private uses and the daily necessities of domestic life; the 2nd, the preservation of public health, the salubrity and the welfare of the million; the 3rd, including the various and different branches of industry.

The following summary gives fuller details of the varied applications of ice and the apparatus of M. Lespine:

For private purposes and the daily requirements of domestic life:—

1. The production of rough ice at will, soft or hard, transparent or opaque.
2. The manufacture of sherbet and comestible ice in masses, more or less dense, iced wines, &c.
3. The preservation of meat, butter, cream, pulse and alimentary substances in general.
4. The cooling of beverages of all kinds.

For public health and salubrity, by lowering the temperature in crowded localities, &c.—

1. As in theatres, factories, work-shops, hospitals, ambulances, and dissecting-rooms, slaughter-houses, &c.
2. By employing ice or cold in all its forms, within and without buildings, as a remedy for, or a preventive of, many epidemic and endemic diseases resulting from intense heat.
3. The separation of salt from sea water, so as to render it drinkable on board, or to promote congelation.
4. Cooling the cabins of passengers and officers in ships, so as to enable them to defy the heat in the tropics in long voyages, &c.

For scientific and industrial purposes:—

1. Various preparations and the concentration of a great number of chemical products.

2. The manufacture of essential oils, certain colours, sea salt, sugars, &c.
3. Cooling the wort of beers, and by consequence improving the make of beer, especially in warm countries.
4. Concentration of alcohols, spirits, and wines, and the improvement of wines in middling years, so as to admit of their keeping when shipped, &c.

M. Lespine adds to his machine a particular method of action of extreme simplicity of detail, by which blocks of ice may be formed of considerable weight with the smallest possible volume, thus rendering the preservation and transport of the ice more easy.

COTTON CULTIVATION IN ITALY.

Of all countries to which we can turn our attention for an immediate supply of cotton, none offers better prospects of success than Italy, and we hope that it will be one of the grand results of the International Exhibition to establish this fact. The Italian cotton attracted till lately so little notice that its bare existence was scarcely known out of the very districts where it is cultivated, although it is one of the most ancient agricultural products of the country, whose introduction is lost in the mist of ages.

The depressing political condition of the Southern provinces of Italy, where cotton is grown, had a more prejudical effect on this cultivation than the competition of the cheap American cotton.

It would seem as if Providence, to alleviate the fearful distress from which Europe suffers, on account of the failure of the usual supply of cotton, had now restored liberty and independence to Italy, in order to open a new and extensive cotton field.

There are in Italy upwards of 1,500,000 hectares of land which might easily be devoted to this cultivation. An hectare of land produces in Italy from 250 to 600 kilogrammes of cotton.

In the province of Principato Citeriore even 700 kilogrammes per hectare are often gathered. By good farming, it would be easy to get an average crop of 400 kilogrammes. Supposing, then, that at some future time, half this land should be alternately cultivated with cotton, we should have a produce of 300,000 tons, or 1,500,000 bales of cotton, equal to the quantity imported into England from the United States, and half of the total produce of that country. Our conviction is that, if we develop properly the favourable elements we have at our disposal, Italy, as a cotton-producing country, may take the same position with regard to England as that occupied for the last half century by the United States.

The greater part of the land in Italy that may be cultivated with

cotton has an extremely low value from the entire deficiency of roads, as well as for the want of general improvement.

The cultivation of cotton in Italy is very general, and carried on with considerable intelligence.

In quality, Italian cotton may rival that of America, as may be seen by the "Report on the samples of Cotton in the International Exhibition, made on behalf of the Manchester Cotton Supply Association, by one of their members," where full details are given as to the estimation in which the Italian cotton is held, being often superior in value to middling New Orleans.

South Carolina used to produce about half a million bales of cotton, with a population of 750,000 inhabitants. The agricultural population is very abundant in Italy, and the wages low. The population of the Italian cotton districts is not less than 10,000,000. That of the provinces of Terra di Otranto, Basilicata, and Calabria, on the Ionian sea, perhaps the best adapted to an immediate extensive development of cotton cultivation, is alone upwards of 2,000,000.

Almost all these cotton districts will soon be traversed by railways. One of these railways, passing through the provinces of Terra di Lavoro, Naples, and Principato Citeriore, along the shores of the Tyrrhenian sea, will be entirely thrown open in the course of a few months, and the section from Ancona to Foggia, on the Brindisi line, will be terminated within a year.

The greater part of the available land to become fit for growing cotton requires drainage and irrigation.

It results from the foregoing considerations that we have within a few days sail from Manchester, a country in which the following elements exist :—

1st. A vast extent of land, at a low rent, suited to the growth of cotton.

2nd. An abundant population already accustomed to this branch of agriculture.

3rd. Good species of cotton already acclimatised.

Add to this that there is a free and liberal government desirous by every means in its power to promote the industry and welfare of the country.

Leaving the United States out of the question, there is no country except India, which could give such a large supply of cotton as Italy, but *there is this most important difference between them;* in India, any change is introduced with great difficulty, and there is plenty of room for improvement in the quality of Indian cotton, while in Italy it is merely a question of developing an existing cultivation established on good principles.

The consumption of cotton increases so rapidly in our days, that, even after the American crisis is over, it will doubtless be grown with success in many countries.

Italy has the great advantage of possessing the conditions to give the *quickest supply* at the present moment. If all these favourable circumstances be duly taken advantage of, Italy might be able to furnish at least 100,000 bales of cotton next year to the English market, and a million of bales within a few years time.

But what steps are to be taken in order to establish this production on a proper footing ?

1st. The Italian Government should expedite, to the utmost degree, the construction of the railways which pass through the cotton regions, and especially the line along the Adriatic and Ionian seas.

2nd. Private companies should rent or purchase land in those provinces for growing cotton.

3rd. One or more companies should be formed for drainage, irrigation, and general land improvement, similar to those in existence in this country.

When once the land is improved, there is no doubt that cotton cultivation would be established there in preference to all others for the large return it would yield.

It is questionable whether these last two objects might not be embraced by the same Company.

While it is the interest of Italy to develop so great a source of national wealth, it is no less that of England to create this new field of cotton supply.

Italian capital is so taken up in an endless variety of both public and private undertakings, that it could not suffice for immediately carrying out this cutivation on a large scale ; it is, therefore, extremely desirable that Italian and Foreign capital and energy should be combined, in order to give an instantaneous impulse to so important an enterprise as the establishment of an extensive European cotton field.

ON TAMANU RESIN AND OIL FROM THE SOCIETY ISLANDS.

BY G. CUZENT.

The *Calophyllum Inophyllum* of Linnæus, which bears in Tahiti the names of Ati and Tamanu, belongs to the Guttifera family of Jussieu.

Resin of Tamanu.—In the crevices of the bark of this tree is found a green, heavy resin, which remains fluid and sticky for a long time, and subsequently becomes dry and solid. It is then brittle, and breaks like glass, and is aromatic. This resin must not be confounded with those obtained from *Icica Tacamacha, heptaphylal Guyanensis* and *altissima,* which are known in the 'Pharmacopæia' under the name of Tacamahaca. In fact, its physical characteristics are not the same ; the colours of reddish-yellow, black and yellow, a dull yellowish green,

which distinguish the different kinds of Tacamahaca resins used in commerce, are not found in the resin produced from the *Calophyllum inophyllum*, which is very green while it is in a fluid state. Sometimes it is also of a bright yellow, but that is only the case when it exudes from the young branches of the tree. This resin has a peculiar aromatic odour, which has been compared to that of angelin, but is entirely different. Like all the resins, it dissolves in alcohol, to which it imparts a green colour. Evaporated, it deposits a clear green resin; on the contrary, when containing water, it becomes milky. The resin is precipitated; and by exposure to the air, it acquires a greenish tint, and becomes odoriferous. Ether dissolves it readily. Heated in a glass tube, surmounted by a muffle, it does not produce any crystalline sublimation. It exhales an aromatic odour, and gives off much white smoke; and on the heat being continued, it forms brown tears, which flow on the sides of the tube: the resin becomes brown, and emits a strong empyreumatic smell. The remainder is soluble in ether, which leaves, when evaporated, a sticky, rich-coloured substance. In some countries—the Seychelles and the Mauritius, for instance—the resin of Tamanu is employed to caulk ships. At Tahiti it is not used.

Oil of Tamanu.—The almonds are formed by two cotyledons, of a pale yellow when fresh. They contain no oil, and before it can be obtained a change must be effected in the colour, the characteristic odour—in a word, a complete transformation must take place from the resinous gum sap of a yellowish green to an oily sap. That result is obtained by exposing the almonds to the sun for about two months. The oil is obtained by pressure. The almonds, reduced to powder, are put in linen sacks. All the virgin oil is obtained in this manner. They break the cakes up again, and expose the paste to a gentle heat to coagulate the albumen, and then submit it anew to the action of the press. The oil flows more readily, and they procure by those means a great quantity.

From the commencement of the operation, the almonds having been crushed, might be submitted to the action of heat for the purpose of facilitating the production of the oil; but it is known that oil obtained in this manner becomes rancid sooner than those in whose preparation heat takes no part; and, therefore, it is advisable to avoid as much as possible the employment of heat. The following is a general table of results:—1,000 grammes of almonds have given, after the first pressure, when cold, 418 grammes of oil. The cakes, pulverised and warmed, again pressed, have produced 408 grammes of oil, which gives a total return of 810 grammes, or 81 per cent.

One hundred kilos of entire nuts give 39 kilos of almonds; 100 kilos of almonds furnish 81 kilos of oil. The hectolitre contains 93 kilos.

This oil, obtained in the manner described above, is greasy, of a greenish yellow, translucid, and sometimes very green, but this occurs when the almond is more advanced towards maturity. It has a perfume

that is *sui generis*, and an insipid flavour, which is not agreeable. Its density is 8·9347.

When it is boiled, it becomes thick and strongly coloured. It is insoluble in alcohol. If shaken in a tube with that liquid the mixture becomes very green. This colour is owing to the resin, which the spirit separates from the oil and keeps in a state of solution. When allowed to settle, the oil, which has taken a yellow tint, occupies the lower part. If the alcohol be poured off, and the tube, which now only contains oil, be plunged into warm water, it clears, becomes translucid, and is very much like olive oil. The alcohol having been evaporated, a residuum of green resin is obtained. Such would be the means of purification employed were it not too expensive. This oil is insoluble in ether and chloroform. When a drop of concentrated sulphuric acid is added to some drops of oil, previously poured upon a lamina of glass placed on a small piece of white paper, a yellow stain is soon seen to form, which continually increases in the intensity of its colour, and finally becomes a reddish brown, but this colour disappears after twelve hours exposure to the air. Concentrated sulphuric acid, poured into oil of Tamanu, precipitates a resinous substance of a brown red colour, and the oil takes an orange tint without producing a sediment. Azotic acid has no immediate action on it; but if the mixture be stirred with a glass rod, the oil takes an orange tint without producing a sediment. Clorhydric acid produces the same result on stirring the mixture, except that the colour which the oil takes is yellow, like that of a lemon.

Corrosive potash with heat forms with this oil a yellow soap, very soluble in water.

Corrosive soda changes it, in the same manner, into a hard soap of a green colour, very soluble in water.

Liquid ammonia also produces soap from it; the combination is greenish and soluble in water.

The acetate of lead gives a yellowish green soap, quite insoluble in water.

If 7 grammes of litharge are boiled with 1,000 grammes of oil of Tamanu, a black substance is the result, which very readily dries.

When the oil is treated with the Poutet reaction, it grows yellow, and then takes the colour of ochre, which soon changes to a very bright green. That colour in time disappears, and the mixture remains of a brown yellow.

The oil does not congeal at 25° of temperature, it remains fluid; and at the bottom of the phial a brown, solid, and elastic deposit is formed, and this too is very abundant. If two or three drops of ammonia are poured into the modified oil, which swims on the deposit, it becomes, when stirred, of a very bright orange colour.

The following results have been noticed in trials to purify the oil by the Thénard process:—

One hundred grammes of Tamanu oil, into which 2 grammes of concentrated sulphuric acid were poured, and shaken quickly in a flask for a quarter of an hour, became of an orange colour. The resinous and the viscous matter formed a deposit thick and sticky, of a reddish brown colour. If 30 grammes of hot water are added and the mixture shaken, the oil becomes of a clear yellow, and resembles the yellow of an egg. After standing for 24 hours, the mixture separates into three layers; the lower is formed by the deposit of the middle layer of acidulated water, and the third of oil. This oil, when poured off, is shaken with a new quantity of warm water; and after this operation has been performed for ten minutes, it is left to stand, they pour it off again, filter it, and the result is the oil purified and in a fit state for use.

The oil of Tamanu is useful for many industries, especially when it has been cleared of the green resinous matter which colours it, and which it retains in solution. It can be used in the manufacture of soap, in painting, and enters into the composition of some kinds of varnish. The soap obtained from it is of a yellowish green, aromatic, and of an excellent quality.

Experiments have been tried with paint in one instance, made with oil in its natural state, and in another with oil that had been previously boiled. In both cases the paint tried on new doors was completely dry in twelve hours.

Experiments have also been made to ascertain the fitness of the oil for sharpening tools made of steel. A number of graving tools were sharpened, and others, with the aid of water alone, or of cocoa-nut oil, which is sometimes used for that purpose.

After they had been marked those tools were given to workmen for trial, and, according to their accounts, those which had been sharpened with the oil of Tamanu remained sharp for a longer time than the others. This is a new merit which deserves to be taken into consideration. Ainslie pretends that this oil has soothing properties, and that it can be used in embrocations, in rheumatic attacks, and especially in gout. Formerly the Tahitians used the resin of Tamanu for their "mouoi," which cosmetic is certainly held in great esteem at Tahiti, but the resin does not enter into its composition. Cocoa-nut oil is the principal ingredient, and as it is seldom fresh, it communicates to the hair an odour strong and disagreeable to which everybody cannot become accustomed.

The *Calophyllum Inophyllum* prefers damp soils. It is found at Tahiti from the border of the sea to the valleys, where it spreads, and often near streams. The seeds which fall on the soil nearly always germinate; there is no necessity for increasing them, to do anything except protect their development. We have gathered seeds that have sprouted and young plants at Fâa, just on the sea coast, in a soil that was muddy and impregnated with salt water. Formerly the tree was exceedingly abundant; there were numbers of large forests at many points of the

island. It is still found in great numbers at the present day, and principally in the districts of Papara, Hitiaa, and Tiarei. The natives have cut down many of these trees to make the posts and stakes which they used at Hitiaa for enclosing their portions of land. Fine specimens of this tree are rare at this present day, but are still to be found in the valley of Papara. They distinguish two varieties of Tamanu, which differ only in the more or less bright colour of the wood and in the fibres which are either straight or undulating. The first kind bears the name of *Tamanu hiva,* the wood of it is hard and works easily; it is common at Tahiti, Moorea, Huahine, and Raiatea. The second, called *Ati,* has a less hard wood which splits easily and is more difficult to work. It must be bought a long time beforehand, and well dried in the shade before made use of.

The islands of Huahine, Raiatea, and Bora Bora, possess a great quantity of it; all the canoes in these islands are made of Ati.

Raiatea contains an enormous quantity of Tamanus. There are considerable quantities on the numerous small islets which surround that island. The trees are of very great size, and the quantity of nuts that can be gathered from them for the manufacture of the oil is prodigious. At the Marquesas Islands there are a few enormous trees of this kind, of which the wood is very red. The island of Atiou in Cook's archipelago, contains it in profusion; the wood has less colour. It is found also at New Caledonia, where it bears the name of *Pits.* The tree blossoms many times a year, and gives a large quantity of seed. It is planted at Java in avenues on account of the perfume of its flowers and the elegance of its foliage. It is in request for cabinet-making; beautiful furniture is made from it. When intended to be thus used it is important that it should be bought a long time previously; for if it be not very dry the articles of furniture warp and split in a short time.

From what has been said about the Tamanu, its value for industrial purposes can be appreciated, and how far it would be useful to multiply this plant which is diminished continually in number. We cannot lay too great a stress upon the facility of extraction of the new oil which is lost, and which might be a true source of riches for the country. When it becomes better known it will doubtless be in request for the arts, and will, with oil of Aleurites, so long neglected in these seas, lead to loads being brought back by ship, which have been up to this time so completely deprived of it.

WOOL AND WOOLLEN MANUFACTURE.

BY EDWARD T. STEVENS.

Although wool is but a modification of hair, yet under the microscope it exhibits well marked characteristics. Wool is defined by Professor Owen to be "a peculiar modification of hair characterised by fine transverse lines from 2,000 to 4,000 in the extent of an inch, indicative of a minutely imbricated scaly surface," upon this and upon its curved and twisted form depends its remarkable and valuable felting property.

Wool is not peculiar to the sheep, but it forms an under coat beneath the long hair in very many animals. Articles for clothing have been made from the wool of the musk ox (*Ovibos Moschatus*), from the wool of the skyn, or ibex, of Little Thibet, but in these and in other such instances they have been produced as objects of curiosity rather than for any commercial purpose. In the sheep, judicious management has in the course of years increased the growth of wool, and rendered the occurrence of hair unusual.

From the time of Abel downward, attention has been paid to the breeding of sheep, and particularly so by the races of men inhabiting the southern parts of Europe, a considerable portion of Southern Asia, and the Northern part of Africa, with a few remarkable exceptions, as in the case of the Medes, the Phœnicians, the Egyptians, and the inhabitants of some of the islands in the Mediterranean, The Egyptians, however, as early as the time of Moses had become sheep-breeders, and about 1,500 years later it is related that the sheep of Egypt throve so well upon the rich alluvial soil of the country that their owners were able to shear them twice in the year.

As an instance that the sheep of antiquity possessed a good fleece, examples may be cited from the Nineveh marbles. But the celebrated breed of sheep of antiquity was the *Milesian.* It was delicate in constitution, but it yielded a peculiarly fine wool, admirably adapted for manufacturing purposes.

This breed, I believe, first appears in history at and near Miletus, in Asia Minor, about 540 B.C.—it was from thence probably introduced into Greece about 490 B. C.—and shortly after that into Italy, where it became famous under the name of the *Tarentine Sheep.* By the Romans this breed was carried to their various colonies, and amongst others to Spain. In Spain material improvements were effected in this breed about the commencement of the Christian era,—the fleece, which before was spotted, and frequently dark coloured, was rendered a pure white, and a sounder constitution was given to the delicate Tarentine Sheep. This regenerated race became known as the *Merino Sheep*, and from them have descended those animals which from that time to the present have supplied our clothiers with their best quality of wool.

About 1765 the Merino sheep was introduced into Saxony, and after some years the Saxon fleece was found to be even superior to the Spanish. At the present time but little Spanish wool comes into the English market.

The Merino sheep was introduced into Australia, Tasmania, New Zealand, the Cape of Good Hope, America, and other countries, with marked success, about the commencement of the present century. In Australia, the Merino succeeded the Leicester and South Down, which in their turn had supplanted the gaunt, hairy sheep imported by the early colonists from Bengal.

The fibre of Merino wool exceeds in fineness that which any other breed of sheep produces, and North American Merino wool now surpasses most other wools for its felting properties. Samples have been obtained from American flocks, which contain 2,552 serrations to the inch, while the finest Saxony wool only contain about 2,400 serrations to the inch.

The increase of the sheep in some of our colonies is truly wonderful. In 1788 Australia had no sheep. In 1796 the entire stock of sheep in the colony of New South Wales was 1,531 ; in 1859 this number had increased to 7,581,762 ; whilst in 1861 the quantity of sheep's wool imported into the United Kingdom from our Australian colonies amounted to 68,084,202 lbs.

It must have struck every observer that man exercises a wonderful influence over the members of the animal kingdom, no less than over the members of the vegetable kingdom. Wherever attention has been paid to sheep-breeding, there a marked improvement has been manifested in the particular direction in which that improvement has been sought—whether in the carcass or in the fleece. This may account for the superiority of the breed of sheep around the ancient seats of civilisation.

Climate greatly affects the quality of wool—in very hot countries scarcely any wool is produced ; the animal is clothed with hair only. Variations in the temperature are very injurious—any sudden check of perspiration produces an irregularity in the staple of the wool (distinctly seen under the microscope), and this of course greatly diminishes the value of the fleece.

The sheep produces the finest quality of wool in two of the isothermal zones only—the warmer-temperate and the sub-tropical. Thus the most celebrated breeds of ancient times were the Coraxic, the Milesian, the Greek, the Tarentine, and the Spanish—all the spots upon which these sheep pastured are within the sub-tropical zone ; England, the United States, Buenos Ayres, the Cape of Good Hope, and South Australia are in the warmer-temperate zone ; whilst Tasmania and New Zealand are in the sub-tropical zone. It must, however, be remembered that elevation above the sea-level reduces the temperature, and that in ascending a mountain range, a few hours will take you from the tropical scenery

surrounding its base to the pines which fringe its snow-capped summit, passing through the familiar forms of the temperate zone on your way. For instance, the alpaca is a native of Peru, which is in the tropical zone, yet the alpaca succeeds well in Australia, which is in the sub-tropical ; but, then, this animal inhabits the elevated, and consequently cold, table lands of South America, and really finds the temperature of Australia warmer than its native habitat. The wool produced by the alpaca in Australia is stated to be superior to that produced in South America.

Before quitting this part of my subject, I must remind my readers that the sheep did not exist in America, in Australia, or in New Zealand when those countries were first visited by Europeans.

Naturalists and geologists draw some interesting conclusions from this fact. They state that the sheep is the most recent type of animal with which they are acquainted ; it is even a question whether it is found in a fossil state at all—it is peculiarly an animal belonging to the human period, and whether viewed as affording man food and clothing, or as imparting fertility to the soil he cultivates, it is scarcely possible to conceive an animal more valuable to him.

Stages of Manufacture.—Wools are divisible into, firstly, those best adapted for carding, and, secondly, those most fit for combing. These two varieties may be classed as (1) short and (2) long wools, although the length of the staple is by no means their only distinction.

(1) Short wool is used for the production of woollen cloth. It is first scoured ; next it is scribbled and carded ; it is then "slubbed ;" and, lastly, it is spun, or drawn finer, and twisted. None of these processes destroy the felting property of the wool.

(2) Long wool for the production of worsted goods is deprived of its felting property by the process of combing, which destroys the imbricated structure of the wool, and approximates it to the nature of smooth fibres, such as silk and cotton. In fact, the process by which combed long wool is made into worsted yarn is analogous to that employed for spinning cotton, and consists in doubling the slivers or slubbings over and over again, until the fibres are laid parallel to each other, after which it is roved and then spun.

As will be seen, the great distinction between woollen cloth and worsted goods is, that the wool in the former retains its felting property, whilst the wool in the latter has been deprived of it. Woollen cloth, as it leaves the loom, looks like a mere flannel, but after it has been submitted to the action of the fulling mill, it becomes compact and uniform—the fibres of the wool cohere, interlock, and conceal the threads beneath. Woollen cloth is then quite different in appearance from any article made from worsted, and which goods it must be remembered are never fulled.

Woollen cloths are either piece-dyed—that is, they are dyed after being woven, felted, and cut—or they are wool-dyed—that is, the scoured

wool is dyed before being spun—in this respect again differing from the worsted or cotton manufacture, for cotton and combed wool are never dyed before being spun.

In closing this very brief account of the stages of woollen manuacture, I may add that recently improvements have been made in the preparation of both woollen and worsted yarn. For instance, in the former, one machine now feeds the other; and scoured wool passes through every stage short of being spun, without it being necessary for a human hand to touch. The fulling stocks are likewise supplanted in many mills by a fulling machine, which does the work in a shorter time, and requires less soap.

In the preparation of worsted, the disagreeable and tedious process of hand-combing is superseded by a most exquisite machine, in which the movement of the wooden hands, as they draw the wool through the heated steel combs, and then place it upon a revolving wheel, is as nearly copied from a human action as it is possible.

Three forms under which wool appears in manufactured goods still remain to be described, these three are known as *mungo*, *shoddy*, and *extract;* the former is obtained by tearing up old woollen garments in a machine called the "Devil," and a most formidable looking machine it is with its array of iron teeth, the wheel upon which they bristle making about 600 revolutions in the minute. *Shoddy* is the result of a similar process exercised upon old worsted stockings, blankets, &c. No less than forty millions of pounds of mungo and shoddy are made annually in Yorkshire, the value of which is 800,000*l.* sterling, and yet this branch of manufacture only dates back about fifty years.

The third article reproduced from old material is known as *extract;* it consists of the wool obtained from goods having a cotton or linen warp or mixture, the cotton is destroyed by chemical agency leaving the wool intact. Neither *shoddy*, *mungo*, nor *extract* are used for making new fabrics alone, they are mixed with a varying per-centage of new wool.

Several qualities of wool are usually mixed together and form *blends* from which yarns are spun, both *fleece* wool—*i.e.* that shorn from the live sheep and *skin* wool—*i.e.* that obtained from the skins of such as are slaughtered are used, the per-centage of the latter and of inferior wools being reduced in spinning the better qualities of worsted yarn.

The threads which extend the long way of any woven material are called the *warp*, those which pass across the width of the article are the *weft.* In the process of weaving there is much greater strain upon the warp than upon the weft threads, and, therefore, the former are more twisted in spinning, and indeed are altogether stronger than the latter. A most striking instance of this difference is displayed in the manufacture of blankets—the warp threads used *are spun*, but the weft threads *are not spun*—they are not carried beyond the stage of slubbing,

consequently being scarcely twisted at all, the peculiar woolly surface can be given to the blanket by the subsequent processes.

Worsted yarn is largely employed as a weft with a warp of cotton (in some cases of silk) for the production of fancy dress goods ; these frequently have a check stripe, or figure of silk introduced upon the surface ; recently also mohair yarn (the hair of the Angora goat spun), has been employed as a weft for stuffs.

Felting.—Wool and hair can be felted, that is made into a dense and compact cloth without the intervention of the processes of spinning or weaving. So great is this tendency that in a flock bed, the carded wool of which it is made is constantly felting itself into lumps, and from time to time the bed requires to be taken to pieces and the wool has to be carded afresh. With some animals, which possess a fine and soft fur such as Skye terriers and Persian cats, every one must have observed that the hair felts itself into ugly masses.

This felting property of wool and certain kinds of hair is caused by a peculiarity in the structure which may be detected under the microscope, the filaments are notched or jagged at the edges—the teeth invariably pointing upwards, that is from the root to the point. A barley-ear will travel up your coat sleeve by the slight friction between it and your arm, because it possesses the same structure—but it will not move downward—so the fibres of wool moving in one direction only when subjected to gentle friction, mat together and form the kind of cloth called Felt. This felting property of wool is greatly assisted by the peculiar crimp in the fibre which it retains with great pertinacity, and if drawn out straight it immediately contracts again on being released, thus the forward motion of the fibre under friction is partly counteracted or converted into a circular or zig-zag movement, which is precisely that which most completely effects the matting together of the various fibres.

Wool in the yolk, that is with the natural grease adhering to it cannot be felted—the roughness of the fibre being in that case smoothed over by the oil—were it otherwise the wool would felt on the sheep's back and be comparatively useless.

As St. Blaise is the patron saint of wool-combers for no better reason, so far as I can ascertain, than because the unfortunate martyr before he was beheaded (A.D. 289) was tortured by having his flesh torn with iron combs ; so St. Clement is the patron saint of the felting brotherhood, for he is said to have placed carded wool in his sandals to protect his feet during a pilgrimage, and to have found at its close that the wool had felted itself into cloth ; thus rendering himself the reputed discoverer of felt.

The process of Felting, however, claims a far earlier origin, and was probably discovered before weaving. Felt was anciently in ordinary use among the Medes, the Persians, and the Bactrians. The Greeks were acquainted with its use as early as the age of Homer, and the Romans seem to have obtained their knowledge of felt from the Greeks.

Among the Romans the felted cap was regarded as an emblem of liberty and freedom—they were on that account worn at the Saturnalia. At the death of Nero, the common people to express their joy went about the city in felt caps. Not to multiply instances, when a Roman slave obtained his freedom he had his hair shaved, and wore instead of his hair the pileus or cap of undyed felt. Felt was used by the Romans as a lining for helmets, and both Greeks and Romans anticipated St. Clement in the use of felt for socks. Just as the Aztecs used thickly quilted cotton garments through which arrows could not penetrate, so the ancients employed garments of felt—for instance when the soldiers under Julius Cæsar were annoyed by Pompey's archers they made shirts and other coverings of felt, and put them on for their defence.

Felt was used for covering the wooden towers and military engines employed in warlike operations, to prevent their being destroyed by fire—and lastly, the Greeks and Romans covered their *molles oves* with felt. The Circassians still use large mantles of felt which they sleep under by night, and wear when required over their other dress by day. The postillions in Phrygia wear a cloak of white Camel's hair felt half an inch thick

Mr. Naish, of Wilton, has lately turned his attention to the production of felt with considerable success—he has recently patented in this country and in France, a most ingenious combination of partly woven and partly felted wool, to replace the ordinary felted saddle pads used by cavalry—this invention is receiving the warm support of our government. Mr. Naish also makes the wedge-shaped sheets of felted cloth used by piano-forte manufacturers—this material is exquisitely compact and fine.

The manufacture of felt is exceedingly simple—the wool is first carded—the loose sheet of wool from the carding engine is then placed in the felting machine, where it is subjected to gentle friction, a current of steam passing through it during the operation—under this friction the loose fibres felt together and form a compact cloth. This cloth is next taken to a bench sloping towards a boiler, where it is worked, I may almost call it *kneaded*, by hand, and from time to time the hot fluid in the boiler is poured over it ; after this the mere finishing operations such as pressing and cutting take place.

A pneumatic method of making felt exists. A quantity of flocculent wool is put into an air-tight chamber, these particles are kept floating equally, by a kind of winnowing wheel ; on one side of the chamber is a net-work of metal, communicating with another chamber, from which the air can be exhausted by means of an air-pump. When the communication between the two chambers are opened, the air rushes with great force to supply the partial vacuum in the exhausted chamber, carrying the floating wool against the network of metal, and so interlacing the fibres, that a felted cloth is at once produced.

The great objection to felt for many purposes is its want of elasticity,

—how far this may be obviated remains to be shown. As a surface for printing, felt answers in one respect most admirably—the substance is so firm that it does not shift its position, and the successive blocks deposit their colours with extreme regularity and precision; from the close texture of the material, however, the colours do not penetrate deeply into the substance of the cloth, and hence, if subjected to hard wear, the coloured portion is rubbed off, and the appearance of the article is spoilt. By a method yet to be perfected, felt may be made to supersede the thick cloths, (Kerseys), used for overcoats, and by this method a much finer face could be given to the material, than to the present woven goods.

Felt is largely employed as a non-conductor for covering steam-boilers, &c., and thus preventing loss of heat by radiation; it might, also, I imagine, be used with advantage *under* slate, in roofing houses, by which the upper rooms would be rendered cooler in summer, and warmer in winter.

Reviews.

A Plain and Easy Account of British Fungi. By M. C. Cooke. London: Robert Hardwicke.

Mr. Cooke has done the public good service in bringing forward this subject in a popular form, in a well-written and fully illustrated book of 160 pages. Not only have we twenty-four coloured lithograph plates after his own drawings, and numerous wood-cut illustrations, but a great deal of useful, general information, supplemented by so much scientific description as seems to be requisite to identify the different species of esculent fungi. There has been hitherto no complete list or useful guide to the cryptograms; as Mr. Cooke truly remarks:—"That part of our scientific literature which is devoted to them is remarkably scanty; and the young student, or the operative botanist, whose means are limited, enquires in vain for assistance in gaining even a slight knowledge of a very interesting section of our Flora." This little hand-book is just the work required for ordinary and general reference, not too scientific to place it beyond the reach of the many, and full of valuable and curious details as to the edible character of this widely-diffused family of plants, of which hundredweights, admirably adapted for food, are wasted, and yet furnishing to those seeking information a synopsis of classification based upon the researches of some of the most eminent mycologists of the age.

"As articles of food," Mr. Cooke justly remarks, "fungi are certainly deserving of more attention than they have hitherto received from the majority of our countrymen. People widely separated by

mountains, oceans, or vast tracts of desert, have been found employing certain species as delicacies. Not only in China, as evidenced by the examples of dried edible fungi sent to the International Exhibition of 1862, but also in the Himalayas and in the Rocky Mountains, as well as in Terra del Fuego, New Zealand, and Australia, to say nothing of European countries, certain species afford wholesome and nutritious food. Of their chemical composition we are very deficient in information. Few authentically-determined species have yet come under the cognizance of the chemist, and there is but little doubt that not only does the composition vary greatly in different species, as evidenced by their wholesome or unwholesome properties, but also in the same species under different conditions of climate and habitat, as well as during the different stages of its existence; a few hours being sufficient in some cases to convert a wholesome food into a very injurious, and, perhaps, dangerous substance."

It would be scarcely fair to the author to draw largely upon his pages, but we are tempted to give the following extract, concluding with a strong recommendation of the work to general perusal:

"Subject as all fungi are to speedy decomposition, which intimates the existence of new compounds as the result of the chemical action, it is always advisable that all mushrooms, whether of the ordinary kind or those less commonly included under that term, should be prepared for the table as soon as possible after being collected. Not only do they lose flavour by keeping, but they are then more likely to produce unpleasant results. It is also an excellent precaution to employ plenty of salt and spice in the preparation. Even poisonous fungi, and those of an active character, have been cooked with plenty of salt, and eaten with safety. It is only under such circumstances that we can imagine a fungus so injurious as *Amanita muscaria* being eaten at all, as it is said to be in Russia. The fact is equally well known, that in Russia fungi are thoroughly cooked and with plenty of salt. We have always exercised what we believed to be a prudent caution in experiment upon the esculent qualities of fungi, and would recommend others to follow our example. It is true that we have a number of species which are now known to be wholesome; but an amateur testing a species for the first time would do well to exercise caution in conducting the experiment, to have regard to the taste when raw, and to proceed still more cautiously if there is any evidence of acridity in the uncooked fungus."

Publications Received.—'Die Technischen Eigenschaften der Holger für Forst-und Baubeamte Technologen und Gewerbtreibende.' By Dr. H. Nordlinger. Stuttgart: Cotta'scher.—'Revue des Monde Colonial,' Nos. 13 and 14. (Paris).—'The Vineyards and Orchards of South Australia.' By Ebenezer Ward. Adelaide: Platts.—'Mauve and Magenta,' a Lecture delivered at the Royal Institution. By Dr. Hoffman.—The 'Technologiste,' Nos. 274 and 275 (Paris).—'The Journal of the Board of Arts and Manufactures, for Upper Canada.' July and August.—'Transactions of the New York State Agricultural Society, for 1861.'—'Fine Wool Sheep-Husbandry.' By Henry S. Randall, LL.D., of Cortland Village, New York.—'Pharmaceutical Journal' and 'Chemist and Druggist' for August.

THE TECHNOLOGIST.

ON THE AMARANTH WOOD AND THE COLOUR OF WOODS.

BY J. ARNAUDON.

Of the natural products and more especially those which form articles of commerce in the Colonies, there are several kinds of woods, the origin of which, though they were formerly made use of by the Ancients, is almost unknown to us. They are designated only by a local name, derived either from their appearance, from a peculiar property of application which they possess, or it may be from the locality which produces them. Such a nomenclature can only be very artificial. Not to enumerate a crowd of examples which the history of drugs would supply, I will confine myself to one alone. I mention this because it forms part of the subject of which I have undertaken to treat—viz., the study of woods. It is neither the strength, colour, nor other physical properties, that the apothecary and the druggist would first pay attention to. Their object would be rather, to collect into one group all those woods, the action of whose extractive principle and animal economy was identical or analogous. The chemist, in his turn, would class them by their immediate and predominating influence, or by that to which he attaches the most importance. The cabinetmaker again will group them according to the disposition of their colours and the direction of their fibres. The latter will sometimes also take into consideration the odour, which is an essential point in the eyes of the perfumer, whilst for the artillery-waggon builder and for the shipbuilder, the most valuable properties are those of tenacity and power of resistance to atmospheric effects.

When employed for fuel, woods are classed according to their calorific power, their manner of burning, the nature of the flame they produce,

&c. Those engaged in some trades, and especially that of powder-making, pay particular attention to the quality of charcoal made from woods. The dyer disregards all the above-named properties, even that of colour, if he cannot utilise it, and forms a class of dye-woods which he subdivides according to the colours which he can extract from them, and apply to his textiles.

It is not my intention to enter upon a discussion of the relative value of the methods used in classifying woods. I shall content myself with stating that of the different systems, I prefer that which collects into one group those which have the same immediate principle, as a marked property of a certain number of plants. I propose in this paper to distinguish the immediate principles which are the characteristics of violet-coloured woods. Those which are included in a group to which the general name of amaranth wood has been given, will form the first subject of our enquiry. A little consideration will show that many of those at present used only in cabinet-making, may also be enumerated amongst dye-woods. I have, moreover, some hope that these researches may in some small degree contribute to the solution of the great problem of the colours in living animals.

Under the name of violet-wood, wood of amaranth, &c., different kinds of wood for cabinet-making, are distinguished in commerce according to their deeper or lighter shades of red, purple, or violet. They are obtained principally from South America and the Antilles. The requirements of the cabinet-making trade are satisfied chiefly from Guiana and Brazil; but these woods also abound in New Granada, Mexico, and Paraguay. A great uncertainty still exists as to what species and botanic family the amaranth wood may belong, though probably the immediate colouring principle of the wood is, like that of indigo, spread over different families.

But to remove all this uncertainty, we must arrive at the seat of the commerce of these woods; we should be present where they are felled—in a word, we ought to be able to examine the plant which produces them. In making enquiries up to the present time, we have taken into consideration merely the general appearance and the violet colour of the wood of amaranth, but the exterior characteristics of vegetables, as of minerals, are very often liable to deceive us in the determination of their race or species. I have found woods classed, on account of their colour, among the amaranth woods, which, judging from the nature of their colouring matter, are of a very different species from those comprehended in that group. I will now enumerate and describe, in a few words, those whose nature I have examined and which I class among woods of amaranth.

The *Pao colorado.* A red wood of Bolivia and Brazil (this specimen came from the collection of Mr. Weddell). The wood is of a blood red colour, resembling red sandal wood, which is not merely superficial, but

penetrates equally through the whole mass. The fibres are thick and straight, the specific gravity is less than that of water, and it is easily worked and polished. There appears to be no connection between this wood and that which M. Guibourt in his 'Histoire des Drognes,' vol. iii, p. 322, describes as red wood of amaranth, and which, according to him, is a nissolia, tribe of the Dalbergii?

The *violet wood of Cayenne* is of a less intense, more yellowish red. The colour is more violet in the interior than the outside. The colour is not, however, equally distributed, but fibres of a rich red intertwine with others of a smaller size and orange hue; the grain of this wood is coarser, and its specific gravity greater than that of the *Pao colorado.* The specimen which I examined was procured from the Museum of Natural History, Paris, and formed part of the collection of woods, from Cayenne, sent over by M. Ducier. I also found some specimens in the museum of the ministry of the Colonies. This wood is used at Paris for the manufacture of furniture, and is said to be fitted for shipbuilding purposes, and M. Noyer bears witness as to its efficiency for the latter object. This gentleman is ex-deputy for Guiana, and has published a work entitled 'Des Forêts vierges de la Guyane,' in which he says, that the violet wood belongs to a tree very common to the forests of that country.

The *Mariwayana* or *purple heart*, called courabarel by the Arawaak in British Guiana. The specimen experimented upon, which I owe to the kindness of M. A Brogniart, was taken from the collection of Sir R. Schomburgk. According to the opinions of that learned man, and of the committee for British Guiana, in their Exhibition catalogue, this wood belongs to the *Copaifera pubiflora* and *bracteata*, Benth. This wood has a yellowish white, light and almost spongy exterior; the heart is of a purple colour, less vivid than that of the *Pao colorado*, a little richer at the outside than in the interior. Its fibres run equally, and it is easy to work. It is esteemed superior to all other wood for artillery carriages, and is used in the colony for windmill shafts, rollers, and machinery. If better known it would be likely to take the place of rosewood in the ornamental work of the cabinet-maker. The Indians of the Berbice construct of its bark canoes called "wood-skins," able to contain twenty-five persons.

The *Tananeo* or Tanane, of New Granada. The specimen I examined was brought from Carthagena in 1853, by M. Fontainier. According to information obtained from M. José Triana, a learned botanist of Santa Fe de Bogota, the *Tananoe* belongs to the family of Bignoniacea, and will be comprised in the genus Tecoma. This wood is heavier than the preceding, and its specific gravity is superior to that of water. Its fibres are slender, close, and irregularly disposed, one forming an angle with another. This causes the wood to be as difficult to work as the quebracho and sandal woods, and to show the same variations of reflection exhibited

by their surfaces when they have been once polished. The exterior colour of the wood is a red violet, or rather a colour less purple than that of the preceding woods. The colour in this case is merely superficial; towards the centre it becomes greyish, and approaches to the hue of walnut wood. When exposed to the air, the colour changes gradually to purple. This wood abounds in the forests of the Andes, and is especially plentiful in the original seats of vegetation, and not far from the great rivers which flow through that region. It is used for turnery, mill-wheels, sugar mills, and even for fuel.

The *Palo morado*, violet wood of Paraguay. The specimen from which the observations are drawn formed part of the collection of natural products sent from Paraguay to the Paris Universal Exhibition of 1855. I owe it to the kindness of M. Laplace, Consul-General of that Republic at Paris. The characteristics of this wood are very similar to the one just described ; sometimes it is not quite so heavy ; its fibres, although undulating, are not so much interlaced, and its superficial colour is of a more intense violet red. But as is the case with the "Tananeo," this colour does not extend far into the interior, the wood below that of the superficial layer is of a greyish white hue, and by exposure to the air soon becomes a light blue. The tree which produces this wood should be of a large size, judging from the specimen which I possess, the diameter of which is more than two decimetres. It appears to be rather plentiful on the banks of the Paraguay, the Parana, and the Uruguay.

Lastly, I have examined a wood which I have been told is much used for cabinet-making, and a piece of which I obtained from the saw-mills in the Faubourg St. Antoine. This wood comes from the Rio de la Plata, and is something between the "purple heart" and the "*Palo morado*." All these woods burn generally with a clear flame, and leave very little ash.

It will be remarked from the short descriptions just given, that all these woods contain a colouring matter, which is a red violet. There is this difference, however, between them, that in some it penetrates through the whole mass of wood, in others it is merely superficial, as if in the former the colouring matter were developed in the course of vegetation ; in the latter, circumstances prevent its being so produced. But everything necessary to produce this colour is present in the tissues, for it requires but a very short exposure to what is called atmospheric action, to bring colour in those woods that were previously free from it. After having proved that transformation, it becomes necessary to inquire to what physico-chemical agent the colouring matter in woods is owing, especially what causes the phenomenon just mentioned. With that design I have made on the wood of amaranth experiments of which the following are the results : With the wood and air rarefied or exhausted by the pneumatic machine, it was found that when kept in darkness for fifteen days no change took place, as was also the case when

the term was lengthened to a month. But when the wood was exposed to the light, at the end of fifteen days it became of a violet colour. The same results were obtained when hydrogen, carbonic acid, and steam were used—that is to say, darkness produced no effect, but light caused a violet colour to appear ; except that in the case where the last-named agent was employed, the violet was of a more intense hue, owing to the moisture. With air confined in an hermetically-sealed tube, it took a month to produce any change in the colour, when the wood was kept in darkness. At the end of that time it became a light brown. When exposed to the light at the end of fifteen days it became violet, like those described above, but the violet in this case was more red.

When common atmospheric air was used, the effect produced upon pieces kept severally in darkness for fifteen days and a month was the same—namely, to produce a light brown hue, but the light caused a brownish red violet to appear. The above experiments on the action of outward agents on the uncoloured woods of amaranth have been tried chiefly on the *palo morado* and the *tananeo.* The specimens operated upon were presented to the Chemical Society of Paris on the 18th August, 1857. The following conclusions may evidently be deduced from the above observations : 1. That light affects greatly the development of the colour of these woods. 2. That water is favourable to that phenomenon, probably, as has been said, in consequence of a physical action. 3. That atmospheric action is insufficient to develope the colouring matter, even with the assistance of water. But aided by light, it modifies the violet produced by the action of light alone, and gives it a tendency to become red. I think it expedient to glance at the results of analogous experiments made as to the influence of atmospheric action on the colour of the woods of *Quebracho* and *Taigu.* These experiments determined the fact, that although air and light were necessary to the development of the yellowish red colour peculiar to the Quebracho, yet air alone was sufficient to cause the appearance of a yellowish green tinge in the " Taigu." In the case of Amaranth, on the other hand, light seems to take an active part in the production of the purple colour of that wood. Although very limited, these results show us how necessary it is to multiply, repeat, and extend our experiments before laying down general assertions. I have been induced to make these researches from a natural love for these pursuits, and also from a desire for that applause accorded to those who discover any one of those laws which we consider as so many conquests gained by intelligence over matter, or beacons which light us over the vast untraversed space which surrounds us.

Like causes always produce like effects, but like effects may arise from different causes. We are tempted to take the weakness of our understanding for the simplicity of nature. We seek everywhere the original type of existence and unity of action. Nature, it is true, may sometimes follow the beaten track, but its methods and resources are

inexhaustible ; it arrives at the completion of its purposes by ways the most diverse, and it is to the agreement of these differences that the harmony of creation is owing.

The preceding experiments were made at the ordinary temperature which had no sensible influence on the result. I ascertained in the same manner that a temperature of 100°, even where sustained for some hours, developed no trace of colouring. Sometimes, however, when ascertaining the nature of the flame produced by the combustion of those woods in the open air, I have found that those portions of the wood closest to the point of ignition, before becoming carbonized, take a purple tinge. This colour forms a violet-coloured belt shading off on one side into black, and on the other turning gradually to grey, the original colour of the wood. From this phenomenon I deduced the discovery of the formation of the colouring matter by means of heat, which I now proceed to show : I submitted to the action of heat at about 100° small pieces of woods without colour, in different mediums, hydrogen gas, &c. ; at the same time, I raised the temperature to 130° without perceptible change, but when it reached between 140° and 150°, there showed itself in all a magnificent purple colour.

The observations I had made on these woods induced me to examine into the effects of different solvents on their extracts. Dissolved in warm water it is of a light brown yellow colour, and deposits when cold a slate-coloured sediment. I took four equal quantities, A. B. C. D., of that solution, in a perfectly limpid state, and kept them as follows : the quantity A. in vacuo and in darkness, B. in darkness only, C. exposed to the light, was separated into two portions, one open to the air, the other guarded from it ; lastly, the quantity D. was exposed to the action of heat. The following were the results :

A. No colour, no precipitate ; the liquor is still, after several years, as limpid as before the experiment.

B. No red colour, but a slaty grey sediment, the hue of which changed gradually to a brown.

C. After some minutes a light violet colour made its appearance on the side directly exposed to the light, but no perceptible difference between the portions respectively exposed to and protected from the air.

D. Boiling prolonged up to 100° developed no colour either in vacuo or not. These experiments demonstrate that air has some effect on the solution, but that light or heat up to 140° have none, and that light produces a purple colour in the matter dissolved in water.

Examination of the effects on these solutions of the wood of amaranth by the different reactive agents have shown me that the acids and the salt acids, even when very much diluted, produce at the end of a certain time an extraordinary phenomenon in the formation of the purple colouring matter. Whilst the action of light alone produces only a very small quantity of colouring matter. In the liquid exposed to the rays

of the sun, when aided by diluted acids, it developes in a few minutes a beautiful red colour. It takes some days to produce this phenomenon if the operation is performed in darkness. Again, having raised the solution of colourless matter to a temperature of 80° or 100°, and mingled with it a few drops of acid, a magnificent crimson colour speedily appeared, which deposited, when cold, a flaky sediment of the same colour. We have thus assured ourselves of the following facts :

1. That the different woods treated of all contain the same colourless matter, which can be changed into red under the influence of light, of heat, and of acids.

2. That these woods, together with all whose properties in their immediate principles present like characteristics, may be classed in the same group. This classification is a useful one in science, if not in botany, and chemistry will derive especial benefit from it.

3. That this colourless matter pre-existent in the wood must not be considered as possessing colour, until it has undergone a simple dis-oxydation. In other words, the connection between these matters is not the same as between blue indigo and disoxydised indigo.

4. That the purple matter can be changed to a colourless one by the action of reductive agents, but in that case it differs from the original colouring matter of the wood.

5. The most colouring matter is found in those woods which have the least colour in the interior.

6. Lastly, that the art of dyeing will be enriched with a new dye, at the same time that the cabinet-makers will find a profitable means of disposing of their waste.

AFRICAN PALMS.

BY DR. W. BALFOUR BAIKIE, R.N.

FAMILY CALAMACEÆ :—1. *Calamus sp.* possibly *secundiflorus*, at mouths of the Nun and Brass branches of the Kwóra or Niger. 2. *Calamus sp.* apparently different, near the banks of the Niger above the Delta. 3. *Raphia vinifera*, the Wine or Bamboo Palm. Constant along mouths and in deltas of rivers ; also inland in moist places in Ibo, Benín, Yóruba, Dahómi, &c., and still further from the sea in Korórofa, Adamáwa, Bautsi, Yúriya, Gbári, Núpe, Kámbari (as far as near to Yaúri), Bórgú, Gúrma, and along the road to Gónja. The greatest known distance from the sea is in the town of Kŭno, and more than 400 miles from the sea.

Uses: Dried pinnæ of leaves used for making ropes, bags, mats, hats, and for tying thatch. Long midrib of leaves, often upwards of thirty feet in length, used in construction of roofs of houses, for poling canoes, for making seats, couches, &c. The soft inside part of this used for making a large kind of mat used in travelling, and called by Hánsa and Núpe "Mémme." Sap used as a kind of Palm-wine, and much relished by the drunken savages of the coast. Fruit occasionally eaten (the mesocarp), but bitter, and in a few places, as in Kúpa, oil is made from it. The fibre of the midrib is also woven with cotton into a kind of cloth in Benín and Yóruba.

FAMILY BORASSACEÆ:—1. *Borassus æthiopum*, African Fan Palm. Nearest approach to sea along river Niger in Ibo, nearly 150 miles up. In Yóruba and some other places it is found very near the sea, abundantly scattered throughout Bonú, Núpe, Hánsa, Bórnu, scarce in Márgi, abundant along banks of river Binuwe in Korórofa, and Húmarrúwa in Adamáwa, and in the west in Borgú and Gúrma. Wherever it is plentiful elephants abound as they are very fond of its fruit.

Uses: Wood used in building. Fruit edible and pleasant, though with a slight terebinthine flavour. Pulp beaten with milk in Hánsa. Root-buds of seeds taken as an annual crop in October and November, and the spindle-shaped body roasted and eaten, and very palatable. Sap used as a kind of Palm wine. Mats and hats made of leaves. Of very slow growth, and the tallest of the African palms, trees of 70 or 80 feet being often met with. Remarkable for the great swelling of its trunk, generally about two-thirds from the ground.

2. *Hyphœne Thebaica*, Dum Palm. Most abundant in Góbir, Maúri, Kábbi, Azben, northern parts of Hánsa, Bórnu, Márgi; scattered in southern parts of Hánsa, Núpe, at Hórin, and in Borgú; the most southern station is at Lukója, where I have planted them. *Uses:* Fruit edible and very pleasant; kernels made into little perfume boxes at Kŭno; leaves used for mats and the best kind of hats at Sókoto and Gwándu.

3. *Geonoma sp.* Found by Barter growing near the Niger.

FAMILY CORYPHACEÆ.—1. *Phœnix dactylifera* (Date Palm).—In Azben, northern parts of Hánsa, Kábi, &c., but a few are found in South Hánsa, in Núpe, where they bear fruit, and at Hórin. They are now growing at Lukója. *Uses:* Fruit an important article of food.

2. *P. spinosa* (Spiny Date).—In delta of Nun and Brass, in upper parts of Yóruba, in Núpe, Kámbari, Záriva, Báutsi, Korórofa, and Adamáwa, generally with Oil Palms. *Uses:* Leaves extensively employed in Núpe and Záriya for making fine mats.

FAMILY COCOCEÆ.—1. *Elais Guineensis* (Oil Palm).—Most abundant in Ibo, Benín, Yóruba, and Bonú; also very abundant in Korórofa, and in countries behind Adamáwa. Plentiful in Báutsi, Zárya, Gbári, and Núpe. Plentiful along road to Góuja. Extends along Niger to near

Yaúri. Dr. Barth mentions a solitary specimen in Kabbi, vol. v., p. 316. Farthest from the sea in Záriya, or 300 miles, and in Adamâwa, or about 350 miles. Barter and I considered the Oil Palm to be Polyœcious.

Uses: Sap forms the sweetest kind of Palm wine. Fruit and kernel eaten. Mesocarp of fruit yields "Palm oil," kernel yields "Palm-nut oil" or "Nut oil." Young leaf-buds eaten occasionally. Leaves, when *Raphia* is not procurable, used for thatching. Wood employed in building.

At West Bay, in Prince's Island, we saw either a variety of the Oil Palm, or else another species of *Elais.* The nuts were larger, the foliage brighter green, and the trunk more robust, but we saw neither flowers nor ripe fruit.

2. *Cocos nucifera,* Coco-nut Palm. All along sea-coast, and in deltas of rivers near towns. Extends up the Niger to Idda, where it fruits at 120 miles from the sea. I have two young trees at Lúkoja, more than 150 miles from the nearest salt water.

Uses: Fruit eaten. Oil said to be made in small quantity in Kwíta, E. from Akkrá.

This list thus includes 10 species of Palms at present known in Sudán, a number not likely to be much increased.

Bida, Feb. 18, 1862.

A VISIT TO THE GREAT EXHIBITION.

BY THOS. D. ROCK.

No. II.

The Exhibition is a great popular educator, and there is no man, however exalted his intellect or deficient his knowledge, but must gain some advantage from a contemplation of the mind, and inspection of the matter, which together constitute that marvellous whole. In the labyrinthine courts and avenues of our great Technological Palace, we find the practical evidences of modern civilisation, the entire collection forming, as it were, a barometer of the world's progress in art and industry. The richness and variety of the productions of nature, which are exhibited, in conjunction with the most curious contrivances, and appliances of art, must afford immense pleasure, and satisfaction, to everyone possessed of an appreciation for either the useful or the beautiful. There is, indeed, food for every mind, but such as are warped by envy or buried in hypochondria. Every profession is enlightened, and each trade stimulated and encouraged, not to say benefited, by the

large field for comparison which the Exhibition affords; and the only regret which I feel in common with thousands, is that when the great show is ended there will be no complete or detailed catalogue of the contents for after-reference and consideration. Special catalogues there are without number, and some of them (especially those furnished by the colonies) are full of the most valuable information; but they lack uniformity in size and style; will not bind into one volume; and, moreover, some of them are not to be procured either for love or money. It seems left to the periodicals and general literature of the day to supply the deficiencies of a comprehensive catalogue, and I gladly avail myself of the pages of this Magazine to continue my notices of certain exhibits, specially attractive to its readers.

One of the most beautiful objects pertaining to the mineral kingdom, which I have observed in the Exhibition, is the onyx marble of Algeria, contributed by that French colony, in which department the visitor will find specimens of the material illustrating its peculiar properties, and attractions; whilst in the French Court itself there are several statues of bronze, robed in this same substance, not only proving the special suitability of the marble for such works of art, but also the skill of Gallic artists in the mystery of combination. In colour this marble so-called, is a yellowish brown, with the layers of colour somewhat merged, and yet sufficiently distinct to render the prefix *onyx* appropriate.

The efforts made of late years to develope the quarries of our own country have not been unsuccessful, nor are they likely to go unrewarded. Italy and Greece no longer monopolise the supply of marbles for our mantelpieces and furniture, but native stones are now commonly employed, and amongst them the Serpentine, from the Lizard, is not the least attractive. Sundry useful and ornamental articles from the Serpentine are contributed by the company which works the quarry, and they are worthy of inspection. But of all the building materials which Great Britain affords, there are none more durable and characteristic of the people than our granites; and it is pleasant to observe their growing employment in the construction of buildings, both public and private. Cornwall is the chief source of the serpentine marble, and is also celebrated for its granites, that from the Penryn district having been worked for many years; whilst the Cheesewring granite, more recently quarried, is gaining ground in public estimation, both on account of the excellence of its quality and the skill manifested in its preparation.

In 1851, a medal rewarded the enterprise of the Cheesewring Granite Co., and now again, in 1862, the jurors have been compelled to acknowledge the great merit, both of material and workmanship which belongs to the articles exhibited by them. Only a few weeks since I had an opportunity of inspecting the works of this Company, and a few particulars may serve to elucidate some of the difficulties connected with the

preparation of granite. About six miles distant from the town of Liskeard, in East Cornwall, in a north-easterly direction, the interesting quarries are situated, and named after a curious pile of granite-stones, crudely representing an ancient instrument for wringing or squeezing cheeses. The stones or blocks of granite are eight in number, and about this strange heap there has been much controversy, some contending for a natural origin, and others willing to regard it as a Druidical monument. A large amount of the granite is prepared upon the spot, and then transported by means of a railway to Port Looe, passing *en route* the steam works which have recently been erected at Moorswater for sawing the granite into slabs, and polishing, and also for the preparation of works of art in this excellent material. Granite offers such great resistance to the saw, that to cut through half an inch in depth in a day is fair work, and this is accomplished with smooth, flat pieces of iron set in a frame, with water constantly dripping into the cutting ; and as the frame holds four of the saws or knives, and is propelled by steam power, three slabs can be cut at the same moment. Sand or emery flour are likewise used to facilitate this difficult operation. After the slabs are cut they are transferred to another machine, where the polishing process is carried on ; but the entire operation is so tedious that slabs of granite of any size are necessarily expensive ; three very fine slabs, 7 feet × 3 feet, are to be seen amongst the articles exhibited by the Cheesewring Granite Co. in the south court of the eastern annexe, and as they are only about two inches thick, I should imagine some considerable demand is likely to spring up for such slabs, for table and cheffonier tops, &c.

In ancient times, granite was very commonly employed in the construction of large buildings and monuments, but then labour was so low in value, and so much at the command of the rulers, that any work, however stupendous, was accomplished by a simple multiplication of human power to the requisite amount. Modern nations, on the contrary, can neither quarry nor transport such immense blocks as the ancients employed, not because they possess less skill or determination, but simply on account of the greatly enhanced value of an individual's labour. Machinery will, to a certain extent, however, enable us to do more than the ancients could accomplish ; and, at a considerable outlay, the Cheesewring Granite Company, under the able superintendence of Mr. James Trathan, are prepared to gratify the public admiration for both picked and polished granite to any extent. Although a seeming paradox, leaden saws will cut through granite with much greater rapidity than iron, but cannot be employed, because this soft and yielding metal will not bear the tension necessary in tightening the saws. It is almost invidious to draw attention to the beautiful obelisk in Cheesewring granite, which occupies so prominent a position in the British nave.

In a case exhibited by Messrs. Johnston and Matthey, of Hatton-

garden, in the South Court of the Eastern Annexe, is to be found perhaps a larger amount of rare and useful information than in any other case of equal size in the entire Exhibition. The general public read of a great many metals in school-books, which, except upon occasions like the present, they never see ; and such an opportunity for ocularly learning some of the elementary bodies which compose material things, should not be neglected.

Platinum is a metal which many are accustomed to regard as more curious than useful ; but a glance at Messrs. Johnston and Matthey's case will soon convince the observer that platinum is eminently practical. In addition to native platinum, (and this metal is invariably found pure,) there is a massive ingot weighing no less than 218 lbs. of the value of 3840*l.* and this is in itself a great triumph in the metallurgy of platinum, considering how difficult it is to fuse. Platinum wire, foil, sheet, crucibles and capsules, cones for lightning conductors, telescopic tubes soldered with the same metal, and two fine retorts for distillation of acids, all demonstrate its growing importance. Besides this very complete platinum series, there is some pure metallic iridium, pure silicium, crystallised, metallic boron, palladium foil, and the ammonio-perchloride of palladium, gold in all its forms, and, lastly, some preparations of uranium, including a specimen of the oxide of that metal known to mineralogists as pitch-blende.

Those great sea monsters which, a few years since, served to terrify nervous sailors, and astonish the students of natural history, have to all appearance ceased to exist ; or, if the sea-weed theory be correct, then indeed, the great sea-serpent is to be found in the Exhibition of 1862, "hung, drawn, and quartered," and the several portions of his grisly frame applied to a great variety of useful purposes. It is well known to botanists that certain kinds of algæ exist of great size and length, as well as serpent-like in form, and when the rumours about sea serpents prevailed, they pointed out the great probability of the apparition being nothing more than a length of such weeds, floating upon the waters ; the appearance of life being imparted by the undulating motion of the waves. The genus *Laminaria* is peculiarly possessed of the animal characteristics above mentioned, and it is a species of this tribe, with its singular and highly novel application, which arrested my attention the other day at South Kensington. Adjoining the large cases devoted to the collection of products from the Bahamas, I espied what, to all appearance, was a case of English manufactures in horn ; and should have passed it over as a very ordinary exhibit but for a label with the words, *South African Algæ* upon it ; and after a few minutes' examination, I discovered, greatly to my surprise, that the entire contents of the case were manufactured from South African Algæ, of which a bunch in its crude condition was suspended in the corner.

The weed in question is scientifically termed *Laminaria buccinalis* or

Ecklonia buccinalis, and these names very fairly describe its peculiarities. The generic terms *Laminaria* and *Ecklonia* imply a laminated structure, and remarkable mobility, or power of flotation; whilst the specific distinctive *buccinalis*, or "horn-like," is a further embodiment of its physical formation. It is found in various parts of the world, but, according to the opinion of the importer, nowhere with its hornlike characteristics so prominently defined as on the coast of South Africa. It may be briefly described as a bunch of pipes or tubes of varying length, all attached at one point to a slender and solid stem, which springs from the bed of the ocean; the diameter of the tubes varies from half-an-inch to three inches or more, and increases from the point of junction with the stem, upwards, until each terminates in a sort of club-shaped headpiece or bulb, with a fringed border or leaf-like appendage. The substance of almost all seaweed consists of a sort of vegetable gelatine—which, on drying, both hardens and sensibly contracts; and in the case of the species now under notice, the contraction causes the outer cuticle or epidermis to corrugate, and it assumes the appearance of buckhorn.

The botanists who first examined and named this seaweed were evidently impressed with its external resemblance to horn, but their pursuit was science only in theory, whilst the enterprise and intelligent observation of Mr. T. G. Ghislin has bridged over the chasm which ordinarily exists between theory and practice, and he presents us with the same science applied usefully, proposing, as a new material for man's converting ingenuity, this very horn weed, under the special distinctive of "Laminite."

The most obvious application of Mr. Ghislin's Laminite, and which had been better termed Buccinite, is in the production of walking sticks, for which the tapering form, small diameter, and ornamental exterior, eminently fit it; and perhaps some reader may be picturing to himself the advantages of a seaweed walking stick, which might also subserve the purpose of a weather glass, and keep its owner well up in barometrical changes; but this singular property of marine vegetation is necessarily destroyed by Mr. Ghislin's patented process, which deprives the weed of its hygrometric virtues, and renders it at once eminently suited for an incalculably greater number of purposes. I have alluded to its exact physical resemblance to buckhorn—a similarity which is still further increased after it has undergone the treatment with acid, whereby it is made completely anhydrous and hard. For knife handles it is peculiarly adapted, being lighter, more beautifully and regularly nodulated, and much more pleasant to the touch than common buckhorn. It can likewise be bleached, and we shall therefore have the luxury of white buck-horn handles for carvers, &c. Handles for sticks, umbrellas, and whips, coverings for instrument cases, books, telescopes, and opera-glasses, powder-flasks from the bulbous terminations, and

many minor applications, all produced from the Laminite, are to be seen at the Exhibition, in Mr. Ghislin's case. The hollow form of the Laminaria also invites its application to articles of furniture, as a strong and tough material may be covered with it, and the furniture produced still be as light again, and equally ornamental, with the true horn furniture, of which a complete set is exhibited in the Austrian court.

Men of science and amateurs in this country, as well as the natives themselves of South Africa, have been in the habit of using the Laminaria after a very crude fashion. In this country the custom has been to use the solid stem only of *Laminaria digitata* as a rude handle for knives, the tang of the blade being inserted when the weed is fresh and soft, around which it clings more tenaciously as it hardens. The Kaffirs convert it into rough horns, and from this application the name of Trumpet weed has been given.

Even in its crude state, as imported, the *Laminaria buccinalis* may fairly be taken for stag-horn, and when piled in heaps, it can scarcely be distinguished without close inspection.

Mr. Ghislin will doubtless have to contend with much prejudice on the part of some, but he will, I trust, receive equal encouragement from others in the prosecution of this new industry, which is the more deserved as he stands alone as an exhibitor of Cape productions, and entirely unaided by the government of that colony.

If ever the consumption of this vegetable horn should be sufficiently extensive to make any considerable waste, even that waste may be made available for the production of iodine, inasmuch as this especial variety of Laminaria from the Cape, is supposed to contain more of that valuable medicine than any European alga.

At present, Mr. Ghislin derives his supplies of the Laminite exclusively from the weed that is cast on the shores of South Africa, by the violence of the waves, but when his trade is fairly established, he thinks of dragging in deep water for larger specimens.*

Silks in splendid variety are to be found in almost every court of the Exhibition, every nation, and colony, seeking to prove its anxiety to share in the production of a fibre of such inestimable value. Japan silks are displayed by Col. Howard Vyse, under the native names, his case containing no less than thirty different qualities—white, yellow, and green—and from his report I gather that this number is very far short of the total recognised in Japanese commerce. Other exhibitors of Japanese silks are Messrs. Remi, Schmidt, and Co., who have displayed, in addition to the more ordinary varieties of silk in the skein, a very interesting set of cocoon samples, those termed "*Yama-mahi*" being of a brilliant green colour, which is a decided novelty, but still

* Mr Ghislin's exhibit is not confined to the Laminaria, but embraces a great many other interesting products, which we have not space sufficient to mention.

further eclipsed by the cocoons of a wild worm called *Kourinoki*, which are of a brown colour and retinaceous, the chrysalis being quite exposed. As no sample of the silk accompanies this latter, the presumption is, that at present it has no commercial value. India, as may be imagined, is rich in silks, both raw and manufactured ; but there is no part of the collection of products from our Oriental Empire more attractive to a technologist than the case arranged by Mr. F. Moore, containing numerous specimens of coarse and wild silks produced by large species of moths. The Tusseh silk is pretty well known in the English market ; it is supplied by a large moth measuring five and a-half to six inches from wing to wing, the *Antheræa paphia* of Linnæus : The silk is strong and coarse, of a flax-brown colour. Another species of silk called "Moonga" is from *Antheræa Assama*, and approximates closely to the Tusseh ; but a third variety in this case, described as Mezan-kooree silk produced by *Antheræa Mezankooria*, is of a lighter colour than the Tusseh.*

Algiers also seems to possess capabilities for the successful cultivation of the silk-worm, and besides the ordinary species of Bombyx, I observed two new sorts of cocoons, labelled *Bombyx Cynthia* and *Bombyx arindia*, the former light brown, and the latter reddish brown in colour ; both being smaller in diameter and more elongated than the common kinds. Greece, Turkey, Italy, France, Sweden, and even Russia, also exhibit silks in greater or less profusion.†

Brazil was always celebrated for artificial flowers, and nature has certainly been very profuse in supplying that country with just the very materials suited to the preparation of such elegancies. The plumage of birds in the Brazils is peculiarly splendid, and the natives have long been in the habit of selecting the various, rich coloured, parts of such plumage, and grouping them into flowers without the aid of any paint or dye, the beautiful green feathers of parrots forming the foliage, clipped or cut into suitable shape. Another material worked up by the Brazilians into artificial flowers is fish-scales, and they are so delicate in appearance and durable, that they form ornaments of the most attractive character, and the more so when combined and contrasted with a few feathers. Shells also are occasionally converted into flowers, and their elegant forms frequently resemble the petals of flowers in a remarkable degree. Groups of flowers in all these materials are exhibited in the Brazilian court, and must be closely examined to be justly appreciated. But by far the greatest novelty in this respect is enclosed in a small case at the entrance to the court, being nothing less than a group of flowers made entirely from the wings and wing cases of insects, and to which the jurors have awarded a prize medal. The leaves are formed from the pale green and gauzy wings of some large fly. Flowers yellow, blue, and red, from the

* The moths producing these silks were fully described in a valuable paper by Mr. Moore, in the second volume of the TECHNOLOGIST, p. 410.—EDITOR.

† See the paper on the Alianthus silkworm, vol. ii. p. 336.

brilliant wings of butterflies and moths ; whilst the iridescent elytras of several kinds of beetle are commingled here and there to enhance the general effect. The colours of insects are really so splendid that this first step towards preserving and grouping them in an ornamental form must be hailed with satisfaction, and it constitutes likewise another addition to the very long list of waste products utilised, enumerated in the work recently written by our worthy Editor.

ON THE BANANA AND PLANTAIN.

BY PAUL MADINIER.

The banana (*Musa*, Lin., from its Arabic name, *mouz*) is a remarkable plant which forms a very striking object among the luxuriant vegetation of the tropics. Its elegant leaves, long and broad, majestically crown the stem, which, though it has the appearance of a tree, yet partakes much more of the nature of a grass. The banana* plant is reproduced by shoots cast in great numbers by its root, which is composed of long fibres, which are of a cylindrical shape. Its stalk owes its increase to the successive opening of leaves rolled in the form of a cone, all of which have the same centre. "It can be best compared," says Labat, "to a great roll of many leaves, the exterior ones of which serve as envelopes for those which they enclose." The banana (*Musa paradisiaca*, Lin.), or according to R. Brown, the *Musa sapientum*, is the species which may be considered as the origin of all the kinds of bananas, which are not merely simple varieties. Botanists distinguish more than a hundred, but we will enumerate only the principal of these.

Musa sapientum, Lin., or the wise men's banana, bears from eight to ten rows of fruit, and has ten or a dozen fruits in each row.

Musa sinensis, or *Cavendishii*, H.P., is the Chinese banana.

Musa coccinea, And., or the scarlet banana.

Musa rosea, Jacq., the banana with red spathes.

Musa rosacea, Pridham, is found in Hindostan, South America, and some of the Antilles.

Musa superba, which, as well as the *Musa ornata*, is commonly called the monkey banana, their fruit being only eaten by those animals.

Musa glauca, Roxb., distinguished by the rough appearance of all its parts.

Musa troglodytarum, Lin., is a kind very little cultivated, of which

* Our correspondent uses the name banana where we usually write plantain.

the fruit ought to be eaten green; it irritates the throat, is a diuretic, and gives a red tint to the urine.

Musa textilis, Nees., the abaca of Amboyna and the Philippines. We shall pay more attention to this species when we occupy ourselves with the textile properties of the different species of bananas. According to the most generally received opinion, the banana originally comes from Asia, the most easterly part of which continent has been called the region of *Musas.*

With regard to its geographical distributions, the banana plant is an object of cultivation over an immense zone, which extends, although not continuously, from 38° N. to almost 35° S. latitude. A mean temperature of from 18° to 20° Cent. suits it best, provided, however, the winters are not too rigorous. In Cuba the small species are cultivated in situations where the thermometer falls to 7° Cent., and even sometimes almost to zero. The *Musa sapientum* is satisfied with 18° of mean heat, but the *Musa paradisiaca* requires at least 20° to 22°, and that, too, only in the climates of equatorial regions. It produces the best crops in a temperature of 24° to 28°. It produces no fruit at 20°, nor at an altitude of more than 3,000 feet in the southern latitudes from 0 to 10°. (Humboldt.)

In the Cordilleras of New Granada the banana is productive at an altitude of nearly 6,000 feet, but according to Boussingault, the fruit never ripens at an elevation of 7,000 feet. Schomburgk has seen the *Musa* bearing fruit in British Guiana at 3,000 feet above the level of the sea; the fruit was magnificent, and would have borne comparison with the finest from Porto Rico. In Hindostan the *Musa* is cultivated at an elevation of 3,700 to 5,000 feet, at Kamaon and Gurhwal, in the middle of the Himalaya chain. Major Munro found a wild species at Khondah (Neilgherries), at nearly 7,000 feet above the level of the sea. Dr. Madden also discovered an indigenous *Musa* in the Himalaya range, to the north of the province of Assam.

Asia is, as we have seen, the native country of the banana plant; many varieties are also found in the Indian Archipelago, China, Cochin China, and Hindostan. On one side of the continent they are spread over Polynesia and, lately, in Australia; and on the other, in Persia, in Beloochistan, in Asia Minor, as far as Mount Taurus, and in Arabia. In Africa the banana has not the same importance as in Asia and America, except sometimes in Guinea and Madagascar, where many indigenous *Musas* are cultivated. It is not to be found on the eastern coast, but only in gardens higher up the country, in Abyssinia, Nubia, and Egypt. The northern part of Africa also possesses the plant, which has been carried thither by the victorious Arabs, but no great attention has ever been paid to it in that region. When we pass into Europe, we see the banana appear in some gardens in Greece, in Sicily, and especially in the souther provinces of Spain. It was introduced into the last-named country by the Moors, who cultivated it extensively in the neighbour-

hood of Armenia. The eastern parts of Portugal, whose marine and equal climate is singularly favourable to the naturalisation of tropical plants, enumerate even the *Musa sapientum* among their garden productions. The *Musa Cavendishii* and *Musa sinensis* have also been successfully introduced into that country. Equatorial America has immense resources in the banana; Mexico, Central America, Colombia, Upper and Lower Peru, Brazil, the Guianas, and the Antilles, more especially Haiti and Cuba, cultivate this plant on a vast scale. The banana exists still in Louisiana, Florida, and the other Southern States, where efforts have been made for some time to extend its cultivation.

A warm and rather moist soil is best suited to the propagation of the banana, that is to say, a soil in which there is a plentiful admixture of clay, as in the immense valleys of America and Asia, and in the grassy plains of Malaysia. It seems to like the neighbourhood of the sea, and an atmosphere impregnated with salt, for it is in that kind of situation that it appears to prosper best. In Egypt it grows well in the nitrous plains of Rosetta. In the majority of countries where the plantain is grown no manure is necessary, owing to the decomposition of the stems and the alluvial nature of the soil. But in other less favourable soils manure may be requisite to maintain a vigorous and constant production. A plantain walk is usually established a little before the rainy season commences. The soil is loosened to a foot or less, so as to receive the young plants. It is thoroughly cleansed of all weeds and stones which may be there. Then shoots or suckers are taken from the parent stem, of from two to three feet high, their bulbs being divided from the principal bulb by means of a mattock. These slips are cut about eight inches above the neck, and placed in a slanting direction in the prepared holes, and covered with earth, leaving in sight only about two inches. The length of time which elapses between the planting of the slips and their fruiting, depends on climate, situation, and variety of species. Thus, *Musa sapientum* fruits in the fifth and sixth month, whilst the *Musa paradisiaca* requires ten months, and sometimes even a longer time than that. Two varieties of the Banana fig, the *B. canaya* and *gengi*, produce their fruit in five months. In mountain districts, the fruit of the large banana ripens only at the end of eighteen or twenty months of cultivation; some varieties indeed, in such position, take three years to produce fruit. The leaves of the banana afford a useful shelter, and it is therefore of great service in tropical agriculture to young plants, which would otherwise suffer severely from the excessive heat of the sun. In British India and in Cuba, they use the coffee-plant, the young areca palms, the cocoa-nut, and the betel pepper for this purpose. In the West Indies and in South America, they plant rows of plantain and cocoa (*Theobroma*). In Java, the plantain is made a shade plant for vegetables. In British Guiana, the plantains are set six yards apart, and yams, maize, cocos or canes planted in the intervals.

The cultivation of the plantain is one of the easiest to undertake

and at the same time one of the most profitable; when once it has been planted, there is nothing more to do except realise the harvest, for the trifle of manure bestowed upon the soil two or three times a year is nothing in comparison with the labour necessary in Europe to bring crops to perfection. As these plants renew themselves with offshoots at different degrees of development, it follows that each plantation offers at the same time rows whose branches are laden with ripe fruit; rows whose branches are full of blossom, and young offsets, which give promise of future plenty. In the best situation, three rows are counted to each cluster of bananas, sometimes four; in general they obtain five rows in two years. "There is no culture that can be undertaken with more confidence than that of the banana," says M. Boussingault, "for if climatic influences should sometimes have a prejudicial effect on the crop, they could never completely destroy the prospect of a harvest, as the certainty would always remain of that to be obtained from the surviving and stronger growing offshoots or suckers. No other vegetable production presents similar advantages,—not even the maize, that crop so precious in the warmer regions of the globe.

"The enormous return from this plant assures to the inhabitants of tropical countries an abundant means of sustenance, and one that can be obtained at a low price, as it is acquired without difficulty. But in consequence of the facility with which—thanks to the banana—the means of sustenance can be obtained, as the proverb runs, 'Personne ne meurt de besoin en Amèrique,' the inhabitants have a great excuse for being indolent, which they are already inclined to be on account of the climate."

The large banana is gathered at three different stages; at a fourth part of its maturity, it is rather milky and contains much starch. If it is roasted in ashes, or boiled in water, it forms a very nourishing food, capable of being substituted for bread. If cut at three-fourths of its growth, it is less nourishing, but contains more sugar; in this state it is eaten as an accompaniment to meat. Lastly, when the fruit is perfectly ripe, all the starch is changed into gum or sugar; it then developes an acid principle: in this state it is eaten either raw or in the form of fritters. The banana fig, which is eaten when perfectly ripe, is rather a fruit than a nutritive substance; it is soft, full of sugar, melting, and possesses a powerful perfume, and forms a principal dish for dessert in tropical regions. In some countries they cut them while they are green, and hang them in their houses to ripen. To hasten their ripening in China they are covered with rice, or even with lime. The Chinese also eat the flowers of the banana plant pickled with vinegar.

A banana when plucked keeps fresh for a week, at the end of that time it becomes yellowish and more sugary; in twelve or fifteen days it begins to decompose and ferment. In America there are two methods of preserving the banana; the first, used when the fruit is green,

produces banana farina ; the other, when the fruit is completely ripe, produces the *platano pasado* of the Mexicans, or the *platano curado* of the province of Neyba, New Granada.

The farina of the banana is prepared in the most simple manner, by cutting the fruit into slices and drying it in the sun. The whole, coarsely ground and sifted, forms a farina highly esteemed in South America ; it is the "*conquin tay*" of the colonists of British Guiana. If machines are used in this process, care must be taken that no steel be brought into contact with the fruit, as the gallic acid acting on that metal would discolour the fruit. Implements of nickel, or even of bamboo, should therefore be employed in preference to steel. The quality of the farina depends chiefly on the rapidity with which the slices are dried ; therefore the best way is to roast them in an oven. Eight hours is the time this operation ordinarily takes. When the bananas are taken out they are hard, brittle, translucid, and of a horny appearance. When ground they furnish a white sweet meal, with a smell like fresh hay, or tea, which is very suitable for invalids or children, as it is palatable and also digestible. It is the most nourishing of all introduced into Europe, containing 5 per cent. of azotic matter. Bread can be made from it with the addition of a meal that contains more gluten, for when used alone it is rather stiff and uses badly. Macaroni made from it falls to pieces when put into warm water. This product will, no doubt, acquire great importance in foreign countries when its properties become more known, but the best way of procuring the farina fresh would be to import into Europe the dried slices and grind them. This is a speculation which could not fail to be successful in the colonies, seeing that a bunch of plantains stripped of the skins would give 60 per cent. pulp ; but in general only about 50 per cent. is reckoned on. The fresh pulp furnishes 40 per cent. of dry farina. The yield is usually about 3lbs. per bunch of a mean weight of 25lbs. An acre of plantains would give, on the average, 450 bunches, yielding 2,350lbs. of meal (nearly 6,000lbs. per hectare of two and a-half acres.) If this meal were to realise the price of arrowroot, 1s. a pound, we should obtain the large return of 300*l.* per hectare. But if we allow only 150*l.* per hectare, and deducting the expenses incurred, we have a very large and remunerative return for the culture.

There is another method of utilising this plant, made use of in South America, but it is defective in a great many points as compared with that already noticed. They grate the fruits, having first peeled them, squeeze the moisture out in a press, and bake them, like manioc, in an oven, and by this means obtain a coarse kind of flour. But the nutritive property of this is inferior to that prepared from the dried slices, for no doubt the pressure which extracts the moisture, expels also the soluble albumen, and other nutritious qualities.*

* See some remarks on plantain flour, vol. i., p. 195.—EDITOR.

The next method of preserving the banana very closely resembles that commonly used in the preparation of dried fruits, such as figs, prunes, &c. The time chosen is when the fruit is quite ripe, and its skin has become of a yellow colour, shaded with black. In Mexico, in the "terras calientes," and particularly in Méchoacan and Xalisco, bananas are dried simply by exposure to the atmosphere. According to Colonel Colquhoun, they proceed in this manner: The fruits are exposed to the sun in bundles, and when they begin to wrinkle they are peeled, the skin, if left on, causing a disagreeable flavour. They are kept for some time, until an efflorescence of sugar appears on their surface, as on dried figs and prunes. They are then pressed into masses of about twenty-five pounds each, and wrapped with leaves of the banana plant, or else kept in boxes. Some specimens of bananas preserved in this manner, which had been kept for sixteen years, were shown at the Great Exhibition of 1851. These samples were in a very good state of preservation, although a little changed on the outside. Of course, these methods can only be adopted in countries where the climate is very dry. In others, recourse must be had to artificial means, which are unfortunately more costly. A description of some of these may be seen at full length in the catalogue of British Guiana, in the Universal Exhibition of 1855 at Paris. That interesting little pamphlet states that there are three distinct ways in which the ripe banana may be dried: Firstly, exposing the fruit to an atmosphere of sulphuric acid gas before the dessication is begun. Secondly, boiling rapidly very ripe fruit in water which contains sulphate of lime. Thirdly, by boiling it in syrup. By either of these, the albumen and caseine of the fruit coagulates, and the tendency of the banana to decay and ferment is stopped at a period favourable for dessication. Experience shows that the second method is the best to employ; in moist climates, without this precaution, the fruit, instead of drying, becomes damp. To expose the fruit to the sun's rays after boiling, trays of bamboo, as in Mexico, or of anything which permits the free action of the air and light on the fruits, may be used. If rain falls, they are dried in a furnace, which must be left open, otherwise the bananas bake instead of drying. The heat, also, must be moderate. Bananas, when dry, are pressed and packed in boxes.

This fruit thus prepared is a very good article of food, resembling figs, and its abundance and easy preparation would render it a cheap one. Many spirituous drinks, as well as vinegar, are made from the banana. Banana wine is obtained in Cayenne by pressing the fruit through a sieve, and then making it into small cakes, which are dried in the sun or on hot cinders. When wanted for use they are dissolved in water. Another way is to boil the fruit, and passing them through a sieve to separate the skin, they are melted and bruised in the same water.

From bananas soaked in brandy a liqueur is prepared, which preserves the taste of the fruit; other liqueurs are also obtained by the process of fermentation. Vinegar is made in British Guiana by suspend-

ing in a cask the fruit in baskets, where they liquefy, and their juice flows into the casks and soon becomes vinegar. No water is added.

Bananas baked in their skin, then peeled and boiled in water, are very good for coughs and inflammation of the lungs. The Malays use a variety of this fruit, which possesses considerable tonic properties, to arrest diarrhœa. The bananas are generally very astringent when half ripe and eaten raw, on account of the gallic acid they contain. In the Antilles they obtain from the ashes of the plant burnt in a dry state large quantities of potash, which they use to wash linen.

We will now glance at some of the uses of the stalk. The stem is filled with an abundant pith, enveloped in fibrous cases, and containing much starch. This boiled might serve as human food ; animals like it very much. Cattle, and especially the pig, relish this kind of sustenance.

A curious fact connected with the banana plant is that the sap is so abundant that it escapes whenever an incision is made into the outer coating. The sap has been examined and analysed by Fourcroy, Vanquelin, and Boussingault. According to the last writer it contains tannin, gallic acid, acetic acid, chloride of sodium, salts of lime, potass, and aluminum. If cotton, linen, or flax are dipped into it whilst perfectly fresh, it deposits a colouring matter of a yellowish grey, which adheres to the fibre. When exposed to the air it becomes agitated, and precipitates floccules of a dirty rose colour. This phenomenon is produced by the oxygen contained in the atmosphere. The banana plant is used in Anam, or Cochin China, and the Philippines, in the process of refining sugar. Masses of raw sugar are placed in layers one inch thick and ten wide, which are covered by a layer of stalk of this plant, cut into small pieces. According to Grosie, however, it is the ashes of the *Musa paradisiaca*, which they use in this process. The aqueous liquor that flows from these stalks filtrates through the sugar, carrying away with it all impurities, and leaving the sugar in a crystallized state. This sap is also of great value as a mordant in dyeing ; the Malays by means of it fix the green colour of the *Dolichos lablab.* When employed alone, the sap of the cochon banana communicates to fabrics a purple tint, which is durable. The sap has also medicinal properties. It is used in St. Domingo to stop internal and external hæmorrhage, like tannin is in other countries ; and at the Philippines, to heal a species of venereal disease very common in the province of Bisayas.

We now come to consider those properties of the banana plant which are especially interesting at the present day, and to notice the textile purposes its stalk is applicable to. The species considered the best for such purposes is the *abaca* of the Philippines. There is some dispute as to the scientific name of the variety of the *Musa* from which the so-called " Manila hemp" of the English, and the "abaca" of the Portuguese and Spaniards, is procured. Some name it the *Musa sylvestris*, some *Musa troglodytarum textoria*, and others *Musa textilis* and *Musa*

abaca. The difference that exists between the fibres of the different species of banana plants, appears to be attributable to the fact that some fibres of wild plants, and especially those of the banana, are more or less modified by cultivation. The *abaca* is found in the volcanic islands of the Philippines, and in the neighbouring Archipelago ; still it is principally in the pueblos of Donsol, Sorsogon, Tabaco, Cameli, and Quipa, that the cultivation is principally carried on, and from whence the best material is obtained. The only difference between the *abaca* and other plants of the banana tribe, is the rich dark green hue that pervades every part of the former. The *abaca* has very little care bestowed on its cultivation, as it is grown only for its stalks, and it is an advantage rather than otherwise that its fibres should retain their natural coarseness and tenacity. Nor does it require so rich a soil as the edible varieties ; it is usually planted on the slopes of mountains, where the land has been newly broken up. The ground is carefully and frequently cleared of all obnoxious weeds during the growth of the young plant, and the stalk is cut when the fruits first make their appearance. At the end of the first crop, they have monthly, good suckers springing up, and that, too, during the whole time that the plantation lasts, which is from five to seven years. This duration of course varies with the nature of the soil, the fertilizing properties of which this crop exhausts very rapidly, especially as no manure is applied. The textile material is obtained in the following manner :— The stems are cut down and stripped of their leaves. It is next divided into long strips of two fingers in breadth, then passed between a thick plank, placed in a horizontal position, with a knife resting edgewise The material is then drawn through with one hand, whilst the other presses heavily on the back of the knife, and in this manner the pulpy matter is scraped and cleared off, leaving the textile fibres bare. These are put to dry in the sun, care being taken to protect them from rain and moisture. They are then beaten lightly with sticks, again exposed to the sun, and, lastly, the filaments are separated according to their degrees of fineness. In this manner three sorts of fibre, of varying quality, are obtained, the 1st, called *bandala*, from the outer sheaths of the stem, which is the strongest and coarsest, and from which ropes, &c., are made. The 2nd, known by the name of *Jupis*, which is the finest, is procured from the inner layers, whilst the 3rd, the *tupoz* comes from the intermediate layers of the tissue, and from this last fabrics and gauzes are manufactured. Two men employed at this work, one in separating the outer coats, the other using the knife, can prepare from 24 to 26 lbs. avoirdupois a-day. 50 feet length of banana will furnish from 24 to 26 lbs. of abaca fibre, or 143 to 145 lbs. to every 2½ acres. It is cut at least 10 times a year, which gives a mean return of 1,760 lbs. of bruised abaca, worth from 5*l.* to 10*l.* If the process be properly conducted, at least a lb. of thread, or taking the produce of 2¼ acres for a whole year, 3,520 lbs. of abaca will be obtained, worth at Manila about 20*l.* The abaca intended for weaving, is bruised in a

mortar, such as they use to pound rice in, and thus reduced into a kind of ball, about the size of a child's head. This operation has the effect of rendering the threads more flexible and resistant. These threads having been joined together by women or children, are woven after the manner of cotton, and the texture is immersed in water with a little shell lime, for a day and a night. Afterwards they are cleared in fresh water and left to dry. If mixed with silk or cotton, a beautiful texture is produced, very fine and very valuable, and applicable to a variety of purposes.

Roping and cordage, made from abaca, is employed in the mercantile marine of India, and in the navy of the United States, and is well known under the name of white rope or Manila rope.

THE USES OF THE BAMBOO.

BY S. WELLS WILLIAMS, L.L.D.

The bamboo (*Bambusa arudinacea*),* which grows everywhere within the tropics, is one of the tree-like branching grasses which varies in growth and luxuriance, according to climate and situation, but occasionally attains the height of fifty or sixty feet. It shoots up with great rapidity. Most of the species of bamboo have hollow stems, which often attain a diameter of many inches. Gardner mentions a large species (*B. Tagoara*) having a stem of eighteen inches in circumference, and attaining a height of fifty to 100 feet. The touch-paper of the Chinese is made from a variety of bamboo, by beating the young shoots flat, steeping them in a lime pit for a month, and then washing and drying. A curious under-shirt made of split bamboo, very ingeniously plaited, intended for wear in warm weather, was exhibited in the Chinese Department of the Great Exhibition in 1851. Of it are made implements for weaving, the posts and frames of the roofs of huts, scaffoldings for buildings, portable stages for natives' processions, raised floors for granaries, stakes for nets in rivers, rafts, masts, yards oars, spars, and decks of boats. It is used for building bridges across creeks, for fences, as a lever for raising water for irrigation, and as flagpoles. Several agricultural implements are made of it, as are also hackeries or carts, doolees or litters, and biers ; the shafts of javelins or spears, bows and arrows, clubs, and fishing rods. A joint of bamboo serves as a holder for pens, small instruments, and tools. It is used as a case in which things of little bulk are sent to a distance ; the eggs

* These have already been alluded to by Mr. Cruger, vol. ii., p. 421.—EDITOR.

of silkworms were brought in a bamboo cane from China to Constantinople, in the time of Justinian. A joint of bamboo answers the purpose of a bottle ; and a section of it is a measure for liquids, rice, &c., in bazaars. It is also used as a pot for slips or seeds of plants, and when matured is easily split and separated, when required to be put into the earth. A piece of it is used as a blow-pipe, and as a tube in a distilling apparatus. A small bit of it, split at one end, serves as tongs to take up burning charcoal ; and a thin slip of it is sharp enough to be used as a knife in shelling betel-nuts, &c. Its surface is so hard, that it serves the purpose of a whetstone, upon which the ryots sharpen their bill-hooks, sickles, &c. Its growth is very rapid ; Dr. John Davy has known a bamboo to shoot fourteen inches in twenty-four hours in Ceylon.

The mowchok, the most beautiful bamboo in the world, is peculiar to China. It attains to its full height of from sixty to eighty feet in a few months ; and Mr. Fortune, who was in the habit of measuring its daily growth in the Chinese woods, found that it shot up from two to two and a-half feet in twenty-four hours. Unlike the bushy bamboo of India, with its large joints and branches throughout its stem, the mow-chok usually presents a bare surface for thirty feet from the ground. The freedom from knots and the fineness of its structure render the wood of great importance in the arts. Indeed, the number of uses to which this plant can be put is surprising. When it first shoots from the soil it is cut like asparagus and eaten as a vegetable Mr. Fortune found it excellent, and during the time it was in season had it for dinner every day. The interior portion of the stem is beaten into pulp for paper, the exterior is slit into strips for the weaving of ropes, baskets, and sieves. Ornamental inlaid work is constructed from it, and the entire pole, from its combined lightness and strength, answers every purpose for which poles can be employed. Mr. Fortune has done the service of introducing this invaluable variety into India, and it is now growing on the slopes of the Himalaya.

The Dyaks of Borneo boil their food in bamboo cut into lengths of about two or three feet. These are placed over the fire in such a position that the joint of the bamboo does not come into contact with it, but rests upon the ground beyond it, the fire being placed under the green and harder part of the cane, which from its silicious coating resists the effects of the heat and flame, until the provisions are sufficiently prepared. A bundle of leaves placed in the mouth of the bamboo answers the purposes of the lid of an ordinary cooking pot.

The uses of the bamboo among the "Celestials" are so numerous as to entitle this grass to be called the national plant of the Chinese. It grows naturally throughout the country, nearly to the latitude of Pekin, diminishing in size and strength as one goes northward. The varieties induced during the long period of its culture are numerous ; and a native writer on its propagation observes, at the outset of his treatise,

that he could not undertake so much as to name them all, and would, therefore, confine himself to a consideration of sixty-three of the principal. Some of them are like trees, forty or fifty feet high, with culms eight inches in diameter near the root; others resemble pipe stems through their length, graceful and slender as a magician's wand; while one kind presents a black, and another a bright yellow skin. It is cultivated in or near villages, for its shade and beauty, and a grove furnishes culms from year to year, of various sizes.

No plant presents so rural and oriental an aspect to a villa or hamlet as the clumps of this graceful and stately grass, the many plumes of which, swaying in every breeze, form an object of great beauty, well befitting so useful a plant. The bamboo may well be called useful, for it is applied by the Chinese to such a vast variety of purposes, that they are puzzled to get along without it when they emigrate where it does not grow.

It is reared from suckers generally, but it is necessary after a time to renew the plants from the seed, as it dies down to the root, like all other grasses, after it flowers. Native authors say that the size of the stalk can be increased by cutting off the shoots and filling the topmost joint of the main one with sulphur for three years, after which the shoots will spring forth with great vigour.

It is rather difficult to transplant it; but when once rooted, the suckers annually extend till a clump of a hundred stalks is often produced. The tender but tasteless shoots are cut for food, either boiled, pickled, or comfited, as the customer wishes; but not the "tender buds and flowers cut like asparagus," as one writer on China describes. The seeds, too, furnish a farina suitable for cakes, and the Chinese have a proverb that the bamboo flowers chiefly in the years of famine.

The gnarled roots are carved into fantastic images of men, birds, monkeys, or monstrous perversions of animated nature; cut into lantern handles or canes, known in commerce as whangees; or turned by lathe into oval sticks for worshippers to divine whether the gods will hear or refuse their petitions. The tapering culms are used for all purposes that poles can be applied to—in carrying, supporting, propelling, and measuring—by the porter, the carpenter, and the boatman—in all cases where strength, lightness, and length are requisites. The joists of houses and the ribs of sails, the shafts of spears and the wattles of hurdles, the tubes of aqueducts and the rafters of roofs, the handles of umbrellas, and the ribs of fans, are all constructed of bamboo.

The leaves are sewn upon cords in layers, to make rain-cloaks; swept into heaps for manure, matted into thatch, and used as wrappers in cooking rice dumplings. Cut into splints, of various kinds and sizes, the wood is worked into baskets and trays of every form and fancy, twisted into cables, plaited into awnings over boats, houses, and streets and woven into mats for the scenery of the theatre, the roofs of houses,

and the casing of goods. The shavings even are picked into oakum, and mixed with those of rattan, to be stuffed into mattresses.

The bamboo furnishes material for the bed and the couch, chop-sticks to use in eating, pipes for smoking, and flutes to aid in singing ; curtains to hang in the doorway, and brooms to sweep around it ; besides screens, stools, coops, stands, sofas, and other articles of convenience and luxury in the house, too numerous and trifling to mention. The mattress to lie on, the chair to sit upon, the table to dine from, food to eat, and fuel to cook it with, are alike derived from it. The ferule to govern the scholar, and the book he studies, both originate here. The tapering tubes of the native organ, and the dreaded instrument of the lictor ; the skewer to pin the hair, and the hat to screen the head ; the paper to write on, the pencil to write with, and the cup to hold the pencils ; the rule to measure lengths, the cup to gauge quantities, and the bucket to draw water ; the bellows to blow the fire, and the tube to hold the match ; the bird-cage and the crab-net, the life-preserver and the children's buoy, the fish-pole and sumpitan, the water-wheel and cave trough, sedan, wheelbarrow and hand-cart, with scores of other machines and utensils, are one and all furnished by this magnificent grass, the graceful beauty of which when growing is comparable to its varied usefulness when cut down.

China could hardly be governed without the constant application of the bamboo, nor the people carry on their daily pursuits without it. The very phrase, to "bamboo a man," has almost become incorporated into our language, to express the design and means of Chinese government. It serves to embellish the garden of the patrician, and shade the hamlet of the peasant. It composes the hedge which separates their grounds, and assists in constructing the tools to work their lands, and feeds the cattle which labour on them. The boatman, dyer, and weaver find its slender poles indispensable in their trade, while there is nothing the artists paint so well on wares and embroideries. The tabashir found in the internodes has its uses in native pharmacy, and the silicious cuticle furnishes the engraver a good surface for carving and polishing.

NOTES ON BORNEO WOODS.

Mr. Spencer St. John supplies the following notes of the uses and qualities of some of the woods from Sarawak, which he has sent to the International Exhibition :—

The red Thrangi or Krangi Min wood is, perhaps, not so abundant as the other sorts, but still can be obtained if required. The growth is about 30 to 40 feet to the branches, and the diameter 20 to 30 inches.

It is, perhaps, the heaviest, hardiest, and strongest tree that grows in Sarawak. It is not much used by the Malayans except for their vessels, and occasionally rudders, butts, &c. It is a good durable wood, capable of standing a great strain and chafe, and would make excellent stem and stern posts, windlass pieces, rudder pieces, butts, in fact, anything where great strength is required, and where there is much friction. It takes fastenings well.

The wood of the Pingou tree is much used by the Malays, though of a greater specific gravity than the camphor wood. It is a hard close-grained wood, full of a resinous or oily substance, insomuch that a tree just felled or exposed to the sun will be covered with gum, just as if it had received two or three coats of varnish. It bends very easily when treated by fire or steam, and would make good stringers, lower beams kelsons, coverings for hatches, butts, windlass pieces, and other purposes requiring strength. It is very durable for plankings. The tree attains to 70 or 80 feet by 7 or 8 feet in girth. It grows in quantities on the hills of Santubong, Marang Sundu, and Sungony Water.

Camphor wood (*Drybolanops Camphora*). This tree also grows in abundance in the mountains of Santubong, Marang Sundu, and Sungony Water. Its girth reaches 17 or 18 feet, and the stem often attains the height of 90 or 100 feet to the first branches. The wood contains a quantity of oil, is tough, durable, and owing to its strong scent, withstands the attacks of the kepang, the worm so destructive in these seas. It is much valued by the natives for ship-building, for which it is admirably adapted, either for planks, beams, keels, stringers, or timbers. It takes fastenings well from being oily. Iron has been found not so liable to rust in it.

The Menhubang-Pinang tree is one of the family of trees producing the Vegetable Tallow seed, or Buah Menhubang, and, like the Camphor wood, abounds in the mountains of Santubong, and is, perhaps, equal in growth to that tree, or even higher. On account of its hardness it is not much used by natives for building, but largely for other purposes, such as pillars of houses, piles, &c. It is very durable. It has a great deal of white dammar or resin in it, and is a tough, hard wood, well suited for keels, kelsons, lower beams, butts, capstans, windlasses, stringers, rails, combings, &c. The Chinese know it by the name of *Choco*, and prefer it to any other for the masts of their junks.

SUBSTITUTES FOR COTTON AND NEW FIBRES.

At a time when our principal staple manufacture is paralysed from a lack of the raw material, a discovery which would tend in the slightest degree to relieve this serious state of things would be a boon difficult to over-estimate. The properties of cotton are so marked, and so different from those of any other known fibrous material, that when it is stated that a substitute has been found, that the material is produced to a great extent in this country, and may be furnished to any greater extent that might be required, at trifling expense, without interfering with ordinary agricultural operations—and that in colour, fineness, strength, and length of staple, it is equal to the finest Sea Island cotton—one is inclined to believe that the wishes of some over sanguine inventor have been expressed, and not that a reliable discovery has been made. The announcement is so startling, that we may well be excused, pending more exact information, for fearing that this "wonderful discovery" may share the fate of hundreds of others which, under the rigorous tests of quality, amount of available supply, and cost of production, have failed to realise the anticipations formed of them, or even to establish a claim to commercial value. However this may be, there can be no doubt of the good faith of those who have raised intense public interest by the announcement of a discovery which, if realised, would seem, in the present crisis, to be little less than providential. A legal firm in the City of the highest respectability stated, in the first instance, that a client of theirs had made a discovery by which the cotton manufacturers might be supplied, without any delay, to an extent equivalent, at least, to a million bales of cotton, with a raw material so closely resembling that article that it might be spun and woven by the existing machinery ; that the processes required in the preparation for the manufacturer were of the most simple and inexpensive character ; and that he was prepared to submit his plans to any nobleman or gentleman of scientific attainments upon whose judgment the public might rely for an unbiassed report.

The interest awakened by the announcement led to communications being addressed to Messrs. Phillips and Son, of Abchurch lane, the firm in question, from manufacturers, cotton dealers, and others immediately interested in the vital question of cotton supply. Eventually small samples of the material were submitted to Mr. John Hardy Wrigley, of Liverpool, a retired cotton-broker, who expressed the opinion that in colour, length, and fineness it was all that could be desired. As to the important quality of strength, he could only speak from the report of the discoverer, who stated that it was as strong as, or stronger, than cotton, and could be produced as low in price. Since then specimens have been submitted to the Manchester Chamber of Commerce, and to various large firms in that city. Mr. Fleming, the secretary of the Chamber of Commerce, was permitted to do that which Mr. Wrigley had not done—to test in every possible way the strength of the fibre. As regards the

colour, fineness, and length of staple, Mr. Fleming at once confirmed the judgment of Mr. Wrigley, while its strength proved so satisfactory that he lost no time in calling the attention of the leading public men and manufacturers to the matter. All these gentlemen were unanimous in their conclusion as to the value of the material. The general opinion being satisfactory, the Chamber of Commerce at once took the subject in hand, with the view of forming a committee to investigate and report upon the practicability of working up the material in the same way as cotton, and upon its value and availability for the purpose.

On the 20th of September that committee met, and the discoverer of the new fibre, Mr. Henry Harben, showed small specimens in different states of preparation, and stated that they were the produce of the marine plant, *Zostera marina*, or common grass wrack. Carefully conducted experiment must determine whether the fibre which the *Zostera marina* yields can be produced as cheaply as to make it of commercial value. Both of the suitability of the material, and of the extent of the supply we have very grave doubts. Subsequently to the experiments of Claussen, a patent was taken out by Mr. Thomas Jackson, for preparing paper fibre directly from the flax strands, or from the refuse of the flax manufacture. Though proceeding by a somewhat different method, Mr. Jackson succeeded in producing a material which the papermakers declared to be too good to make anything but bank-notes. When dried and carded, this material also closely resembled cotton, and, but for the low price of the American staple, would undoubtedly have come into use.

The cottony appearance of flax and hemp when half rotten by over retting in the process of steeping, long since led to the idea that those fibres might be made to resemble cotton in the fineness of its filaments, and thus be adapted to cotton machinery. A crude attempt was made to effect this object in Sweden as far back as 1747. Thirty years later, Lady Moira succeeded in producing a substance from flax which closely resembled cotton in appearance, and which possessed many of its properties. Similar attempts were made at different times in France and Germany, but not leading to any satisfactory commercial result. Those who remember the wonders of the Exhibition of 1851 will possibly call to mind a display of textile fabrics exhibited by Chevalier Claussen, made from flax, which had been submitted to this cottonising process. Some material closely resembling coarse cotton cloth was exhibited, which had been woven in cotton-machinery from yarn spun from this flax-cotton. Imperfect as these specimens were, they established the practicability of manufacturing the artificial cotton. Companies in England, Scotland, France, Belgium, and North America, were formed to carry out the Claussen process, and for some time continued in operation. The supply of cotton, however, at that time, was too abundant and too cheap to induce manufacturers to try the experiment of converting a new raw material. The cottonised flax was no cheaper than cotton, while the inequality in the length of its fibre

made its manufacture a matter of some difficulty. It was no wonder, therefore, that the manufacturers declined to take it in hand. Under these circumstances, the Claussen process was confined to preparing flax for mixing with wool. The vast improvement in carding machinery since that date would now probably obviate the only practical difficulty in the way of spinning flax cotton, and, as manufacturers would be as eager to try the experiment as they were then indifferent, the commercial value of the material, if brought again into the market, would speedily be satisfactorily tested. In the Claussen process refuse flax was first boiled in caustic alkali and then steeped in dilute acid. This dissolved out the gum and colouring matter from the fibre, and prepared it for disintegration into its ultimate filaments by the expansive action of suddenly disengaged carbonic acid gas. To effect this, the boiled flax was lowered into a vat of weak carbonate of soda solution, which soon permeated the whole of the fibres. It was then rinsed in a dilute solution of sulphuric acid, which, coming in contact with the carbonate of soda in the fibre, combined with the alkaline base, and set the carbonic acid free. This, in assuming its gaseous condition, exerted a sufficiently great elastic force to separate the normal fibres of flax into fine cotton-like filaments. A peculiar process of bleaching followed, which rendered these filaments perfectly white, and the material, when dried, was then fitted for the processes of manufacture. The favourable opportunity offered by the present cotton famine has induced the owners of the patent for this country to again turn their attention to the production of this flax substitute.

A new mode of preparing jute to mix with cotton for the production of the coarse kinds of cloth has also lately been submitted to practical cotton-spinners, who speak very favourably of its adaptibility for the purpose. If brought into use, this prepared jute will economise cotton, but will not supersede it, as it is unfitted for being spun alone. Several other substitutes for cotton have been spoken of, but they do not promise to become of much utility. They are chiefly valuable as indicating the vast amount of investigation and research that is going on with a view to relieve the present pressing want of raw material, and which, there is good reason to hope, may result in discoveries of importance to the manufacturing and commercial interests of the country.

Mr. Arthur Robottom of Birmingham, who has long been most energetic on all that relates to new fibrous materials, thus writes to one of the local papers:

"Public attention has been drawn of late to the various fibres which are now being brought forward as substitutes for cotton, and although it is my firm conviction that no article will entirely supersede the use of cotton, I wish to call your attention to a fibre* which I have imported in small quantities for some years, and which I think would prove one of

* This is the *Urtica tenacissima.*—EDITOR.

the best substitutes for cotton yet brought before the public. The article, of which I enclose a sample for your inspection, can be procured in unlimited quantity and at a moderate cost ; four or five crops can, I believe, be produced annually. It has been known to some few scientific gentlemen for years, and their surprise is that it has never yet been brought into general use by our spinners.

"A sample of this same kind of fibre was forwarded by Dr. Buchanan to the India House in the year 1811 ; the court of Directors handed it over to a London firm, and they reported that a thread spun of this fibre bore 252 lbs., whereas one of Russian hemp of the same thickness broke at 82 lbs. Some of the finest materials are made in China from a species of this fibre. The Society of Arts in 1814 awarded a silver medal to Captain S. Cotton, then a director of the East India Company, for the introduction of this fibre. It grows spontaneously in Assam, Burmah, Chittagong, Nepaul, the islands of Sumatra, Java, and Borneo, the Malayan Peninsula, Yunan Provinces, Siam, Cambodia, and also in the western parts of China ; and I have no doubt whatever but that it could (like many other fibres) be brought into this country, and sold to a very large extent.

"There are numbers of other fibres which could be advantageously used if spinners and others would only take the matter spiritedly in hand ; but it is only since the extraordinary rise in the price of cotton that attention has been drawn to this very important subject.

"The late Dr. Forbes Royle and Mr. P. L. Simmonds have worked hard in endeavouring to bring undeveloped fibrous substances before the notice of the manufacturers of this country, but there is such apathy on their part to try any article foreign to their regular trade that the successful introduction of anything new becomes almost an impossibility, and it is only in such times as the present that there is a chance of doing so.

"No one knows the difficulty except those who have experienced it, in the introduction of a new article, and very frequently losses are made by the first adventurer, although the article he imports, if it were fairly tried, would be found a good and useful one ; for instance, I have known several firms who have been induced to make small trial shipments to this country, which, on arrival, are placed in the hands of a broker and advertised for sale on the London and Liverpool markets, but the novelty of appearance or strangeness of name under which they are denominated not being known by a single party who sees the articles or reads the advertisement, not a bid is made for them, they are put on one side and forgotten, perhaps never to be heard of again until the dock company or wharfingers bring them to a 'rummage sale' to pay rent and charges, when, if they cannot be sold, they are destroyed—the merchant virtually abandoning the ownership, and taking care how he meddles with a new article of commerce again.

"I trust the present very high price of cotton will induce our manu-

facturers to give a fair trial to such new products as may appear at all likely to answer as substitutes. It would not only find occupation for a large number of our operatives in this country, but would also be the source of employment for a number of natives who are now dependent upon a precarious mode of obtaining a living."

In Jamaica, Mr. N. Wilson, the island botanist, has long laboured most earnestly and zealously to develope and utilise the rich indigenous resources, and to introduce new plants. Hundreds and thousands of useful plants have already been distributed gratuitously over the island, and we trust to find that many new staples may thus be brought into cultivation, and the rich lands now lying unproductive, become utilized. There are very many fibrous plants, the culture and preparation of which for market will require really very little labour. Every day experience is gained, and a better amount of knowledge respecting them is diffused, new machines are invented, suited to the maceration and cleaning of leaves and barks.

In the Island of Jamaica may be found or cultivated profitably all the most valuable fibres of commerce. The Rheea fibre of India (*Boehmeria nivea*), furnishing the Chinese grass cloth, which grows there more freely and luxuriantly than it does in the east. The Sanseviera, which thrives in any sand-bank, and the fibre of which is so strong that it has received the name of bow-string hemp. Jute, about which there has lately been so much furor, is indigenous.

We have lately received from Mr. Wilson the following statement of the produce of an acre of bananas, which is one of the most valuable plants that can be grown, and the contingent expenditure. This estimate is made on the most moderate calculation, for the banana requires little or no culture, and the stem, instead of weighing 100 pounds, yielding 2½ lbs. of fibre, will in most cases double that weight, and a bunch of fruit frequently weighs 80 lb., instead of 50 lb., as set down; indeed, we have known a bunch of bananas to weigh 120 lb. The value of the bunch of fruit at 6d. is also very low. A few years ago the ripe fruits were selling at New York at 6d. each, and in this country they readily fetch 3d. or 4d. each. A bunch will number from 100 to 200 fruit. Mr. Hill certainly holds out no prospects to speculators which cannot be realised, and after more than twenty years' experience of tropical culture, he ought to be able to judge correctly, and would not suggest speculations likely to end in loss.

Banana (*Musa sapientum*).—This plant, with judicious management, would be found to be one of the most profitable for tropical cultivation, for its products—viz., fruit and fibre, and by a moderate estimate the following result would be obtained.

At an average of 10 or 12 years, an acre planted at 12 feet apart, will contain 302 plants; each stool will produce at least 7 strong suckers = 2,114 stems per acre; per-centage of clean fibre, 2½ or say 2½ lbs. per stem, = 5,285 lbs. Or 47 cwt. 21 lbs. Or 2 tons 7 cwt. 21 lbs.

per acre. Value at 6d. per lb. per acre, 132*l.* 2s. 6d. Value of fruit at 6d. per bunch, of 2,114 stems or bunches per acre, 52*l.* 17s. Or fruit and fibre, 184*l.* 19s. 6d.

Were the fruit to be dried like figs, allowing four-fifths waste for peel and absorption, the weight of fruit of 2,114 bunches (each weighing at least 50 lbs.), would be = 21,140 lbs. of cured fruit, value at 4d per lb., 352*l.* 6s. 8d.

The expense incurred in culture of the banana and preparation of product, cannot at present be correctly estimated, but as the plant scarcely requires cultivation after the first and second year, 1 man would keep clean 3 or 4 acres, or say 3 acres, at 12*l.* per annum, being high wages; 100 acres would thereby require say 34 labourers, at 12*l.* each would be £408

For cleaning fibre, drying fruit, cartage of produce, and raw materials from field, &c., say 20 hands, at 12*l.* each, would be	240
Superintendance by skilled labour, say . .	300
Total, excluding wear and tear, freight, and other charges	948

The above must be considered a high estimate of expenditure, but an estate cultivating 300 acres of canes would cost from 3,500*l.* to 4,000*l.* per annum, an acre yielding at an average 1 hhd. per acre, and 90 gallons rum.

At a time when there is such an outcry for new textile materials, to come to the aid of flax and cotton, it does seem somewhat singular, that with money so cheap and abundant, and with the very fine collections of prepared fibres exhibited from our colonies at the International Exhibition, so little attention has been given to these by practical men.

The collection of prepared fibres sent from Jamaica, by Mr. Wilson, is one of the largest and most carefully prepared that has, perhaps, ever been seen. The fibres sent by Mr. Cruger, from Trinidad, have already been described in our pages. Then there are most interesting collections from British Guiana, Ceylon, Mauritius, and the Cape, and a well arranged series from the India House Museum; to say nothing of the French, Guiana, and other foreign collections. We do not think that our home merchants and manufacturers have taken much trouble to examine them systematically, to determine their practical worth—and hence the labours of the collectors and exhibitors will be so much time and trouble lost.

Among the fibres shown from British Guiana, are several specimens of silk grass or corawa fibre (*Bromelia karatas*, Linn.), which is very strong, and is used by the Indians for bow-strings, nets, fishing lines, ropes, &c.

Wild ochro (*Urena sp.*)—The fibre is in a rough state, but when bleached and dressed it is adapted for making cloth equal to linen. It is very strong, and may be used for making rope, twine, gasketting,

&c. There is abundance of the plant all over the colony, and the expense of obtaining the fibre is simple and inexpensive.

A great number of specimens of prepared plantain fibre are exhibited. Burke's patent machinery for the manufacture of this fibre on a large scale, has been introduced, but it has not as yet been made to work satisfactorily. Pittie fibre is from an undefined species of *Hibiscus*, and kratta or krattu fibre from another species. Mahoe fibre is also obtained from the *Hibiscus elatus* of Linnæus, the *Thespesia populnea* of Correa.

Tibisiri fibre is made from the young leaves of the Ita palm *Mauritia flexuosa*, Linn., and is used by the Indians for making hammocks, &c.

Iturite fibre (*Maranta obliqua*, Rudge.), is used by the Indians for making their pegalls. There are two other fibrous substances in this collection which deserve mention, and these are Winna fibre, the inner bark of the cacaralli tree (*Lecythis ollaria*, Linn.), used by the Indians to wrap their cigars, and the fibrous root of the *Pothos macrophylla*, Swartz., used by the Indians to make baskets.

It is to be regretted that the colonists have not yet achieved the systematic production of their numerous vegetable fibres in a style or to an extent snitable for exportation. Experiments highly satisfactory in this character have, it is true, been repeatedly made, but unfortunately the machinery sent out was found in some respects unsuitable. The desired improvements will, however, it is hoped, be soon effected, when the trials will be resumed under more favourable auspices.

CHEMICAL SUBSTANCES AND PRODUCTS OF INDIA.

Two descriptions of salt are produced at Cuttack ; the first, called *Pungah* salt, is obtained by boiling to a residuum highly concentrated brine ; the second is the *Kurkutch*, or gravel salt. As the word signifies, it is produced by the aid of solar evaporation only, from sea-water. The water is introduced into small beds prepared with a smooth bottom of clay, slightly depressed in the ground, and surrounded by a slight ridge of earth. A few hours' exposure in the burning sun of March and the two following months, is sufficient to evaporate the water in these beds, which deposits the salt it held in solution. A fresh supply is then let in, and the process of total or only partial evaporation is continued, till the bottom of the beds is covered with a layer of this salt, more or less thick, which is then scraped up.

Both these kinds of salt are produced all along the sea-board of the province from February to June, and under what is practically a Govern-

ment monoply. The last season's manufacture amounted to 50,000 tons of the one and 44,000 tons of the other. The production is considered handsomely to remunerate the petty contractors who engage with Government for its supply, at 10 annas and 4 annas per maund for each kind respectively, which is equivalent to 35s. 5d. per ton for the one, and 14s. 5d. per ton for the other, in English money and measure. To the Pungah must be added about 50 per cent., to the Kurkutch about 25 per cent., for expenses of superintendence, &c. To the more extended manufacture of the white salt, the present insalubrity of the producing localities, and the consequent difficulty of procuring labour, as well as the insufficiency of the fuel supply, are obstacles. The coarser kind may be manufactured *ad infinitum*, but it is no where appreciated so much as locally, that is, in the district, as, not being "cooked" like the Pungah, it is more acceptable to the scrupulous caste prejudices of the Oryahs. The bulk of both kinds is exported to Calcutta. The local retail price at Cuttack in the shops of the bazaar for Kurkutch is 6s 3d. per maund of 100 English lbs.; Pungah is sold at the Government depots at 8s. 8d. per maund.

The Local Committee of Cuttack, in specifying the local prices of articles, do so with this explanation, that it is impossible to give any rates which are average ones, or which are in any degree equally applicable all over the district. Where any particular article is produced, there it is cheapest, and the cost and difficulty of transport and the want of competition are such, that a distance of 50 miles between the place of production and the central market, makes a difference in price of 50 or 100 per cent. in the rates at which some articles are bought and then sold. This is especially the case with the oil-seeds of the province, cotton, &c. Under these circumstances it would have been impossible for the Committee to have stated any average rates. The prices which have been generally mentioned in the Indian catalogue are the local, that is, the Cuttack bazaar retail prices. It may be as well to state that all articles coming from Sumbulpore or elsewhere, by river carriage, are cheapest in the months of July and August, when the rivers first admit of navigation, and that between July and January the rates for the same articles may vary as much as 50 per cent.

There are five salt mines in the Shahpore district worked by Government in the salt range; one at Kalabagh, across the Indus, and several in the Kohat district, and the supply from these sources may be said to be inexhaustible. An excise duty of 3 rupees per maund of 80 lbs., is now charged upon all salt sold, the rate having been lately increased (two years ago it was but 2 rupees); and the revenue derived from this source amounted to upwards of £280,000. The salt mines are the means of supplying the traders of the Punjab with a kind of paper currency. By payment of the regulated price at any of the Punjab treasuries, a warrant for the delivery of so much salt at the mines may be obtained; these documents are transferable, and pass from hand to hand like bank notes.

Nitre saltpetre, locally "*Khai jabkahi*," is produced in Cuttack. Some is manufactured by a process of solution and filtration, (which it would be unnecessary here to describe,) from a thin whitish efflorescence scraped off old mud walls and buildings, &c., where it is produced more or less in all localities freely, that are continually exposed to the action of sea air in the cold season, and dependent on the existence of certain conditions. Some is more carefuly prepared, for the most part only in the hill tracts, from a similar efflorescence found in the cold months on the base of cow-house walls, and there generated, it is to be supposed, by the action of the ammonia thrown off from the urine of the cattle. Neither kind is manufactured extensively enough for commercial purposes, still the local manufacture furnishes a good deal of the saltpetre, if not the bulk of it, used in native gunpowder for shooting and fire-works

Sal-ammoniac for tinning and frigorific mixture, 12 annas per seer, is made in various parts of Oude. It is manufactured from the contents of cesspools, and is used for tinning copper pots and pans ; mixed with common salts, nitre, &c., it forms a frigorific mixture.

Nitrate of potash for frigorific mixtures and for gunpowder, three seers per rupee, is made in various parts of Oude. This is nitre of the first crystallization ; nitre is found in the earth of old buildings and ruins, which has long been exposed to the air ; water is filtered through this earth, and then boiled and concentrated. This kind is only used for frigorific mixtures.

Saltpetre and salt are produced abundantly in some parts of Shahabad ; the crude saltpetre is prepared at from six to seven rupees per local maund by the Nooneahs ; this would be 15*l.* to 18*l.* per ton. The salt produced with the saltpetre is of a coarse kind, and only sold to the poorest of the community, under the names of "*Kharree Nimuck.*" It can, however, easily be purified by boiling, and then is a good and pure salt.

It may be here noticed, as an important and singular fact, that het strata on the north, east, and south faces, (where the face of the plateau towards the plains is invariably precipitous) has a considerable dip inwards, varying from 5 to 45 degrees. This circumstance prevents any springs making their appearance on the face, which would have the effect of leaving the table lands dry, and would render them a desert. This fortunate dip has a contrary effect, retaining the moisture as in a basin, and water in consequence may be had in most places on the table lands at a moderate depth, while in several localities springs of pure and limpid water flow above the surface all round the year, consequently numbers of villages dot the table lands, and it is probable that not many years will elapse before large tracts are brought into a more profitable cultivation of coffee, cotton, and oil-seeds, by European energy and skill. The finest rice raised in the district is already grown in these shallow valleys, and when the soil has been subjected to the plough proves by its abundant crops what it might produce under a proper cultivation.

Vitriol was once largely manufactured on the banks of the Soane, in Shahabad, from sulphate of iron, the product of the Kymore range ; but the death of the gentlemen who instituted the manufacture stayed it, It is now only a native manufacture on a small scale.

Soap is made from cows's suet and a peculiar efflorescence gathered from barren land, called by natives Oosur. The efflorescence is called Rêh. It is used for washing ; eight seers per rupee.

Tinder, a kind of which is found under the leaf of the sago palm tree, ignites very easily.

Bats' dung is mixed with water and ashes, and strained and left to dry, when ammonia effloresces, and is used as an ingredient for gunpowder. It is also used for manure like guano.

An article called Sajjee is used in soap manufacture. Sajjee is made in considerable quantities in the districts of Mooltan, Jung, Jhelum, and Thanessur. It sells at about 32 lbs. for a shilling.

Oil Seeds.—The *Ricinus communis*, known by the provincial name of Bheeree, has two or three marked varieties ; it is largely cultivated in Shahabad, principally for home use, though a considerable quantity finds its way into the castor-oil factories of Dinapore. The native process only succeeds in making a very impure oil, which is so offensive for its smoking qualities in burning, that it is not sought after by them for that purpose, but only for anointing leathern well ropes, shoes, &c., and, being a cheap oil, is largely used for the latter purpose. It is thick and viscid, and, extracted under the native process, soon turns rancid, while by the European process, it is next to cocoanut oil, one of the purest and best burning oils known. The plant requires scarcely any cultivation, and in South Shahabad is oftener sown on the borders of a valuable field as a hedge than for any other purposes. It loves, however, a sandy loam, and will not grow in the clays. Its yield under the native process is about 33 per cent. of the impure oil above described, but a larger quantity, and a purer oil, is extracted by the European process. Newly cleared jungle lands grow the castor plant abundantly, and its extended cultivation is only bounded by the demands in the market, so long as the rates are remunerative ; for although the sowing and tendence of the plant costs little trouble, yet the picking of the seed is a troublesome process, and it requires a much larger amount of room to come to perfection. The natives sow and uproot the plant yearly. It is not known why this should be, as it grows and yields abundantly, the second and third years, in hedges, or other open places. When cultivated by itself, the natives always sow the seed too close, and consequently the plant is comparatively small ; for attaining its full perfection no place is better suited than a hedge or a bank.

The *Ricinus communis* is cultivated in Lucknow as a mixed crop. It is sown in June by almost all the villagers, not extensively, but principally for their own use. Its cultivation can be extended all over Oude. This oil is extracted by bruising the seed and then boiling it in water. The oil is afterwards skimmed off. This is the only seed out of

which the oil is extracted by boiling, as in this case it is found cheaper than the method used for other seeds, which is by pressure. The cost of the seed is one rupee per maund, and the price of the oil is from two to five seers per rupee, according to the abundance of the crop in the season. The proportion of the oil yielded is about half the weight of the seeds boiled ; used only for burning.

The plant is grown all over the province of Cuttack, a good deal in patches of newly cleared land in the jungles of the Tributary States and Sumbulpore. The oil is extracted in two ways. It is used for burning and culinary purposes, and also medicinally. The local market is now 11½ petuls of the seeds per rupee. Both the native methods of extracting oil are wasteful and tedious, and therefore expensive. European oil-presses and a knowledge of some methods of clarifying the expressed oil, seems only to be required to render the oil-seed crops of this extensive division of great value.

The flax *Linum usitatissimum* is a well-known plant almost all over the world, but is in most parts of civilised Europe more cultivated for its flax than for its seed. In Russia and in India the contrary is the case, and it may fairly be said that in India its flax-producing qualities are unknown. It is, therefore, cultivated as an oil-seed alone. It is, however, probable that the stunted plants grown in India would be of little use as a flax bearer, until improved cultivation had again raised its standard of height. In the Punjab and in Scinde considerable attention has of late been paid to this subject, and it would be an additional staple added to the agricultural resources of Shahabad and Behar, could it be brought under cultivation as a flax bearer here, which it doubtless could be with the same advantage as in the Punjab. It is always grown in Shahabad as an auxiliary crop with wheat, masoor, barley, and the spring crops ; its bright blue flowers are a pleasing relief to the yellowish brown of the other cereals. I have never known it cultivated alone, so that I have no data as to its probable yield per beegah or acre. It would probably not be found to differ much from the linseed crops of England in that respect, were the cultivation equal : that is to say, were the same labour bestowed upon its cultivation, which, however, is not the case in this district at least. Its favourite soil appears to be the black clay, (*kurile*), but it is sown largely in other soils, and the only difficulty to its indefinite extension appears to be want of facilities for carrying the crop to market. It is therefore grown in south Shahabad, principally for home consumption, and is used largely for lamps under the name of *Teesee-ka-Tel.* Under the native process it produces 25 per cent. of oil : what it would produce with the European method I am unable to say. The native method produces a tolerably clear-looking oil, but it smokes much in burning, showing that a large proportion of vegetable fibre finds its way through the rude press into the pure oil. Considerable quantities are grown near the Ganges for export. The price varies much according to the season and the quantity in the

market. I have known it to sell for Rs. 40, or 4*l.* sterling per ton, and I have known it fetch double that price. Until roads, railroads, and canals, with better modes of conveyance than exist at present, equalise prices, no average of price can be given with any certainty, as one season in one part of the country may have been favourable, and in another part unfavourable, all within a radius of twenty miles, and the two places show a difference of 50 per cent. in the selling price as well as in production: thus proving how imperfect are the means of transport from one part of the country to another, which would otherwise equalise the produce in the dearest market till a medium was found, or in other words, till further export to that place was unprofitable.

It is grown all over Oude, and only cultivated for the sake of the oil of its seed. Some fishermen make their nets from the fibre. This is cultivated as a mixed crop, principally with *gram*, all over Oude. It is sown in the month of October, and never irrigated. It is never sown thickly, as the object is to get a large amount of seed for oil, and not fibre. It can be cultivated extensively, and there is no doubt that, with proper treatment, profitably, for its fibre. The oil is extracted by pressing. The seed sells for 18¾ seers per rupee, and the oil for 5 seers per rupee. Every five seers of seed yield 1¼ seers of oil by the native process of pressing. It is used for cooking and burning.

Mustard (*Sinapis ramosa*) is cultivated for its oil; one maund of mustard produces 13 seers of oil; cost rupees 5-3. Cost of conveyance to Calcutta, in dry season, rupees 10 per 100 maunds.

The *Sinapis juncea* and *ramosa* are not sown together, but each is cultivated as a mixed crop, with either grain, barley, wheat, or peas. In this way it is cultivated all over Oude. The oil is extracted in the usual way. The cost of the seed is 15½ seers per rupee, and that of the oil varies from three to eight seers per rupee. The proportion of oil extracted is 1½ seers from every five seers of seed; it is used for cooking and burning.

The *Sinapis ramosa* and *Sinapis dichotoma* are grown generally mixed with the rape seed, also called sarson, although the plant is a distinctly differing one, and the seed is a whitish yellow, while the seed of the rape (*Sinapis dichotoma*) is a dark brown. They are rarely grown separately, though such is the case in many parts of the country, and ought to be the case here. It is grown extensively all over the district, principally for local consumption, and, being sown in the month of October, is generally sown as an auxiliary with grain crops, amongst which its white and bright yellow flowers are easily distinguished. Being always sown as an auxiliary, it is impossible to ascertain what would be its yield per acre if sown separately. It loves the loam, and does not take kindly to any of the clays. It is ready before the close of February for cutting, and is always cut slightly green, or the seed pods would burst and scatter the seed. Being cut, the plant is dried on the threshing-floor by the heat of the sun, which does its work in three or

four days, when the seed is easily threshed out. Cattle eat the broken stalks, but it is questionable how far it is a very nourishing food for them. It is sold in the bazaar at from 16 to 20 seers per rupee, and yields, under the native method of crushing, 30 per cent. of a tolerably pure oil, while the residue, or cake, is used as a food for cattle. It would yield more and a purer oil, under the action of the oil-pressing and purifying processes of Europe ; and probably 35 to 40 per cent. of its gross weight. It is largely used by the native community with their food, instead of ghee, under the name of *metah*, or sweet oil ; although, for all other purposes it passes under the name of *kurwah*, or bitter oil. Most natives prefer it for the preparation of their curries and other warm dishes. The native oilmen give one seer, or 25 per cent. of the expressed oil, for every four seers of seed sent them, retaining the balance and the cake as the price of labour ; so that, with the seed at 16 seers per rupee, the value of the oil would be four seers per rupee.

Of the *Sesamum Orientale* (Teel) a most useful plant, there are in the district of Shahabad two kinds, and both are extensively sown in various parts. The first is sown in July, and is ready for reaping in Kartick or Aghun, say in November : the second is sown in August, but they are both ready nearly at the same time. These plants are also sown as auxiliaries, but with the highland rain crops, such as Ruhur, Motha, &c. The seed has about the same value as *Surson* in the bazaars, but the oil being thinner and purer, and almost tasteless, while burning with little smoke, is extensively used in Indian perfumery. It is extracted from the seed in the same manner as other oils. The residue or cake is eaten by the poorer classes as an article of food, and is greedily devoured by cattle. It grows on sandy loams.

There are two varieties of the *Sesamum indicum*. The one white seeded called "Teellee," the other black seeded, called "Kala Teel." The two kinds are never sown together, but each is cultivated as a mixed crop with either *Eleusine Coracana*, "Merwah ;" *Paspalum scrobiculatum*, "Kodo," *Cajanus Indicus*, "Arhar," or with cotton in the month of June. These plants grow all over Oude without the slightest difficulty, and without any care being taken of them. They are often met with growing luxuriantly by the road side. The oil is extracted by pressing. The cost of the seed of the white variety is 11 seers per rupee, and of the black 12 seers per rupee. The oil of the former fetches from $2\frac{1}{2}$ to 4 seers per rupee, and of the latter 3 to 8 seers per rupee. Every 5 seers of each kind yield $1\frac{1}{2}$ seers of oil. These seeds are also eaten by the natives made into sweetmeats ; used for cooking and burning.

One maund of Teel (*Sesamum Orientale*) seeds produces 13 seers of oil. Cost, $4\frac{3}{4}$ rupees. Expense of conveyance to Calcutta, in dry season, 10 rupees per 100 maund. It is cultivated all over Oude for the sake of the oil contained in it. It is used for cooking and burning, and the seed boiled in sugar makes a sort of sweetmeat. It is often grown as a mixed crop.

The black *Sesamum* (Kala Teel) contains more oil than the white kind, and is eaten with *goor:* price 11 seers per rupee.

The white and black sesamum are ordinarily used in the manufacture of oil in Rangoon. In Moulmein it is used as oil for household purposes ; one basket will yield about 25 viss of oil.

Price at Lahore about 9 lbs. per shilling. Both teel and linseed are mentioned by Strabo as staple products of this part of India. Of late years the cultivation of these seeds, and oilseeds generally, has greatly increased, especially in the Mooltan and Ferozepore districts, and considerable quantities have lately been exported to France.

The *Brassica E. rucastrum* (Taree "Gomvah" or "Semvah") is cultivated in Lucknow in the same way as the above, the cost of the oil is from 3 to 10 seers per rupee. It is used for burning.

All oils in Oude are extracted by the native press called "Kolhoo," turned by means of bullocks, with the exception of castor-oil seed, the oil from which is extracted by boiling in water, and afterwards skimming.

The *Carthamus tinctoria* (Kussoom) found in Lucknow, is sown in October either alone, or along the edge of wheat crops ; both light and heavy soils are adapted to it. It is cultivated in every village, but not extensively. There would be no difficulty in further cultivating it to any extent. The oil is extracted by pressing ; used only for burning. The cost of the seed, which is called "Barré," is 18¾ seers per rupee, and of the oil from three to four seers per rupee. This plant is also useful for the bright scarlet dye that its flower yields.

The *Bassia latifolia* (Mohwah) a middle-sized tree, grows wild in the Taree, and is also planted in groves in most parts of Oude, near villages, &c. Its cultivation can be extended all over Oude, and it thrives without any trouble. Its flowers have a thickened and enlarged tube, in which is contained a considerable amount of sugar. They are dried and eaten by the natives, and also fermented for the manufacture of *Mohwah Spirits.* The cost of the oil extracted is 3 rupees per maund. The proportion of oil yielded by the native process is about half the weight of the seed ; used only for burning.

The poppy plant (*Papaver somniferum*), Poshtah-ka-danna, is largely cultivated in all parts of Shahabad and Behar, as also in the neighbouring districts, for the drug (which is a Government monopoly), the well-known opium of commerce. The seed has no intoxicating qualities, but has a sweet taste, and is used parched by the lower class of natives as a food ; it is also much used by the sweetmeat-makers as an addition in their wares. This and the seed of the teel *Sesamum Orientale* are the only oilseeds, with the exception of the pulp of the cocoa-nut, which are used for that purpose. It produces, under the native method, a clear limpid oil, which, however, has the disadvantage of burning very quickly. About 30 per cent. of oil is extracted, and the cake is then sold as a food to the poorer classes. The oil at present sells at about 5 seers per rupee.

It appears that this oil, if properly prepared would, from its thin and limpid character, be admirably adapted to supersede many of the purposes, if not all, for which the more expensive olive oils of southern France and Italy are now used, and would be an admirable watchmaker's oil. This is thrown out as a suggestion for some practical men to decide. The production of this seed is only limited by the production of the poppy.

In Lucknow each ryot sows from two to four beegahs in the month of October. It is capable of being cultivated all over Oude. The oil is extracted by the common native press. The cost of the seed is 10 seers for the rupee, and the oil sells at 3 seers for the rupee; two-fifths of the weight of the seed employed is about the proportion of oil yielded by the native process. The poppy seed is eaten by the natives made into sweetmeats, provided the opium has been extracted from the seed vessel, otherwise it is bitter and narcotic, and under these circumstances the oil extracted is also bitter. It is used for cooking and burning.

These seeds are grown to a very considerable extent all over this province, and are, at least the *sesamum* is, beginning to be an important item in its exports, principally to Marseilles, where it is used for the manufacture of Lucca oil. Large quantities are brought down from Sumbulpore; and Ungool, Dhenkanal, Hindole, and Talchar also supply a good deal of these seed oils. In the above-named States the cultivation of these crops can be extended to an indefinite degree, as the principal oil seeds there grown, the *sesamum* and castor, are sown broadcast over slightly tilled land, from which the jungle has been superficially cleared, or on rocky ground unfitted for the cultivation of any other crop. The oil of these seeds is expressed in the common native *Ghana*, or oil mill. For domestic use the farmer generally extracts the oil from the above as from other oil seeds, by making a mash of the seed and boiling it, by which process he obtains more oil of a better quality than from the oil mill, though the cold-pressed oil is purer or clearer. Mustard seed oil is used generally for culinary purposes, and with the other oils for burning. The linseed plant, though grown extensively in the Sumbulpore district, and more or less all over the province, is nowhere cultivated for the flax it yields. All these oils are mixed together and sold under the name of mols, or thick oil. The local price of this common oil is, at the time of writing, 17s. 6d. per Cuttack maund, 28 of which go to the ton weight. A good deal of this oil is exported to Calcutta, where the ruling prices are more than double the local. The most valuable of these oilseeds, namely, the *sesamum*, is of two kinds, named respectively *Maghee* and *Bhodoe*, after the months in which they are plucked. The latter is the plumper seed, and yields most oil. The season and prospects of the crop so govern the rates for these seeds that no average prices can be safely given.

ON BEBEERINE FROM THE GREENHEART TREE.

BY DR. H. RODIE.

The Greenheart tree (*Nectandra Rodiei*) of British Guiana, is found in the greatest perfection immediately behind the alluvial soil of the coast and rivers, or clay hills, but little elevated above the level of the ocean, and degenerates as it extends into the interior, till on the more elevated region of the Cinchonas, it disappears. The tree seems almost peculiar to British Guiana. It generally stands single and rises on an erect cylindrical, gently tapering stem to a height of 80 or 90 feet, to 40 or 50 without a branch, by a circumference of 9 or even 12 feet. It is recognised at a distance by its dense glossy foliage and comparatively white trunk. On striking it with the edge of a cutlass, the bark flies like sandstone, and is very bitter. The bark occurs in large flat pieces, from one or two feet long, and varying in breadth from two to six inches. It is about four lines thick ; heavy, and with a rough fibrous fracture, dark cinnamon brown, and rather smooth within, and covered externally by a splintering greyish brown epidermis. It has little or no pungency or acrimony, but a strong persistent, bitter taste, with considerable astringency.

The wood is extremely strong, hard, and heavy, sinking in water, and taking a high polish. Neither the white ants on land, nor the teredo in the water, affect it much ; it has stood on wharves, totally unprotected, for sometimes thirty years in the tide's way. Its various shades of colour from black to yellow cannot be ascertained until the sapwood be cut through, which is invariably of a pale yellow ; no difference in their botanical character or medical virtue has been observed. It appears to be of slow growth, for from the detritus accumulated round the old trees, and from the young trees in the formerly exhausted ground, having in say 70 years, scarcely attained the size of a spar (8 inches diameter), it is supposed several hundred years would be required for its growth. Almost every tree above 8 inches in diameter has a quantity of obovate compressed nuts lying around its root, about the size of an apple, enveloped in a grayish brown brittle shell, $1\frac{1}{2}$ line thick, that parts readily from a kernel, which is yellowish when cut, but immediately becomes dark brown on exposure to the air, and is intensely bitter, and indeed richer in bebeerine than either the greenheart bark, or yellow cinchona bark. Its tincture, which is by reflection-light, dark olive green, does not affect the test-paper as the infusions of those barks do. The Indians, when their provisions fail, have from time immemorial used this nut as food (bread). They first break and part the pericarp from the cotyledons, which they then scrape and grate as they do cassava, throw the pulp into an open basket placed over a pail, and pour water over it, so as to wash away the bitter, and this is repeated five times or oftener.

It is then invariably mixed with about one third part its bulk of decayed wallaba (another native wood), pounded to powder and sifted, on a like quantity of cassava pap, put into the press, and the farinaceous substance thus expressed, baked into bread. This mixture is probably intended to correct the bitter of this seed, for the wallaba wood is rich in tannin, which precipitates and renders tasteless bebeerine. Green-heart bark adheres firmly to the tree even when full of sap, requiring to be gently beaten, so as to crush the liber, or inner rind, when it can be parted in flat pieces of six to twelve inches square, and from one-eighth to one-fourth of an inch thick. On subjecting it to the process by which quinine is made, two alkaloids are obtained, and the term *bebeerine* has been applied to them collectively. One of these only, when combined with a slight excess of sulphuric acid, and the solution reduced to the consistence of syrup, appeared to form small circular crystals, which could not be separated from the mass.

Its infusion, like that of the cinchonas, reddens litmus paper; is clearer, though darker coloured than the latter, and deposits much less sediment on standing. Its productiveness, compared with that of yellow cinchona, appears to be nearly as 3½ to 5. When long subjected to a boiling temperature (212°), or long contact with alkaline and caustic earthy substances, its bitter is destroyed. Bebeerine, when properly administered, generally cures intermittents where quinine has failed, seems not to affect the head, nor to produce its effects by counter-morbid action, as the alkaloids of the cinchonas are supposed to do.

Green-heart wood, bark, and seeds are well known now in commerce, and the sulphate has also come into use here. The British Guiana collection in the International Exhibition contains specimens of the wood, bark, and seeds, which may be referred to by those who desire to identify them. We may state that the green-heart wood has a reputation for fishing-rods, as well as for shipbuilding purposes.

An esteemed correspondent supplies us with the following personal testimony as to the value of bebeerine :—

"In the latter part of 1848, when in Jamaica, a very heavy loss threw me into great affliction (grief), and concomitant with that came a very severe pain in the left hind portion of my head: the palm of my hand covered it. It was not to be called 'intolerable,' as I *did* bear it, nor could I imagine it so acute as I have heard tic doloreux described. But it became very constant and wearying (distressing). I placed myself under Dr. Gilbert M'Nab (son of Mr. M'Nab, of Edinburgh), who stood justly very high in colonial repute. He prescribed one drachm of sulphate of bebeerine, mixed with a sufficient quantity of colocynth to make, I think, about twenty good sized pills; two pills to be taken every three or four hours, according to the intensity of the pain, and at longer intervals as the pain decreased. The cause of the pain—mental anxiety—did not subside; the pain was entirely relieved for intervals—it returned three or four times—but repeating the remedy, it finally vanished.

"Travelling much in the different parts of Jamaica, I found acquaintances suffering from somewhat similar pains in the head, arising from different causes. The bebeerine was usually unknown in such country parts, and, in fact, not in general use anywhere; I was therefore requested to procure and forward a sufficiency from Kingston, and in three or four instances that came under my observation, it was a complete 'success.'

"Dr. M'Nab afterwards assured me that he had in one or two instances found it very efficacious in *delirium tremens*, and that in one case it was decidedly a temporary cure for tic doloreux.

"I was cured of my disorder, and Dr. M'Nab left Kingston for the country in Jamaica, and so I heard no more about it. Bebeerine was not in vogue among other doctors. I only speak from my own experience, and am certainly surprised that it is not more generally tried by the profession in England in all cases of neuralgia.

"Some constitutions cannot take Quinine, while on others it has no effect (on my own, I might say, it has little effect, for I can take 10 or 12 grains a day without feeling it). Some can take 20 or 30 grains, while others again are deafened and bewildered by four or five grains. Therefore in some cases Bebeerine ought to prove a most valuable addition to our Pharmacopœa, and I believe confidence in it will prove it of great value."

Scientific Notes.

English Ink Galls.—At a meeting of the Exeter Naturalists' Club, held in Exmouth last month, Mr. D'Urban read a paper on these galls. Most persons, he said, must have noticed the hard brown galls, about the size of musket balls, so conspicuous in winter on the oaks about Exeter. They are supposed to have made their first appearance in Devonshire about the year 1847. They were first noticed by Mr. Parfitt, who sent specimens of the insect causing them to Mr. Westwood, in 1848 or 1849. It has only lately, however, been determined to be *Cynips Kollari*, of Hartig, a species well known in Germany. About three years ago it suddenly appeared in the woods to the north of London in vast numbers. It is closely allied to *Cynips gallœtinctoriæ*, producing the ink gall of commerce on *Quercus infectoria* in the Levant. The galls of the Devonshire species contain a considerable amount of tannin, making excellent ink, and yielding a good and permanent dye. Like all other insects which multiply rapidly, it is subject to the attacks of a parasite, which contributes to keep its increase within certain limits. This is a beautiful green chalcite, first bred from these galls by Mr. Parfitt, and described by him in the 'Zoologist' for 1856, under the

name of *Callimome Devoniensis.* Mr. D'Urban did not think that the galls occasioned much injury to large oaks, but to young trees they are very injurious, frequently distorting the leading shoot, and seriously retarding its growth. They make their appearance on the oaks in this neighbourhood early in July, and growing rapidly reach their full size in August. They are formed on the young shoots of the year, always in the centre of a bud, and are monotholasmous, that is, they contain a single individual only. Some of them produce the flies in September, nearly all being females. The males are remarkably scarce, and have but rarely been obtained. Some remain in the larva state within the gall all through the winter, and emerge in the spring. Few, however, of those hybernating escape the different species of tit, those little birds picking the hard galls to pieces to get at the fat white grub inside. The galls themselves are very persistent, remaining for several years on the trees. Those from which the fly has escaped may readily be known by the presence of a single round hole on one side. Mr. D'Urban then explained the manner in which galls are formed, and the mechanism of the instrument with which the gall-fly makes a puncture in the bark of the trunk or shoots, in the young bud, on the leaf, or on the peduncles of the flowers, according to the part of the tree selected by a particular species, of which a great many infest the oak.

Albumen from Fish Spawn.—Some years ago La Société Industrielle at Mulhausen (Alsace) offered a prize of the gold medal of the Society for the invention of some substitute for albumen prepared from eggs ; and further, 17,800 francs as a remuneration for the first manufacture, on a large scale, of such a substitute. The prize was gained in 1860, by J. G. Leuchs, of Nuremburg, and who has a patent for extracting lbumen from fishes' roe, spawn, &c. The albumen thus gained is a complete substitute for that of hen's eggs, contains even less water, and is much cheaper. Some exhibited in the Swedish Court, made by Sahlstrom, of Jonkopine, is 2s. 4½d. per lb. For certain purposes, the fat is separated from the albumen, which then no longer retains the smell of raw fish. This fat is used for grease. The residue of fishes' spawn, after the albumen has been extracted, is used in the manufacture of ammonia, prussiate of potash, &c.

Algerian Silk.—For many years past the silk-worm has been attacked by disease, and in all the productive countries the harvest has been sensibly diminished. The Algerian cultivators have particularly suffered by this state of things, and the Administration, which had engaged to pay to the spinners a sum of 12 francs per kilogramme of silk spun from Algerian cocoons, have so far modified their first decision as without diminishing the bounty offered, to permit the spinners to buy elsewhere the cocoons they require to keep their factories going. The results of the silk operations in Algiers in 1861 were as follows :—Number of breeders, 257 ; quantity of cocoons raised, 4,206 kilogrammes, from 15,253 grammes of eggs ; sum paid to the spinners by the Government, 25,588 francs.

Panama Hats.—The famous Jipajipa, or Panama hats, are principally manufactured in Panama, from the leaves of the *Carludovica palmata*, a Pandaneous plant. Not all, however, known in commerce by that name are plaited in the isthmus; by far the greater portion is made in Manta, Monti Christi, and other parts of the Ecuador. The hats are worn almost in the whole of the American continent and the West Indies, and would, probably, be equally used in Europe, did not their high price—amounting often to 150 dollars for a single one—prevent their importation. They are distinguished from all others by consisting of only a single piece, and by their lightness and flexibility. They may be rolled up and put in the pocket without injury. In the rainy season, they are apt to get black, but by washing them with soap and water, besmearing them with lime juice, or any other acid, and exposing them to the sun, their whiteness is easily restored. So little is known about these hats, that it may not be deemed out of place to insert here a notice of their manufacture. The straw (paja) previous to plaiting has to go through several processes. The leaves are gathered before they unfold, all their ribs and coarse veins removed, and the rest, without being separated from the base of the leaf, is reduced to shreds. After having been put in the sun for a day, and tied into a knot, the straw is immersed in boiling water until it becomes white. It is then hung up in a shady place, and subsequently bleached for two or three days. The straw is now ready for use, and in this state is sent to different places, especially to Peru, where the Indians manufacture from it, besides hats, those beautiful cigar cases, which fetch sometimes more than 6*l.* a-piece. The plaiting of the hats is done on a block, which is placed upon the knees; it commences at the crown and finishes at the brim. According to the quality of the hats, more or less time is occupied in their completion; the coarse ones may be finished in two or three days, the finest take as many months. The best times for plaiting are the morning hours and the rainy season, when the air is moist. In the middle of the day and in dry clear weather, the straw is apt to break,—which, when the hats are finished, is betrayed by knots, and much diminishes their value.—Seemann's 'Botany of the Voyage of the Herald.'

Australian Lerp.—Laap or Lerp is a whitish saccharine matter, a singular insect production found on the leaves of the Eucalypti in some parts of Australia. The name was given by the aborigines of the north west part of Australia Felix. We have samples of it in our private collection. The insects producing it are closely allied to the aptides, or green flies of rose bushes, geraniums, &c. Its chemical composition appears to be from an animal secretion, perfectly anomalous, so far as known, being composed of pure starch, which tastes sweet on the tongue, it is supposed by a rapid change into sugar by the action of the saliva. It has been suggested that from its large quantities in some parts of Victoria, and the ease with which it might be obtained, it may form a substitute for sugar or malt in distillation.

THE TECHNOLOGIST.

THE MARBLES OF ITALY.

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The name of marble is restricted to certain limestones of a crystal line or granular structure which are sufficiently compact to be susceptible of taking a high polish.

As examples of the crystalline or saccharoidal structure, we may take the white marbles of the Apuan Alps (Lunigiana, Carrara, Massa, Seravezza, &c.), the "Bardigli" of the same localities, those of Valdier, in Piedmont, and certain of the marbles of Venetia, Trentino, and the province of Brescia.

If the crystallisation is of a very decided character, the structure becomes lamellar, as in the white marble of Pallanza, the Bardigli, and statuary marbles of Monte Rombolo, Monte Calvi (Campiglia), and the island of Elba, which are in every respect equal to the famous marbles of Paros.

The granular structure is seen in the white marbles of the Monte Pisano, the yellow of Siena, or *giallo di Siena*, and the majority of the marbles exhibited by the Neapolitan and Northern provinces.

The black marbles of Spezzia, Brescia, &c., certain varieties of *alberese* and the fine slates from Perugia, exhibited by Count Orini, furnish examples of compact limestones of a very fine grained structure.

These limestones mark the limit dividing the ornamental marbles from those that are only fitted for building purposes. The price of the former is more or less considerable, according to their varying capacity for taking and retaining a fine polish, like that of black marble, a quality which is not possessed by any other rock of the same colour.

The breccias, or brecciated marbles, are formed of fragments of limestones united by a more or less calcareous cement, or they may contain

fragments of different rocks set in a calcareous base. They are found in great variety, many of them being extremely beautiful, as, for instance, the brilliantly-coloured breccia of Terra di Lavoro, the superb *affricano* of Seravezza, that of Rondone (Seravezza), that of Finocchioso (Carrara), the *Mischi* or mixed marbles of Seravezza and Massa, and the *Mandorlato* and *affricano* of Vicentin.

The breccias command a very high price, on account of the vivacity of their tints, and the delicacy and harmony of their variegations and shading; in addition to which they are extremely durable, from the hardness of the fragments, and the homogeneous nature of the cementing material.

In a commercial classification the breccias form the class of variegated or spotted marbles, and it is under that head that they will be noticed. The marbles, properly so called, fall into the two principal divisions of white and coloured marbles.

White Marbles.—This is the most important class, on account of the extensive commerce of which it is the object. There are three commercial divisions; the first of which is exclusively employed for fine sculpture, and is distinguished as statuary marble; the second is also used for sculpture and higher class of architectural ornamentation; it includes the clear white marbles, *marmo bianco chiaro*, and the common white quality; the third includes all the other varieties, which are often excellent, but are generally inferior to the foregoing, either in tint or structure, or are veined or spotted; they are used for making chimney-pieces, tables, paper-weights, &c., and may be called furniture marbles.

These three classes are susceptible of further sub-division, according to well-known types, around which all the varieties and sub-varieties known in commerce may be arranged.

Statuary Marbles.—These are the most beautiful of the white marbles, and it will be convenient to divide them into statuary marbles proper, and those of lamellar structure, having for type the marble of Paros. The most valuable varieties are those of a fine white colour, with a slightly bluish tint, having a certain amount of transparency, and a perfectly homogeneous lamellar structure, so that the unequal reflection from different sized lamellæ shall not produce a disagreeable effect. The *Venere dei Medici* and the Farnese Vase are examples of the use of the very highest class of material. The varieties uniting all the above characters are of a very high price; among them, are the marbles of the Island of Elba, of Campiglia, and more especially those of Monte Rombolo, which are in nowise inferior to their Greek type.

The friability of some marbles, analogous to that of several kinds of dolomites, is a consequence of their lamellar structure, a fact that should make the artist hesitate in choosing blocks of this character, as they offer but little resistance to the chisel, and are too fragile to be used for ornaments and cornices.

The statuary marbles proper are divided into several qualities; those

of the first quality are exclusively obtained from the Apuan Alps, and may be referred to four types, which are as follows :—

1st. The statuary marble of Monte Altissimo, superior to all others, and universally preferred by sculptors, is the dearest. Of this class are the marbles of Girardino, those of Tambura, and Arni, the large specimen exhibited with the breccias of Massa, and a few others.

2nd. Yellowish statuary marble of Carrara (or *giallgnoeo*), which is principally obtained from Cressola.

3rd. Bluish (*statuario ceruelo*) marble, having for type that of Poggio Silvestro, near Carrara.

4th. Snow white (*bianco niveo*) marble, which is represented by that of Monte Corchia. The extreme whiteness of this variety is considered objectionable by sculptors, as rendering it unfit to reproduce the effect of flesh ; and a defective quality of the grain to which it is subject renders it of inferior value to the preceding varieties.

The presence, or complete absence of spots or veins, and the greater or less homogeneity of the mass, are the essential elements which determine the price of statuary marbles.

After the first class come the statuary marbles of the second class. This term is generally applied to all marbles of a defective structure.

Some of these may be grouped around well defined types, such as the second quality of Monte Altissimo, and those of Massa and Seravezza.

The marble of Betogli, among the specimens from Carrara, forms another type belonging to this group, of which the principal characteristic is the feeble cohesion of its particles, and consequently slight durability. It has, nevertheless, rather a fine appearance, and as it is easily worked it commands a ready sale. This class of marbles, which are known to artists as *saloni*, should be avoided as much as possible for all works of sculpture. The well-known flexible marble of Carrara approach very nearly to this type.

The varieties inlcuded in this division are very numerous, and with the exception of the *saloni*, all, or nearly all of them, are suited for the sculptor's use. Many of these varieties are admirably adapted for large monuments, especially for such as are intended to stand atmospheric exposure, which rapidly alters the delicate grain of first-class marbles ; many, however, are less suited for exposure, and the artist should be careful to avoid using them for such a purpose.

The most esteemed varieties of this class are the marbles of La Polla, in Monte Altissimo, which are of a very close grain, and hard to the chisel, and resist perfectly shock and pressure, and the variable action of the atmosphere. Many of the marbles of Massa are of a similar character.

The varieties of clear white marble extracted from the quarries of Massa, Carrara, and Seravezza are extremely numerous, and are all more or less adapted for the various purposes mentioned above, when properly chosen.

The series of *Ravaccioni*, so called from the marble of Ravaccione of

Carrara, belongs to a transition group leading to the third class, which is represented by the marbles of Trambiserra, Cossa, Monte Altissimo, Monte Corchia, Massa, Carrara, and Lunigiana.

Veined White Marbles.—Under this category are included a series of white marbles, more or less translucent and crystalline, which are traversed by parallel sinuous or reticulated veins of colour, or which are more or less irregularly spotted.

These marbles are not fitted for sculpture ; they can be used for certain architectural purposes, but their chief use is for certain decorative objects, such as balustrades, table-tops, and chimney-pieces. They form a series parallel to the preceding one ; and the prices vary according to the whiteness, transparency, and granular structure of the mass. Those possessing these qualities in the highest degree are the *tigrato* of Altagana (Massa), that of Monte Corchia, the veined statuary (*statuario venato*) of the same locality, the splashed or spotted (*statuario macchiato*) marble of Massa, and many of the marbles of Carrara, which are very fine, although they are veined and spotted.

In addition to the numerous samples of these different marbles, the block of bust size from Monte Altissimo, and the objects shown by Messrs. Guerra in the Exhibition are deserving of special examination. A visit to the sculpture gallery will also be very useful in order to appreciate exactly the nature and properties of the marbles which have just been described.

White Granular Marbles.—These marbles are not nearly so important commercially as the crystalline varieties. In these the metamorphic action has not been sufficiently energetic to destroy the last traces of organic matter, and the original stratification of the rock ; and the crystallising force has not been sufficiently exercised to allow of the entire re-arrangement of the whole of the molecules so as to expel the included impurities.

They are, thereby, impaired by more or less grave defects ; their hardness, solidity, resistance, and impenetrability being greatly inferior to those of the more perfect marbles already described.

From the absence of better marbles, and their extremely low price, they are extensively employed in the localities adjacent to the places where they are quarried. The varieties most in repute are those of the Pisan mountains, Trentino, Vicentin, and the environs of Ascoli. The collection from the Pisan mountains contains some fossiliferous specimens, although they are of the same age as the most perfectly crystalline statuary marble.

Coloured Marbles.—Under this head are included all marbles of a more or less uniform colour, or which are veined, splashed, or spotted equally upon a uniformly coloured base.

Among these marbles, which are very numerous, the following are the most important :—

1. Black marbles, with a uniform or clouded base, or veined with white or yellow.

2. Bardigli.

3. Red marbles of a uniformor clouded tint.

4. Yellow and violet marbles (*broccatelli*).

5. Reddish marbles (*ceciato unito*) or variously veined, which are specially obtained from the *alberese*.

6. Certain varieties of a greenish colour (*verdognolo*).

7. Among the coloured marbles are also included certain breccias, in which the uniform tint of the base is broken by small fragments, or pebbles of limestone of different colours, which were introduced into the mass during the formation of the sedimentary deposit.

Black Marbles.—The finest black marbles with which we are at present acquainted in Italy are those of Caserta Vecchia (Terra di Lavoro) the Pisan mountains, Carrara and Spezia, in the metalliferous chain, and that of the province of Brescia.

The analogy existing between the black marbles of the two latter localities is probably due to an important geological fact. They are for the most part streaked with small white sparry veins, which, by reason of their constitution, traverse the marble in regular lines like small lodes. These white veins are often replaced by smaller yellow ones, as in the celebrated marble of *Portoro* or *Portovenere*, very fine specimens of which are to be found in the collection from Spezia. The most beautiful variety is that in which interlacing veins of a golden yellow colour are set into a uniform black ground.

It must be remarked that the grain of this marble is such that it will not keep its polish without extreme care.

Bardigli.—The numerous series of the bardigli comes next in order; it contains many very precious marbles, the rarest of which is the turquoise blue variety (*bardiglio turchino unito*); the finest specimens are from Monte della Cappella, near Seravezza, some of which are exhibited by Messrs. Garfagnini, Brothers.

The veined bardiglio (*bardiglio venato*) is due to an incipient discolouration of the black marble, which changes the primitive colour into a vague tint, which is much sought after. If the discolouration is only partially extended through the mass, the product is known as flowered bardiglio (*bardiglio fiorito*); when it is carried to its extreme limit we obtain white marble, which, when seen in places or in selected specimens, show the transition from its original to its present condition. The flowered bardiglio is one of the richest marbles that we possess. The finest specimens are obtained entirely from the quarries to the eastward of Seravezza.

Other equally precious varieties are the veined bardigli of Valdieri, in Piedmont, those of Recoaro, Oliero, and Arsiero, in the province of Venice, as well as those of Campiglia, Monte Rombolo, and the island of Elba, in Tuscany, which furnish us with a new example of marbles of lamellar structure.

Red Marbles.—The ammonite limestone, which forms a well-

marked geological horizon throughout the whole of the metalliferous chain of Tuscany, by its regular stratification and its characteristic fossils, is generally of a more or less bright red colour, which is usually very agreeable to the eye. It is quarried in several places.

In spite of its compact character, however, it scales off very readily, and is friable, vitreous, and full of cleavage planes ; in addition to which it is usually only found in thin beds, which prevents it being used for other than table tops and flooring slabs. It is very rarely found of a fine uniform red colour ; when it is so it is usually less defective, and sells at a higher price. The ordinary specimens are of a light red colour, with ocellated marking (*occhiato*), and of a brecciated structure. The specimens of this marble are exhibited in the Italian collections from Spezia, Seravezza, Campiglia, and Camajore, at the Exhibition. In the Central Appennines the middle lias is represented by a red limestone, analogous to the preceding one, and which can be used for similar purposes, as may be seen in the collection from Ascoli. The upper lias also contains a red marble in some of the provinces.

All the red Italian marbles are obtained from one or other of these liassic formations.

Yellow Marbles.—By a peculiar alteration of its colour and structure, the red ammonite marble is changed into a yellow granular form, in the brocatellos and yellow breccias. The valley of Santa Maria del Guidice, in the mountains of Pisa, the mountains of Carrara, the Montagnola Senese, and many of the southern provinces, produce marbles of this kind, which are more or less in demand.

The most famous are the marbles of Sienna, represented by fine specimens from the estate of Cerbaie, belonging to Count B. Tolomei, and from the estate of Seniere, belonging to Mr. G. Nomis. The marbles from the last-named property have not as yet been quarried for sale, but the great beauty of its clear yellow colour, and the large size of which the blocks can be obtained, together with the fine quality of the statuary marble already worked at the same place, make these quarries peculiarly interesting in an industrial point of view.

The three remaining classes of coloured marbles are of an inferior importance. The fine slabs exhibited by Count Orfini, of Fuligno, are good examples of the reddish yellow limestones (*ceciato*) of close grained and uniform texture, which occur in the alberese. The peculiar and delicate colour of this rock renders it very suitable for ornamental purposes. The quarry belonging to Count Orfini is capable of furnishing a large supply, but up to the present time it has only been employed in the immediate vicinity, where there is no great demand for it.

A few specimens of inferior green marbles are to be seen in the collection from Carrara.

In the collection from Ascoli will be seen a breccia belonging to the necomian system ; this is a red limestone, with white spots which are produced by an intermixture of white calcareous pebbles.

VARIEGATED MARBLES.—The most beautiful among the breccias known to us in Italy are those of Terra di Lavoro, but they are not quarried for sale ; some of the alpine varieties are extremely valuable ; that of Coregna, near La Spezia, is very beautiful, but its excessive hardness necessarily prevents it from being very largely used. The mountains extending from Carrara to Seravezza are also remarkable for the ex-excellence of their produce in this particular class, as will be seen by an examination of the breccias and mischi of Seravezza, Massa, and Carrara. The light and dark coloured mixed marbles (*mischi*), the breccias known as *affricano*, the breccias of Rondone, and other localities, the *persichino* of Corchia, and Vallata di Renaia, and the *paonazzi* of Laghetto, Finocchioso, Cava di Sponda, Boccanaglia, &c., are all very brilliant and costly marbles,

BRECCIAS.—The breccias of the metalliferous chain are formed of fragments of highly crystalline limestone, united together by a siliceo-calcareous cement, containing an admixture of a hornblendic substance, which is eminently hard and resistant to the action of the atmosphere. The cement is due to a particular action of the adjacent masses or veins of iron ore, which are found in contact with the rocks in question. The hornblendic cement, with its iron or manganese base, produces the variegated appearance resembling the peacock's tail, and rose colour, peach blossom, and other delicate tints, which may be seen in the specimens from the different localities.

As may be imagined from their composition, these rocks are, as a rule, very impervious to ordinary atmospheric agencies. Examples of this fact are furnished by the *mischi* and *affricano* of Seravezza, employed in some of the principal monuments of Florence.

The great column which formerly stood in the square of San Felice, but which has been lying on the ground for many years, exposed to the action of atmospheric water, has in nowise been injured by such unfavourable treatment. The tenacity with which the Porto Santo, the Affricano, the Brillante, the Paonazzo, and other varieties retain their polish is another valuable quality which renders them eminently adapted for the more costly class of decorative works.

The whole of the Italian calcareous formations, of all ages, furnish a supply of excellent marbles from the miocene lumachella, down to the upper triassic and muschelkalk limestones, and perhaps those of an older period.

The best known and most esteemed marbles are, as has already been seen, principally obtained from Tuscany.

The white marbles of saccharoidal structure are those which are now principally preferred by sculptors. The most perfect blocks that could possibly be obtained are those of lamellar structure, derived from the quarries of Campigliese and the island of Elba. As regards saccharoid marbles, they are exclusively obtained from the Apuan Alps, and more

especially from the wild mountains which rise above Carrara, Massa and Scravezza. Large quantities of marble were obtained in the time of the Romans from the mountains of Lunigiana (*Montes Lunenses*); and the name of Carrara statuary marbles is known all over the world. Leo X., Cosmo I., and Francis I., of Medicis, devoted much of their time and attention to the working of the marbles of Seravezza, the excellent quality of which was demonstrated by Michael Angelo, as well as the difficulty of obtaining them "until the mountains were lowered and the inhabitants tamed," two processes which have never been fairly accomplished until a very recent period. The extraction of the marbles of Seravezza has been re-established on a large scale, Russia alone having taken them to the amount of one million roubles (about 150,000*l.*) for the construction of the cathedral of Saint Isaac, at St. Petersburgh; and the population of the district of Pietrasanta has increased in 30 years (from 1819 to 1850) from 15,495 to 23,200 inhabitants, or nearly 50 per cent.

In addition to rough blocks, Seravezza exports a considerable quantity of table-tops, flooring-slabs, and other sawn products. The trade of Carrara has recently increased to a considerable extent, owing chiefly to the efforts of the Local Academy of Fine Arts. In like manner the trade of Massa has increased in a manner that leads us to expect a still further expansion, for a great number of its marbles are of a character resembling the statuary marble of Monte Altissimo, and their architectural qualities are in every way equal to those of Seravezza, both as regards uniformity and durability, and they are equally well adapted to the most delicate kinds of sculpture. A marble, analogous to that of La Polla, already described, and comparable to the statuary quality of Crestola, is found in large quantities in the romantic and picturesque ravine of Equi, in the Lunigiana.

The greatest possible care is necessary in the selection of marbles for exportation. The opinion current in Paris, that the marbles of Carrara are unable to withstand the effects of the climate of that city, is due to the frequent use of Saloni and Ravaccioni of a bad quality, the slightest coherent marble of Betogli, and other inferior descriptions from the Carrara country.

The Montagnola of Sienna furnish *broccatelli* and yellow marbles. If the quarries belonging to Mr. Nomis were opened and properly worked, the supply of these rare qualities might be largely increased, more especially the yellow variety, which is now rarely found in large blocks.

The *Portoro*, which is obtained from the western chain of the Gulf of Spezia, is also extremely rare, if fine golden-veined specimens are required; fresh supplies might, however, be obtained by opening quarries on the other slope of the chain, where this formation passes to that of the ammonitiferous limestones of the lias and of the palæozoic rocks.

The mixed marbles and breccias are very abundant; and, with an in-

creased demand, they might be supplied in England and France at a lower price than the marbles of the country.

For the purpose of comparing the cost of the different varieties of marble, the following tables of the prices at the most important seats of production, and at the city of Florence, are added :—

PRICES OF THE PRINCIPAL VARIETIES OF MARBLES AT FLORENCE.

	Per Cubic Metre.		
Statuary, first quality, Monte Altissimo	£56	0	0
„ Carrara	48	0	0
Marble of La Polla, first quality	24	0	0
Statuary veined or clouded, for architectural purposes, furniture, &c.	24	0	0
Clear white, good quality	16	0	0
Ravaccione of Carrara or Seravezza	12	0	0
Bardiglio, plain or veined, Seravezza	16	0	0
„ flowered, Retignano, Seravezza	26	0	0
Portoro of Porto venere (Spezia)	20	0	0
Plain red Caldana	15	4	0
Red spotted, from Maremma	8	0	0
Yellow and brocatello of Sienna	24	0	0
Partasanta of Maremma	20	0	0
Mixture (mischi) of Seravezza	40	0	0
Breccia of Rondone di Stazzemma (Seravezza)	24	0	0
Breccia affricana of Seravezza	60	0	0

It must be remembered that no fixed list of prices can be given for statuary, coloured or variegated qualities of a high class, as the price of the individual block depends on its size, uniformity, colour, and a number of other circumstances which can only be determined by inspection.

The price is generally given at per palm (palmo), Genoese measure, and the rate increases more rapidly, particularly in good marbles, for blocks measuring several palms. The cubic metre, mentioned in the tables, is a conventional measure of 64 palms, or about 28 cubic English feet ; it must not be confounded with the cubic metre of the French system, which is equal to 35·3 cubic English feet. The ton is equal, on an average, to 25 palms.

PRICES OF THE MARBLES OF SERAVEZZA, DELIVERED AT THE WHARF OF FORTE DEI MARMI.

		£	*s.*	*d.*		£	*s.*	*d.*
Ordinary white from Costa di Ceragiola, Solaio, &c.,	from	4	0	0	to	6	0	0
Ravaccione from Trambiserra	„	5	0	0	„	6	0	0

		£	s.	d.		£	s.	d.
Bardiglio, plain, best quality - -	from	6	0	0	to	10	0	0
„ flowered - - - -	„	18	0	0	„	22	10	0
White clear della Polla - - -	„	16	0	0	„	20	0	0
„ ordinary - - - - - -	„	5	12	0	„	6	8	0
Falcovaja ordinary - - - - -	„	9	4	0	„	10	5	0
Statuary, best quality, from Falcovaja, for blocks cubing 1 metre 16s. per Genoese palm - - - - -	„		...		„	51	4	0
For blocks of 1,000 palms and upwards, the price ranges up to 24s. per palm or per metre - - - - - -	„	80	16	0		...		

MARBLES OF CARRARA AND MASSA, DELIVERED AT AVENZA AND SAN GIUSEPPE.

		£	s.	d.		£	s.	d.
Paonazzo from Finocchioso - -	from	12	0	0	to	51	12	0
Bardiglio - - - - - - -	„	5	8	0	„	8	8	0
Clear white Ravaccione - - - -	„	5	8	8	„	8	8	0
Statuary veined - - - - -	„	7	12	0	„	10	8	0
„ 1st quality, up to 1 metre cube	„	16	0	0	„	30	8	0
„ „ 2 metres „	„	28	0	0	„	40	0	0
„ „ 3 metres „	„	36	0	0	„	48	0	0

MARBLES OF LA SPEZIA.

	£	s.	d.
Black - - - - - - - - - - - -	8	0	0
Portoro, 1st quality - - - - - - - - -	18	0	0
„ 2nd quality - - - - - - - - -	14	0	0
Biassa red - - - - - - - - - - -	12	0	0
Breccia of Coregna - - - - - - - - -	24	0	0

MIXED MARBLES AND BRECCIAS OF SERAVEZZA.

	£	s.	d.
Pallidone - - - - - - - - - - -	28	16	0
Light coloured mixture (mischio chiaro) - - - - -	20	8	0
Granitello - - - - - - - - - - -	26	16	0
Breccia of Rondone - - - - - - - - -	20	8	0
Paonazzo - - - - - - - - - - -	15	12	0
Giallino (yellow) - - - - - - - - -	22	8	0
Rosato (rose coloured) - - - - - - - -	22	8	0
Affricano - - - - - - - - - - -	44	16	0
Campaneso - - - - - - - - - - -	44	16	0
Brillante - - - - - - - - - - -	44	16	0
Mischio cupo (dark mixture) - - - - - - -	33	15	0
Doratello - - - - - - - - - - -	44	16	0
Broccatello - - - - - - - - - - -	88	0	0

TABULAR VIEW OF THE AVERAGE ANNUAL EXPORT OF THE MARBLES OF CARRARA, MASSA, AND SERAVEZZA.

Compiled from the Customs' Register for the years 1855–59, *and from Returns furnished by the Exporters.*

DENOMINATION.	CARRARA.		MASSA.		SERAVEZZA.	
	Tons.	Cub. Met.	Tons.	Cub. Met.		
Ambrogette (flooring slabs) - - - -	904	18,080	652	13,040	No. 1,000,000	
Lastroni (large slabs)	163	1,954	1,011	12,632	,,	
Slabs - - - - - -	1,090	939,800	804	16,080	,,	
Ravaccione - - / White pure - - / ,, veined - -	Bardiglio and other coloured marbles.	12,400	Bardiglio and other coloured marbles.	1,200	Striped marble (tigrato).	Cub. Mt. 5,000
Statuary, 1st qual. / ,, 2nd ,,	...	480	...	35	... / ...	20 / 100
Bardiglio, plain, veined, & flowered	...	...	...	...	...	2,500
Breccias and mixtures	...	...	...	...	...	70

Of the above quantity produced, about one-third is taken by North America, another third is sent to France and England, while the remaining third supplies Belgium, Holland, Russia, Turkey, South America, and the interior of Italy. The greatest export of flooring slabs is to the Levant; the prices are from 2*s.* 6*d.* to 3*s.* 6*d.* each, for squares of 9¾ inches.

In 1859, the export duty on marble was abolished, so that there is no means of ascertaining the production during that year.

THE SEED OF OWALA OR OPOCHALA, OF THE GABOON AND FERNANDO PO, AND THE OIL WHICH IT CONTAINS.

BY J. ARNAUDON.

Among the products sent by the French Colonies to the Universal Exhibition at Paris, in 1855, was the owala seed, exhibited as coming from the Gaboon (Western Africa) from whence it had been sent under the direction of M. Aubry-le-Comte, now curator of the Paris Colonial Museum, and it is to his kindness that I owe the specimen which I have made the subject of this paper. I could obtain only very vague information at Paris, as to the nature of the fruit and the plant to which this seed belongs, for they were unknown in the various museums of natural

history in that city, and it is only recently that I have, by the assistance of Sir Wm. Hooker, been enabled to examine them in the Botanical Gardens at Kew. I succeeded in seeing there the entire fruit, which is a pod of about 1 foot in length by $1\frac{3}{4}$ to 3 inches wide. Its general shape resembles that of a large haricot, its surface is brown and wrinkled. The two valves open easily, and display four or five seeds separated from each other by the same number of compartments. Of these seeds those near the ends of the pod are smaller and more angular in shape than those in the centre, which are oval. The length of this seed is nearly double its breadth, its weight varies from $\frac{1}{3}$ of an oz. to $\frac{3}{4}$ of an oz., and its density is greater than that of water. It consists of two principal parts, a husk and a kernel. The husk very much resembles that of the large chesnut in colour and brilliancy, but it is thicker and its structure more compact and less elastic. Its surface too is unequal, presenting sinuosities or raised fibres, which extending from the sharp end of the seed, where it is attached to the pod, reunite themselves towards the opposite extremity. The husk is strongly attached to the kernel, though it can be peeled clean off without fracture, and the imprint of the fibres can then be seen on the perisperma or exterior husk. The kernel is of a greenish white colour, which becomes darker by exposure to the air; it consists of two cotyledons closely united to each other.

Many experiments have shown me that the mean between the weight of the husk, and the total weight of the seed, is from 1 to 6, for instance,

Husk	16·66
Kernel	83·34

The quantity of water in the whole seed is $5\frac{1}{3}$ per cent., and of ash $2\frac{6}{10}$ per cent. The husk contains $5\frac{1}{2}$, and the kernel $2\frac{3}{5}$ per cent. of ashes, but the ash of the former contains more silica than that of the latter. The oil of the kernel, although considerable in quantity is obtained with difficulty by pressure. In an experiment with ether, I obtained from the kernels alone, 62 per cent. of oil, and 57·47 per cent. from the seed and husks. When the oil had undergone repeated washings in distilled water, and the superfluous moisture had been drained off, its proportion was reduced to 56 per cent. in the case of the almonds, and 50·11 per cent. in that of the whole seed,

This oil known as *owala* in the Gaboon, and *opochala* in Fernando Po is of a clear yellow colour, but becomes brown when it has been purified. At a temperature of 11 deg. it gradually becomes less limpid, at some degrees lower it becomes turbid, and at zero changes into a viscous mass. Its density is very nearly the same as that of olive oil. If this oil be spread in thin layers over the surfaces of different substances, and left for several days exposed to the air it still preserves its original fluid state. This property the oil of owala possesses in com-

mon with the oil of ben (*Moringa aptera*), and is valuable for diminishing friction in clockwork.

The oil which I obtained was rather acrid, but this might have been the result of the age of the seeds, and the damage inflicted upon them by the voyage. It has rather a marked odour, which, however, is by no means disagreeable ; it resembles very much that obtained from various pulses. The flavour, too, which it possesses is an agreeable one ; indeed, I have but little doubt but that this oil will some day be a useful addition to those already in use for comestible purposes ; in fact, the *Boulons* or *Bushmen*, a tribe in Senegal, employ it in the preparation of their food.

If an attempt be made to dissolve this oil in alcohol without heat, the improbability of success soon becomes apparent, the spirit, however, carries off a peculiar matter as well as a part of its aroma.

One of the most remarkable properties of this oil is the colour which it developes under the influence of sulphuric acid. If the farina, or the oil obtained from the kernel be dissolved in concentrated sulphuric acid, the mixture takes first an olive, then a violet, and finally a bright crimson red colour, which will, however, sometimes disappear on the addition of a certain quantity of water. I was induced by the appearance of this phenomenon of colour to seek for the producing cause, and endeavoured to find in what part of the seed this property displayed itself in its maximum of intensity. To accomplish this I commenced by dissolving part of the kernel in water. Upon this solution, the moisture being all drained off, I poured a quantity of concentrated sulphuric acid, and it became slightly brown, but no trace of the red colouring matter appeared. From this experiment I concluded that the part of the kernel wherein lay the power (when aided by sulphuric acid) of producing a red colour was insoluble in water. The same operation was performed upon another portion of the kernel dissolved by the aid of heat in alcohol. This experiment produced a magnificent red colour, and proved that the colouring matter is soluble in alcohol. When ether was substituted for alcohol, the colour produced was no longer red, but violet, which became less intense upon the admixture of ether or alcohol, and this caused me to infer that the application of ether changed in a great degree the nature of the colouring matter, or that to develope the red colour some matter insoluble in ether was necessary. If so, this would be found in the etherised residuum. That the last supposition was correct will be seen from the following experiment. Having exhausted with ether a certain quantity of kernels, and dried the insoluble residuum, I recovered it again with alcohol boiling. I subjected the alcoholic extract to evaporation, and there remained a viscous mass very similar in appearance to molasses, which became brown when I added a little sulphuric acid. I mingled a little sugar syrup with the oil obtained by ether (which, as I have said, took only a light violet tinge), and poured on the mixture some concentrated sulphuric acid. The mass

speedily took first an olive and then a red colour ; in fact, the result was the same as in the case of the kernel itself. As I perceived that the absence of sugar was the cause of the etherised extract not developing the red colour on the application of sulphuric acid, I conceived the idea of replacing the natural saccharine matter of the seed by common sugar. Experiment encouraged that idea, for the result in all cases was the same phenomenon of red colour, and therefore the presence of sugar is absolutely necessary to produce it. After I had ascertained in what parts of the kernel that red colour could by the aid of sulphuric acid be produced, I was desirous of assuring myself whether extérior agents had any influence on the production of this phenomenon. I first tried the effect of light, and for that purpose exposed one portion of the mixture of the nut and acid to the rays of the sun, and kept another portion in darkness. In both cases the red colour made its appearance after a short time, with nearly the same degree of intensity. The next agent experimented upon was the atmosphere, and two quantities of the solution were kept, the one in the open air, the other in an hermetically sealed vase. The result was that in the latter no colour made its appearance, while in the former it was very vivid. At one time I fancied that the colour was attributable to the admixture of a small quantity of water, but further experiments proved that water was of no service, that oxygen alone of all atmospheric agents had any influence. The path of a current of air passed over the mixture of oil, sulphuric acid, and saccharine, could be traced by the appearance of the bright red crimson on the parts of the surface exposed to its influence. The pulp divested of oil by the aid of ether, contains albumen, more or less coagulated ; an albuminous matter that is not coagulated by ether, although it is by alcohol and heat ; tannin, precipitated by salts of iron, or carbonate of potash ; an azotic matter, combined with an organic acid ; a saccharine matter, which is the principal agent in producing the red colour of the oil, by the addition of sulphuric acid. To dye stuffs, it is only necessary to boil them in an infusion of the kernels of the seed of owala, or of the cake. They are then exposed to the air, and the result is a rich brown colour, and this colour can be varied by the different mordants, or of étain ; if put into an iron bath, they become very black.

The seed of owala may be considered one of those substances which are richest in oil principle. Oil obtained from it can be employed for domestic purposes, in mechanical industry, and in soap making. The residuum, or *tourtean*, which remains after the extraction of the oil, is a powerful dye, especially to produce black, and the remains of this tourtean used for that purpose will serve for " engrais." Lastly, we have seen that there exists in the kernel a curious principle, at least in a scientific point of view—viz., that of taking a crimson hue when acted upon by a saccharine matter and concentrated sulphuric acid.

PURIFICATION OF PETROLEAN OILS.

An almost colourless naphtha arises from the earth at Baku, on the border of the Caspian Sea, accompanied by hydrocarbon vapours, which are collected and used for heating and lighting. It is also used in lamps in its natural state. A single distillation renders it quite pure. From the presence of paraffin the Rangoon petroleum is nearly of the consistence of butter at the ordinary temperature. It has been treated with sulphuric acid and the alkalies in the manner recommended for coal oils. The paraffine, which was first discovered by Mr. Faraday, is also treated with the acids, and then submitted to pressure. Much of the Persian oil is colourless, and is consumed in lamps without purification.

The petroleum of South America and the West India Islands often contain much sulphur, and their odour is very offensive. The petroleums of volcanic districts were much more offensive than those of undisturbed localities. Boiling mud with steam issues from the earth on the shores of Trinidad, and raises itself into conical mounds, sometimes fifty feet high. The petroleum at those places has an intolerable odour, and contains sulphuretted hydrogen. Gold is immediately tarnished by the gases of these sulphurous distric s. All these natural hydrocarbon oils require active treatment to render them unobjectionable for domestic purposes. The alternate use of acids and alkalies have been found the most effectual in their purification.

The petroleums of the United States, of which great quantities are now obtained, differ much in their densities of proofs. Some of the wells in Venango county, Pennsylvania, afford oils of a specific gravity 0·800. In other parts of the oil region the petroleums have densities of 0·850, and even 0.900. Indeed these heavy semi-liquid hydro-carbon compounds sometimes pass into compact bitumen, an example of which may be seen in Jackson county, Kentucky, and also at other places.

These deposits of solid bitumen have probably been produced by the evaporation of the higher hydro-carbons, and by the oxydation of those beds which now appear like the sites of ancient lakes. They are quite different in their origin and characters from the injected masses of solid asphalte discovered in Richie county, Virginia, and in Albert county, in the province of New Brunswick.

From the great difference in the densities of these petroleums, there is a great difference in regard to their value and their treatment in the process of purification. Of the lighter oils, ninety per cent. of pure oil for illuminating purposes may be obtained; but of the more dense varieties, and those which contain much tarry matter, not more than forty or fifty per cent. of lamp oil is at present produced. The result has been the same as that in the manufacture of coal oils. Large quantities of the heavy oils and impure paraffin accumulate in the distilleries, and

will continue to increase until a cheap and successful process is discovered for their decarbonisation.

The methods practised by persons engaged in refining the American petroleums are as different as those in use for the purification of the oils distilled from coal. Some employ acids and alkalies, others use alkalies alone, and steam is applied at various degrees of heat. Some of the oils produced by those means are of good quality, others are inferior, and do not ascend the wick of the lamp in sufficient quantities to afford a constant light. In others, the illuminating principle, by some change effected on the carbon, is partially destroyed, and in almost all the odour is disagreeable. The oils from some of the wells contain traces of chloride of sodium, others carbonate of soda in quantities sufficient to affect their treatment. The denser oils, or those which contain too much carbon to admit of being consumed in lamps without smoke, are excellent lubricators, either mixed or unmixed with animal oils.

It will be perceived by the foregoing statement that it would be a difficult task to prescribe a mode of purification to meet the requirements of the oil-refiners. Neither the petroleums, nor the oils distilled from them, contain creosote, or carbolic acid, and other impurities which contaminate the oils distilled from coals and coal shales, their purification, therefore, is simple and comparatively cheap.

When the proof of the oil is not below 38°, distillation with water, or by the use of steam, will most frequently render the lamp-oil of good colour, and its illuminating properties will be of the highest order. Before the heavy oils, or those below the proof of 38°, are submitted to any treatment, it is necessary to give them a preliminary distillation, by the aid of common or superheated steam, and the distillate should be separated into two parts, all below proof 38° being set aside to be treated for lubricating oil, and a farther portion to be added to the illuminating oil. Washing a lighter part of the charge with a solution of caustic potash, or soda of specific gravity not exceeding 1,400, is useful. A final distillation over a weak solution of either of those alkalies will generally render the oil pure. The heavy parts of the oil may require agitation with equal parts of sulphuric acid and water, followed by an alkaline wash, and then distillation. It is only the most impure oils, and those from the wells of certain localities, that require the use of acids, which, like the strong alkalies, when used in excess, greatly impair the illuminating properties of these hydro-carbons. The lighter the oils the lighter the colour. At proof 45° they are colourless. At proof 42° colouring matter begins to appear in the distillate, and continues to increase until the charge is exhausted. In order to present the lamp-oil of a light colour, some refiners have sent it to the market at proof 45°; but it should be understood that such oils are much more inflammable and liable to explode than those at proof 40°. Colour, in this instance, should be sacrificed to safety. The offensive odour of these oils is removed by the means laid down for the deodorisation of coal oils. A

valuable property of all the before-mentioned oils consists in the fact, that they never become rancid nor ferment; indeed, they become improved by age, and gradually lose their unpleasant odour.

It is unnecessary to enlarge upon the advantages which must evidently result from the manufacture of oils from mineral substances. Some of the uses to which those oils may be applied have been noticed. Doubtless there are others to be discovered. The light afforded by the hydrocarbon oils is equal to that of gas, and in an economical point of view it is unrivalled.

ON THE CULTURE OF LATAKIA TOBACCO.

BY M. CHARLES EDWARD GUYS.

The district of Latakia is situated in the northern part of Syria, and produces the best tobacco that is obtained from that province; the town is built near the sea of Tripoly, on the place where stood formerly the ancient Laodicea.

It could once boast of a harbour which has, in course of time, been completely blocked up, and a kind of exterior roadstead, which has been so reduced in size that none but vessels of the smallest burden can now enter it. Unless some speedy steps are taken to remedy this evil, it will soon be closed to all but the smallest boats.

Behind this town there is a plain of about 6 leagues broad by 14 long, extending from Gibelette on the south, to the foot of Mount Cassius (or Gebel Akerar) on the north. From Gibelette to this mountain there is a plain of smaller mountains, which extends in the form of a circle for many leagues into the interior. These mountains are inhabited by the Nerseris or Ansaries, who, in the time of the crusades, were, from the cruelties committed by them, known by the name of "Assassins." They are also to be found in the valley, and there, as well as on the mountains the cultivation of tobacco forms their principal occupation. It certainly requires a great amount of attention and care, but the returns obtained are proportionally remunerative. The plain is traversed by a river, known as the Nahr El-Thebir, from which, by means of drains, they obtain sufficient water both for the tobacco, and all other plants to whose sustenance that element is necessary. Soon after the commencement of the rainy season (about the end of October), the soil destined for the tobacco plant is broken up, and this process is repeated a second and a third time if rain has fallen in the interval. The soil is also harrowed for the purpose of breaking the clods.

In the month of January, the seed is sown in a situation that has some degree of shelter. The soil has been previously so well worked

that a stick can be easily thrust into it, and by this simple means they make small holes of about 4 or 5 inches deep, and from ten to twelve seeds are put into each hole. As soon as they begin to shoot, the ground is covered with mats, which are removed only when the sun appears. Women and children are then employed to keep off poultry and other birds, whose attacks would be very prejudicial to the young crops. At a more advanced stage the weaker stalks are pruned off, while at the same time all parasitical plants are carefully removed, and great care must be taken to perform this operation properly, in order to ensure a good crop.

During the month of February, before the hot season (which is very early in Syria) commences, the process of transplantation takes place. The plants are removed to fresh soil, surrounded with earth and well watched. As they become larger, all buds and yellow leaves are pruned off, and this refuse is placed round the roots of the plant, to which it serves as excellent manure. In March they must be well watered, a supply of which is procured from the drains, and caused to flow through all the rows in which the plants are placed. The water is cut off as soon as the supply is sufficient. The leaves now begin to make their appearance in great numbers.

In April the plant is ready for manufacture. The leaves are removed and dried, either in the sun or before an open fire. This is the favourite tobacco of the Fellahs, and is called "new tobacco;" it is said to be stronger than that which has been kept some little time. But as far as my own experience goes, tobacco, like wine, needs age to bring out all its qualities, and certainly the taste of the much vaunted "new tobacco" was, in my opinion, not very agreeable.

From April to August the quantity of water required for the sustenance of the plant varies according to the temperature. Those leaves that begin to get yellow are removed, and in the month of May they also cut the tops of the stalks. Finally, only about 15 or 16 leaves are left on, these are the greenest and the nearest to the summit of the stalks.

All the leaves have turned yellow by the end of August. The harvest commences in July, in the south in September; when the stalks are cut just above the root and the leaves removed, great care being taken that the leaves are not bruised or injured in any way. They are then made up into bundles, having been tied together at the lower part of the side and placed on mats, which are removed into the cabins, the principal drying places in that country. These bundles are turned from time to time, in order that the tobacco may be equally dried on both sides. In November it has become perfectly dried and the bundles are made up into packages, or else folded up in a great number of layers.

The tobacco is now transported into the town in sacks of horsehair, and placed in the hands of merchants. In their storehouses it undergoes a new preparation: the first step being that of drying it again, it evidently being the interest of the peasants to sell it when wet, in consequence of the increase thus gained in weight. It is next divided according

to the soil from which it has been obtained. The different qualities are thus produced, and again subdivided according to the colour and flavour of the leaf. All the tobacco that comes from the plain of Latakia is denominated Dgidar, and we class it among the *Nicotiana rustica.* That produced in the mountain districts, of which we shall presently speak, is known and esteemed in Europe as Latakia tobacco. Dgidar tobacco, although esteemed an ordinary kind of tobacco, is rendered suitable for exportation, and preserved from damp, by means of the preparation received in the storehouses. It gains by a sea voyage, for the air impregnated with saline matter, has a favourable effect upon it, while the heat in the hold of the ship also has a tendency to improve the quality. So greatly does a sea voyage improve the tobacco, that it is not an uncommon thing for merchants to entrust captains of outward bound vessels with large quantities to be returned at the end of the voyage. And I know, from actual experience, that tobacco thus treated is more brittle and agreeable in flavour than that which has not received the benefit of the sea air. With regard to the seed, care is taken to leave as many plants uncut as will produce sufficient for the next seed-time. The plants are carefully protected from the attacks of the winds, which would break the stalks that are now heavy with pods. These pods must ripen on the plants in order that the seeds may be well matured, and dry. A sure method whereby to ascertain if the seeds are properly dry is to shake the pod. If the result is a rattling sound, they are immediately gathered and placed in large quantities in horsehair sacks. Horsehair is preferred to any other material, because it is naturally dry. These sacks are bound at the orifice by rope of the same material, and are hung in the interior of the huts or cabins.

The different kinds of Latakia tobacco are—1. The *Dgidar*, of which we have already spoken, considered as a medium or ordinary quality. 2. The *Abou-Riha*, or *Dgebeli*, which is the finest tobacco, but is found in its best state only in the mountains of Nesseries, or Ansaries, as they are called by us. Its superiority is besides principally owing to a particular kind of preparation, which we will speak of hereafter. There are two kinds of this tobacco, different in quality, and it requires a connoisseur to distinguish between them. The Abou-Riha has a great reputation, in Europe particularly, and also in Egypt, and other places where a mild tobacco is preferred. 3. The *Dgidar*, which includes the Gauti and other inferior kinds. It holds a medium place between strong and weak tobacco; is rough, and burns easily, because it contains very little oil. Rejected by good smokers, it is a tobacco much in favour, on account of its cheapness, with the common people, who as long as they have a pipe in their mouths would smoke anything, even straw. 4. That known by the name of Schiek-el-Bent, the quality of which approaches the Abou-Riha, with which, indeed, it is often mixed by the merchants of Latakia. The Nesseries formerly dwelt in large numbers in the plain of Latakia, but being constantly harassed by the

Turks, the greater part of them removed into the mountains which form a cordon around the town, and extend as far as the borders of Antioch, and abut on Dgerser-el-behowel, a town dependent on the pachalick of Aleppo. Their almost sole occupation was the cultivation of tobacco. At the time of the harvest they were at war with Latakia, and determined to keep the crop, when gathered, in a safe place until the return of peace. It being then the commencement of winter, fires were lighted in the cabins, in which as usual the tobacco was hanging. The wood which served them for fuel was a species of the *Quercus ilex*, known by the local name of "Ozer," and as chimneys were unknown, the cabins speedily became filled with smoke, and the tobacco thoroughly impregnated. In April of the ensuing year peace ensued, and the commerce in tobacco was renewed with the town. At that time mountain tobacco was known by the name of Dgebeli. Surprise was felt by the buyers at the colour of the tobacco, which was of a black instead of, as formerly, a yellow hue. They thought it expedient to taste it before completing their purchases, and filled and lighted their pipes for that purpose. Their astonishment was increased instead of diminished at finding the flavour and odour of the tobacco far superior to that which it possessed before. A few inquiries elicited that it was the smoke which the tobacco had, so to speak, imbibed during the interval it was retained in the cabins that had produced this extraordinary effect. A demand speedily arose for this kind of tobacco, and the name of *Abou-Riha* (father of perfume) was given to it in consequence. Now all tobacco from this part is kept in the above manner from November to April, and it is to this that its quality is in a great measure owing. The product of the tobacco from the mountains is about 3,000,000 Turkish piastres, and as cotton and silk also form profitable occupations in that country, the Nesseries would be very wealthy and comfortable were it not for the attacks and demands made on them by the Pachas. Egypt obtains almost all her tobacco from the province of Latakia, for its own soil is not fitted to its cultivation. Nor have they succeeded in growing it in Arabia. This plant needs a pure, cool, and fresh soil, whilst in those countries sand is the principal component, and coolness is almost unknown. The richer orders in Egypt smoke Abou-Riha, and the poorer classes the ordinary qualities, while those whose poverty will not allow them to buy any tobacco at all, make shift with the residuum in the pipes of their more fortunate neighbours, who, luckily for the poor, only smoke their pipes half through.

From the Koura, or plain at the foot of Mount Lebanon, to the Nahr-el-Kelb (or dog river), are found the most esteemed tobaccos in Turkey. They are, perhaps, rather strong, but are very much liked by those who are really good judges. We will now proceed to mention some of the countries which produce these articles of luxury.

The Koura is a large plain which lies at the foot of Lebanon, between Tripoli and the mountains ; is traversed by two rivers, and intersected by

many streams. Protected by the neighbouring mountains from the south and east winds (the driest and most sultry in the East), it lies open to the north and south, which are cooler and more refreshing. From these advantages this district enjoys a considerable vegetation, and a soil very suitable to the production of tobacco. It is cultivated there in considerable quantities, and transported thence into almost every part of Turkey.

On the lower part of Lebanon, on the same side, are the villages of Sebail and Serai, where tobacco is produced that is held in better estimation than that of the Koura.

In the Kesrasan, or as we call it, Castravan, lies the district of Gebail, from whence comes the best, and, consequently, the dearest, tobacco in Syria. It is very brittle, and its ash is white, unlike that of most other tobaccos, which usually, when smoked, leave a black or dark grey ash.

The south of Lebanon, like the district of Tripoly, produces only tobacco of very ordinary quality, known as Salili, Tanoné, Takibé, and also under the general name of Bérraoni. There is very little care bestowed upon their cultivation, and they are planted in the first bit of soil that comes to hand. These three kinds (which, in fact, are one and the same) are also inferior to the Dgidar. However, tobacco is obtained in the south of Lebanon, of which large quantities are shipped at Sour the ancient Tyre) for Egypt, where it is smoked, after being mixed with a stronger tobacco, in the same manner as the Koura.

We have said, when on the subject of Latakia, that the best of the Dgebeli tobacco was called Abou-Riha, but it is the Karn-el-Gazel (horn of the gazelle). The plant grows to a height of a little over three feet, its leaves are numerous, very compact, long and narrow. The flower is large and white, but when the plant has arrived at maturity, it takes a purplish tinge.

The second quality of the Dgebeli is the *Bonati.* The plant which produces it, grows to a greater height than the Karn-el-Gazel, and the leaves are larger, of an oval shape, and thicker at the sides.

The Dgidar, I have been informed by creditable authority, is identical with the *Nicotiana rustica*, and the same class will include all the tobaccos which bear the name of Bezzaoni, and many others of the inferior kinds.

I have been informed that there is a tobacco in Syria called Ksar, which, as they say, belongs to the second quality, and is very good, but I have never seen it. The provinces of Aleppo and Damascus produce very small quantities of tobacco, neither is much obtained from Palestine.

THE SULPHUR OF ITALY.

BY P. BIANCHI.

The present production of the Italian sulphur mines is not less than 300,000 tons yearly, which, taken in a crude state, represents a money value of 1,200,000*l.* It is estimated that the annual production in the year 1830 was only one-tenth of the present yield.

The greater part of the above quantity is derived from Sicily; the Romagna, however, is commencing to increase the supply, and at the present time contributes about 8,000 tons per annum.

An important improvement in the method of separating the sulphur from the accompanying limestone has been practised in Sicily for the last ten years.

The separation of the sulphur from the gangue is always effected by liquation, the necessary heat for the fusion being obtained by burning a portion of the ore; this operation, which was formerly effected in small cylindrical open kilns (*calcarelle*), is, by the improved process, performed in heaps which are often 400 times the capacity of the kilns. The ore is arranged in a manner similar to that employed for charcoal burning, the air being excluded by an impermeable covering of earth.

By the new process, the loss occasioned by the formation of sulphurous acid has been largely diminished, the production is increased by one-fifth, and the new heaps can be placed close to houses and gardens, instead of its being necessary to keep them several miles off, as was the case with the old system. Another advantage consists in being able to ignite the heaps at any time, doing away with the necessity of keeping large masses of ore in reserve for firing at a particular season of the year, and, lastly, it has converted a process, formerly of the most deadly effect on the workmen employed, into one almost entirely free from danger.

The mines belonging to the Romagna Sulphur Mining Company of Bologna are eight in number, five of which are in the district in the province of Forli, Romagna, and three at Monte Feltre, in the province of Urbino and Passaro, in the Marches.

The names of those in the first group of five are, Firmignano, Luzzena, Fosso, Busca, Lontemauro.

In the second group the mines are named, Perlicara, Marazzana, Montecchio.

The most important of these are the first one in the first group, and the first two in the second group.

The refined produce is exported chiefly from Rimini, where the refining establishment is situated, to the principal centres of consumption among the large towns of Italy, including Venice, Trieste, Ancona, and to Lombardy, Tuscany, Rome, &c.

Refined sulphur is used in various manufactories for making sulphuric

acid, and, for several years past, a new use has been found for it in the sulphuration of vines.

The price of sulphur is constantly increasing. The following are the present prices, delivered either on board ship at the ports of Rimini and Cesenatico, or at the railway stations of Rimini and Cesena :—

	£	s.	d.	
Refined sulphur in lumps...	8	10	6	per ton
,, sticks...	10	3	6	,,

Sulphur is found here and there at different places in the Neapolitan provinces, but not in any considerable amount.

In the volcanic country of the Solfatara it is mixed with clay and other substances, from which it is separated by sublimation. The produce is very unimportant in amount.

Small scattered deposits are also found in Majella, the largest is that of Santa Liberata, near Lettomanopello, which belongs to Messrs. Leonelli, and yields a small annual profit.

The discovery of a sulphur-bearing deposit at Civitanova, in the province of Molise, has been recently announced to the Royal Institute for the Encouragement of the Useful Arts, but nothing more is known of it beyond the fact of the occurrence at the spot named of a limestone impregnated with sulphur, whose extent and value is as yet undetermined. Sulphur has also been found at a place called San Regina, about two miles to the eastward of Ariano, but whether it is in workable quantity or not is at present unknown.

From the above evidence we are forced to conclude that no commercially valuable deposits of sulphur have as yet been discovered in the southern continental provinces.

The gypsum and sulphur bearing formation of Sicily covers a large portion of the island, extending from Mount Etna to the neighbourhood of Trapani. The most important mines are principally situated in the provinces of Caltanisetta and Girgenti. The provinces of Catania and Palermo are next in importance, while the mines in the province of Trapani are the least productive.

The geological horizon of the gypsum beds is not yet satisfactorily determined ; these have hitherto been supposed to be of mesozoic age, but more recent observers are inclined to assign them to a more recent period. In Sicily, as well as in the Romagna, the gypsum formation includes limestones, clays which are more or less marly, and beds of gypsum ; in the latter rock, as well as in the limestones, the sulphur is found as an uniform or irregular mixture, sometimes concentrated in small parallel seams, and occasionally crystallized. In the latter case it is often associated with sulphate of strontia, or celestine.

In the clays and slates the sulphur occurs in a different manner, being found concentrated in globular masses ; this method of occurrence is also observable in all the sulphur mines of the continent, which are contained in argillaceous strata.

The liquation is performed in the Calcaroni or open kilns already described ; the loss of sulphur is estimated at one-third of the whole contents of the ore.

The greater part of the sulphur obtained is not refined in the island, but is exported in the crude state. For commercial purposes it is classified into three qualities, which are further divided into seven subclasses, which are known as :—

1st quality.

2nd quality, { best, good, ordinary.

3rd quality, { best, good, ordinary.

There are about fifty mines at present at work in Sicily, employing twenty thousand hands.

The production of 1861 is approximately estimated at 150,000 tons of commercial sulphur, of which about one-half was from the province of Caltanisetta, one-third from Girgenti, 25,000 tons from the province of Catania, and 20,000 tons from Palermo. The province of Trapani did not contribute more than a few hundred tons.

The principal shipping places are Girgenti, whence about half the total amount is exported, Licata, Catania, Palermo, Terranova, Siculiana, Palma, and Messina. About two-thirds of the quantity exported is taken by France and England, the remainder goes to Germany, Holland, the remaining countries of Europe, and the United States of America.

The price has increased very considerably during the last few years ; in 1860 it varied between 12s. and 16s. per ton.

The Sponge Fishery of Rhodes.—The following shows the value in round numbers of the sponges sold in 1861. Fine, 41,000*l.* ; common, 63,000*l.* ; coarse, 7,000*l.* ; total, 111,000*l.* Part of the sponges fished in the autumn of 1860, were sold in the early part of 1861, at 450 piastres per oke, for fine, 120 for common, and 60 for coarse, which are the highest ever reached for the fine and coarse qualities. Towards the end of the year, the prices declined nearly one-fourth. The crop of 1861 was abundant, the proportion of fine sponges was larger and of a better quality than in former years. The divers say that the same quantity are not now found as ten years ago, so it must be inferred that they do not grow as fast as they are fished. The amount of crop sent to each country, was in the following proportion ; out of 36 parts, Great Britain 13, France, 15½, Austria, 5½, and Constantinople, 2 ; total 36.

THE PERFUMERY TRADE AS REPRESENTED IN THE INTERNATIONAL EXHIBITION.

BY EUGENE RIMMEL.

In England perfumes were at first imported from Italy and France and came into great vogue during the reign of Queen Elizabeth. Shakspeare often mentions musk, civet, perfumed gloves, and pomanders, or pommes d'ambre, which were balls of perfume, to be held in the hand and smelt occasionally: the latter were supposed to preserve from the plague.

It is difficult to ascertain the precise date when manufactories of perfumery were first established in England, as perfumers did not form here a separate corporate body as they did in France; but an old English recipe book, printed in 1663, contains a dentifrice prepared by M. Ferene, of the New Exchange, perfumer to the Queen, so that they had already at that time begun to manufacture. Since that period the perfumery trade of England has followed about the same progress as that of France, until it has reached its present state of prosperity.

Perfumery is now divided into two distinct branches, the preparation of perfumery materials, and the manufacture of perfumes, cosmetics, and toilet soaps. The former is chiefly carried on in the south of France, Italy, Spain, Turkey, Algeria, India, and other warm countries, where the climate gives to flowers and plants the intensity of odour required for a profitable extraction. England has produced only hitherto lavender and peppermint, but which are both greatly superior in quality to any grown elsewhere. The following shows the principal materials employed in making perfumery, with their commercial and technical names, the form in which they are used, their average prices, and the places where they are produced:—

Almond, bitter (fruit of the Amygdalus amara); expressed oil, emulsion, or meal; 6d. per lb.; Northern Africa.

Almond, bitter (fruit of the Amygdalus amara); essential oil; 1*l.* 12s. per lb.; distilled in England from foreign almonds.

Ambergris (secretion of the Physeter macrocephalus; powder and alcoholate; 32*l.* per lb.; found floating on the sea, or on the coasts of India, China, Japan, Greenland, and other places.

Aniseed (seed of the Pimpinella anisum); essential oil; 9s. per lb.; North of Europe.

Aniseed, star (capsules and seeds of the Illicium anisatum); essential oil; 16s. per lb.; China and Japan.

Balsam of Peru (exudation of the Myroxylon Peruiferum); natural form; 6s. per lb.; West Coast of South America.

Balsam of Tolu (exudation of the Toluifera balsamum); natural form; 5s. per lb.; West Coast of South America.

Benzoin Gum (exudation of the Styrax benzoin); powder and alcoholate; 6s. per lb.; Siam.

Benzoin Gum (exudation of the Styrax benzoin); powder and alcoholate; 3s. per lb.; Sumatra and Singapore.

Bergamot (expressed or distilled from the rind of the Citrus bergamia); essential oil; 14s. per lb.; Calabria and Sicily.

Bigarrade (expressed or distilled from the rind of the Citrus bigaradia); essential oil; 16s. per lb.; South of France and Italy.

Camphor (from the wood of the Laurus camphora); powder and alcoholate; 2s. 6d. per lb.; China and Japan.

Carraway (seed of the Carum carui); essential oil; 8s. per lb.; England Germany, and France.

Cascarilla (bark of the Croton cascarilla and eleuteria); powder; 6d. per lb.; Bahama Islands.

Cassia (distilled from the bark of the Laurus cassia); essential oil; 16s. per lb.; East Indies and China.

Cassie (flower of the Acacia farnesiana); dried flowers; 6s. per lb.; South of France, Italy, and Algeria.

Cassie (obtained by maceration from Acacia farnesiana); pomade or oil; 10s. per lb.; South of France, Italy, and Algeria.

Cassie (distilled from Acacia farnesiana); essential oil; 64*l.* per lb.; Tunis.

Cedar (distilled from the wood of the Pinus cedra and Juniperus Virginiana); essential oil; 16s. per lb.; Syria, United States, and Honduras.

Cedrat (distilled or expressed from the rind of the Citrus cedrata); essential oil; 1*l.* 4s. per lb.; South of France and Italy.

Cinnamon (distilled from the bark of the Laurus cinnamomum); essential oil; 3*l.* 4s. per lb.; India.

Cinnamon leaf (distilled from the leaves of the Laurus cinnamomum); essential oil; 4s. per lb.; India.

Citronella (distilled from the leaves of the Andropogon citratum); essential oil; 12s. per lb.; India.

Civet (secretion of the Viverra civetta); alcoholate; 16*l.* per lb.; Indian Archipelago and Africa.

Cloves (flower bud of the Caryophyllus aromaticus); powder and alcoholate; 1s. per lb.; Indian Archipelago and Zanzibar.

Cloves (distilled or expressed from the Caryophyllus aromaticus); essential oil; 6s. per lb.; distilled in England and France from foreign cloves.

Dill (seed of the Anethum graveolens); essential oil; 8s. per lb.; England.

Fennel (distilled from the Anethum fœniculum); essential oil; 8s. per lb.; South of France.

Geranium (distilled from the leaves of the Pelargonium odoratissimum); essential oil; 3*l.* per lb; South of France, Italy, Algeria, and Spain.

Ginger grass (distilled from the leaves of the Andropogon nardus); essential oil; 12s. per lb; India.

Iris, or Orris (root of the Iris Florentina); powder and alcoholate; 9d. per lb; Italy.

Jasmine (obtained by absorption from the flowers of the Jasminum odoratissimum); pomade and oil; 10s. per lb.; South of France and Italy.

Jasmine (distilled from the Jasminum odoratissimum); essential oil; 96*l.* per lb; Tunis and Algeria.

Jonquil (obtained by maceration from the flowers of the Narcissus jonquila); pomade and oil; 10s. per lb.; South of France and Italy.

Laurel (distilled from the leaves of the Cerasus lauro-cerasus); distilled water; 1s. per lb.; south of France and Italy.

Lavender (distilled from the flowers of the Lavandula vera; essential oil; 2*l.* 8s. per lb.; England.

Lavender (distilled from flowers of Lavandula vera); essential oil; 6s. per lb.; South of France and Italy.

Lemon (distilled or expressed from the rind of the fruit of the Citrus medica; essential oil; 16s. per lb.; Coast of Genoa, Calabria, Sicily, and Spain.

Lemon grass (distilled from the Andropogon schænanthus; essential oil; 1*l.* per lb.; East and West Indies.

Limette (expressed from the fruit of the Citrus limetta); essential oil; 1*l.* 4s. per lb.; South of France.

Mace (expressed from the refuse nutmegs); concrete oil; 8s. per lb.; Indian Archipelago.

Marjoram (distilled from the Origana majorana; essential oil; 8s. per lb.; South of France.

Mirbane (nitrobenzine or artificial essential oil of almonds); essential oil; 8s. per lb.; England and France.

Musk (secretion of the Moschus moschatus); powder and alcoholate; 24*l.* per lb.; Thibet, China, and Siberia.

Musk seed (seed of the Hibiscus abelmoschus; powder and alcoholate; 4s. per lb.; West Indies.

Myrtle (distilled from the leaves of the Myrtus communis); essential oil; 16s. per lb.; South of France.

Myrrh (exudation of the Balsamodendron myrrha); powder and alcoholate; 6s. per lb.; India.

Narcissus (obtained by maceration from the flowers of the Narcissus odorata); pomade and oil: 10s. per lb.; Algeria.

Neroli, bigarrade (distilled from the flowers of the Citrus brigaradia); essential oil; 10*l.* per lb.; South of France, Italy, and Algeria.

Neroli, Portugal (distilled from the flowers of the Citrus aurantium); essential oil; 6*l.* per lb.; South of France, Italy, and Algeria.

Nutmeg (distilled from the fruit of the Myristica moschata ; essential oil ; 6s. per lb. ; Indian Archipelago.

Orange (distilled or expressed from the fruit of the Citrus aurantium ; essential oil ; 12s. per lb. Calabria and Sicily.

Orange flower (obtained by maceration of the flowers of the Citrus bigaradia ; pomade and oil ; 10s. per lb. ; South of France and Italy.

Orange flower-water (distilled from the above) ; distilled water ; 1s. per lb. ; South of France and Italy.

Patchouly (Leaves of the Pogostemon patchouli ; powder and alcoholate ; 2s. per lb. : India and China.

Patchouly (leaves of the Pogostemon patchouli); essential oil ; 4*l.* per lb. ; distilled in England and France from dried leaves.

Peppermint (distilled from the leaves of the Mentha piperita); essential oil ; 2*l.* 10s. per lb. ; England.

Peppermint (distilled from the leaves of the Mentha piperita); essential oil ; 12s. per lb.; United States.

Petit grain—bigarrade—(distilled from the leaves of the Citrus bigaradia); essential oil ; 3*l.* per lb.; South of France.

Petit grain—Portugal—(distilled from the leaves of the Citrus aurantium); essential oil ; 2*l.* per lb. ; South of France.

Rose (flower of the Rosa centifolia); dried flowers ; 5s. per lb.; South of France.

Rose (obtained by maceration of the leaves of the Rosa centifolia) ; pomade and oil ; 10s. per lb.; South of France and Italy.

Rose (distilled from the flower of the Rosa centifolia); essential oil or otto ; 24*l.* per lb. ; Turkey.

Rose (distilled from the flower of the Rosa centifolia); essential oil or otto ; 40*l.* per lb.; South of France.

Rose (distilled from the flower of the Rosa centifolia); essential oil or otto ; 64*l.* per lb. ; Tunis.

Rose (distilled from the flower of the Rosa centifolia) ; essential oil or otto ; 192*l.* per lb. ; India.

Rose-water (distilled from the flower of the Rosa centifolia) ; distilled water ; 1s. per lb. ; South of France and Italy.

Rosemary (distilled from the Rosmarinus officinalis) ; essential oil ; 4s. per lb. ; South of France.

Rosewood (distilled from the wood of the Lignum aspalathum) ; essential oil ; 3*l.* per lb. ; distilled in France and Germany from foreign wood.

Sandal-wood (wood of the Santalum citrinum) ; powder ; 1s. per lb. ; India, China, Indian Archipelago, and West Australia.

Sandal-wood (distilled from the wood of the Santalum citrinum) ; essential oil ; 3*l.* per lb. ; distilled in England and France from foreign wood.

Sassafras (distilled from the Laurus sassafras) ; essential oil ; 6s. per lb. ; United States.

Serpolet (distilled from Thymus serpyllum); essential oil; 8s. per lb.; south of France.

Spike (distilled from Lavaudula spica; essential oil; 4s. per lb; south of France.

Styrax (exudation of the Liquidambar styraciflua); Alcoholate; 6s. per lb.; Turkey.

Thyme (distilled from the Thymus vulgaris); essential oil; 6s. per lb.; South of France.

Tonquin (beans of the Dipterix odorata); powder, expressed oil, and alcoholate; 5s. per lb; South America and West Indies.

Tuberose (obtained by absorption from the flower of the Polianthes tuberosa); pomade and oil; 10s. per lb.; South of France and Italy.

Vanilla (pod of the Vanilla planifolia); powder and alcoholate; 8*l.* per lb.; Mexico.

Verbena (distilled from the Aloysia citriodora); essential oil; 5*l.* per lb.; Spain and Algeria.

Violet (obtained by maceration from the flowers of the Viola ordorata); pomade and oil; 16s. per lb.; South of France Italy, and Algeria.

Vitivert (Rhizoma of the Anatherum muricatum); powder and alcoholate; 2s. 6d. per lb; India.

Vitivert (distilled from Anatherum muricatum); essential oil; 2*l.* per lb.

Winter-green (distilled from the Gaultheria procumbens); essential oil; 1*l.* 4s. per lb.; United States.

It will be seen from the preceding that some of those materials are used in their natural form, and others have to undergo some mode of preparation. There are four processes employed for extracting the aroma from fragrant substances: distillation, expression, maceration, and absorption. Distillation is applied to all plants, barks, woods, and a few flowers, and is too well known to require any particular description. The fragrant substance is placed in a still containing water, which is evaporated by means of heat, condenses in the worm and issues from the tap strongly impregnated with the aroma, the more concentrated part of which collects either on the surface or at the bottom of the distillate according to its specific gravity, and forms the essential oil. The same water is generally distilled several times with fresh materials, and is sometimes of sufficient value to be kept, as is the case with rose and orange-flower water.

Expression is confined to essential oils obtained from the rind of the fruits of the citrine series, comprising lemon, orange, bergamot, cedrate, and limette. In some parts they rub the fruit against a grated funnel, in others they press the rinds in cloth bags.

Maceration and absorption are used for extracting, by means of fatty bodies, the aroma of flowers, and producing scented pomades and oils,

from which the fragrance can afterwards be transferred by infusion to an alcoholic basis. Maceration is employed for the less delicate flowers, such as the rose, cassie, orange flower, jonquil, and violet, which can bear a tolerable degree of heat without losing their scent. A certain quantity of grease is placed in a pan fitted with a water bath, and brought to an oily consistency. Flowers are then thrown in and left to digest for some hours, after which they are removed, and others put in, and so on for two or three days, until the grease is quite saturated. It is then taken out and pressed in cloth bags. The process of absorption, called by the French *enfleurage*, is chiefly confined to the jasmine and tuberose flowers, but is sometimes applied to the cassie. It consists of a series of square glass frames, covered with a thin layer of purified grease, in which ridges are made, to facilitate absorption. Fresh gathered flowers are strewed on that layer, and renewed every morning as long as the flower is in bloom, and by that time the grease has acquired a very strong odour. The same process is used for oil; but the frames instead of a glass have a wire bottom, over which is spread a thick cotton cloth soaked in olive oil. Flowers are laid on in the same way, and the cloths submitted to a strong pressure to extract the oil when sufficiently impregnated. The frames are piled up on each other to keep them air-tight.

Grasse, Cannes, and Nice, all in the south of France, and close to each other, are the principal towns where the maceration and absorption processes are in use. There are about 100 houses engaged in those operations, and in the distillation of essential oils, giving employment during the flower season to at least 10,000 people.

The following are approximate quantities and values of the flowers consumed in that locality for manufacturing purposes :—

	kilos.		lbs.	Worth about £
Orange flowers . . .	800,000	or	1,760,000	32,000
Rose flowers	250,000	„	550,000	10,000
Jasmine flowers . . .	50,000	„	110,000	6,000
Violets	30,000	„	66,000	7,000
Cassia	30,000	„	66,000	10,000
Tuberose	15,000	„	33,000	3,000

The average quantities of the principal articles manufactured are :—

	kilos.		lbs.	Worth about £
Scented pomades and oils . . .	300,000	or	660,000	250,000
Rose water	80,000	„	176,000	5,000
Orange flower water, 1st quality .	500,000	„	1,100,000	30,000
Orange flower water, 2nd quality .	1,000,000	„	2,200,000	50,000

This does not include essential oils, which are also distilled to a large amount.

The manufacture of perfumes, cosmetics, and toilet soaps is carried on in the principal cities of Europe, but especially in London and Paris, which may be called the head-quarters of perfumery, and whence those products are exported to all parts of the world. Perfumes comprise toilet waters and vinegars, and scents for the handkerchief, the whole composed with an alcoholic basis. The most universally known of toilet waters is eau-de-Cologne, so called because it was invented by an apothecary in that town, in the last century. It consists of a mixture of alcohol and various essential oils, mostly of the citrine family, such as bergamot, orange, lemon, neroli extracted from the flowers of the citrus bigarradia, and petit-grain obtained from the leaves of the same tree, thus forming a very harmonious compound. Lavender-water was formerly distilled from the flowers with alcohol, but this process has been abandoned as too costly, and it is now simply a mixture of alcohol and essential oil of lavender, the best being made from English oil. Toilet vinegar contains somewhat the same ingredients as eau-de-Cologne, with the addition of a little acetic acid, which gives it greater pungency. Perfumes for the handkerchief are composed in various ways ; the best are made by treating with alcohol the pomades and oils obtained from flowers by maceration or absorption : this alcoholate possesses the true scent of the flower, entirely free from the empyreumatic smell inherent in all essential oils : as, however, there are but six or seven flowers which yield pomades or oils, the perfumer has to blend those together, and by studying affinities and resemblances to imitate all other flowers from which no extracts are made. Those artificial extracts, when successfully achieved, constitute the truly artistic part of perfumery. Common perfumes are made simply by mixing alcohol with various essential oils and infusions, but they never possess the fine and delicate odour of the others.

Cosmetics embrace pomatums, lotions, washes, and dentifrices, and other preparations for the toilet, which are, however, too numerous and too uninteresting to be described at full length.

Toilet soaps being now in universal use have become one of the most important branches of the perfumer's trade. There are four kinds of soaps made for toilet purposes : hard soap by the hot process, hard soap by the cold process, soft soap, and transparent soap. The first, which is also called the large-boiler process, because it is generally made in considerable quantities, consists in boiling grease or oil, and sometimes a small proportion of rosin, with an excess of soda-lees. The lees are drawn or pumped out when exhausted of their alkali, and fresh ones added until the whole mass becomes saponified. In foreign countries they perfume the soap thus made when poured into the frame where it is placed to cool ; but in England it is customary to remelt it and perfume it then, which no doubt improves the quality. The second way of manufacturing hard soap is by the cold process, which is also called the small-boiler process, it being necessary to make it in vessels of small

dimensions, for the facility of working. It consists in mixing fat liquified to a milky consistency with a fixed dose of concentrated soda-lees, in the proportion of one-third of lees to two-thirds of fat. The mass is kept at a gentle heat, and constantly stirred for about two hours, and then poured into a frame, where the saponification becomes complete. Mutton suet or lard is generally used for this purpose; the latter produces a soap of a finer grain. This process is not generally so much esteemed as the other; but yet when the fat and lees are perfectly pure, and the doses nicely calculated, it may produce as good a soap as the hot process, but it requires to be kept some little time to become perfect. It offers a certain advantage to perfumers for producing a delicately scented soap, by enabling them to use as a basis instead of fat some pomade obtained from flowers, which could not be done with the other process, as the heat would destroy its flavour. Soft soap, known in the trade under the name of saponaceous cream, or cream of almonds, is also made by the cold process, and consists in a mixture of lard and a little cocoa-nut oil with potash-lees. Transparent soap is a combination of hard soda soap with alcohol. A soft transparent soap may also be made by substituting potash-soap for soda-soap. Soaps are usually perfumed with essential oils of a cheap description, such as those distilled from aromatic plants or spices, to which are sometimes added balsams or tinctures. They are coloured in various ways to suit the tastes of the markets for which they are intended. The new mauve dyes have been tried with them, and found to succeed very well with the violet colour, but the pink is apt to fly. There are some soaps, however, in the Austrian department which have a rosy hue, apparently produced by one of those dyes.

In former Exhibitions perfumery was classed in different ways, sometimes with miscellaneous articles, as in 1851, sometimes with chemical products, as in 1855. It has obtained for the first time in the present Exhibition—thanks to the exertions of the London perfumers—the privilege of forming a separate sub-class; a distinction it is entitled to, not only for the importance of its trade, but also on account of the nature of its manufacture, which is totally different from any other. There are 232 exhibitors of perfumery, of which 109 exhibit perfumery materials, and 123 manufactured perfumery and toilet soaps.

United Kingdom.—The perfumery materials exhibited in this department consist in essential oils, some distilled from indigenous plants, such as peppermint and lavender, and others from aromatic substances imported from abroad, such as almonds, cloves, &c. Several exhibitors also show specimens of artificial essences or ethers, comprising nitrobenzole, called by the French mirbane, made by treating rectified benzole, or rectified coal-tar naptha, with nitric acid; and alcoholic solutions of various ethers, known under the names of fruit essences, comprising essence of pear, which is an acetate of amyl; essence of apple, which is a valerianate of amyl; and essence of pine-apple, which is composed of

butyric ether. The other fruit essences are simply combinations of the above, sometimes with the addition of vanilla or other flavouring ingredients. Nitro-benzole is used by perfumers to give to soap the scent of bitter almonds, which it closely resembles, but the others are principally used by confectioners, and seldom only by perfumers.

The principal manufacturers of perfumery and toilet soaps reside in London, where they number about sixty, employing a large number of men and women; for female labour has been introduced since the last fifteen years in almost all the London manufactories, and found to answer very well for all kinds of work requiring more dexterity than strength.

According to official returns published, the exports of perfumery for the year 1860, amounted to 86,464*l.*, sub-divided as will be seen in the following table; we must, however, say that very little reliance is to be placed on those figures, which do not represent perhaps one-fourth of the actual amount exported. Taking for instance the sum given for Australia at 10,145*l.*, it appears ridiculously small; there are undoubtedly several manufacturers in London who each and individually ship perfumery to at least that amount every year—

Exports of Perfumery from the United Kingdom in 1860.

Countries to which Exported.	Amounts declared.
	£
Russia	2,524
Hamburgh	3,522
Holland	1,188
Belgium	1,539
France	2,018
Egypt	2,050
China	4,409
United States	6,018
Brazil	2,316
British Possessions in South Africa	4,272
Mauritius	1,552
British India	20,861
Australia	10,415
British North America	2,655
British West Indies	7,294
Other countries	13,831
Total	86,464

This does not include soap, of which 195,183 cwt., valued at 249,538*l.* were exported in 1860; but as perfumed soaps were not particularised, these figures give us no information.

The manufacture of perfumery for home consumption is no doubt very extensive, but it is very difficult to ascertain its actual importance; for besides what is produced by the London perfumers, almost every

perfumery vendor throughout the country has commenced of late years to make his own toilette articles. It is therefore impossible to form even an approximate idea of the quantity consumed in the United Kingdom.

The British manufacturers of perfumery make a very creditable show which manifests great improvements in that trade since 1851. The removal of the excise restrictions on soap-making have no doubt operated very favourably in allowing perfumers either to manufacture their own soap, or to have it made for them of the most suitable ingredients for toilet purposes. The greater part of the English scented soaps exhibited are made by the hot process from tallow or palm-oil and soda-lees. A small quantity of rosin and cocoa-nut oil is generally added. The former renders the soap softer and easier to work, increasing at the same time its detergent properties. The latter gives it a fine grain and improves the lather, but it must not exceed a proportion of five per cent. on the fat used, as otherwise its fetid smell would become perceptible. The most celebrated of English soaps is the Windsor soap, which is not only much used for home consumption, but also exported largely to all parts of the world. It was originally a white soap which turned slightly brown with age, but it is now coloured artificially with brown umber or burnt sugar. Honey soap is also made in considerable quantities. It is a tallow soap, containing about five per cent. of rosin, and is perfumed principally with oil of citronella. It is an excellent toilet soap, but contains no honey. Several so-called glycerine soaps are also exhibited. Some made by the hot process, which evidently contain no glycerine (unless crushed in afterwards), as it is pumped out with the waste lees, others made by the cold process, which have retained all the glycerine of the fat, to which, in some cases, more has been added mechanically.

Some very fine specimens of transparent soap are exhibited. A few best and expensive soaps are also shown, but they appear scarcely equal to the French; a circumstance easily explained, as the market for them is exceedingly limited in the United Kingdom, and consequently but little inducement is offered to manufacturers. On the other hand we must say that after carefully comparing the ordinary British toilet soaps with those of foreign soaps, they seemed to us to be decidedly superior to any others. The commonest of them afford a copious lather, and leave a clean pleasant smell to the hands, an advantage rarely to be found in any ordinary foreign soap. Their price is also proportionately cheaper, due regard being had to the quality; and this arises from several causes —the facilities afforded by English markets for procuring the necessary ingredients on the best terms, various improvements effected in the manufacture, but above all the great simplicity of the process used for reducing soap into saleable shapes; for whilst abroad soaps are cut up, crushed pounded, made into balls, dried and then stamped, English soaps being generally of a softer consistency are simply cut up into suitable

squares, and stamped at once, which saves at least three-fourths of the labour used in foreign countries.

The perfumes exhibited are mostly of good quality, the alcohol used for their basis being generally distilled from grain, and perfectly inodorous. It was formerly thought that spirits distilled from wine (usually called Montpellier spirits) were the best for perfumery purposes; but the principal houses have now adopted grain spirits, as being the most neutral and free from that ænanthetic flavour inherent to spirits of wine, which is liable to impair the fragrance of very delicate perfumes. Now even French perfumers are beginning to use English grain alcohol to make their best perfumes.

The toilet preparations exhibited in the British department are mostly deficient in that outward attractive appearance which is the distinguishing feature in foreign preparations; but this does not affect the quality, which is generally good. The principal novelties we noticed were the happy introduction of glycerine into some toilet articles, and a new method of fumigation by volatilizing fragrant molecules through a current of steam.

India exhibits a very extensive and interesting collection of native fragrant herbs, waters, oils, and other materials adapted for perfumery purposes, the principal of which will be found in the following, together with such information respecting them, as we have been able to derive from the East India catalogue, and from our own observations:—

Roosa-grass, *alias* Ginger-grass, or Indian Geranium (Andropogon nardus); Jubbulpore; grass and essential oil.

Lemon-grass, *alias* Verbena (Andropogon schænanthus); Chota Nagpore; essential oil.

Citronella (Andropogon citratum); Madras and Penang; essential oil.

Vetivert (Anatherum muricatum, called, in Indian Catalogue, Andropogon muricatum); Khus-khus; Lucknow and Cuttack; Rhizome and essential oil.

Pot-pourri (Mattaghussa); Calcutta; mixture of fragrant herbs.

Gingelly, or Sesamum Oil (Sesamum Orientale); Teel; Shahabad and other places; oil used in India for perfumery.

Pand (Michelia champaca); Champa-ka-utter, or Keenla-ka-utter; Calcutta; essential oil.

Pandang (Pandanus odoratissimus); Kawra-ka-utter, or Keenla-ka-utter; Calcutta and Lucknow; essential oil.

Artemisia indica; Donna-ka-utter; Calcutta; leaves and essential oil.

Mesua ferrea; Nagkusur-ka-utter; Calcutta; essential oil.

Jasmin sp. (Jasminum hirsutum, or Sambac); Motia-ka, or Bella-ka-utter; Calcutta and Lucknow; essential oil.

Patchouli (Pogostemon patchouli); Puchaput-ka-utter; Calcutta; leaves and essential oil.

Phœnix dactylifera; Kurna-ka-utter; Calcutta; essential oil.

Jasmin sp. (Jasminum grandiflorum); Tore-ka-utter, or Chamelé-ka-utter; Calcutta and Lucknow; essential oil.

Minusops elengi (Bookool-ka-utter); Calcutta; essential oil.

Sohag-ka-utter; Calcutta and Moulmein; essential oil.

Bahar-ka-utter; Calcutta; essential oil.

Henna (Lawsonia inermis; Hina, or Mehndee-ka-utter; Lucknow; essential oil.

Damask Rose (Rosa damascena); Golab-ka-utter; Lucknow and Ulwar; otto and water.

Spikenard (Nardostachus natamansis); Buttsi, or Jatamangsi; Hills and Nepaul; root.

Wild Lavender (Lavandula stacha); Yertakhudus; Kashmeer; leaves.

Carraway (Carum nigrum); Zera; Kashmere; seed.

Sweet Flag (Calamus aromaticus); Bach; Kangra; canes.

Musk-seed (Hibiscus moschatus, or abelmoschus); Kala Kustooree; Calcutta; seed.

Ocymum basilicum; Babooi Toolsi; Calcutta; leaves.

Cyperas rotundus; nagor mootha; Calcutta; tubers used as scent.

Cassia (Laurus cassia); Calcutta; bark.

Cinnamon (Laurus cinnamomum); Kabab; Calcutta; bark.

Fenugreek (Trigonella fœnum græcum); Mathie; Cuttach; seed.

Aniseed (Pimpinella anisum); Pan Mohoree; Cuttach; seed.

Sandalwood (Santalum citrinum); Canara; essential oil and wood.

Kohl (Trisulphuret of antimony); Soorma; Kandahar; used for darkening the eyebrows.

Besides the above, Bombay sends seventeen specimens of essential oils, but although under different names, they seem to be of the same kinds as those sent from Calcutta and Lucknow. We expected to find a lage display in Ceylon, as it is from that island that we derive the great bulk of the Indian essential oils consumed in this market; but nearly all the samples collected were unfortunately lost on their way to London, so that the list of exhibitors is reduced to two, who make but a meagre show of indifferent products.

Eight only out of the materials contained in the above statement are regular articles of commerce—viz., cassia, cinnamon, lemon-grass, ginger grass, citronella, patchouli, vitevert, and sandal wood. The first five are usually sent from India in the shape of essentials oils, but the other three are mostly imported in the natural state, and distilled in this country. The remainder of the materials enumerated are very little known in Europe, but would no doubt find a ready market if they could be produced in sufficient quantities and at reasonable prices. They would indeed be very acceptable to our perfumers, who are constantly in quest of novelties; but in order to make them saleable, they would have to be manufactured in a different way, for they are now more or less impregnated with a nauseous flavour of sandal-wood, which arises from the natives being accustomed to place sandal-wood shavings in the still with the flowers. This facilitates

the operation and increases the distillate, but sadly at the expense of quality. This evil could, however, be easily obviated. Gingelly, or sesamum oil, is largely used by Indian perfumers for drawing the perfumes of flowers, and for making hair oils; but the specimens shown have a rank flavour which would unfit them for such purposes in Europe.

The whole of this collection reflects great credit on the various official and private individuals engaged in the task.

The colony of *Victoria* shows some very interesting specimens of new essential oils distilled by two Melbourne chemists under the superintendence of Dr. Mueller, the able director of the Botanical Gardens. These oils are principally extracted from the leaves of the trees of the *Eucalyptus* family which abound in Australia, and from a variety of native plants, including some of the mint tribe. Although they are represented as intended to be used for dissolving resins and making varnishes, it appeared to us that some of them possessed a sufficiently grateful fragrance to render them available for perfumery purposes. If such be the case, it will prove a great boon to perfumers, on account of their abundance and cheapness, for in the course of time the supply can be unlimited; and the price quoted for some of them now—viz., six shillings per gallon, is about one-fourth of the cost of the commonest essential oil used for scenting soap. Among the numerous specimens shown, the following seemed the most fragrant:—the *Eucalyptus amygdalina* (Tasmanian peppermint), the *Eucalyptus odorata* (peppermint tree), the *Eucalyptus globulus* (blue-gum), the *Atherosperma moschatum*, the *Melaleuca ericifolia* and the *Ariostemos squameus*. We tried an experiment with the essential oil of *Eucalyptus amygdalina*, which has a strange flavour, partaking at the same time of nutmegs and peppermint, and we obtained the following results:—

Three ounces of the oil were sufficient to scent very strongly eight pounds of soap, at a cost of about one farthing per pound. The perfume produced by this oil alone would, however, be considered by some more peculiar than agreeable, and we obtained a much better result by combining it in a second experiment with oils of cassia, cloves, and lavender, which mixture yielded a very pleasant fragrance. We have, therefore, every reason to think that soap-makers would find great advantage in using those new essential oils, and especially that of the eucalyptus amygdalina, which is yielded most abundantly by that tree, three pounds of oil being the result of the distillation of a hundred pounds of leaves. The specimens of essential oil of peppermint (*Mentha Australis*) is very fair, and could find a market in Europe provided it can compete with others for price. We were shown besides a sample of emu fat, a grease of very fine grain, which could be adapted to perfumery purposes, if procurable in quantities worth exporting.

From *New South Wales* we have a small but interesting collection of essential oils, comprising that of orange and orange flowers, made from

the fruits and flowers of the edible orange-treee (*Citrus aurantium*), not equal, however, to those made from the bitter orange-tree (*Citrus bigarradia*), and that of *Eucalyptus citirodora*, which bears a strong resemblance to the citronella grown in the East and West Indies, and might be used as a substitute. A very fine grease taken from the alpaca is also exhibited, and may become a useful article to perfumers when the herd of those animals reaches the proportions it is expected to attain.

Queensland sends us a very good toilet soap made from the oil of the dugong, a fish said to abound on the Australian coast, and a very pretty casket made from myall-wood (*Acacia pendula*), which has an intense and delightful smell of violets. This tree is very plentiful in all parts of Australia; and when the remarkable property it possesses becomes known to European manufacturers, the wood will no doubt be in great request for making glove, handkerchief, and other fancy boxes, for as long as it remains unpolished, it preserves this remarkable fragrance of violets, which does not occur with such perfection in any other known substance.

In *Tasmania* we find the tonga-bean wood (*Alyxia buxifolia*), which has an odour similar to that of the tonquin-bean, and the muskwood, which might be perhaps applied to perfumery purposes; the silver wattle (*Acacia dealbata*) is also very common in this island, and the colonists may one day turn their attention to gather the flowers, which much resemble in fragrance those of the cassie (*Acacia farnesiana*), so useful to perfumers. The eucalyptus amygdalian and other fragrant species likewise abound in Tasmania.

The other British colonies exhibit but few objects worthy of notice. *Jamaica* sends a few specimens of oil of ben (*Moringa pterygosperma*), which was in great request with perfumers some time since, but for which there seems to be no demand at present, although it is less liable to become rancid than any other oil. *Mauritius* has two exhibitors of vanilla, but we could not obtain a near inspection of it, the case being kept locked. *Canada* sends some indifferent perfumery, and *Natal* a little soap, chiefly made from cocoa-nut oil. The *Ionian Islands*, which we include in the British colonies, contribute a very fine specimen of otto of roses made in Corfu, which appeared to be the purest in the Exhibition.

Belgium exhibits principally toilet soaps, in which branch of manufacture it seems to have made great progress since the last Exhibition. These soaps are made by the hot process, and are very similar to those of the French makers. The excess of cocoa-nut oil which was at one time their great fault, has been judiciously suppressed, and the quality is now very creditable. Some good specimens of transparent soaps are also shown. The alcoholic perfumes exhibited are not equal to the English or French.

Brazil shows an interesting collection of fragrant substances, available for perfumery purposes some of which are already in use, though not

generally imported from Brazil, such as tonquin-beans, cloves, vetivert, gum benzoin, &c.; and others are not known in this country, comprising camara and jerporta beans (a smaller variety of the tonquin), a sort of pimento, and a wild lavender resembling the rosmarinho (*Lavendula stacha*) found in Spanish and Portuguese Estremadura.

France.—Perfumery materials are exhibited by Grasse and Cannes, and comprise pomades and oils obtained by maceration or absorption, and essential oils distilled from various indigenous plants and flowers. They contain nothing particularly novel. An extract said to be made from the flowers of the cotton-tree was found on examination to be a combination. A crystallised oil of patchouli is exhibited, but we could find no special merit in it, as it does not appear stronger or purer than the usual sort. One house sends its essential oils in glass bottles cased in tin, a very appropriate sort of packing, as it excludes light, which impairs the quality of many oils, and at the same time prevents breakage. Nice does not exhibit any products in this department, which is to be regretted, as it possesses peculiar advantages over other localities, especially for violet preparations, of which there is a large consumption.

The French perfumery trade has increased considerably within the last thirty or forty years. The average of—

Exports for ten years from 1827 to 1836 was 6,000,000 f.
" " 1837 to 1846 " 8,000,000 f.
" " 1847 to 1856 " 10,000,000 f.
The exports in 1858 were 12,000,000 f.
" " 1860 " 31,000,000 f.

The quantities and values of perfumery exported to each different country will be found in the following table:—

EXPORTS OF PERFUMERY FROM FRANCE IN THE YEAR 1860.

Countries to which Exported.	Quantity in kilos.	Value in francs.
United Kingdom	310,033	2,170,231
Russia	37,769	331,373
Zollverein	75,047	525,329
Belgium	251,326	1,759,282
Hanse Towns	11,376	70,980
Portugal	21,650	151,550
Spain	135,705	949,935
Two Sicilies	10,353	72,471
Sardinian States	70,483	493,381
Tuscany	13,095	91,661
Switzerland	45,813	320,691
Greece	18,305	128,135
Turkey	129,476	906,332
Algeria	90,850	635,950
Egypt	30,816	215,712
Tunis and Tripoli	10,534	73,738
Western Africa	3,042	21,294
Cape and Mauritius	64,096	448,672

EXPORTS OF PERFUMERY FROM FRANCE IN 1860.—(*Continued.*)

Countries to which Exported.	Quantity in kilos.	Value in francs.
British India	40,872	286,104
Dutch possessions in India . .	9,502	66,514
China, Cochin China, and Siam .	6,938	48,566
Polynesia	2,248	15,736
United States of America . .	216,770	1,517,390
Mexico	28,313	198,191
New Grenada	25,371	177,597
Venezuela	23,051	161,357
Brazil	187,717	1,314,019
Uruguay	110,670	774,690
River Plate	212,542	1,487,794
Guatemala	6,026	42,112
Ecuador	3,171	22,197
Peru and Bolivia	119,181	834,267
Chili	96,758	677,306
Hayti	52,712	368,984
Spanish possessions in America .	298,097	2,086,679
British and Dutch ditto . .	7,613	53,291
Danish ditto	87,400	611,800
French West India possessions .	78,581	410,071
French East India ditto . .	30,789	215,523
Other countries	89,241	624,687
Total	3,063,332	31,361,592

It will be seen from the preceding table that the principal exports of French perfumery are made to other parts of Europe, and to North and South America, whilst English perfumery is chiefly sent to India, Australia, and other British colonies. The amount sent from France to the United Kingdom consists principally of perfumery materials, manufactured perfumery forming but a small proportion of it. The imports of perfumery from foreign countries into France during the same year amounted in weight to 29,792 kilogrammes, and in value to 166,379*l.*

Paris is the great centre of the manufacture of perfumery, and forms an important item of what are called "articles de Paris." There are in that capital 120 working perfumers, employing about 3000 men and women, and their united returns may be estimated at not less than forty millions of francs yearly.

The Parisian perfumers have turned to the best account the limited space assigned to them in the Exhibition ; and their articles are mostly of good quality and elegantly got up. Their ordinary soaps are not equal to the English, but their fine soaps are decidedly superior; the large cousumption they have for them making it worth their while to pay particular attention to that branch of their trade. Their alcoholic perfumes and toilet preparations are very fair, but, with the exception of a few of the latter containing glycerine, and of the substitution of paraffine

to wax in some instances, offer but little novelty. A most interesting exhibition, however, is that of M. Piver, who shows perfumes obtained by two new processes. The first, invented by M. Millon, a French chemist, consists in placing flowers in a percolating apparatus, and pouring over them some ether or sulphuret of carbon, which is drawn off a few minutes after, and carries with it all the aroma of the flowers. It is afterwards distilled to dryness, and the result obtained is a solid waxy mass, possessing the scent of the flower in its purest and most concentrated form. The other process, which is the invention of M. Piver, consists in placing in a pneumatic apparatus layers of flowers on perforated plates alternately with layers of grease, and causing a current of air to pass through several times until the scent of the flowers becomes fixed into the grease. These two processes have not been used hitherto to any extent; but they are no doubt both susceptible of commercial application, if not found too expensive to work. M. Piver also exhibits drawings of the various mechanical appliances used to simplify labour at his divers manufactories. They comprise improvements in soap-boilers, lye-tubs, soap-cutting, planing, crushing, and stamping machines, agitators, macerating pans, &c., which are all very ingenious.

The French colonies only send perfumery materials; and among them stands pre-eminent *Algeria*, which bids fair to become soon one of the most important marts for that kind of products. The Algerian soil and climate are particularly favourable to most of the flowers grown for perfumery purposes, such as the rose, jasmine, orange, cassia (*Acacia farnesiana*), tuberose, jonquil, geranium, &c., and they are now cultivated on a large scale in the vicinity of Algiers,—at Blidah, Oran, Chéragas, Rovigo, Bone, Philippeville, and other localities. Besides the above, some of the indigenous flowers might be turned to good account, and among others the nessri, or musk white rose, which has a beautiful fragrance, and grows wild in great abundance. The specimens sent by Algerian distillers are not so complete and numerous as we could have wished; nevertheless they comprise a fair assortment of perfumed waters and oils. Among the former we noticed one distilled from the verbena plant (*Aloysia citriodora*), which is a novelty.

The island of *Réunion* has a magnificent display of vanilla, contributed by no less than thirteen different exhibitors. This cultivation, which was originally carried on exclusively in Mexico, has been introduced lately into Réunion by M. de Floris, and has already acquired a wonderful extension, the annual production, which in 1849 was only three kilogrammes, having reached, in 1860, 6097 kilogrammes. This has naturally brought down the market price of the article, and will tend to popularise this really excellent aromatic, which is no less grateful as a condiment than as a perfume. The vanilla shown in this department has all the characteristics of the best Mexican species; it is long, moist, well

crystallised, and very fragrant. Réunion exhibits also cassia, cloves, nutmegs, and citronella.

The French *West India colonies* send specimens of vanilloes (*Vanilla pompona*), a sort of wild vanilla, and various spices. We have also to notice a very fine specimen of sandal-wood (*Santalum Austro-caledoniscum*), and one of *Ocotea aromatica*, a bark possessing a strong sassafras flavour, both from *New Caledonia*; a very fair sample of vanilla from *Tahiti*, the first grown in that island, and a fragrant bark from *Cochin China*, called *Alyxia aromatica*.

The specimens sent by the French colonies are altogether very interesting and extremely well arranged.

Austria makes a fair display of toilet soaps, the colours of which are very good, but they generally contain too large a proportion of cocoa-nut oil, a fault common to all German soaps. Cocoa-nut is largely used by German soap-makers, because it improves the appearance and the lather, and takes up more alkali than any other fatty substance, thereby diminishing considerably the cost price of soap; but it has the serious inconvenience of leaving a persistent fetid smell to the skin after washing with it. Some Austrian manufacturers exhibit various combinations of glycerine with soap and other toilet preparations. One of them shows a very good sample of transparent soap, said to contain twenty-four per cent. of glycerine, and a liquid soap with forty per cent. of it. The alcoholic perfumes exhibited in the Austrian department are generally inferior.

The *Zollverein* has a large number of exhibitors of perfumery, but few that call for any particular notice. There are no less than twelve manufacturers of eau-de-Cologne, seven of whom exhibit under the name of Farina, although it is asserted that there is but one house (that opposite the Jülichs Platz), who can lay real claim to the name.

The toilet soaps exhibited are extremely varied in colours and shapes (some of the latter indeed being more fanciful than delicate), but they are all spoiled by an excess of cocoa-nut oil, which can be easily tested by applying the tongue to the soap, or by rubbing it briskly in the palm of the hand. It is to be hoped that the Germans will turn their attention to this very serious defect in their soaps, and will endeavour to render them more fit to be used by people of refined tastes. Even as regards price, there is no real advantage gained by employing cocoa-nut oil, for if it takes up more alkali, it naturally follows that the soap made with it wastes away faster than any other, so that its apparent cheapness is a deception.

The alcoholic perfumes and toilet preparations exhibited in the Zollverein, with the exception of eau-de-Cologne, are not equal in quality to those of French or English makers. They have also the great fault of being most servile imitations of the Paris and London articles.

Italy sends a good collection of essential oils, mostly of the citrine

series, comprising bergamot, orange, lemon, and cedrate, some obtained by expression, and others by distillation. The latter process yields a larger quantity of oil, but of an inferior quality. Some pretty fair toilet soaps, chiefly made with an olive-oil basis, are also exhibited.

The collection of essential oils from *Portugal* is very meagre, yet that country is admirably situated to grow all flowers used for perfumery. It is to be hoped that this branch of manufacture will be improved and extended, which could be easily accomplished with a little spirit of enterprise and perseverance. The soaps exhibited are made with olive-oil, and are mostly of middling quality, a circumstance to be attributed to this manufacture having been until very recently a government monopoly, which precluded all private efforts and improvements.

Five Russian exhibitors have sent perfumery and toilet soaps. One of them shows a series of soaps and toilet preparations, said to be made with the oil extracted from yolk of egg. It appears that the same house manufactures albumen from white of eggs, and have a quantity of yolks left, which they have thus tried to turn to account.

Spain.—M. Robillard, the director of the botanical gardens at Valencia, sends some very excellent specimens of essential oils, distilled from plantations which he has created, and is constantly extending, in the fertile "Huerta de Valencia." His essence of geranium (*Pelargonium odoratissimum*) was found superior to any other in the Exhibition, having a sweeter and more rosy fragrance. This oil is much used by perfumers for producing, combined with other oils, the perfume of rose in soaps and other articles where price is an object, its cost being about one-tenth of that of otto of roses. Other specimens exhibited by M. Robillard, comprising verbena (*Aloysia citriodora*), artemisia, albahaca, lavender, malva poma, schinas, rosemary, neroly, &c., are also very interesting, and might come into general use if produced in sufficient quantities, and at reasonable prices. An essential oil of lemon is sent from Malaga, but it is obtained by distillation, and is of inferior quality.

Sweden has made a good display of perfumery and scented soaps, which is very creditable, considering that this manufacture is yet in its infancy in that country. We would, however, recommend to the toilet-soap makers to avoid in future the excess of cocoa-nut oil, a fault which they share with the Germans.

There are several very interesting collections of fragrant oils and waters exhibited from Turkey; some from the main-land and others from the Archipelago. They comprise the far-famed otto of roses, which is principally distilled in the neighbourhood of Adrianople, rose and orange-flower water, essence of geranium, orange flower (neroli), peppermint, sage, sandalwood, laurel, rosemary, aloes, bergamot, and last, not least, the celebrated balsam of Mecca, of which the quantity gathered is now so small that it is reserved for the special use of the Sultan. Some of these products are of good quality, but many appear adulterated, or im-

perfectly made. There is no doubt that great improvements might be effected in their manufacture, and render them an important and lucrative article of export.

We also noticed some specimens of the Turkish pastilles called kours, which are round, flat, gilt discs, used in the harem for sweet fumigations, or by smokers to increase the aroma of the tobacco. Chaplets and bracelets made of scented paste, kohl for darkening the eyelids, and various other cosmetics used by Turkish ladies, are likewise exhibited. All these preparations are of a very primitive form, and exhale a strong odour of musk, ambergris, and sandalwood, which appear to be the prevalent perfumes in the East, but are generally considered too strong and oppressive for European nerves.

In 1851 the United States sent nine exhibitors of perfumery, which number has dwindled down to two in the present Exhibition—a fact easily explained by the present disturbed state of that country. These two show essential oils of American production, comprising peppermint, spearmint, sassafras, and winter-green. The first is not equal in quality to the English oil, but sells at about one quarter of the price; the other three are largely used by perfumers for scenting common soaps.

ON THE SILKS OF JAPAN.

BY COMMODORE LORD JOHN HAY, C.B.

The collection shown in the International Exhibition, containing specimens of every description of silk that can be obtained in Japan, was made up by H.M. Consul at Kanagawa (Captain H. Vyse) and myself. We were assisted by that well-known and very greatly respected gentleman Monsr. Jaquemont, of Yokohama, who has been for some time past engaged in the silk trade with Japan, where his industry, intelligence, and probity in all his dealings are thoroughly appreciated. On reference to the appended table it will be seen that of the great varieties of silk in Japan the larger proportion have never been permitted to reach the European market; and any one conversant with the subject will observe, in a glance at the specimens, that five or six of the best qualities of silk have never before appeared in England. This restriction upon the export of the better qualities of the raw silk, no doubt arises from the action of the Government of Japan, always most jealous of Foreigners and of any increase to the Foreign trade: but it is gratifying to find that the supply of these better qualities, although at present limited, could, under more liberal government in trade, be indefinitely increased.

Captain Howard Vyse observes, in reference to the silk trade, that "twenty-one provinces produce silk; they are designated in the annexed table, which shows at the same time their approximate production. Eight or ten other provinces might be added, but their production is of too little importance to be noted.

"If we compare this table with the geographical map of the country, it will be perceived that all the provinces between the east and north produce silk.

"Aussion and Montsen alone represent 45,000 bales, about 22,500 piculs of annual production. In comparing the total production of Japan (which is about 67,500 piculs) with the principal silk countries of Europe, before the malady among the silk-worms broke out, we find, according to documents in our possession, that the production of France was 2,000,000 kilogrammes, of Italy 4,000,000 kilogrammes, of Spain 300,000 that is to say, that Japan produces as much as Italy and Spain put together, (4,300,000 kilogrammes) and as much again as France.

"The export for the season 1861 and 1862 will not exceed, it appears, 8,000 piculs, but there is a promise of a great extension when affairs in Europe return to their normal state, when the Daimios no longer oppose the best kind of silk being exported, and especially if in exchange for the Port of Neeagata (which, situated in the centre of the silk provinces, the province of Itchingo, was not opened to Europeans in 1860, as being inaccessible to large ships) other ports be opened in the same district."

I trust that the agreeable appreciation that this collection has met with ever since its first exhibition in England, will encourage others to redouble their efforts in obtaining information such as may lead to the development of the resources of the wealthy, but as yet, little known empire of Japan. It is admitted in Japan, that the country is capable of producing an indefinite quantity of these superior qualities, but that the cultivation restrained by law, and that the higher qualities are absorbed by certain classes for their use alone. We are in prosecuting these inquiries, greatly indebted to Her Majesty's Consul at Kanagawa, in Japan, Captain Howard Vyse, whose energetic and determined efforts in the course of trade will be more fully appreciated when these present obstacles that exist are at last swept away.

Since the opening of the ports of Japan, a large quantity of silk has been received from them. At first it realised from 15*l.* to 30*l.* The quality has not been found equal to the exportations formed at its early introduction, and like Chinese silk, its character has deteriorated; it is now inferior in quality, and much more mixed. The total imports have in the last three years been 17,295 bales, of about 103 lbs. nett, of which 14,709 bales were taken by manufacturers. In the Japanese collection of Sir Rutherford Alcock, there are samples of manufactured silks and crape scarfs of peculiar fabric, printing of silk and pieces of embroidered tapestry.

Approximate Production of Silk in Japan.

Provinces.	Classification Japanese.	Locality or District.	Approximate production.	Remarks.
			Bales.	
Sinchion . .	1 2 3 4 5	Ida . . . . . Ohonida . . . Jakato . . . . Matsemoto . . Senhoux . . .	20,000	Half of this Production is sent to the Miako Market.
Djossion . .	1 2 3/4	Maibassi . . . Annaka . . . . Issezaki	5,000	The greatest part is sold at Kanagawa.
Aussion . .	1 2 2/4 3/4	Kinhassan . . Foukoussima . Amatsenki . . Ahiaze	45,000	The 3/4 of which is sent Miako, the remainder to Kanawaga.
Mino	1 2/3	Gondjio Sodai . Massida	10,000	The 3/4 has been sent to Miako.
Etssion . . .		Iatsenho . . .	5,000	Almost all goes to Miako
Kanga . . .	1	Dahissiodgi . . Kanazawadzahi	5,000	All sent to Miako.
Tanba . . . Tango . . . Tadzma . .		Santan	6,000	All sent to Osaka and Miako.
Deva		Akita	6,000	The 3/4 is sent to Miako
Itchizein . .		(*Unknown*)	3,000	The 1/4 is sent to Miako
Itchingo . .		(*Do.*)	3,000	Almost all sent to Miako
Kossion . .	1 2	Kofon . . . . . Dza hibossi . .	3,000	The greatest part is sold at Kanagawa.
Boussien . .	1 2 3	Atzodgi . . . . Tsitsibon . . . Kava nghoé . .	2,000	Ditto
Tchikondzein Chingo . . . Tchikungo . Chizein . . . Oseumi . . .		(*Unknown.*)	10,000	A part of this Silk is sent to Nagasaki, the remainder is used at the place, or sent to Miako.
Noto		(*Unknown.*)	2,000	All sent to Miako.
Shida	1 2	Shirakava . . . Takagamo . . .	10,000	The ¾ sent to Miako.
			135,000 Bales.	67,500 Piculs.

Messrs. Remi, Schmidt, and Co., show an interesting collection of the silks and cocoons of Japan, especially reticulated cocoons, which appears to be undescribed, and the large wild green cocoons of the *Bombyx Yamimai*, the caterpillars, moth, and cocoon of which have been figured and described by M. Guerin de Menville, in the *Revue et Magazine de Zoologiè* of Paris, for 1861. The value of the raw silk imported into this country from Japan in 1860, was 90,115*l.*, and the value of that received in 1861, was larger, notwithstanding the decline in price.—Editor.

MANUFACTURE OF MENHADEN OIL.

In our bay (the Peconic) there are no less than six manufactories consuming, in the aggregate, about 2,000,000 fish weekly. The fish are chiefly caught in Gardiner's bay, where they abound in great quantities. They are taken chiefly in what we call purse seines, and can be caught in any depth of water. The fish are bought for 1 dollar per thousand. These seines some days catch 150,000 each, which, you see, makes a paying business of it. The manufactories are nearly all on different plans. Some use large tanks, in which the fish are placed, and into which steam is forced. A portion of the oil is extracted coming on the surface of the water, and is skimmed off; the water is then drained off, and the refuse is pressed by hydraulic presses or powerful levers. In another way of working used by one manufactory, the fish are placed in a large iron cylinder, similar to a boiler, and steam is let in at a given pressure while the cylinder is made to rotate by a steam-engine. The fish are steamed from 12 to 15 minutes, then turned out, and subjected to hydraulic pressure, which, of course, extracts oil and water together. This runs through pipes into tanks, where the oil rises to the top, and is taken off. There is a patent for this cylinder style, as it is called. The fish, after having being pressed, are dried on large platforms (some of them covering half an acre of ground), and after being thoroughly dried, the mass is ground down to what is called fish guano, ranging in price from 25 to 35 dollars per ton, and is considered an excellent fertiliser. These manufactories employ from 15 to 60 men each, and consume an enormous quantity of fish. That it is a paying business I have no doubt, considering the amount vested in it, which is considerable, the manufactories costing from 10,000 to 60,000 dollars each.

Greenport, Long Island. WHITE HILL.

Scientific Notes.

THE PROPOSED NEW SUBSTITUTE FOR COTTON.—The grass-wrack (*Zostera marina*) for the manufacture of paper, was patented by Lucius Henry Spooner, in 1855; it is also much used for packing, and for stuffing common beds and pillows. Although apparently flaccid and tender, it is employed in some parts of Sweden for thatching, and is found to be very durable; another species (*Zostera oceanica*) has leaves a foot long and an inch broad, this is even more valuable as a material for thatching than *Zostera marina*, it also furnishes the rush-like substance used as a covering for Italian liquor-flasks.

The fibre of Zostera bleaches well, indeed, endogenous fibres are for the most part of a beautiful white colour, as seen in the fibre of the pine-apple, the agave, the manilla, &c. The separation of the fibre of the grass-wrack and of all endogens is also more easy and economical than

that of exogens, because in the former the veins are parallel, and not reticulated, as in the latter ; therefore, in order to separate the fibres it is simply necessary to pass them between rollers. It is stated, however, that the per-centage of clean fibre yielded by the grass-wrack is very small—scarcely more than a few pounds to the ton, and if such should prove to be the case, however cheaply the material may be separated, in a commercial point of view the operation can scarcely be remunerative. But should such even prove to be the case, the question of the strength of the fibre and its adaptation for dyeing and printing yet remain to be tried before we can reckon much upon its adoption as a substitute for cotton.

It may be well to bear in mind that the structure of cotton differs entirely from that of the fibre of the grass-wrack and of all other woody fibres. The structure of cotton is identical with that of the hairs found upon various parts of plants, yet even the silk cottons which resemble cotton in this respect have hitherto proved of no commercial importance, although the material is abundant and cheap. The silky down of the Bombax is spun in Africa, and stockings made from it were exhibited at a recent fair held in Liberia. In Zanzibar this substance is a favourite substitute for cotton, and costs about half the price. The down from various species of Bombax and other plants has also been spun and woven in the East Indies, in several parts of America, and in some other places, but the shortness of the staple and its elasticity prevent its being spun by the machinery in use in this country.

The grass-wracks are marine plants and very abundant—the scientific name (Zostera) has reference to the girdle-like appearance of the long linear foliage. This order of plants is very interesting, as affording the stepping-stone between the flowering and the flowerless plants, yet even to eyes little practised in such matters the superiority of Zostera in point of organisation to the common sea-weeds of our coast has been sufficiently apparent to give rise to a popular myth mentioned by the late Hugh Miller. Directly opposite the town of Cromarty are a series of sand-banks partially uncovered at spring tides, and green with Zostera marina ; these are pointed out as the *meadows* of the old town which was swept away by the encroachments of the sea some two or three hundred years ago. The fishermen of the neighbourhood affirm that these sand-banks are still covered with what were the luxuriant terrestrial grasses of ancient Cromarty—that they are in fact essentially the same, only they have made a virtue of necessity under their altered circumstances, settling down into grasses of the sea, but that they are not at all akin to the brown kelp or tangle which every boisterous north-east wind heaps along the coast. This is quite an inverse Darwinian theory.

The grass-wrack can claim for itself a most remote ancestry. Hugh Miller has given an engraving of a fossil plant closely allied to Zostera from the trilobite-bearing schists of Giruan—associated with graptolites of the Lower Silurian type. In order to appreciate in any adequate degree the extreme remoteness of the geological period named, we must bear in mind that since that epoch, rocks about 37,000 feet in thickness, have been deposited for the most part as the sediment of long-since dried up rivers, estuaries, and seas. This 37,000 feet of vertical thickness is no blank record, but bears upon its ample pages full testimony that during its accumulation, species, genera, and even entire orders of plants and animals have been summoned into existence, and have passed away, never to re-appear as living species ; and this has taken place, not once only, but again and again, since that little Zostera-like plant fringed the shore of the Silurian sea ;—who may say how many ages since ?

Salisbury. EDWARD T. STEVENS.

THE TECHNOLOGIST.

THE ECONOMIC USES OF LEAVES.

BY THE EDITOR.

Setting aside many of the most important leaves which furnish staples of commerce, like tobacco, tea, indigo, senna, &c., there are many local uses which deserve notice, and the object of the following remarks is to bring a few of these prominently forward in a collected form.

The leaves of many trees furnish occasional fodder for cattle—especially several of the Mimosa in India, Australia, and the Cape Colony. From others an essential oil is distilled, as from the orange, cinnamon, and lemon grass.

From the large leaves of the *Cannabis sativa*, bhang, an intoxicating drug is produced, and they are also smoked to cause the same effect. They have been imported into this country under the name of guaza.

The leaves of coltsfoot (*Tusselago farfar*) have long been smoked for chest complaints, and are said to form the chief ingredient in British herb tobacco. The leaves of milfoil or yarrow (*Achillœa millefolium*), another plant equally common with the last, have been recommended to smokers in lieu of tobacco, and are occasionally used for that purpose. The leaves of rhubarb are sometimes smoked by those who are too poor to furnish themselves with a regular supply of tobacco, and those who have used them state that although devoid of strength, they are not a bad substitute when tobacco is not to be obtained. For the same purposes they are collected and used in Thibet and on the slopes of the Himalayas.

The leaves of the bog bean (*Menyanthes trifoliata*) are used in the north of Europe when hops are scarce, to give a bitter flavour to beer, and have been also adopted as a tobacco substitute.

The Virginia or stag's horn sumach (*Rhus typhina*) supplies leaves which are dried and used by some of the native American tribes for smoking. The Indians of the Mississippi and the Missouri use the leaves of another sumach (*Rhus copallino*), and Indian tobacco (*Lobelia inflata*),

supposed to be indebted for its name to the fact that it was one of the plants smoked by the Indians instead of the genuine "weed." Under the name of "tomboki," the leaf of a species of *Lobelia*, is smoked in parts of Asia. Beet leaves have been lately recommended as a tobacco substitute in France.

The leaves of the betel pepper vine are in extensive use in Asia with the betel nut. In the markets incredible quantities of the leaves are offered for sale in piles carried about in baskets. The betel leaf is a powerful stimulant to the salivary glands and digestive organs, and diminishes the perspiration of the skin.

In Peru and Bolivia an important trade is carried on in the leaves of the coca, another narcotic, which is considered stimulant and tonic. Large heaps of the freshly-dried leaves, particularly while the warm rays of the sun are upon them, diffuse a very strong smell, resembling that of hay, in which there is a quantity of milfoil. Birch leaves were formerly used internally and externally in cases of dropsy. They are employed at the present day in Finland for tea.

Palm leaf hats are common in many countries. The well-known and high-priced Panama hats have already been described in our pages. From Catacaos, Peru, there are frequently exported 10,000 or 12,000 doz. of palm fibre hats, valued at 60,000*l.* Palm leaf is sold in Salvador Brazil, in bundles of sixty leaves, at about 14s. to 16s. Palmetto is a common name for several small palms. One species is much utilised in Bermuda, where the leaves are worked into baskets, table mats, hats, bonnets, and other articles. There is a utensil also formed of the leaf doubled very neatly at the end of a turned handle. The palmetto is about sixteen inches long, and is used in bed like a fly flapper, much to the discomfiture of that little insidious insect, the mosquito. The Bermudians make them with painted and decorated handles, and few towns in the islands are without them.

The stately Corypha Palm (*Livistonia Australis*) one of the "princes of the vegetable world," attains the length of more than sixty feet. It furnishes in its young leaf stalks and terminal buds the palm cabbage, a food equally wholesome and delicious, whilst the fan-shaped leaves are eagerly collected for the manufacture of the well-known cabbage-tree hats of Australia, which if not so fine as the Panama hats, are equally strong and serviceable.

The leaves of the dwarf fan palm (*Chamaerops humilis*) are used in Algeria for making brooms, seats of chairs, hats, thatch for cottages, &c. The leaves of another class of short palms, the *Thrinax*, have many economic uses. *T. argentea* furnishes the chip which is woven into hats, and made into baskets and wicker-work; while other species of the genus supply the palmetto thatch, which forms an article of export from North America. The leaves of *Borassus flabelliformis* are used for writing on, for thatching houses, and making baskets, mats, umbrellas, and fans. Strong and durable fibres are produced from the petioles of the

fronds. A fine downy substance is found at the base of the leaves used for stopping bleeding wounds.

The leaves of the palmyra and talipot palms are made into umbrellas baskets, &c., but they furnish no useful fibre. Palmyra mats are used for packing betel nuts in. In Tinnivelly, from a single palmyrah leaf buckets are made which are used for drawing water from wells.

A flexible integument of the leaf of the Areca palm is used for numerous purposes, and especially for making a kind of shelter or covering to protect the blossom of the tree from the rain. The tying on of these caps is one of the chief expenses incurred in this cultivation.

It is also made into sooparee caps, which are worn by the Bunts, an agricultural class of Hindoos in the district of Canara, and into coverlets.

The fibre of the lower end of the leaf of the Bynee (*Caryota urens*) is of remarkable strength, and applied to many purposes, especially for fishing lines. In England it is termed India gut. Lately it has been largely introduced as Kittool fibre from Ceylon.

Under the name of Nipap, or atep, the leaves of the *Nipa fruticans* are used very generally in the far East for thatching.

Of the leaves of the date palm (*Phœnix dactylifera*), brooms and brushes are made in Egypt. Of the fibre (lif, or loof), by which the petioles are bound together, all sorts of cordage are made ; and it is used as a flesh rubber in the baths.

Mats, baskets, and plates, are made by the Nubian women of the leaves of the doum palm (*Hyphaene Thebaica*). Palm-leaf mats are also made at Tripoli and other places. Mats are made of date-leaf in Madras, of the fragrant screw pine, and the pandanus-leaf.

In Ceylon, many of the indigenous inhabitants, as well as natives of Europe, thatch their houses with coco-nut leaves, by the Singalese called *polattu*, and sometimes *cadjans*. The latter term has, I believe, a Malay origin. To prepare *cadjans*, the stipe, or central ligneous portion of the leaf is divided longitudinally ; the leaflets of each half are then interwoven, by which means they are adapted for a variety of uses. In this state they are employed to thatch cottages, to shelter young plants from the scorching rays of the sun, to construct fences, to form the ceilings of rooms, and to make baskets for carrying fruit, fish, &c.

Sometimes baskets are made of palm-leaves, so close as to serve the purpose of buckets to draw water from deep wells. In the Maldive Islands, *boneta*, a species of fish, is preserved by a process in which coco-leaves are employed. The process consists in removing the backbone and laying the fish in the shade, occasionally sprinkling it with salt water. After a certain period has elapsed, the fish is wrapped up in coco-nut leaves and buried in sand, where it becomes hard. Fish thus prepared is known in Ceylon, and perhaps over all India, by the name of *cummelmums*. The pieces of this fish brought to the market have a horny hardness. It is rasped upon rice to render it savoury. The inhabitants of several of the South Sea Islands manufacture a kind of mask or vizor

of the leaves of the coco-tree to defend their faces from the scorching rays of the sun; and this kind of armour is said to have a somewhat pleasing and graceful appearance when worn by young persons. The unexpanded leaves are employed to show marks of respect to persons in power. When the Governor or Chief Justice travel, lines made of the stems of creeping plants are stretched along on each side of the road about three or four feet from the ground. Upon those lines young palm leaves are suspended. The head civil servant of a district may command the inhabitants under his immediate control to ornament the road along which he passes; but he is not warranted in claiming this mark of attention beyond his own district. The immature leaves of the coco-nut palm have a fine yellow colour, and a beautiful texture resembling fine leather or satin. In some parts of Ceylon, natives evince great taste in ornamenting triumphal arches, as also ball-rooms and similar places of public resort, with the leaves of this tree, and some remarkably beautiful species of moss. As the young leaves are translucent, they serve to make lanterns, in the construction of which many of the inhabitants are very dexterous. The practice of showing respect to individuals by means of the branches of palm-trees is very ancient. (See Matt., xxi. 8; Mark, xi. 8.; and John xii. 13.) The foliage of the palm tribe has been in many countries considered an emblem of joy and victory; and hence the word palm is sometimes employed as a synonyme of victory and triumph. (See Levit. xxiii. 40.) It is remarkable that a similar mode of showing respect by waving palm branches prevailed among the aborigines of America when it was discovered by Columbus. In ancient times, when pilgrims resorted to Palestine, they commonly returned bearing palm-leaves; on this account they were denominated *Palmers*. Captain Lyon, when describing the amusements of the natives of some parts of Northern Africa, informs us that the dancers "were directed by an old woman, with a torch in one hand and a long palm-branch in the other, and sung in chorus verses which she repeated to them." In the island of Otaheite the female inhabitants wear bonnets constructed of the leaf of the coco.

The leaflets are sometimes used to write upon, and the instrument employed to make the impression is an iron stylus, the pen of the Scriptures. The stylus was used by the Romans to write on waxen tablets, leather, &c. The leaves of the Palmyra (*Borassus flabelliformis*), or Talipot (*Corypha umbraculifera*), are, however, much more frequently employed for this purpose. Contracts and other legal instruments are often engraved upon tablets of copper, similar in shape to a slip of the Talipot leaf, which have occasionally a border of silver or gold.

An allusion is made to the practice of writing on tablets in Isaiah xxx., 8, and Habbakuk ii., 2. Palm leaves, when they are prepared to receive the impression of the stylus, are called *ollahs*. The natives write letters to one another on *ollahs*, which are neatly rolled up, and sometimes sealed with a little gum lac. In this manner they pass

through the post-office. During the operation of writing the leaf is supported by the left hand, and the letters scratched upon the surface with the stylus. (Marshall on the coco-nut.)

Instead of moving the hand with which they write towards the right, they move the leaf in a contrary direction, by means of the thumb of the left hand. To render the characters more legible, the engraved lines are frequently filled by besmearing the leaf with fresh cowdung, which is tinged black by rubbing the lines over with coco-nut oil, or a mixture of oil and charcoal powder. The natives can write standing as well as walking, and they rarely use tablets. Palm-leaves, and perhaps the leaves of trees that do not belong to this natural class, were much used by the ancients as writing materials; hence the word *leaf* (of a book) is synonymous with that of a tree.

The leaves of *Sabal Mexicana*, Mart., are used for making hats and mats, the dried leaves used for platting being called "petates." They are prepared for platting by being dried and bleached in the sun, and then reduced to narrow shreds.

The leaves of *Corypha inermis* are devoted to the same purpose.

The large, broad fronds of the well-known fan palm of Ceylon (*Corypha umbraculifera*) are used for thatching, and also for writing on with an iron style. Such records are said to resist the ravages of time. The dried leaf is very strong, and is commonly used for umbrellas by all classes. It opens and shuts like a lady's fan, and is remarkably light.

An entire leaf of the *Mauritia flexuosa*, a Brazilian palm, is a load for a man. The unopened leaves form a thick, pointed column. According to Wallace, this is cut down, and, by a little shaking, the tender segments fall apart; each one is then skilfully stripped of its outer covering, a thin, ribbon-like pellicle, of a pale yellow colour, which shrivels up almost into a thread; these are then tied in bundles and dried, and are afterwards twisted, by rolling on the breast, as though into string, or with the fingers into thicker cords. The article most commonly made from it is the "rede," or netted hammock, the almost universal bed of the native tribes of the Amazon. This is formed by doubling the string over two rods, or poles, about six or seven feet apart, till there are forty or fifty parallel threads, which are then secured, at intervals of about a foot, by cross strings, twisted and tied on to a very longitudinal one, a strong cord is then passed through the loop formed by all the strings brought together at each end, by which the hammock is hung up a few feet from the ground; and in this open cot the naked Indian sleeps beside his fire as comfortably as we do in our beds of down. Other tribes twist the strings together in a complicated manner, so that the hammock is more elastic; and the Brazilians have introduced a variety of improvements, by using a kind of knitting-needle, producing a close kind of web, or by a large wooden frame with rollers, in which they weave in a rude manner with a woof and

wift, as in a regular loom. They also dye the string of many brilliant colours, which they work in symmetrical patterns, making the "redes," or "maqueiras," as they are called, among the gayest articles of furniture to be seen in a Brazilian house on the Amazon. Beautiful specimens of these hammocks were shown in the Brazilian, British Guiana, and other Courts of the International Exhibition this year.

The women of the island of Mahe, one of tha Seychelles group, work largely at making hats of a superior description from the leaves of the cclebrated coco-des-mer (*Lodoicea Sechellarum*), found only at Praslin and Cunense.

The leaves open like a fan; they are of large size, often attaining a length of twenty feet, with a breadth of ten or twelve, and in some few cases, thirty feet in length, including the petiole, which is of sufficient strength to support the weight of a man. In 1859, 3,310 of these coco-nuts were exported, valued at 331*l.*, and 11,800 cups made of them of the value of 590*l.* The foliage is employed to thatch the roofs of houses and sheds, and even for walls. With a hundred leaves a commodious dwelling may be constructed, including even the partitions of the apartments, the doors, and the windows. In the Isle of Praslin most of the cabins and warehouses are thus made. The down attached to the young leaves serves for filling mattresses and pillows; the ribs and fibres of the petiole constitute baskets and brooms. The young foliage affords the material for the hats. For this purpose, the unexpanded leaves only are taken, dried in the sun, and cut into longitudinal slips, two or three lines in breadth, which are then plaited, and scarcely any other covering for the head is worn by the natives of the Seychelles.

The leaves of many plants yield excellent fibre, such as the agave, the pine apple, the New Zealand flax, and others. The fine white fibres of the pine apple leaves have been formed into the most delicate fabrics, as well as fishing lines, ropes, &c. Unlike other fibres, they are not injured by immersion in water,—a property much increased by tanning, which process is constantly used by the natives of India. In Malacca and Singapore a trade is carried on with China in these fibres, which are there used in the manufacture of linen stuff. As a substitute for flax, they are, perhaps, the most valuable of Indian fibres.

Plantain leaves (*Musa*) are converted in Africa into spoons, plates, and even bottles. They are also made into thatch, fuel, and a substitute for wrapping papers. From their cooling nature, the leaves are generally used in the tropics to dress blisters. The leaves of *Abelmoschus esculentus* are used for poultices. In Africa, the leaves of *Adansonia digitata* are also made into poultices and fomentations for rheumatic affections of the limbs and irritable inflammatory ulcers. The natives eat the leaves with their food, and they are considered cooling and useful in restraining excessive perspiration. The leaves, too, are used

for leaven. The leaves of several species of *Amarantus* are employed as emollient poultices in India.

A clean leaf of the *Dillenia speciosa* forms the plate of the Dyak. The leaves, which are hard and rough, are used for polishing furniture, like others of the same family. The leaves of a plant called "bua palas," probably a *Dillenia*, are used in Sumatra for polishing creeses. The rough leaves of the *Curatella alata* are used in Guiana and Trinidad for polishing bows, sabres, &c. The leaves of *Celtis orientalis* are used in India for polishing horns, &c. Cadjan fans painted, coloured palmyrah fans, and various palm fans are common in India.

The leaves of the *Bergera koenigii* are used by the natives of India in their curries, to which they impart an agreeable flavour. When rubbed together they emit a pleasant aromatic smell. They retain this flavour when dried, and are sold in that state in the bazars. The mucilaginous leaves of *Cassia tora* have many medicinal uses in India.

Baskets for catching fish, shrimps, &c., are made of the ligneous ribs of the leaflet. The same substance is employed by the natives for many of the purposes for which we use pins. A bundle of these ribs is in universal use, as a broom to sweep the cottages ; and when an European asks for a tooth-pick, his servant brings him a portion of one of these fibres. The South Sea Islanders make the teeth of combs for the hair of this part of the leaf. In a domestic state, elephants are fed chiefly upon coco-nut leaves, and this animal evinces much sagacity in separating the elastic woody fibre from the thinner margin of the leaf. For temporary purposes, cadjan houses are frequently constructed both by natives and Europeans. During the insurrection in the Kandyan country in 1818, almost all the sick were accommodated in cadjan hospitals. Except the frame-work, every part of the house-walls, and roof, is formed of coco-nut leaves, and they are capable of resisting all kinds of weather for a year or more. A tent or hut made of talipot leaves sent home from Ceylon for the International Exhibition, was recently set up in the gardens of the Royal Horticultural Society, but it could not stand our inclement climate, for the sharp gales soon shattered the dry leaves to pieces.

To prevent thieving, the owners of topes frequently fix a coco-nut leaf along the stems of the fruit trees. As the leaf rustles much when touched, a thief is cautious of ascending the trunk of the tree lest he should alarm some of the inmates of the neighbouring huts. Thunberg mistook the use of these leaves, and supposed that they supplied "the place of ladders, by means of which the natives could climb up and gather the fruit." In warm climates, it is customary to travel during night, with a view of avoiding the influence of an ardent sun. Torches then become necessary, and coco-nut leaves are chiefly employed for this purpose. By tying the leaflets close to the centre rib of a leaf, the ignition is prevented from being too rapid. Torches of coco-nut leaves, commonly called *chœls* (oaloo attu, Singhalese), are in constant use, to

obstruct the inroads of wild beasts upon cultivated fields, more particularly of elephants. In the interior of Ceylon, every field under cultivation must be watched during night, to prevent depredations which would be made upon the crops, were these animals to have free ingress. When burned, the coco-nut tree, especially the leaves, affords a large proportion of potash, whence the washermen procure all the potash they require by the incineration of different parts of the tree. Soap is very little used by the native washermen of Ceylon. Boats are rowed with the centre rib of the leaf, in which operation it forms a substitute for paddles. The end of this part of the leaf when well bruised, and thereby converted into a brush, is used for a variety of purposes, such as whitewashing houses, &c.

In British Guiana, the natives make a species of Æolian harp of the stipe of the leaf of a coco-nut tree ; and some tribes split the stipes, and after rendering the split portions very thin, they are attached together laterally by means of their silky grass, thereby forming a sail for canoes.

The foliage, that part of the palms which render them objects of such beauty and elegance, generally forms a magnificent crown at the end of the trunk. The leaves supported on petioles or leaf stalks, sheathing at the base, are alternate, coriaceous, and often of such gigantic size,—measuring as they do in some species, fifty feet in length, and eight in width,—that they surpass in the latter respect those of any natural order of plants.

Their structure may be summed up in a few words : they are simple, and furnished with a midrib, from which parallel veins branch off. This structure best seen in some species of (Geonoma) *G. simplicifrons*, Willd., for instance, when it appears in all its normal simplicity is common to all palms, but assumes in different species different forms, easily recognised by accomplished botanists wont to look upon the vegetable kingdom with a morphological eye, but not so readily traced by those who have made only a limited progress in phytological studies.

In some species, as for example, the species of Geonoma just quoted, the blade of the leaves is quite entire, while in others, of which the coco-nut may be cited as the type, it is cut into long segments (pinnatisect) giving it the appearance of the plume of a feather : occasionally, in the genus Caryota, these segments are again divided (bipinnatisect), their ultimate divisions resembling in shape the fin or tail of a fish. The midrib in these three forms it must be observed, extendst hroughout the whole length of the leaves ; when the contrary is the case—namely, when the midrib is less developed, palmate or fan-shaped leaves are the result. This, however, does not happen very frequently, for out of 582 known species only ninety-one have fan-shaped leaves.

The leaves are green, generally on both sides, as in the different species of Chamaldorea, but occasionally on the under side of a silvery white, as in the *Copernicia miraguama*, and *C. cerifera*. Sometimes the

middle of some leaves is adorned with concentric bands of yellow and blue, in the manner of a peacock's tail, as in the prickly Mauritia, discovered by Bonpland on the banks of the Rio Atabapo. The direction of the leaves is a character of no less importance than that of form and colour.

The segments are either ranged in a comb-line manner close to one another, with a stiff parenchyma, allowing the solar rays to play over their surface, and causing them to shine with a brilliant verdure in the Coco-nut palm, and with a fainter ashy-coloured hue in the date tree, or they have a more flexible, grass-like texture, and are curled near the extremity. Another peculiarity is also notable, the more acute the angle made by the leaves with the upper part of the stem, the nearer the leaves approach the perpendicular, the bolder and nobler is the aspect of the species to which they belong.

This will at once be evident by comparing the pendent leaves of the Palma de Covija (*Copernicia tectorum*), with the more horizontal leaves of the coco-nut palm, and the lofty heavenward pointed foliage of the Jagua, the Cucurito, and Pirijao.—*Seeman on Palms.*

THE MINERAL RESOURCES OF NEW BRUNSWICK.

BY L. W. BAILEY,

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As the subject of the mineral resources of this province is at the present time absorbing a large proportion of public attention, and as a very general interest seems to be manifested in almost all parts of the province, in searching for and developing our metallic wealth, I have thought that a brief list of the ores already known and their localities, together with a few simple directions for the discrimination of future specimens, might possibly prove interesting to those engaged in such pursuits, and perhaps to the public generally. I have therefore prepared and given below a short list of the principal ores known to exist in the province, with a few observations appended upon their quantity, quality, and facility of working, so far as has been hitherto ascertained. My authority for the greater part of the following facts are the labours of the late Dr. Robb, the metallurgical collection of the University, and statements, published or otherwise, of the late M. H. Perley, Esq., Dr. Gesner, and other gentlemen in various parts of the province :—

Iron.—Red Hæmatite, found at Woodstock, King's County, Queen's County, Bathurst, and Richibucto. Micaceous ore, specular iron, red hæmatite, found at Morrison's, West Beach. Specular iron, found at Black River and Campo Bello. Iron pyrites and cubic pyrites, found at

Campo Bello. Micaceous iron pyrites, found in the vicinity of St. John. Red hæmatite, found at Restigouche and Dorchester. Iron pyrites, found at Botsford, Westmoreland. Bog iron ore, found at Rush Hill, Queen's County, Sunbury, Campo Bello, and Charlotte. Blue phosphate, found at Madawaska.

Manganese.—Manganite, found at Tattagouche River and Dalhouise. Gray oxide, found at Woodstock. Wad, black oxide, found at Quaco, Dorchester, Fredericton, Westmoreland, and Queensberry, York. Pyrolusite, found at Shepody and Quaco.

Lead.—Galena, found at Campo Bello, Norton Kings, Tobique, Restigouche, McLeod's, Macadavic ; Long Island, Digdeguash ; Emerson's Little Falls ; Woodstock ; and L'Etang, Charlotte. Anglesite, found at Campo Bello.

Copper.—Native, found at St. David's, Charlotte County. Copper pyrites, found at St. Stephen's and Bathurst. Green carbonate, found at Bathurst, Tattagouche River, and Simpson's Island, Charlotte. Chalcopyrite, found at Bull's Creek. Erubescite, found at Macadavic, Salmon River, Albert St. Stephen's. Copper pyrites, found at Campo Bello.

Zinc.—Blende, found at Lubec, Nerapis, and Restigouche.

Antimony.—Stibonite, found at Prince William, York, and vicinity of Fredericton.

Molybdenum.—Molybdenum, found at Nepisquit.

These are by no means all the localities in which the above-named metals occur, especially as regards the sulphurets of iron and copper. These are very generally diffused ores, and occur in almost all parts of the Province. Only the purer and more extensive deposits are above given. It is impossible however, from small cabinet specimens to judge accurately in regard to the quantity or quality of an ore, average specimens being necessary to decide this point. The above list may therefore contain many which from their peculiar position or other causes may be in reality worthless, while some really valuable ores may be omitted.—This source of error it was impossible to avoid.

It will be seen, from an inspection of the list, that some two or three localities contain good ores of several of the metals. Among these Woodstock, Campo Bello Island and the vicinity of Bathurst on the Tattagouche River are the most prominent. Campo Bello Island, especially, is rich in iron, lead and copper, while Native (*i. e.*, pure) copper occurs at St. David's Charlotte, and zinc blende at Lubec, Mame.—Gold having also been discovered near Calais, by Mr. Goodale, this section of the Province may be regarded as one of the most promising for future exploration. Moreover no position could be more advantageous for transportation than these southern Shores and Islands of the Bay of Fundy. It is to be hoped that the immense resources here stored away for use may soon be made a source of revenue and profit.

In regard to the ores of iron, I may say, generally, that the best ores for the purposes of smelting are the Specular Ores and Red Hæmatite

(the first easily recognised by its steel-like metallic lustre, and bright reflecting surfaces, resembling mirrors, the second by its dull red earthy or rusty character), while the sulphurets (generally called *Pyrites*, from the fact that they strike fire like steel), are seldom used except when existing in large quantities and of great purity. Slate however, impregnated with decomposing Pyrites is valuable as the chief source of the manufacture of Copperas or Green Vitriol. It may be of great value at some future day, but exists elsewhere in such great quantities as to be at present worthless. The same is partly true of Copper Pyrites, which closely resembles the above, but which is of a deeper yellow colour, and unlike the former will yield to the point of a knife. These two ores, Iron and Copper Pyrites, together with an entirely valueless mineral, called Mica, are those most frequently mistaken for metallic gold, and are hence frequently called Fool's Gold. The three may always be easily distinguished by the following means :—

1. Gold can always be cut in slices like lead with a common penknife, is unchanged by the hottest fire, and is beaten out without breaking by the blow of a hammer.

2. Iron Pyrites is of a much lighter colour than gold, cannot be cut, is very brittle, when heated gives off strong fumes of sulphur, and flies into atoms by the blow of a hammer.

3. Copper Pyrites looks more like brass than the preceding, yields to the point of a knife, but crumbles instead of cutting into slices like gold, and also gives off strong fumes of sulphur when heated.

The two latter are very frequently intimately combined, and the resulting mineral is then called chalcopyrite. Mica is so wholly unlike any metal, that it has always been a matter of surprise that any one should mistake the two. As, however, the mistake is of frequent occurrence, I may say that Mica can be easily recognised by the fact of its splitting readily by the point of a knife into thin laminæ or leaves. I may also state in regard to gold, that I am unaware of any authentic specimens having been as yet discovered in the province, notwithstanding the numerous reports circulated to that effect. The report which was current in several of the papers last winter, that specimens had been sent to the University, and found to contain the precious metal, was entirely without foundation, no such specimens having even been seen at the University during the past twelve months. It is highly probable, however, that such discoveries may yet be made.

Manganese, of good quality, occurs in various parts of the province, and resembles the ores of iron in many respects. The means of distinguishing the two, however, although simple, are not generally available to the public at large. This metal is used in the manufacture of glass, both for producing and removing colours. It is also extensively used for glazing and bleaching.

The ore of lead (galena) is easily recognised by its lead-grey colour and sharp angles, easily breaking into cubical blocks. It melts very

readily when heated, and generally contains a small per-centage of silver, varying in amount in different localities.

Antimony has been found in the two localities mentioned in the list. The statement now circulating in the papers to the effect that this is the only locality of antimony known in North America is incorrect, it having been found (though sparingly) in Maine, New Hampshire and Maryland, Moreover, the discovery is not one of recent date, a specimen of the ore examined by Dr. Robb, and marked with his handwriting, having been in the museum of the University since before my arrival in the province. Whether he was the discoverer or not, or whether the locality is the same as that recently announced, I do not know, he having apparently been in some doubt himself in regard to the same. This ore resembles the preceding, but has a darker lustre. It may be recognised by boiling a little of the ore in strong ley (caustic potash) and after solution adding a little common muriatic acid. If antimony is present a dark red powder will appear in the liquid. The metal is used in the manufacture of type, Britannia ware, tartar emetic and various medicines.

Zinc blende occurs in the province, but of no great purity. It is transparent and wax-like, with a brilliant surface. *Molybdenum* is a rare metal, of no importance in the arts.

I have reason to think that the metal bismuth also occurs in great purity in the province, but as there is some doubt regarding the only specimen yet shown to me, I omit it from the list. It is used for the manufacture of type metal, plumber's solder, fusible metal, &c.

In conclusion I would say, that it is highly desirable that authentic and representative specimens of the valuable ores and minerals of the province should be collected and preserved for future reference. Such a collection of minerals, ores and fossils, representing their various localities, would be of inestimable value in the preparation of local agricultural and geological reports, or the conducting of future geological surveys. As a numerous collection has already been made with this object, by my lamented predecessor, in the museum of the University, and as this collection is not only valuable for reference, but also directly for the purposes of instruction in the Institution, it is to be hoped that those interested in the collection of such objects, will favour us with authentic and average samples of the different deposits, as they may from time to time be discovered. Such specimens, whether of ores, minerals, or fossils would be most thankfully received and duly acknowledged by the University. I would especially ask those visiting Campo Bello, Grand Manan, the north shore of the province, the coal mines of Albert and Grand lake, and other interesting localities, to obtain and preserve the specimens they may meet, or forward them to the University. Any reasonable expense incurred in such transportation will be cheerfully repaid. The locality where the specimen is found should always be mentioned.

To the farmers generally, throughout the province, and indeed, to all living in the country districts, I would say, that they may render service of great value to the future interest of the province, by the simple preservation of whatever objects of curiosity may chance to meet their notice, even though they may be unable of themselves to decide upon their value. Such collections cannot fail to be of interest and profit to those who make them, while the assistance they may render to scientific investigators cannot be over-estimated. Wherever geological surveys have been conducted, such private collections have invariably been the source of much useful information.

ON THE TANNING MATERIALS AND DYE-STUFFS USED IN ITALY.

BY J. ARNAUDON.

The art of working skins has been practised in Italy from very ancient times. The cities of Venice, Naples, Florence, and Mantua were renowned for their production of coloured gilt and morocco leather; and the gloves and coloured skins produced by the two latter towns, as well as by Rome and Rimini, were at the same period much esteemed. These branches of industry, however, have very greatly declined, though not to so great an extent, perhaps, as those of wool and silk, as they are not so dependant on the adaptation of machinery and the caprices of fashion.

In spite of its general importance, few documents can be found that throw light upon the history and technology of this art in Italy, those which exist giving but very little information on this interesting subject. The political disturbances of this country also cause great obstacles to lie in the way of any researches into its commercial welfare (the more so with regard to skins and leathers, as these branches of industry are chiefly practised at the extremity of the peninsula), and all accounts that have been obtained are limited to the exports and imports; the important points of national production and consumption being left almost wholly untouched. The documents that are found were written at a time prior to the formation of the Kingdom of Italy, when great and almost insuperable commercial barriers existed between different parts of the same nation. In subdividing the business connected with the preparation of the skins of animals, as far as the means in our power will allow us to judge, the production of tanning materials, and raw and half-cured hides, belongs to Sicily, Sardinia, the Tusban Maremmas, Trentino, Umbria, the Marches and the valleys of Susa, Finerola, and Aosta. From the towns of Turin, Naples, Florence,

and Bologna, the finished productions of ordinary morocco and glazed leather are obtained. If there is a branch of industry susceptible of development in Italy, it is certainly that which comprehends works in leather; for material is abundant, and those substances, or elements, necessary to its preparation are to be found in this country in great quantities. That some progress is being made, a comparison of the manufactures exhibited by it in the former exhibitions at London and Paris, with those displayed in the World's Fair of 1862, will testify. The total amount of the products of skins and leather may be computed at rather more than 30,000,000 kilogrammes, of the value of about 120,000,000 francs, and this without reckoning the value added by supplementary processes which the skins undergo during their preparation. In the ancient provinces there are 500 tanneries, which produce about 6,000,000 kilogrammes of leather. There are about 30 tanneries in the town of Turin alone, which employ 600 or 700 workmen, and produce more than 140,000*l.* There are from 60 to 80 tanneries divided amongst Liguria, Savoy, Genoa, and St. Maurice, with about 700 to 800 workmen, the greater portion being at Genoa and Savoy; at St. Maurice there are 18, which produce leather to the value of 360,000 francs.

Tanning establishments of some importance are beginning to be established in the isle of Sardinia, from whence more than 100,000 skins are now exported, besides large quantities of the bark of tanning oaks, which are so abundant in its rich forests. Cagliari has seven manufactories, and Sofrari two; those of the former town employ from 110 to 120 workmen, and the latter about 20. The value of exports and imports for ancient Piedmont may be approximately computed at 6,000,000 francs.

	frs.
1817	6,685,960
1818	5,311,182
Imports.	
1818	4,092,964
1817	4,806,427
Exports.	
1818	1,633,753
1817	1,879,513

Lombardy can boast of more than 100 tanneries, which employ 1,000 workmen, and of these Milan furnishes at least 300. In the new town of Milan there are about 28 or 32 manufactories, which turn out leather to the value of 100,000*l.* In the province of Brescia there are only 23 tanneries, which work every year about 138,000 skins, of the value of 30,000*l.*; but there are, besides, many alum-leather and glove manufactories. The province of Lodi possesses eight tanneries, three of which are in the town of Lodi, one at St. Angelo, and four at Lodogno,

and those of the last-mentioned town produce the greatest amount. In the province of Cremona there are three, and six in that of Pavia. In the Neapolitan provinces there are about 20 tanneries, besides 300 which are on a very small scale, and in which the leaves of the myrtle (*mortella*) are used.

There are also numerous other towns which carry on this trade, and together work about 8,000,000 francs worth of skins, two-thirds of which are imported. The island of Sicily possesses a certain number of tanneries, which are found chiefly at Catania and at Messina. In the latter town the works of the Brothers Ollaverini alone employ 100 workmen; and the total amount of leather produced by the various tanneries is 193,000 kilogrammes, of the value of 33,160*l.* In various other Italian localities are found 547 tanneries, in which 10,000 workmen are employed, and which produce about 2,200,000*l.* worth of leather.

There is great difficulty in ascertaining the exact amount of tanneries in Tuscany, they are so numerous, and, at the same time, many of them on a very small scale. In Venice the number is computed at about 80, some of which are very large, and produce more than 200,000 kilogrammes, the value of which would amount to almost a million of francs. At Florence there are about 20 tanneries, employing about 380 workmen.

We will now proceed to glance at some of the principal substances used in the preparation of leather. In the collection which I have exhibited in Class IV. of the Italian department are to be found the most important of the mineral, animal, and vegetable substances that are used for tanning purposes; and employed with success, not only to enable the skins of different animals to resist the effects of putrefaction, but also to make them supple and elastic.

The word sumach (*sommaco*) is generally applied to various species of *Rhus*, and especially to the *Rhus Coriaria*, the *Rhus typhina* (Virginian sumach), *Rhus pentaphylla* (sumach from Tezera), *Rhus Cotina*, *Rhus glabra*, and others, the leaves of which are often mixed with those of the lentiscus, the myrtle, the myrtillia, the tamarisk, and the arbutus. That which comes from Sicily is considered the best, and sumach is one of the principal articles which that province exports. Two houses alone (those of M. Florio and M. Vetrano) in Palermo produce annually 6,000,000 kilogrammes, valued at about 4,000*l.* M. Majorana, of Catania, and Burgarella, of Trapani, produce pretty much the same quantity. The annual exportation of sumach from Sicily is valued at about 400,000*l.* The countries which receive it are England and France, as well as the other Italian provinces. Sardinia, also, produces and exports sumach, but only in small quantities, and the article itself is considered inferior to that obtained from Sicily. Sumach is principally used in the tanning of goat and sheepskins that are intended to take darkish colours, such as green or red (for lighter colours it is necessary to combine the sumach with the bark of holm

oak), and is used, also, in the preparation of saddlery leather. The leaves of the fustic tree, or Venetian sumach (Italian *ocotano*), are used, like those of the common sumach, but almost exclusively in Umbria and the Marches, where the tanning process is carried on in pits.

The usage of leaves of the myrtle (*mortella*), especially of the *Myrtus communis*, is very ancient in Italy. They are steeped in the water which is used to impregnate the hides with tanning. This mode of tanning, known as the Italian process, is very prevalent in Tuscany and in some of the southern provinces, and is adopted solely for tanning the skins of animals. In Sardinia, for sheepskins, they use sumach, mixed with myrtle and alum. The leaves of the lentisk tree (*Pistacia Lentiscus*) are employed for the same purposes as the myrtle in the Neapolitan provinces, Sardinia, and the Volterrano; it is worth about six francs the 100 kilogrammes. The leaves of the tamarisk are used by the Sicilian tanners, and are valued at about five francs the 100 kilogrammes. The leaves of the arbutus (*Arbutus unedo*) were, in former times, greatly used and esteemed for tanning purposes.

The leaves of the *Rhododendron ferrugineum*, which are very plentiful in the Alps which surround Piedmont, are used by some tanners particularly at Bielle, where, under the name of "*rate*" they are mixed with oak, bark, and the produce of the *Cœsalpinia Coriaria*, or *dividivi*, which are imported from abroad. Leather produced by this means is used principally for soles. Various species of oak furnish very valuable bark, and great quantities are still procured in spite of the gradual disappearance of forests. The preference is given to those barks which are obtained from the cork tree of Tuscany and Sardinia, in which a large trade is carried on with England. In the forests belonging to the state lands of Tuscany alone 900 tons are annually collected, and from those which are the property of M. Maffei, at Volterra, 930 tons of different barks.

The bark of the *Quercus Robur*, that of the *Quercus sessiliflora* and *pedunculata* are used, but chiefly in Southern Italy. At Turin the species known as the "Turkey oak" which comes from Montserrat and the Comba are much esteemed.

The *Quercus Cerris* is found abundantly in the central provinces; its bark is used in the tanneries Mondovi, Cuneo, and Alexandria, for thick leather.

The holm oak (*Quercus ilex*) produces a bark which is almost exclusively employed in the preparation of calf and goat skins, which are used for saddlery and shoemeking. Sardinia and Tuscany import considerable quantities of it. It is worth about ten or twelve shillings the 100 kilogrammes.

The bark of the cork tree (*Quercus suber*) is used with very few exceptions, for sole leather only. The bark of the *Alnus glutinosa* and *Alnus cordifolia* is used in Piedmont and Sardinia sometimes alone, but frequently mixed with other barks.

The bark of the chesnut tree (*Castanea vesca*), which is used in Piedmont, and especially at Biella, is highly esteemed for the preparation of skins, though it imparts a dark colour to them; but this is, of course, an advantage when black is the colour desired.

The Birch (*Betula alba*) grows abundantly in the Valtellina, and in the valleys of Aosta and Susa, but it is only used to prepare oxhides and cowhides in the same manner as Russia leather.

The Norway spruce (a very excellent dye), gives to the sheep skins of Savoy and the valley of Aosta, which are sold profitably under the name of Savoy sheep skins, a fine light chamois colour closely resembling hazel.

The bark of the larch (*Larix europæa*, Dec.), as well as that of the fir, is frequently used in the small tanneries of the Alps, beyond Susa, where the value of it is estimated at from 5s. 5d. to 5s. 10d. per 100 kilos., and with this they prepare sheepskins, which, however, are not highly thought of in the market of Turin; and before they are made into morocco, it is the custom to pass them through a bath containing oak-bark and sumach.

Gall-nuts are excrescences which are produced on the leaves, on the fruit, or on the bark of various plants, and especially on the leaves of the different species of oak. They are much used in Piedmont for the preparation of strong leather, but the hardness and greenish colour which they impart to it lowers their price at Turin. Quantities of gall-nuts are collected at Mondovi, at Cuneo, Borgo Maneco, in Piedmont, Ascoli, in the Marches, in the Tuscan Maremmas, Calabria, &c.

The valonias (*vallonea, gallonea*) are the cups of oak acorns (*Quercus Ægilops.*) Those with the finest scales, which almost entirely cover the acorn, are the most esteemed by our tanners, who call them "valoni sticks" (*vallonea camata.*) Trieste and Leghorn are the most abundant markets for this produce, which is brought to Italy from the Levant, and particularly from Turkey, Greece, and the Ionian isles. Sicily also produces it, but in very limited quantity. In Lombardy and the Romagna, valonia is almost exclusively used by the tanners; they mix it in Piedmont with oak bark.

The *Scilla maritima*, which grows naturally on the shores of the Mediterranean, is a plant which the Algerian tanners have utilised.

I have made some attempts to utilise the residue of the tanneries in paper making.

Knoppern, or Hungary gall, is an excrescence growing on the acorn, and common oak, *Quercus Hayern*, and *purbescens.*

Some application of the *dividivi*, or fruit of the *Cœsalpinia coriaria*, have been made in the Piedmontese tan-yards, and especially at Biella, Borgomanero, and Turin.

Some attempts have been made in England on *Catechu*, extracted from the *Areca Catechu*, and the leaves of *Nauclea Gambir.* This substance is but little known, and being always charged with rather heavy

duties, as the custom-house apply to it the the tariff of pharmaceutical substances, it cannot be employed in the Italian tanyards and dyeworks until its price shall be much reduced.

The *Algarobilla* is the fruit of a leguminous plant of the genus *Mimosa*, which grows in abundance in Paraguay. Besides tannin and a yellow colouring matter, I have extracted from it starch, which is converted into alcohol during the tanning process, and which can be obtained by distilling the water that is left.

The Bablah, the fruit of the *Acacia Bablah*, which is used in Africa, is little known among our tanners.

The *Ou-poci-tse*, or Chinese gallnut, is an excrescence growing on the leaves of the *Distylum racemosum*, according to M. Decaisne. It comes from China and Japan ; it is used for tanning and for dyeing black, and produces a peculiarly beautiful pearl grey colour.

We now come to the colouring matter, and in this list we include those which are used for dyeing, colouring, and graduating the shades of the tissues, either by a direct process, or by means of heat, light, or the use of acids. For staining skins mineral substances, such as Prussian blue, or sulphate of iron—vegetable substances, such as the woods of Cuba, Pernambuco, Campeachy ; indigo, the bark and roots of the berberry tree, the florets of the safflower, and lastly animal substances, such as cochineal are used. Leather dyeing is not altogether dissimilar to silk dyeing, but it is the most difficult branch of the dyeing art, because the nature of the animal tissue must be taken into consideration. This becomes changed at 70 degrees of heat, and it therefore requires skill to adjust the properties of tanning and colouring matters, and the various effects of all those processes which have for their object to convert raw hides into tanned leather.

The chief colours produced are yellow, blue, and red ; the principal yellow colouring matters are the following :—The berberry (*Berberis vulgaris*) is a shrub which grows abundantly in the Piedmontese Alps ; its bark, and especially its roots, impart to hides tanned with alum and sumach, a rather durable tint of light yellow.

The wood and the roots of the fustic, or the sumach, yield a yellow or scarlet colour when they are mixed with cochineal, even tawny colours when they are mixed with indigo, carmine, orchella, or Campeachy wood, &c.

Woad (*Reseda luteola*) is occasionally used for dyeing skins which have been steeped in sumach ; it is used principally for sheep skins. It grows in abundance on the hills of Montferrato and the mountains of Ascoli ; and was formerly cultivated at Cortona, in Tuscany.

The broom used by the dyers (*Genista tinctoria*) is applied to the same purposes as woad. It is very abundant in the first zones of the Alps.

Saffron (*Crocus sativus*) is used in the dyeing of skins, but merely to give more brilliancy to the scarlet of the cochineal. The cultivation of saffron is very general in Italy ; the most celebrated places are those of

Castelnuovo, Catania, in Sicily, Aquila in the Capitanata, St. Gavino in Sardinia, Bibbiena, and Montalcino in Tuscany.

The seeds of Avignon (*Rhamnus cathartica*) are very plentiful in the Maremmas, and are used to dye the skins yellow, or green when they are mixed with indigo.

Fustic (*Maclura tinctoria*) is employed for similar purposes as those of the roots of the berberry tree, but it does not give so deep a colour. The best comes from Cuba.

Quercitron, or the bark of the *Quercus tinctoria*, might be used in the same manner as sumach. If this kind of oak were more cultivated, it would be very useful in the tanning business.

The green ebony from the Antilles (*Excœcaria glandulosa*) or *Jacaranda avalifolia*, has been used with success in some of our dyeing works, but at present is not much known.

For a description of the sulphur yellow ebony of Guiana, or Taigu of Paraguay, or Tpé of Brazil and Uruguay, the Olombeire of the Indian colonies of Portugal, see the paper which I presented, in 1858, to the Academy of Sciences at Paris.

Respecting the yellow bark of Australia, see a second treatise, published by me in June, 1857. If Australia sent us any great quantity our dye works would be able to employ it largely for the purpose of giving sheep skins and stuffs a deep yellow colour, produced by an alkaloid similar to that of the berberry tree.

We may also mention various sorts of wood coming from Siam and Australia, and among them the *Ouan-disi* of China, *Gardenia sp.*

Picric acid, which is made at Turin and Milan, by the action of nitric acid upon indigo and coal tar, is obtained by the distillation of the bitumen of coal (phenic acid).

With regard to the production of blue colour. Amongst the matters employed by dyers, there is Prussian blue, obtained by the reaction of a salt of iron with soda and prussiate of potash. The blue colour of the indigo is produced in a large tub, either by a cold process with woad, or by dissolving indigo in sulphuric acid. Azuline is not used because of its high price. Indigo, lime, and sulphate of iron, are also used.

The red colouring matters come next in order, and are as follows :—Madder (*Rubia tinctoria*) has for a long time been used in the dyeing of skins. The best comes from the plains of Capaccio, the neighbourhood of Salerno, Naples, and the Tuscan Maremmas, where it has been cultivated for many centuries. At present, Brazil wood and cochineal are used for the same purposes. Attempts have been made to rear cochineal in the kingdom of Sardinia, with not very satisfactory results ; some small quantity is produced in Sicily.

The berries of the *Phytolacca decandra* are used for dyeing purple and violet the skins prepared with sumach, and the sheepskins of Florence. The preparation and the use of the orchella (*Rocella tinctoria* and *Rocella fusiformis*, *Variolaria orcina*, and *V. dealbata*, *Lecanora*, &c.), has been

discontinued in Tuscany, where formerly it was much esteemed. That which is at present used is prepared at Lyons and Huddersfield ; and the suggestions of Giobert and Cantu have not yet succeeded in inducing our workmen to use the colouring lichens, which are plentiful in Sardinia and the Alps. The safflower (*Carthamus tinctorius*) is used for dyeing skins and giving to them a metallic lustre. Ascoli, in the Marches, and Castrocaro, in Tuscany, have some commerce in this article.

Sorgho (*Sorghum glycichilum*) is also a colouring plant, the stem and the rind of which, being fermented, produce a crimson, yellow, and red dye. Under the name of "violet woods," I have grouped a certain number of dyewoods, belonging to different species, but which all alike have the property of giving a colourless substance, susceptible of being converted into a crimson red colouring matter by the influence of acids, heat, and light ; each of these agents will give wood, or its extract, or any textile fabric, passed through a decoction of the wood itself, different tints varying from purple to violet, and from green to brown. Arnotto (*Bixa orellana*), in non-alkaline solution is used to give the leather particular tints.

Besides the *Tsai*, and the leaves of the *Chica* (*Bignonia Chica*), with which the Indians of South America prepare the *curare*, or curaruru, we have also to mention the numerous series of dyeing substances—red, violet, and bordering upon violet, known in commerce under the improper names of *fuchsines*, *azuleines*, &c., produced by the action of bichlorate of tin and mercury, arsenic acid, and the peroxide of manganese upon aniline, extracted from the distillation of coal-tar. These colours are brilliant, but not durable ; they resemble the yellow colour of berberry—in that they are more durable on tanned leather, the presence of the tannin, and the chemical substance of leather having some influence upon these phenomena.

As regards the process undergone by the skins in their conversion into leather, tanning by steeping has been generally relinquished, but is still used for goats' and sheep's skin. The processes followed by tanners, and the substances which they make use of, vary very much in each province, and, indeed, in every place. It cannot be said that there exists an Italian method of tanning ; that which bears this name in Tuscany, and which is confined to that province and to a few other localities, being itself doomed to disappear for economical reasons.

Italian, or rather Tuscan tanning, consists essentially in giving the skins a preparatory treatment (*addobbo*) by immersion in six or seven successive baths (*ripassature*) of a decoction of myrtle leaves, to which are added oak bark and valonia : the next thing done is the covering over (*rammorto*), which is effected by spreading the skins in a pit, with layers of a composition made of ground valonia, steeped in a decoction of myrtle. The tanning lasts from 300 days to a year, according to the thickness of the skin. The small streaks, more or less regular, which

may be seen on the surface of the leather curried in Tuscany arise from the peculiar process applied to it, to give it a finish, by currying the skins with the *liscia* or *l'orbello*, which is a glass implement, resembling the bottom of a glass bottle ; it is furnished with a handle ; to lift up the skin, it is held on one side, and a little elevated, but to smooth the skin, it is held horizontally ; the skin is next stretched with the *orbello*, and afterwards the last polish is given by the *liscia*.

Tanning with myrtle leaves, which is still of great use in the small tanneries dispersed over the Neapolitan provinces, is effected by stretching out the skins, covered with myrtle, in a pit filled with water, where they remain from 30 to 36 months ; the leaves are changed every 30 or 40 days. In Sardinia many tanners make use of myrtle, lentiscus, tamarisk and alum. In Lombardy, and particularly at Pavia, Brescia, Trento, and Venetia, they use almost exclusively valonia for tanning, even without mixing it with myrtle.

A method of tanning, called French tanning, has been for a long time carried on in Piedmont ; it might indeed with propriety be called an Italian method. In the provinces of the centre and south of Italy, it is performed by spreading layers of yew bark and cork bark over the skins, whilst in Piedmont they more generally make use of oak bark, common oak bark, &c. In certain parts of the north of the peninsula, at Biella, Bra, and Mondori, for instance, they make use of oak galls, but this method, less approved than that where bark is used, is growing more into disuse every day, and is already confined to certain localities. In some tanneries they use a mixture of oak bark, *dividivi*, and the leaves of the *Rhododendrum*.

The bark tanneries which enjoy the highest reputation in Italy, are those of Messina, in Sicily ; of Castellamare of Naples ; of Pavia, Milan, Leghorn, Santa Croce, in Tuscany ; Turin and Pinerolo, in Piedmont.

For the manufacture of leather for saddlery and harness, the skins coming from the slaughter-houses are almost exclusively used ; they are treated with holm oak bark, cork bark, and the leaves of the sumach. The skins for saddlery are made chiefly at Fabriano, at Turin, and at Castellamare, and are exported to the various provinces of Italy, to the Levant, and Germany.

This manufacture of cow-hides and calf-skins curried and waxed for boots and shoes, which has acquired such importance in Nantes, Bordeaux, Geneva, and Lausanne, has been now for some time imported into Italy. Turin, Naples, and Florence have made great progress in its prosecution.

Italy imports from France, and still more from Germany, the greatest part of the japanned leather which it makes up. For some years this manufacture has been introduced into Lombardy, Naples, Florence, and especially at Turin. The art of dyeing tanned skins with bark and with oil, &c., flourished in the fifteenth century at Venice and Florence. The

ancient reputation for this business has now passed to Naples and Turin, where the manufacture of late years has largely increased.

The greater part of the goat and sheep skins are tanned with sumach brought from Sicily. In the Romagna they use fustic, which they enclose in sewed skins, like a bag, according to the Danish method of tanning. This method is also practised in Sicily.

In Piedmont the skins which are to be dyed colours are prepared with sumach, and those which are to be dyed black with oak and fir bark. Sardinia, the valleys of Piedmont, the Brescianese, the Abruzzis and the Calabrias furnish the greater portion of raw skins ; the Marche, and Umbria export their skins half raw. Turin imports a certain quantity with the outside skin on, and some in leather, from France especially from Gap, Nice, and Marseilles.

The manufacture of white sheep-skins for lining is confined to the localities in which they are consumed, or to those parts in which vegetable substances for tanning are not to be found. Savoy was a province which supplied a certain quantity for exportation. Naples furnished sheep-skins for gloves, and Milan, Bologna, and Turin were the chief centres of these manufactures. The greater part of the skins destined, for glove leather, only partly made up are exported to Paris and Grenoble because if they were sent in a completely finished state they would be subject to very high duties on passing the frontier.

The manufacture of chamois leather, formerly so flourishing in Italy, has disappeared in a great degree from this part of the country, particularly from Piedmont, so that sheep-skins take the place of chamois leather for gloves ; calf leather has been substituted for military buff leather and cloth in dress. At present, the greater part of the sheep-skins made up chamois fashion come from England, and they are manufactured upon a small scale at Lando, in Piedmont, and Florence. Turin has two manufactories of curried skins in imitation of buff leather ; there are others at Florence, Naples, and Leghorn.

NOTES ON INDIAN CORN.

Indian corn or maize may be said to be the staple and peculiar crop of North America. The export of this grain is fast becoming the *hydra* of famine throughout the world. Whenever Europe is short of food, America stands ready to supply the deficiency with the excess of her corn crop. No plant is more beautiful, and none so well suited to the varieties of the climate ; for anywhere between the 43rd degree of north latitude and a corresponding parallel south, it may be grown in the greatest perfection. Its ease of hybridation has produced innumerable varieties, suited to every kind of soil and every degree of

temperature, from the time-enduring hard corn of Canada, to the Stowell's evergreen for boiling in the unripe state. We have it suited to summers, varying from three to six months ; thus we find it in the North requiring but half the time for its growth that is requisite in the South, and still in each locality are kinds appropriated to the different lengths of summers. We may say of the Indian corn crop of America what Mr. Webster said of the turnip crop of England, that "its failure for three successive years would nearly bankrupt the nation." Fortunately, however, by the recent improvements in agriculture, they are enabled, in the growth of this crop, almost to defy drought, and to render every variety of soil suitable for the production of maximum quantities. It is the food of both man and animals ; and even its stalks, by proper treatment, have been rendered equal in value to the whole labour and expense of raising the crop. To it America is indebted for her fine beef, her plentiful supply of pork, and also as an article of human food. It is the plant of the country ; and the olive branch might with propriety be taken from the claw of the national emblem, and the Indian corn plant substituted in its place.

In proof of the American origin of this plant, it may be stated that it is still found growing in a wild state from the Rocky mountains to the humid forests of Paraguay, where, instead of having each grain naked, as is always the case after long cultivation, it is completely covered with glumes or husks. Columbus found the natives of Hispaniola cultivating it in extensive fields, and those of other places first visited by him were also in possession of it. The first Englishmen by whom it was cultivated were they who settled in Virginia in 1760.

In England all cereals used as food for man are called "corn ;" but those who first landed in America from that country found a new cereal, also used as food by the aborigines. They added it to their catalogue of corn with the prefix of Indian. As it had been for ages the main dependence of the Indians, so it has since become the real staff of life to thirty millions who now occupy their places, while it is gradually making its way to favour among other millions in Europe. The pioneers give no accounts of the Indians having many varieties of corn. They seem to have been content with what they had. The higher civilisation of the whites quickly seized on the new cereal, recognised its value as food for man and beast, improved its culture, multiplied its varieties, made its increase a hundred-fold, and, by the invention of machines for shelling it rapidly and grinding it cheaply, raised it to the position of a staple so important, that if the whole wheat crop of America were suddenly annihilated, the corn crop alone would supply the people plenteously with food. It already equals the wheat crop of the whole world. The latter can be profitably cultivated only within certain latitudes, but corn grows luxuriantly in all. The border states of the tropics refuse to yield wheat. Louisiana and Florida produce but 1,500 bushels annually, but nearly 14,000,000 bushels of corn.

The annual average wheat crop of the world is 900,000,000 bushels, of which nearly 200,000,000 may be credited to the United States. In 1850 her corn crop was over 590,000,000 bushels, and in 1860 it was fully 900,000,000, thus equalling the wheat crop of the whole earth. The varieties of corn are numerous, and are continually increasing by improvement, and the introduction of seed from one section to another. The plant hybridises with great facility. Some choice varieties have been originated in this way. It would be almost impossible to enumerate the many varieties now cultivated, or to give the reasons why one is preferred above the others.

Visitors at the recent Royal Horticultural Society's collection, had an opportunity of inspecting the greatest variety of Indian corn, perhaps, ever before exhibited here, in the collections of Mr. P. L. Simmonds, Messrs. Barr and Sugden (both of which received prize medals), and the New York State Agricultural Society. The varieties of size, colour, and shape were remarkable.

With proper cultivation in an ordinary season the crop should not be less than 60 bushels to the acre; 100 bushels is not an uncommon yield. The New York State Agricultural Society require a yield of 80 bushels to the acre to be entitled to a premium.

It is a remarkable fact in connection with this subject that, although the experience of the people of the entire American continent bears uniform testimony in favour of the palatableness, the healthfulness, and the economy of Indian corn, it is but little known to the people of those portions of Europe to whom cheap food is the great desideratum. The famine of 1847 brought it prominently into notice here, and once having tasted it, even after imperfect cooking, it has secured a perfect foothold. European chemists have discovered that corn contains 77 per cent. of nutritive matter, while wheat contains but 95. When a bushel of wheat is worth 95 cents, one of corn is worth 77, nutriment alone considered; yet when corn has stood at 1 dol. per bushel, wheat has stood at 2 dols. 50 cents; thus, in buying wheat, we obtain, for any given amount of money, a little less than half the nutriment we obtain when buying corn. Why this disparity in price? It must be mainly sought for in supply and demand. Wheat is relished by a greater portion of the human family; it may be kept sweet more readily in any of its stages of manufacture, whether stationary, or during transportation by sea or land; hence its superior commercial value. Then, all the world is familiar with it as an article of food, while not a tenth of its population ever heard of Indian corn. Wheat needs no introduction among any people, while corn has required thorough judicious and persistent effort by European Governments to induce even famishing communities to consume it.

It is well known that residents in American cities are small consumers of Indian corn in comparison with those who live in rural districts. This is because the former do not so well understand the art of

cooking it in the numerous forms of which it is susceptible. No wonder that European nations, to whom the grain and meal are novelties, should be more ignorant of their value, and should, therefore, refuse to consume them. But since 1855 the Prussian Government has left no means untried to ascertain the best mode of preparing corn bread. As corn meal, even when the dough is nicely risen, always falls when placed in the oven, producing an unsatisfactory bread, a multitude of experiments were tried with mixtures of potato flour, wheat, rye, and other substances. Rye flour was found to be the best. But most of these experiments were unfortunately made with meal which had soured before reaching Berlin. Finding it to be coarsely ground, the operators caused it to be ground very fine, not knowing that no kind of grain is spoiled by fine grinding except Indian corn. In spite of these discouragements, Germany is annually consuming larger quantities, as her people become better acquainted with the article. In England and Ireland it has become permanently domesticated. Its introduction has been slow, but nothing seems more certain than that a few years hence will witness an enormous European demand, not the result of famine, but of popular appreciation of this cheap and wholesome staple.

Common preference, as well as chemical analysis, proves that the round northern yellow variety contains the most nutriment, and is in all respects best adapted for the consumption of people living in high latitudes. The white variety, by its resemblance to wheaten flour when manufactured, meets with a ready sale where the difference is not known or where the appearance is alone consulted.

There are a great number of varieties of corn in cultivation, and these varieties have become considerably intermingled. The principal varieties, which may be distinguished by the number of rows or grains, on the cob, and the colour, shape, or size of the kernels, may be classified and described as follows :

1. Yellow corn. Golden Sioux, or Northern Flint corn, having a large cob with twelve rows of moderate-sized grains ; very oily. This is regarded as one of the best varieties for fattening animals, or for human food. By skilful tillage, 130 bushels have been raised to the acre, weighing 9,216 lbs. in the ear ; when dry, 75 lbs. of ear gave a bushel when shelled.

2. King Philip, or the eight-rowed yellow corn. Its ears, which contain only eight rows, are longer than those of the Golden Sioux, and it will yield about the same quantity of oil. It is a hardy plant which belongs to a high latitude ; grows to about nine feet in height ; stalks small ; ears from 10 to 14 inches in length.

3. Canada corn, or eighteen-rowed yellow corn, which is smaller, earlier, and more solid than any of the preceding, contains more oil than any other variety except the rice corn and the poss corn. It is exceedingly valuable for fattening poultry, swine, &c., and is grown by many in gardens for early boiling.

4. Dutton Corn. The cob sometimes grows to a length of fourteen or fifteen inches, but the grain is so compact on it, that two bushels of small ears have yielded five pecks of shelled corn, weighing 62 lbs. to the bushel. With proper management, an acre of ground will yield one hundred to one hundred and twenty bushels to the acre. As it is very oily, gives a good yield, and ripens early, it has always been a favourite variety for culture in the North.

5. Southern Big Yellow Corn. The cob of this corn is thick and long the grain much wider than it is deep, and the rows unite with each other. The grain contains less oil and more starch than the Northern Flint kinds; yet its outward texture is somewhat flinty, solid, and firm. It comes to maturity rather later, affords an abundant yield, and is much used for fattening animals.

6. Southern Small Yellow Corn. The ears of this variety are more slender as well as shorter than the last named; the grains are smaller, though of the same form, of a deep yellow, more firm and flinty, and contains an abundance of oil, which renders it more valuable for the purpose of shipping, or for feeding poultry or swine.

7. Rhode Island White Flint Corn. The grains of this variety are about the size and shape of those of the Tuscarora corn, but differs from them in containing an abundance of a transparent colourless oil, which may be easily seen through their clear pellucid hulls. The farinaceous parts of the grains are white, and as the quantity of oil which they contain is large, the flour or meal is more substantial as an article of food, and less liable to ferment and become sour.

8. Southern Little White Flint Corn. The kernels of this variety are smaller than those of the preceding, and much resemble them in shape, but they are more firm and solid, contain more oil, and consequently are of more value for feeding poultry and swine, and for human food.

9. Dutton White Flint Corn. A variety not differing materially from the Yellow Dutton Corn, except in the colour of the oil.

10. Early Canadian White Flint Corn. Cultivated principally for early boiling and roasting, while green.

11. Tuscarora Corn. The ears contain from twelve to sixteen rows of grain, which are nearly as deep as they are broad, of a dead whitish colour on the extreme end, are entirely composed within of pure white dextrine, except the germs. As it contains neither gluten nor oil it may be profitably employed in the manufacture of starch. It is much softer and better food for horses than the flinty kind, and if used before it becomes sour, it may be converted into excellent bread. It is also an excellent variety for boiling when green, or in the milky state.

12. Fine White Flint Corn. The ears of this variety contain twelve rows of rather white, roundish, thick grains which are filled with a snowy white flour composed principally of starch, but contains neither gluten nor oil. It is much used. As it possesses similar proper-

ties with the preceding variety, it may be profitably used for the same purpose. It is also an excellent variety for boiling, when green.

7. Virginia White Seed Corn. The ears of this corn which are not very long (nor is the cob so long as those of the Big White or Yellow Flint), contain from twenty-four to thirty-six rows of very long narrow grains. These grains at their extreme ends are almost flat, and grow so closely together from the cob to the surface, that they produce a greater yield than any other variety in proportion to the size of the ears. They contain more starch, and less gluten and oil than those of the Flint kinds, and from their softness they serve as better food for horses; but are less nourishing to poultry and swine. This variety ripens later, though it is more productive than any other kind.

8. Early Sweet Corn. There are two kinds of this corn; one with the cob red, and the other white. The ears are short, and usually contain eight rows, the grains of which when mature, are of a higher colour, and become shrivelled, appearing as if they were unripe. It contains a very large proportion of the phosphates, and a considerable quantity of sugar and gum, though but little starch. It is extensively cultivated for culinary purposes, and is delicious food when boiled green.

9. Rice Corn. A small variety, with small conical ears, the kernel terminating in sharp points which give them the appearance of burrs; the kernels in size and shape something like rice. It contains more oil and less starch than any other kind, and when ground its meal cannot be made into bread alone, but is dry like sand. From its oily nature and peculiar size this corn is well adapted for feeding poultry.

10. Pearl Corn, commonly called pop-corn, from the fact of its being used for popping or parboiling. The ears of this variety are small, the grains are sound, of various shades of colour (8), the white of a pearly appearance; and contains with the rice corn, more oil and less starch than any other variety.

11. Chinese Tree Corn. It is a pure white variety, a very handsome ear, about ten inches long, has ten rows, grain very closely set, long and wedge-shaped, well filled out to the end of the cob, some of the grains slightly indented. One peculiarity of this corn is, the ears grow on the buds of the branches, hence its name "tree corn." It is said to yield from one-third to one-fourth more than the common varieties; when ground into meal it is handsomer and better flavoured than the common varieties of white corn. There are generally two ears on a stalk, and often three.

There are many other species of corn, but the foregoing embrace pretty well all those worthy of cultivation.

INDIAN MANUFACTURES IN PRECIOUS METALS.

BY A. M. DOWLEANS.

The finest enamelled work of India is produced in the independent Rajpootana state of Jeypore, and considered of great artistic merit. The enamellers came originally from Lahore. The enamel is a kind of glass made in earthen vessels, and when fused the colouring matters are added; the whole is then allowed to cool, and in this state is kept for use. Only pure silver or gold articles are enamelled. From the silver the enamel may come off in course of time; but it never does from the gold. All good enamel is consequently only applied to gold, which must be free from alloy, or otherwise it would tarnish by contact with the enamel in the great heat to which it is subsequently exposed. The gold is first carved of the required pattern; the enamel, having been ground to an impalpable powder, and made into a paste with water, is then placed on the exact spot required by the pattern. The article is then strongly heated, much skill being required to take it out at the precise moment when the enamel is thoroughly fused, but before the colours begin to run into one another. As soon as removed, the workmen then exert the full power of their lungs in blowing upon it as quickly and as violently as possible. The hardest colours are first placed in the furnace and fused, and then those which melt more easily. Afterwards the whole is ground and polished. The enamelled work of Jeypore is very highly valued, and can only be procured through H. H. the Rao of Jeypore himself, by whom the workmen are employed. The artisans themselves form a small family, and the real process of enamelling is kept by them as a secret, which descends from father to son like an heirloom.

Enamelling, as applied to jewellery, consists of an extremely fine pencilling of flowers and fancy designs in a variety of colours, the prevailing ones being white, red, and blue, and is invariably applied to the inner sides of bracelets, armlets, anklets, necklaces, earrings, surpezes, tiaras, and all that description of native jewellery, the value depending upon the fineness of the work, and often exceeding that of the precious stones themselves. In general the cost is moderate, as the finest specimens are only made to order. The best come from Benares, Delhi, and the Rajpootana states.

The manufacture of enamels on articles of domestic use like the above is almost entirely restricted to Hyderabad. It presents no varieties, but in general consists of a blue coating interlined with white on a surface of silver, and is applied to rose-water sprinklers, spice-boxes, basins, and such-like articles. The merit of the manufacture lies in the simplicity of the enamel itself, and in the lightness of the silver article to which it is applied. Though pleasing, it is the coarsest enamel produced in India.

Bidri, or Biddery ware, derives its name from Bider, a city situated

about sixty miles to the N.W. of Hyderabad. It is a species of inlaid ware of excellent form and graceful pattern. The stages of the manufacture are as follows :—

A mass of finely-powdered and sifted old laterite dust mixed with cow-dung is put upon a rude lathe, and when dry, carefully turned to the correct shape. The model having been smoothed with a chisel, is next covered with a mixture of wax and oil boiled together ; when dry, the whole mass is carefully smoothed and turned. Over this coating is plastered a second layer of laterite dust, moistened with water alone ; this coat is rough, and not subsequently smoothed down. The next stage consists in boring two openings in the composite mould, and placing it in the fire, the effect of which is to melt the intermediate layer of wax, and thus to leave a vacant space for the reception of the alloy. Into this space is poured the alloy, consisting of one part of copper and four parts of pewter.* The vessel has now a dull leaden look ; it is hard, but easily cut. This shell, as it may be called, is carefully turned, and upon its smooth surface the pattern is traced by hand. This tracing is done rapidly. The workman next takes a small chisel and hammer, and, following the lines of the pattern, cuts it deeply and expeditiously, scooping out the tracings of the little leaves, &c., and leaving an indented, but rough surface. This rough surface is next smoothed down by hammering gently with a blunt-pointed chisel, and the space is then ready for the process of inlaying. Thin plates of very pure silver are then taken, and the little leaves (or other patterns) are cut out with a small hammer and chisel ; each little leaf is then raised separately by the chisel and finger tip, and hammered gently but carefully into the depression intended for it. This part of the process is tedious. In the more durable kinds of Bidri ware, silver wire is substituted for silver leaf. The vessel in this state is rough, and requires smoothing ; this is done with a common file and a curved scraper of a rude and clumsy form. The hole in the bottom of the vessel is filled up with lead, and smoothed down. Finally, the vase is gently heated, and, while warm, is blackened by the application of a powder (supposed to consist of chalk and sal-ammoniac, chloride of ammonium). This imparts a brilliant black polish to the shell, and careful hand rubbing brings out the polish of the silver.

Glass inlaid with Gold.—This manufacture is peculiar to Indore, in Central India, but it does not constitute a regular trade. It is invariably applied to articles of personal decoration, such as necklaces, armlets, brooches, earrings, &c., which are set by native jewellers according to the taste of the purchaser. These subjects generally consist in a re-

* The metal employed for the groundwork of the 'Bidri ware' is stated by Dr. Hamilton to consist of zinc 12,360 grains, copper 460 grains, and lead 414 grains, melted together, a mixture of resin and bees' wax being introduced into the crucible to prevent calcination. Dr. Hayne states that it is composed of copper 16 oz., lead 4 oz., tin 2 oz., and that to every 3 oz. of this alloy, when melted for use, have to be added 16 oz. of zinc.

presentation of the avatars, or pictures of the metamorphoses of Indian deities; and the work is so perfect that it will stand, not only the influence of climate, but even rough handling.

The specimens of this kind of work have no fixed market value, and the price is therefore entirely dependent upon the number of competitors that may be in the field when any of them are offered for sale. A set of these ornaments, consisting of a necklace, earrings, two armlets, and a brooch in plain gold, contributed to the Exhibition of 1851, was valued at 1,700 rupees or 170*l.* A duplicate forwarded to the Paris Exhibition in 1855, was purchased for 600r., or 60*l.*

Koftgari work, or steel inlaid with gold, has in former days been carried on to a considerable extent in various parts of India. It was chiefly used for decorating armour; and among the collections exhibited on the present occasion are some very fine specimens of guns, coats of mail, helmets, swords, and sword handles, to which the process of Koftgari has been successfully applied. These specimens, however, are not the manufacture of the present day. Since the late rebellion in India, the manufacture of arms has been generally discouraged, and Koftgari work is consequently now chiefly applied to ornamenting a variety of fancy articles, such as jewel caskets, pen and card trays, paper weights, paper knives, inkstands, &c. The process is exactly the same as that pursued in Europe, and the workmen can copy any particular pattern required. The work is of high finish, and remarkable for its cheapness.

Koftgari is chiefly carried on in Goojerat and Kotli, in the Sealkote district. It was formerly much in vogue for decorating armour and the blades and hilts of swords, but the artisans now confine themselves chiefly to the manufacture of ornamental paper knives, &c. The specimens above mentioned have been contributed by the Kotli artisans.

Several admirable specimens of inlaid metal work by the native artisans of Bhooj were to be seen in the collection of arms contributed by H. H. the Rao of Kutch for the Exhibition.

The native silversmiths of Cuttack have long been noted for the fineness, neatness, and lightness of their filigree work. This kind of work is executed, for the most part, under supervision, by mere boys, whose nimbler fingers and keener eyesight are supposed to enable them to bring out and put together the minute patterns with more distinctness and accuracy than their elders can; comparative cheapness is, perhaps, another reason for their employment. The ruling rates for this filigree work are from two to two and a half rupees, that is to say, taking the first rate, two rupees or four shillings is charged for every rupee weight of finished silver work, namely, one rupee for workmanship, and one rupee as the price of the silver. This branch of industry is, however, declining from want of sufficient demand. These articles are all of the purest silver. The filigree work in gold seems almost as good as that of Delhi.

A large number of articles in gold and silver are annually made at

Bhooj, principally for Europeans. The Goolabdanas, or rose-water sprinklers, are, however, manufactured for native use. The silver and gold used is very nearly pure. The principal artisans are Vishram Goldsmith, Jewram Shamjee, and Heerjee Nagjee. The charge is at the rate of eight annas per tola weight.

Bangles made of jade from Mogoung, in the north of Burmah. The bright green tint seen in these specimens is the characteristic peculiarity of the Burmese jade, or precious serpentine. The Chinese have a perfect mania for it, using it for Mandarins' buttons, pipemouth pieces, and various articles of personal ornament and luxury. They estimate it according to the purity of the white and brightness of the green tints.

These bangles, though of good quality (they cost 125r. or 12*l.* 10s., and were obtained from the owner with difficulty even at that price), are by no means of the finest description.

The Chinaman who sold the bangles showed the Committee a specimen which he assured them would fetch in China sixty times its weight in silver, and that the really first-rate is sold for as much as forty times its weight in gold ; this appears incredible, but all inquiry tends to show that the Chinese will give almost anything for fine jade.

THE CULTURE AND TRADE IN ALMONDS.

BY M. DE BEC.

Almonds are objects of considerable commerce in France, Spain, and Italy. There are two kinds, one bitter, which is obtained chiefly from Majorca, Algeria, and Mogador, and is used in the preparation of liqueurs, macaroons, and different medicinal compounds ; the other kind is sweet. This last was perfectly represented at the Exhibition by fifty varieties, shown by M. de Bec, Director of the Agricultural School of Montaurone (Mouths of the Rhone). The production of almonds is an important source of revenue, the more so as their quality is first rate, the atmosphere being very favourable to the growth of the plant which produces them. The exhibition of them has therefore rendered a great service to agriculture in displaying at the same time the best and the worse kinds, and the French jury has thought proper to reproduce in its official report this nomenclature, which is the fruit of forty years assiduous labour. M. de Bec gives the following details with regard to the different species of almonds.

Sweet Almonds.—1. The shell very tender, easily receives the impressions of the weakest fingers. This almond is known by the name of Princess. Its price in the shell is about 40 francs the hectolitre. It be-

comes eatable in July, ripe towards the end of August, and the seeds are gathered in September.

2. The shells not quite so soft as the preceding. There are four varieties known as the Matheson, the Abeysasse, the Sans Grace, and the Boutreve, which are of a fine quality, and are sold at 30 francs the hectolitre. These ripen in the early part of September.

3. The shells rather hard. Of these there are two varieties, which are sold in the shell at 25 francs the hectolitre. They flower in February and the beginning of March, and are ripe by the end of August or beginning of September.

4. The shells hard. Of this kind also there are two varieties, the large and the small, and these are esteemed the best of all the hard almonds. They are sold in the shell at 20 francs the hectolitre. They are in flower during the whole of March, and ripen about the 15th of September.

5. These shells are hard, the plant flowering late in the year. There are six kinds of this species distinguished from each other by the names of the large green, the small green, the spring, the Laty, and the late almond. The two first flower in March and September, and ripen in April, and are of great value as an article of commerce. That known as the spring almond flowers very late in April, and ripens in September. This variety is a new one. The late almond, which flowers in March and ripens in September. They are sold at the price of 18 francs the hectolitre, and the demand for them is very great.

6. Hard shells, common quality, large quantities produced. Of these there are a great many varieties, of which the chief are those known by the names of Madame, Ailland, pointue, grosse of aumove, jumette, Bordette, Guillaume, noisette, ventre, Mastan, Aveline, pistache, of the Levant, Psate, Lisette, La Boule, La Vignerone, the round almond, the double almond, the croix, Robert, St. Esteve, Longnette, naturelle, Lastane, La Gommée, admirable, la rouge, &c. &c. There is a considerable sale of the above variety of almonds, but the production of them is uncertain. The price given for those in the shell is about 18 francs the hectolitre. In commerce, however, they are only bought when freed from the shell, and the price varies according to the demand that may exist, and indeed this is the case with every variety.

7. Shells very hard, skins bitter. These almonds, which possess a very bitter flavour, are sold at about 20 francs the hectolitre. They are much valued, especially for the preparation of liqueurs, and hold no despicable place in the list of useful and medicinal drugs. Great quantities of them are produced, as their cultivation requires only ordinary care and skill. The study of the cultivation of, and commerce in almonds is one of no slight importance, for the fruit enters pre-eminently into domestic and other uses, forming a principal ingredient in cookery, medicine, and commerce.

The ordinary varieties of commerce in Provence are the Crombees

and other sorts, naked and soft-shelled, called Aberanes, Matterones, and Molures, sold ordinarily in the shell; Princess almonds, consumed in France, Belgium, Holland, Germany, and Russia; Ladies' almonds, sent chiefly to the United States; and wavy almonds (*Amandi flot*), employed principally in confectionery, as burnt almonds, and for fine pastry. The last kind is obtained especially from Lower Provence, and the best comes from the territory of Aix, and are all consumed in Paris, where they realise double the price of the ordinary varieties of almond. They are also those which keep the best.

The imports of almonds into France were, in 1860, 714,256 kilogrammes, and the exports 2,379,839 kilogrammes. The imports into England for the same year were 7,361 cwts. of bitter almonds, and 19,638 cwt. of sweet almonds.

SILK MANUFACTURE IN THE EXHIBITION.

BY THOMAS WINKWORTH.

The silk manufacture in Europe is of considerable antiquity, its introduction dating from the thirteenth to the fifteenth centuries. Depending so much on mild and uniform temperature, the difficulties of acclimatising the worm and the source of its food—the mulberry-tree—have often been insuperable. When, however, these have been surmounted, as more especially in Italy and France, the profit has rarely failed to reward the adventurers. But it is an industry of slow growth, requiring great care, and involving much dead capital.

The manufactured article is susceptible of important adaptations, as well for the splendid garments of the luxurious and the wealthy as for the economic decoration of the humbler classes. From the Queen on the throne, resplendent in all the magnificence of damask and many-coloured brocade, to the factory-girl who can afford to purchase a dress of plain or checked Gros de Naples, silk is the material which, beyond all others, may be made to suit the tastes and pecuniary means of nearly all grades of civilised society.

A glance in the International Exhibition at the many forms manufactured silks assume, and at the many textures into which it is more or less incorporated, demonstrates the fact that modern discoveries and inventions have opened up channels for its use, of which, but for this extraordinary opportunity of seeing for ourselves, we could scarcely have formed a conception. The demand, therefore, for the raw material, has been rapidly increasing, while, like its rival necessity, cotton, but from a very different cause, the supply of late has been comparatively scanty. In the one case, a most disastrous and unnatural war has closed the channels

of export to Europe, while in the other a disease as mysterious in its origin, progress, and agency as the cholera, has destroyed myriads of worms in the silk producing districts of Italy, France, and elsewhere on the continent.

But severe as are these trials, they are not unmitigated evils, and afford additional illustrations of the theory—as paradoxical as it is true—that war, pestilence, and famine are more frequently than otherwise the harbingers of improved civilisation, open up new fields of production, and give to the resources of art and science, larger scope for profitable development. It cannot be doubted that when the American ports are again thrown open to the commerce of the world, cotton cultivators and merchants will find that in the European markets, which they have so long abandoned, they will have seriously to cope with other and newer producers in far distant climes, who have been encouraged and stimulated to competition by the prices their cotton has commanded during the years of famine. So of silk ; China and Bengal have come to the rescue, and have not only supplied to a great extent the vacuum occasioned by the devastating worm-disease with the raw material, but millions of eggs from the vast regions of Asia have been exported to Europe, where, by crossing enfeebled breeds with the more healthy and hardy races of the far East, the foundation has been laid for an ultimate supply of silk larger in quantity and better in quality than was ever before known.

It will also be found that a new and formidable producer has recently entered the field of competition. Japan, whose many natural resources are beginning to be understood, is already giving earnest of an intention to achieve for itself a position as a commercial country. Of this, as regards silk, some interesting particulars have been furnished to the Jury by Lord John Hay, published in the last number of the TECHNOLOGIST.

In reviewing the progress of this trade since 1851, so far as the silks now exhibited afford the necessary evidence, it is proposed to take each important country alphabetically, and to group together those which do not seem to require separate notice. Acting on this arrangement, the first country which challenges attention is—

AUSTRIA.—It will be seen in the list that out of thirty-six exhibitors of raw, thrown, and manufactured silks, the jury have only awarded medals to nine, and made honourable mention of nineteen others. Some progress, however, is apparent since 1851, which may be attributed to the removal of the incubus of prohibition and the substitution of a moderate import duty. This relaxation has produced its natural result, for the opportunity it has for the first time afforded to the silk manufacturers of Austria, of comparing the productions of other countries with their own, has led to an appreciable improvement ; and the occasional introduction of weaving by power enables them to produce some classes of plain goods, which being cheaper than heretofore, find markets in the Danubian principalities, in other parts of Germany, and even in the United States. But the

disposition to cultivate the more showy and weighty fabrics for furniture and ecclesiastical purposes, which give scope for the introduction of inferior materials at the expense of intrinsic value, still prevails. As much that appeared at the International Exhibitions of 1851 and 1855 as of Austrian supply, was really from Italy, then under the dominion of that country, the display is not so considerable of the raw and thrown article as on those occasions.

France.—The silk industry of this country is so important, from the large capital invested, the number of persons employed, and the perfection to which it has attained, that the position it occupies is deservedly prominent. As compared with the display of silk textures made in 1851 some disappointment may perhaps be felt, which can be thus explained. In that year the manufacturers of Lyons betrayed so little disposition in the first instance to expose their goods to competition, that in order to render it really worthy of the country, the Chamber of Commerce of that city interfered and purchased specimens of the most choice silks, not only of recent production, but of former years, which were very tastefully displayed and commanded universal admiration. The situation also which the French silks occupied on that occasion was one of the most commanding in the building, while the artistic and uniform character of the lofty and well-lighted cases in which they were exhibited assisted the general effect. And lastly, it must be conceded that, as compared with the English departments, the superiority was too obvious to be disputed. In all these particulars the French are now unfortunate. The manufacturers of Lyons and St. Etienne exhibit only their most recent productions, and these, with few exceptions, do not, from the prevailing fashion for comparative simplicity of design, involve the necessity for elaborate patterns and complicated workmanship. The choice of situation made by the French Commission for this important department is certainly not a happy one, and this is not improved by the confined character of the glass cases in which the goods are displayed, on one side exposed to the utmost glare of light, and on the other suffering under a noonday eclipse. As regards the comparison generally instituted between the French and English silk goods, the great improvement so clearly visible in the latter since 1851, as elsewhere noticed, place those of the former at a disadvantage. But it must not from hence be inferred that the fancy silks of France are in any important particular inferior to what they were at that epoch ; and in one remarkable instance of what can be produced when ingenuity, taste, artistic skill, and pecuniary courage are combined, two specimens by one manufacturer (*France*, 1871) are exhibited, which are unquestionably the most elaborately beautiful that have ever yet been seen. The ground of each is the same, namely, rich white satin, but the patterns are different ; and both involve for their complete development no less than about 300 tints of colour, all of which in their distinct gradations are shown on reels strung together, and classed according to their separate shades. One pattern consists of

groups of orchids, the other of birds of paradise and humming birds. The texture of the figures, viz., brocade affords great scope for the introduction of variety of colour, but never before were the skill and patience of the operatives so taxed; the intricacies of the designs, and the delicacy of the colours necessary to throw them into full relief, being of so original and extraordinary a character. The enterprising manufacturer has met with suitable encouragement; one of our silk mercers in London having purchased all that the manufacturer has produced of these two patterns. *Tours de force*, however, are in their nature exceptional, whether woven at Lyons or Coventry; for it is to the production of goods which suit the many that manufacturers find it to their interest to devote their energies, and purchasers soon discover for themselves where to find the best and the cheapest.

There is one advantage which the silk manufacturers of France enjoy beyond those of all other European countries, except Italy,—viz., that they produce on their own soil a large portion of the raw material with which their looms are supplied. This has to some extent been of late curtailed by the worm disease having extended its ravages into the silk-growing districts, which has unfortunately led to the introduction of the raw produce of China, Bengal, and Japan, to supply the deficiency thus created, and with the manipulation of which in the silk mills, throwsters are not yet familiar, but there is no reason to fear the extinction of the races. On the contrary, attention being promptly given to the causes of the calamity, as far as they could with any degree of probability be ascertained, and a special commission having been successfully sent out to search for healthy seed in the Caucasus and elsewhere, an improvement has already obtained, and in due time native production will be restored to its former importance.

In a paper on this subject, signed "Bella," inserted in 'Le Commerce Séricole,' of July 23, 1862, published at Lyons, there are some very valuable details respecting the causes of this calamity, and the steps taken to reduce it. The more important of these will be found, freely translated, as given below. For the technical words "education" and "educators," the reader will understand breeding and breeders. It must be borne in mind that the writer, an intelligent Frenchman, speaks from his point of view, which differs somewhat from ours, but may not be the less trustworthy on that account. After alluding to the relations of France with China, from which he anticipates important advantages, especially as respects the facilities it will afford for the introduction of improved breeds of the silkworm, M. Bella goes on to say that—

"Many of those who admire satins and velvets at the International Exhibition are far from suspecting the imminent dangers that threaten the factories from which they spring. They are probably ignorant of the fact that terrible epidemics have for several years past attacked the precious insects that spin the silk from which those beautiful articles are manufactured, and which, if not arrested in their destructive progress, must

soon exhaust the source of all these riches. What then is that epidemic which has successively extended its ravages over the major part of Europe? Our French savans have named it 'pétrine'; Italians call it 'the predominant malady.' Its characteristics seem to vary, and the bituminous spots which at first appear to mark this disease do not always accompany it, and are not uniformly its most alarming symptoms. But by whatever name it may be called, the epidemic is nevertheless frightful; entire batches of silkworms die before spinning; others only spin poor cocoons, the best of which cannot reproduce without bequeathing to their posterity the germ of a deadly and increasing disease. It is thus that the bombyx Mori, of which France and Italy were so proud, and which they had spent ages in producing and improving, has already in great part disappeared.

"The International Exhibition occurring at so critical an epoch, has interest in this direction to men who desire to trace effects to causes, and who are entrusted with the preparation of the future of production: it is their province to examine, in all its details, the progress made to ward off and subdue a scourge which so cruelly obstructs the rearing of silkworms. The efforts hitherto made towards this object have taken three very distinct directions.

"1st. The spinners requiring, without delay, large quantities of cocoons to supply their factories, have sent out active and intelligent agents, either to buy cocoons or to obtain eggs of all varieties of the bombyx from countries not yet visited with the disease. They have thus created a new industry, that of 'graineurs,' who establish themselves in non-infected districts, where they buy healthy cocoons, which, when developed into moths, are encouraged to breed. They then return to France with a precious supply of eggs, which are sold to our 'educators.' The races which are thus imported are less delicate than our indigenous breeds, and are, perhaps, somewhat coarser in quality; but they resist the epidemic more certainly, and produce passably good silk. The greater part of the cases in the Exhibition of Class XX. of France and Italy, contain remarkable specimens of these varieties of the worm in their first, second, and sometimes third generations. But how long will these races yet continue exempt from the epidemic, the ravages of which are being daily extended? This measure is evidently only a palliative, the success of which may soon cease.

"2nd. Naturalists have endeavoured to find in the bombyx of the palma Christi, which have been imported from India and China, generators of silk less subject to disease and exempt from 'pétrine.' The exhibitions made by the 'Société Impériale d'Acclimatisation' of Paris, and by M. Guérin Meneville, awaken, in this respect, a real interest, and attract attention. The bombyx Cynthia, also, may acquire at some future time, an immense importance from the food on which it subsists being easy of culture and inexpensive. But, alas! how far removed is this silk at the present time in quality and quantity from that of the

bombyx Mori! It is only recently that Dr. Forgemolle and the Countess Corneillan have succeeded in spinning from these cocoons. The silk of the bombyx Miletta and Pernyi, which is reared in India under the name of Tussah silk, is beginning to be thrown with some success in England. In the India department of the Exhibition are some goods manufactured from this silk, which are very fine in texture, but being woven from the raw material, they do not take the dye well, and cannot bear comparison with ours of the bombyx Mori.

"3rd. Others have entered on a more philosophical path, and strive to ascertain and to overcome the causes of the evil from which our cultivators of the South suffer so greatly. Some have conjectured that they may be traced to an affection of the mulberry tree; and have, therefore, sought our more vigorous varieties (such as the ungrafted or stock mulberry), or by sundry processes applying to the tainted trees what have succeeded with the vine. On the other hand, there are those who ascribe the evil to the weakening of our varieties of the silkworm, and are prepared to prove, on good authority, that in our processes of 'education' and reproduction we have forced and violated the economy of nature; and that in our '*magnanières*,' or silk breeding-houses, which are too confined and close, we have produced insects so short-lived and delicate, that they cannot resist the epidemic so well as the rustic races hatched from larger eggs. By way of illustration they show us sundry varieties of the worm imported from countries where they are 'educated' in a manner more in conformity with natural laws, but producing in our confined '*magnanières*' smaller and still smaller eggs from generation to generation, and whose duration of life is proportionately curtailed. We will not venture a definite opinion on either of these hypotheses, as there are serious considerations affecting both which require to be carefully weighed. By producing larger mulberry leaves we have evidently impoverished the quality of the nourishment necessary to the healthy development of the silkworm, and render the trees themselves more delicate. In short, as well from this cause as from overheating and overfeeding this insect on unsubstantial food, we have rendered it feeble, and quite unable to resist infection. Of all this there can be no doubt.

"Insects, like our larger domestic animals, and like man himself, are subject to great natural laws. Agriculturists know well that mild, moist, and temperate climate produce races of silkworms with fine skin and hair; but are not ignorant of the fact that a secluded life and rich nourishment produce also analogous effects and precocious animals; they know, therefore, that the latter condition is not likely to produce rustic races, vigorous and able to resist the morbid influences of rigorous climates. Medical men know well that epidemics are more serious when people are congregated together than when they are isolated. However this may be, we cannot too much recommend visitors to the International Exhibition to examine the case in which M. Duseigneur, the ardent

apostle of tho regeneration of the silkworm fed on the mulberry, has presented the monography of the cocoon.

"We must also direct attention to the excellent cocoons sent from other countries which seemed destined to remain unfit for the production of silk; those, for instance, of M. Tœpfer, of Stettin, and those of the 'Société Séricole' of Stockholm.

"There are at present chances of success for all 'educators' of the silkworm who will remove from the infected centres; and encouragement should be given to the enlargement of the areas from whence the raw material may be purchased. In this direction, Algeria, which exhibits some remarkable samples of the cocoon, may render great service to France. M. Allier, director of the farming school near Gap, who has cultivated the mulberry in the Higher Alps, has also sent some very fine cocoons. And, finally, an excellent collection has arrived from French Guiana, where a clever colonist, M. Michely, conceived the happy idea of making successive 'educations' under simple sheds, an idea which must prove fruitful of good results in a climate so genial as that in which he resides, and which cannot, therefore, be too much encouraged."

The number of exhibitors in this class is 175, to 79 of whom medals are awarded, and of 74 honourable mention is made.

Italy.—In reporting on the silk trade of this country on former occasions (1851 and 1855), it was difficult to assign its due position to the several separate states into which it was then divided. The quantities of silk produced by each was by no means reliable evidence of their relative importance, the profitable results being more or less affected by the fiscal exactions, paltry jealousies, and passport impediments of each petty sovereignty or grand dukedom. Hence in those years this important industry was most imperfectly represented. Much was exhibited in 1855 at Paris, as of Austrian growth, which was really of Italian, particularly of the Lombardian provinces, and much that ought to have found a place amongst the products of Italy was altogether withheld by the caprice of arbitrary rulers, as in Naples and Austrian Lombardy, in 1851. Happily, however, a new state of things has supervened, and, with the exception of Rome and Venice, Italy being no longer divided into fractional autonomies with their many insecure and opposing interests, but apparently consolidated under one constitutional king and government, sounder maxims of political economy have obtained their proper influence on the legislative mind, some tangible results of which were to be found in the recent improvised Exhibition at Florence, and which has been still more largely followed up by what appears in the International one of 1862.

The writer was furnished, when reporting to the Society of Arts on the silk department of the Italian Exhibition of 1861 (which he was deputed to visit for that purpose), with some statistics from which the importance of this valuable indigenous culture may be inferred. From these materials it appears that the annual production of the silkworm in

Italy exceeds 300,000,000f., or 12,000,000*l.* The evidence of this may be found in the following summary, calculated at an exchange of 25f. to 1*l.* sterling, and the kilogram at 2lbs. of our weight, which is sufficiently near for the present purpose. The actual quantity of cocoons produced per annum is said to be about 49,212 tons, which, when separated from the outer coat, is thus divided and accounted for :—

4232 tons raw silk, which, at the price of 26s. per lb. English, would produce - - - - - -	£11,180,000
Besides,	
197 tons of double cocoons, which, at 8s. the lb., would be - - - - - - - - - -	160,000
984 tons of refuse of cocoons after reeling, for which, at 4s. per lb., could be obtained - - - -	320,000
The throwing into organzine and tram of, say—	
1970 tons of native silk, and 984 tons imported from China and India, should produce, at the rate of 2s. 4½d. per lb. - - - - - - - - -	720,000
And lastly,	
344 tons of silk consumed by the looms of Italy (the remainder being exported to foreign markets in the raw or thrown state) would produce, at the rate of 1*l.* per lb. - - - - - - - - - -	350,000
	£12,730,000

From this, however, we should deduct the silk imported from India and China, but principally from the former, and always in cocoons—viz., 984 tons at 2s. 4½d. per lb., or about 24,000*l.*, leaving a net probable produce of 12,400,000*l.*

In Italy, then, this trade is by natural advantages the largest, and should be the most remunerative, of all in that kingdom. Silk is grown, thrown, and woven without the necessity of having recourse to any external assistance, except such mechanical appliances as the ingenuity of the foreigner may supply. Such was the Jacquard, which produced, as is well known, a complete revolution in the fancy trade by its economic adaptation, but to which, from inability to avail themselves, the silk manufacturers of Italy may attribute their position in the rear of progress as compared with their competitors in France and England. No longer, however, exposed to the chilling influence of these difficulties, they ought to recover the relative rank amongst foreign producers which they occupied from the thirteenth to the sixteenth centuries. Why should it not be so? Italy possesses the same genial climate as heretofore—enjoys greater facilities than any other country for the cultivation of the purest taste from the atmosphere of art its inhabitants breathe from the very cradle—is not deficient in genius and the inventive faculty—pre-

serves with an almost idolatrous care the Divine types of the beautiful, so important to such textile and other manufactures as are objects of luxury—produces a raw material of silk of superior quality to that of China, or even of France, and commands the shores of the Mediterranean and the Adriatic. Assuming, then, the complete eradication of the worm disease, the introduction of foreign capital, the application of steam power, and other improved facilities where practicable; the enlarged means of commercial intercourse with England, France, and Germany, which the sub-alpine tunnel now in course of construction under Mount Cenis will open up; the increase of population, and therefore of demand, which always results from a lengthened state of peace and of high civilization; and, finally, the security to life and property which constitutional government affords—assuming the realization of all or most of these conditions, it may safely be predicted that a career of happiness and prosperity, such as already dawns on Italy, will in due time reward the patriotic devotion by which it has broken the fetters of tyranny, emerged into a state of freedom—that first necessity of national regeneration—achieved for itself a moral if not a physical supremacy, and risen to the dignity of true manhood in the comity of European states.

The number of exhibitors is 99, being, therefore, 40 more than those of England, and only 76 less than those of France. Of these 99, medals were awarded to 38, and Honourable Mention made of 40 others.

Russia.—This country, occupying in square miles greater space than all Europe combined, enjoys at some parts a climate so genial, that not only are cereals grown in sufficient abundance for internal consumption, but, whenever the crops fail in this country, we generally look with confidence to Russia to supply, partially or wholly, as the case may be, the deficiency. Silk also, which requires a still more delicate and uniform atmosphere, is grown (the technical word for "bred") successfully as to quantity, in various extensive districts. In quality, however, it cannot yet compete with the productions of more favoured climes. Hence out of twenty exhibitors of raw and thrown silks, only three have Medals awarded to them, and Honourable Mention made of two others; of the remaining eight, who exhibited manufactured silks only, one is Honourably Mentioned and two have Medals awarded to them.

It is to be feared that, until the Russian Government entirely abandons the repressive theory of protection, now so generally exploded elsewhere on the continent of Europe, any important progress towards perfection cannot be expected.

Spain.—In the silks exhibited by producers in this country, some progress is apparent since 1851, when only one exhibitor received the honour of a Medal. On the present occasion, however, out of twenty-six exhibitors, three have achieved that distinction, and of eleven others Honourable Mention is made. This advance may, perhaps, be assigned

to the natural influence of a less stringent tariff than then oppressed the industry of the nation ; but until the exports and imports of silk are absolutely free of duty, a country so favoured by Nature for the successful cultivation of this trade, will not occupy the position to which it is otherwise entitled to aspire.

SWITZERLAND.—If the eight Medals awarded to the forty-nine exhibitors, and the Honourable Mention made of five others, afforded the only reliable evidence of the true position of this trade as compared with 1851, it would not justify the favourable terms in which it may now be honestly noticed. The manufacturers of this country continue to address themselves to the production of low-priced silks, which do not afford scope for individual distinction, but in which they have arrived at a perfection of economical workmanship, which enables them to compete in many markets with the ribbons of St. Etienne, and the thin textures of Macclesfield, and of other places in France, England, and Germany.

TURKEY.—The expectations in which the reporter on the silk department of this country in 1851 ventured to indulge as to the progress of this trade, principally in the raw and thrown material, have been so far justified by the result, that whereas, on that occasion only two Medals were awarded, on this the Jurors have given eight, and made Honourable Mention of eight others, out of forty-two exhibitors. There is room, however, for still greater improvement for the disturbance to the natural flow of commerce which has prevailed so unfortunately since 1851, until recently, and which takes its origin from political complications, having given place to the introduction of foreign capital and customs ; and being now assured in the safe appropriation of the former by a ruler and government capable of protecting their material interests, there is no reason why this important trade should not occupy the position to which, favoured as it is naturally by climate and other necessary elements of success, it is entitled. Turkey still engages the favourable attention of European statesmen ; and if it does not soon emerge from the abject condition into which it was thrown by the cupidity and ambition of some neighbouring countries, and the dishonesty of some of its own executive, the fault and misfortune will be its own.

UNITED KINGDOM.—The number of exhibitors is fifty-nine, to thirty-three of whom Medals have been awarded, and of fourteen others the Jurors make Honourable Mention : thus affording pretty strong evidence of the prominent position this important manufacture is entitled to occupy in this and other countries.

The writer having, at the request of the Board of Trade, furnished a report of the "silk and velvet" (Class XXI.) department of the Paris International Exhibition of 1855, in which he treated at some length on the rise, progress, and then condition of the silk trade of the

United Kingdom, it is the less necessary that he should now do more than refer to it for details of the remarkable vicissitudes to which it has been exposed since its introduction in the 14th century, and which are mainly attributable to unsound legislation. All prohibitory and protective duties on silks being now, however, repealed both in England and France, the canon of free trade is fairly on its trial; but it would be premature to theorise on the subject, for before and since the recent commercial treaty came into full operation, a series of disturbances to the natural current of trade seem to have postponed the mutual advantages which cannot ultimately fail to result from the adoption of the policy therein inaugurated. Commerce generally, so far at least as profitable results are concerned, was then suffering from a serious collapse arising out of production being unduly stimulated, colonial and other external markets being glutted with our goods, and political apprehensions leading to exorbitant expenditure and increased taxation, with all their paralyzing and mischievous results. The manufacturers also of Lyons and St. Etienne having lost their great customer on the other side of the Atlantic, and desirous of keeping their establishments in working order, made more goods than were required elsewhere, principally plain black silks, and sold them in this market at prices which apparently afforded no profit, so that our warehouses and shops were filled to repletion. Our domestic requirements being thus unnaturally over-supplied, and the ordinary vent for excessive production, the United States, being almost hermetically sealed to us by the fratricidal war which then and since has devastated and impoverished that country, the silk industry of Great Britain has suffered longer and to a greater extent than ever before known. The cessation also of the cotton supply has had its effect on this and other branches of internal trade, by curtailing the means of purchase, while the melancholy loss the country has sustained by the death of the Prince Consort partially closed those avenues of consumption which the splendours of court entertainments and the gaieties of the ball-room ordinarily open up. Under these accumulated misfortunes, the statistics of the Board of Trade afford no reliable criterion of the future condition of the silk trade since the repeal of the duties on imports; for both exports and imports, when excessive, may rather be taken as indications of a desire to lessen stocks on hand, by ruinous sacrifices on the part of the sellers, than the results of healthy demand. Some improvement, however, may now be discerned, and demand having recently borne a more legitimate relation to supply, better prices are being obtained, It may also be assumed that the great influx of foreign visitors to the International Exhibition has led to increased consumption; but until the disturbing influences arising out of the civil war in America subside, it would be vain to expect that the trade of this and other countries having commercial relations with them can return to their normal remunerative condition.

In the midst of all these discouraging impediments, there is a redeeming feature which will make itself felt when trade revives, and that is the remarkable progress which our silk manufacturers have made since 1851, and even since 1855, in all that constitutes superiority. Whether in design, colour, or texture, or the whole combined, we compare the specimens of silks in the English department with what were exhibited in those years in London and Paris, the improvement is immense. To single out any for special notice would be to make an invidious distinction where there is so much general excellence. The articles in which this improvement is perhaps most obvious are moirés antiques, and fancy goods of almost every variety that is exhibited. But if all this applies to broad goods, much more so does it to the ribbon branch. Coventry has made strides for which we were not prepared, and their portion of the Exhibition rivets the attention of the most careless visitors, be they natives or foreigners. In no respect are they, as a whole, inferior to those of St. Etienne, while as compared with the productions of Switzerland and the Zollverein, they are much superior.

Even in what may be called minor *tours de force*, two extraordinary specimens of what can be accomplished in Coventry command general attention (*United Kingdom*, 3884). In the one, a group of cacti, most artistically arranged, and thrown into bold relief by twenty-one tints of colour, constitutes a charming picture, to the production of which no less than 22,000 cards were made subservient; and in the other, an illuminated banner screen, designed by R. R. Holmes, F.S.A., and suggested by the legendary historic incident of the "Lady Godiva" procession, is rich in all those colours which are necessary to produce the characteristics of initial letters and illustrations of missals of the early days of the Church. It goes in fact, and as it ought to do, far beyond those exemplars of mediæval taste; for, as elsewhere noticed, these specimens introduce a new application of silk textures for ornamental bindings and other useful purposes, where brilliancy of colour and correct drawing are important ingredients. There is also to be found in case No. 3885 a peculiar and unique fabric made from single filaments of silk spun direct from the cocoon, having about twelve turns to the inch both for warp and schute. The size is only two and a quarter deniers (equal to 2600 hanks in the pound of cotton), and is the finest silk thread ever woven. For the present, or until some useful adaptation for so tender annd exquisite a texture can be discovered, it can only be viewed as a new variety of *tours de force.*

It is true that for the type of fashion and taste our manufacturers must still look to France, for it is there that the former yet holds its court, and those producers in England must be bold who seek to originate and aim at establishing another tribunal. Such courage may ultimately succeed, but it should not be forgotten that, besides the

intrinsic beauty of French fancy silks, there are prejudices in their favour here to be overcome, which it would be difficult to exaggerate. But great as they are or have been, and however much they may impede the full flow of commerce now opened up, with few exceptions, to the markets of the world by the general repeal of import duties, their influence on purchases cannot be long continued when interest and knowledge are combined to dissipate and expose them.

There are also indications that the classes of goods which seem best to suit the genius of our manufacturers, viz., fancy silks where elaborate design is not required, and plain textures, whether like moirés antiques, satins, and glacés, which being comparatively expensive, suit only the wealthy ; or small checks, stripes, and self-coloured Gros de Naples, are likely to meet with an extensive demand for export. Buyers of all nations have already availed themselves of the opportunity of comparison which the present Exhibition affords, and texture for texture, and value for value, it cannot be gainsaid that these goods of English production are evener, more free from knots and floss, and generally cheaper than foreign silks of the same nominal character. If all this be true, can the necessary result be other than a question of time.

Zollverein.—This confederation includes a vast area of distinct German governments, of which it is not necessary to take separate notice, as the most important of them, especially as regards this class, is Prussia, for out of forty-four collective exhibitors no less than thirty are from that kingdom, to twelve of whom Medals are awarded, and Honourable Mention is made of nine. Of the united contributions from the Zollverein, fourteen are in the former, and thirteen in the latter category.

The industry of silk is a most important and increasing one in Prussia, for besides a large home trade, their products in velvet, velvet ribbons, hat plushes, and other articles of large consumption find profitable markets in England, France, and the United States. For reasons already assigned in another part of this Report, and which are equally applicable to the statistics of this country, the exceptional condition, especially for the last two years or more, of European commerce would render any official quotation of quantities and values, both of imports and exports, a most imperfect authority from which to extract evidence of progress or decadence since 1851. And indeed the materials furnished to the Jurors of the Exhibition of 1862, being limited in quantity and variety, do not materially assist them in forming such an opinion on these points as the instructions of the Council of Chairmen would seem to require. But besides these difficulties the "spécialités" of Prussian silk manufacturers, velvet, &c., do not afford scope for obvious improvement ; but so far as a judgment can be formed from the specimens exhibited, they fully sustain their former reputation for care in the selection of suitable silk for their goods, and for skill in the

economical adaptation of it. When the Prussian Government shall have wholly emancipated its industrial interests from the fiscal restrictions still imposed on imports, and of this there seems to be an early probability, we may expect from the genius of the country a progress such as has already obtained in those producing countries which have adopted the principle in all its integrity and fulness.

Algeria, Belgium, &c.—Having now noticed at some length the present condition of this class of manufacture in the ten principal contributing countries, it remains that a few words should be said of some others which are only nominally so. These are—Algeria, from which there are 38 exhibitors, which appear under one number, viz., 3613; Belgium, from which there are 6; China, 2; Greece, 10; India, 1; Portugal, 19; Rome, 3; Sweden, 3: making together 82 exhibitors, or only about one-eighth of the whole contribution to this department.

It would not, however, be just to these countries not to mention that some of them, as India, China, and Algeria, exhibit collectively under one or two numbers, and that the goods shown, especially by the first, are worthy of special inspection: that some, as Portugal, Sweden, Belgium, and Rome, either from climate or political impediments, cannot yet enter the field of competition with countries more favourably situated; and that of Greece, though the promise of future commerce is great, it is yet, as a silk-producing country, in its infancy.

Medals were awarded to six, and Honourable Mention made of seven of these eighty-two contributions.

The whole result of the awards in Class XX., is that out of 639 exhibitors, Medals are assigned to 204, and Honourable Mention made of 193.

Scientific Notes.

Paper.—Among the botanical specimens sent over from Japan to the Societé d'Acclimatation by M. Eugene Simon, there are a few young trees, out of the bark of which the Japanese make very good and strong paper. In China the bark of the *Broussonetia papyrifera*, a kind of mulberry tree, is used. That of Japan is a variety of the species to which Von Siebold has given the name of the *Broussonetia Kaminoki*. Considering the difficulty of meeting the demand for rags, which are sold at about 2*l.* per cwt., the bark of this tree imported from Japan would prove extremely valuable to the paper trade, inasmuch as it would not cost more than half that price. The *Broussonetia Kaminoki* might be easily acclimatised in various parts of Europe; it prefers a stony soil, especially

of a calcareous nature, and should be planted at intervals not exceeding three feet; otherwise the branches would extend, whereby the bark would become full of knots, causing much loss of substance in the manufacture. The soil is not manured until the second year; in the autumn of that year the plant is lopped close to the root, and this operation, as well as that of manuring slightly, is repeated every second year. 100lb. of branches thus obtained, stripped of their leaves, yield 10lb. of bark. The branches, on arriving at the manufactory, are put into hot water for half an hour; the bark can then be easily stripped off by the hands, and is afterwards left in the sun to dry. It is next macerated for three days in river water and bleached in the sun. These operations having been several times repeated, the bark is at last boiled in a lye of ashes for the space of three hours, then manipulated for some time to separate any epidermis that may have remained; and, lastly, when dry, the mass is pounded fine and made into a pulp with water, to which a glutinous liquid is extracted from a shrub called Nebooicko—probably the *Acacia-Nemu*—is added in the proportion of about two pints per cwt. of pulp. The latter is then made into sheets much in the usual way. Sir Rutherford Alcock states that the barks of different shrubs are used, and his collection in the International Exhibition contained some 60 or 70 different kinds of paper, with the various applications for pocket-handkerchiefs, bank-notes, printing and room-paper, waterproof clothing, imitation leather, &c.

Esparto (Lygeum Spartum, *Lœffl.*) is a grass common to the shores of the Mediterranean, and has of late years assumed great commercial importance for paper-making. A city broker assures me that in the course of this year not less than from 10,000 to 12,000 tons will be imported into England alone. Nearly every coal ship returning from the Mediterranean to England brings a cargo of this grass, the demand for which is constantly increasing, and it is stated that some of our largest daily papers are entirely printed on paper made of it. Of all substitutes for rags this fibre seems about to carry off the palm. It is procurable in any quantity both on the European and African shores of the Mediterranean, where it grows on land otherwise unproductive, on arid, rocky soil, having a basis of silica and iron. It is indigenous to Portugal, Spain, Sicily, Naples, Algiers, and, judging from a specimen in the British Museum collection, also in the Island of Crete. But we have hitherto chiefly imported it from Spain and Algeria. On the spot it fetches from 42s. to 50s per ton; but in England, at the present time, 4*l.* 10s. from the ship's side. So readily is this valuable fibre converted into paper, that a cargo which arrived in the Thames in the morning was made into paper in the evening—at least so a city merchant assures me.

Botanists have long been familiar with this grass. Pliny, to go no further back, has much to tell about the innumerable uses to which it

is applied in the Iberian peninsula, and Ray, many centuries later, reported that the inhabitants of that country did the same in his time, and it may be added that there has been no change in this respect till our own days. Mats, baskets, ropes, brushes, are manufactured of Esparto by the Spaniards and Portuguese as of yore, and even a coarse kind of paper was made of it in Spain. In Algeria it is known by the name of Alfa, and the attention of the French Government has for years past been directed to it as a substitute for rags : and in the London Exhibition of 1851 samples of Alfa, as well as paper made from it, were shown in the Algerian section of French products, and in 1862 in the British department. In consequence, however, of the difficulty of transport and the imperfect methods then employed in its preparation, little progress was made in spreading its fame amongst the commercial communities of this country. But the recent legislative enactments in England respecting paper, and the increasing price of rags abroad, have caused manufacturers to pay more attention to this grass, and not only established its superiority to straw, but its perfect adaptability to making paper, either by itself, or when mixed with straw, rags, or other material.

The Rev. H. Tristam, in his book called "The Great Sahara," says that the Esparto is "the principal dependence of both horse and camel for forage during a journey." I should think they find it rather tough, for tough the plant certainly is. Its chemical constituents are said to be : yellow colouring matter, 12.0 ; red matter, 6.0 ; gum and resin, 7.0 ; salts forming the ashes, 1.5 ; paper fibres, 73.5. The Esparto grows naturally in tufts or clumps, but, to quote a broker's circular, only such leaves and stalks as have come to maturity and are full of sap, ought to be gathered. If collected too green, Esparto produces a transparent fibre which is mere waste ; if on the other hand too ripe, the constituent elements of silica and iron are with difficulty removed. The proper months in Africa are therefore from April to June. It must be gathered by hand, and left to dry for a week or ten days before being removed for packing. From the green to the dry state it loses forty per cent. of its weight, but even in this latter form it is so cumbersome, that when shipped in loose bundles it occupies from four to five tons space to one ton weight. When placed under an hydraulic machine, however, it can be packed into pressed bales with iron hoops, and reduced to half the above volume, as far as space is concerned, each bale weighing about $2\frac{1}{2}$ cwt., and ten bales weighing about $1\frac{1}{4}$ ton. Reduced to this volume, the Esparto fibre can be transported not only with greater facility, but this method of packing (resembling, in fact, bales of pressed hay) keeps the fibre clean, and renders it of easy stowage. Indeed, could such a method have been adopted formerly, Pliny's regret that its great bulk unfortunately prevented so valuable a fibre from being carried a greater distance than about thirty leagues, would have been impossible.—*Berthold Seeman in Gardener's Chronicle.*

THE TECHNOLOGIST.

ECONOMISING LABOUR BY MACHINERY.—DEVELOPMENT OF COLONIAL RESOURCES IN AUSTRALIA.

The application of machinery to the economising of labour in the preparation of our natural products, whether mineral, vegetable, or animal, for the markets of the world, affords a most interesting and important field for the employment of energy and capital, and one which promises a rich harvest to those who, possessing the necessary qualifications, are willing to engage in it.

Had any man a few years since proposed to employ expensive machinery and elaborate mechanical appliances for the purpose of slaughtering cattle and turning their carcases to account, in the shape of beef, tallow, gelatine, and even as food for pigs, he would have been laughed at as a visionary and a dreamer. Yet this is now being carried out, and the result promised is precisely what Dr. Johnson said of the tubs and vats of Thrale's brewery,—"a potentiality of creating wealth almost beyond the dreams of avarice."

New South Wales possesses, in round numbers, about 3,000,000 horned cattle, 300,000 horses, and 8,000,000 sheep. Horned stock have increased of late in a more rapid ratio than population, and the consequence is that the supply of beef is greater than the demand, and a market has to be found for the surplus in other parts of the world. The price of cattle is already commonly quoted "at boiling rates." In other words, fat cattle will fetch no more from the butcher than can be realised from their hides, horns, hoofs, tallow, &c., for exportation. Under the old slovenly and shiftless system of sending cattle to the melting pot, it is certain that from one-fourth to one-half of what ought to have been profitably turned to account was wasted. The number of cattle in the colony is, as was observed above, about three millions. Now supposing these to be worth fifty shillings per head, *i.e.*, for slaughtering purposes, it is plain that any man who could invent a method or devise appliances

by which they could be made to realise sixty shillings each for exportation, would increase the value of this description of pastoral property to the extent of a million and a half sterling. With the idea of taking advantage of this state of things, J. H. Atkinson, Esq., M.P., has commenced operations on a somewhat extensive scale at Collingwood, near Liverpool, and with the view of showing that mechanical appliances are capable of effecting, even in such an apparently unpromising field as the slaughtering, boiling down, and other methods of turning the carcases of cattle to account, we are induced to give the following particulars of the plan pursued and the results obtained :—

Mr. Atkinson's establishment is situated on the west bank of George's River, near Liverpool, and is about a furlong distant from the railway station at that place. It is connected with the railway by means of a short branch line, laid down at the expense of the proprietor. The whole premises occupy about 45 acres of land, and the works give employment to from 70 to 100 men. About 25 acres of the land are devoted to the purposes of a vegetable garden, and as such form an important feature in the economy of the establishment, as will be explained hereafter. About ten acres are occupied by a piggery, holding from 800 to 1,000 pigs ; and the remainder is devoted to the necessary buildings for the plant and machinery used in boiling down, raising water, tallow-refining, wool-washing, fellmongering, bone-crushing, &c. The machinery is driven by three steam-engines, a large portion of the power being devoted to raising water from the river. In order to be out of the reach of floods, the engine-house is placed at a distance from the stream, and is connected with the pump by a driving shaft, 700 feet long. No wheeled vehicles, except tramway trucks and trolleys, are used in this establishment, and for this purpose rails are laid down in all positions where it is necessary to move weights from one part of the establishment to the other—even the food for the pigs being carried into the piggeries on tramways, thus enabling one man to do as much work as would require three or four under ordinary circumstances.

To make the great saving effected by machinery in the different processes understood by the reader, it will, perhaps, be necessary to show the *modus operandi* pursued in slaughtering and disposing of the carcass of a bullock. The beast, instead of being driven into a comparatively wide place, and exposed to the cruel and protracted methods of killing usually resorted to, is brought into a place so narrow that he is incapable of movement or resistance, and despatched by the butcher at once, with the greatest ease. He is then lifted for skinning by machinery, and as soon as the hide, head, hoofs, &c., are removed, the carcass is let down on a chopping block running on a tramway ; it is then cut into convenient sized pieces, without the necessity of the men handling or lifting the meat, and the trolleys chopping-block run on the rails to the other end of the building, where the boilers are. The meat is then lifted from the chopping-block into the boilers by means of endless chains with

hooks attached, passing over sheaves, and driven by steam. The boilers are large steam-tight double cylinders, and capable of holding upwards of fifty bullocks at a time. When filled with meat, the orifice in the top of the boiler is closed, and the steam is let on at a pressure of 15 lbs. to the inch. In about seven hours, the whole mass of meat and bone is reduced to a pulp. The steam is then condensed and the tallow floats on the surface. On a tap being turned, it flows into the refining pans; and when the refining is completed, by turning another tap, it runs into large, shallow coolers. These are only about three inches deep, but very wide and long, in order that as great a surface as possible may be exposed to the air. When sufficiently cool, by turning other taps, it is run into casks alongside, and these are run by means of a tramway on to the weighing machine, and thence to the rail for conveyance to Sydney. The mass of pulp to which both bone and flesh has by the steaming process been reduced, is then removed from the boilers by means of an opening near the bottom, fitted with a steam-tight door. It falls into a powerful press, also running on the tramways, and the strong pressure being applied, a large quantity of highly concentrated soup is extracted; the flesh and bone, having by the pressure been made into enormous solid cakes, the trolly-press is then run into the piggery, and the greaves given to the pigs. The concentrated gravy or soup is then placed in a peculiarly constructed boiler, and reduced by evaporation to such a consistency that when cold it becomes solid, previously to which, however, it is run into bladders. It is, when cold, semi-transparent, of a rich reddish-brown colour, and sweet to the smell and taste, almost like confectionery. The first shipment from Sydney of this concentrated soup, which is in great demand in England, was made in June last by the mail steamer. An average bullock will yield about 20 lbs. weight of this portable soup. Mr. Atkinson was, we believe, the first person in New South Wales to turn this substance to profitable account.

It will be seen by the above, that all the operations are carried on with a very small amount of labour. The tallow, gelatine, and other substances, are scarcely touched by the hand of man, from the time the beast is killed until its remains are on the way to market and the pig yards. The above account applies to cattle which are wholly boiled down. The best portions of the best beasts, however, instead of being carried on the tramway to the boilers, are run off to the salting-house. The process there need not be described, further than that every particle of bone is extracted previous to the meat being salted. The leaner portions, not suitable for the casks, are cut into strips, and made (by a process which we are not at present at liberty to describe, as it will probably be made the subject of a patent) into what is known as *charqui*, or *tasejo*, an Indian name for dried or jerked beef. When prepared, it is placed in bags, and somewhat resembles dried apples in appearance, only that the scraps or strips are longer. Each bullock will yield on an average about 100 lbs. of *charqui*, and the market for it is understood to be practically, unlimited.

We need not go into the details of curing the hides, drying and smoking the tongues, extracting the oil from the hoofs, preparing the horns and leg-bones for the English market—or into the fellmongering, or sorting, washing, and scouring of the wool—for large numbers of sheep are slaughtered, as well as cattle. From the abundance of water, however, all these processes are carried on with a degree of cleanliness and an absence of offensive smells most surprising. The paved floors are inclined from the centre of the building on each side, and being frequently flushed, are almost as free from impurity as the surface of a dining table. It will be seen from what is above stated, that every part of the beast is turned to account. All the blood and offal, as well as the greaves, is devoured by the pigs, and thus turned into pork. The solid manure is carefully scraped up and taken to a distance, where it is allowed to ferment and decompose. It is then exceedingly strong, almost equal to guano for gardening and agricultural purposes, and is disposed of readily to the neighbouring settlers for about 10s. per load. The liquid manure, of which, from the quantity of water used, there is a very large amount, is run off in pipes to the garden above referred to. It is then carried through the grounds by ditches or canals, and spread over the surface, and is the only description of manure made use of there in the growth of vegetables, &c.

Steam pipes are carried to almost every part of the premises, so that water of any degree of temperature, for the scouring of wool, &c., can be had at all times wherever it is wanted; and so great is the supply of steam, that a 400-gallon tank can be made to boil in a quarter of an hour. The steam-power, when not engaged in driving the machinery or for heating purposes, is employed in pumping a supply of water from the river into a reservoir. The main building—80 feet square, is surrounded with smaller ones for wool-sorting, fell-mongering, and coopering, all the casks used being made on the premises. The establishment is capable of slaughtering and disposing of nearly 1,000 head of cattle weekly, exclusively of sheep and pigs, and thus affording employment for a very large amount of labour and capital.

Most of the mechanical and other arrangements were designed and carried out by Mr. Blaxland, whose abilities for adapting machinery so as to economise labour, are, evidently, of a very high order, and can hardly fail, if we may judge from the results already obtained at Collingwood, of achieving a magnificent success.

We have alluded above to the fact, that the value of cattle must in future be measured in this colony, not by the local demand for butchers' meat, but by the price which can be obtained for the various constituents of the carcass in the markets of the world. This condition of things will probably be permanent, and no such injurious fluctuations as have frequently been witnessed in the colony need again be feared when the system pursued at Collingwood shall once have come into general operation. The methods heretofore in use were for the most part so wasteful, extra-

vagant, and ill-conducted, that no criterion was afforded as to what results could be obtained under a proper system.

The above remarks have almost exclusive reference to horned cattle, but we shall be much surprised if, in the course of a very few years, they are not equally applicable to horse-stock. Already the colony is being over-run with a race of useless weedy scrubbers, which, being of no value as horses, are fast becoming a nuisance. Horse grease has lately been discovered to possesss superior qualities to almost any other fatty substance for oiling machinery, and we believe is now quoted in the London market as worth from 35*l.* to 40*l.* per ton. The other portions of the carcases may be applied to a variety of useful purposes, and the owners of a description of stock now nearly unsaleable at any price may feel assured that a respectable minimum value will soon be arrived at, below which there is no danger of their animals receding.

The prospect afforded by the result of operations at Collingwood must be highly gratifying to the owners of stock ; and we cannot conclude without expressing our opinion that they owe a deep debt of gratitude not only to the enterprising gentleman whose capital and power of organization have been so usefully engaged, but to Mr. Blaxland, who has designed and carried out the mechanical and scientific arrangements. It is to be hoped that both may meet the success they so well deserve.

As some indication of the extent of capital embarked in the various operations at Collingwood, it may be stated that the cost of the railway appliances alone has been upwards of 3,000*l.* ; while the pumping machinery, piping, and tanks and reservoirs for the supply of water, have probably cost ten times that amount. The field of operations, however, now opened up is so wide that, in the opinion of sound judges, it amply justifies the outlay.

ON THE CULTURE OF BENNE OR SESAMUM IN THE UNITED STATES.

BY EDWARD PARRISH.

The Benne plant (*Sesamum orientale*, Linn.), is believed to be a native of Africa, whence it was probably brought to the United States by the negroes. Mr. Frederick Brown has cultivated the plant in his garden at Burlington, New Jersey. This plant flourishes admirably in our climate, and is adapted to a very dry sandy soil, such as abounds in many sections of the United States ; it is, indeed, said to flourish where scarcely any other crop will grow, and in land of only moderate richness ; it requires no manure. The seeds are sown in drills, about three or four feet

apart, according to the strength of the land and mode of cultivation; thinned to twelve inches or more on the drill, and barely kept clean of weeds and grass; not much earthing up is required. They can be sown just after the frost; in the Southern Gulf States they are planted from first of April till June.

My friend, J. A. M. King, of Savannah, Georgia, from whom these facts are obtained, is of opinion that this plant would richly repay for planting in many localities where the land is allowed to be idle, because unfit for other crops. He thinks one merit of this crop would be its requiring so little stirring of the soil, exposing it to the sun and rains, which he thinks one great cause of sandy soil losing consistence or body, besides by its leafy and leguminous character, this Benne enriches the soil in its decay.

The yield of seed is large, returning twenty bushels to the acre, but the harvest is very wasteful, though easy, as usually managed by the negroes, who chiefly cultivate it on their own account. In the fall when the leaves have dropped off, which happens before the legume expands, the stalks are cut and bound in sheaves and stacked up in the field to dry, when, after a few days, they are simply shaken over a large sheet spread out in the field. Rain does not rot the seed, as it passes with facility through the pods, wasting a portion; after winnowing, the seed is ready for sacking.

As is well known, the chief use of the seed is as a source of oil, and in order to ascertain the yield of oil from a sample grown in Georgia, three bushels of the seed were submitted to the action of a linseed oil-mill, and nine and-a-half gallons of oil were obtained. From this data it will be seen that sesame is among the cheapest of the fixed oils, and must become a popular substitute for some others, if introduced.

In regard to its properties, I have no new facts to offer; it appears to be bland and nearly colourless, though not free from the odour and taste of the seed. It is the oil of Ben of English commerce.

The negroes are in the habit of roasting the seeds and infusing them in water to form a drink like coffee, and it is asserted that its narcotic properties are very decided. The cake left after expressing the oil is probably possessed of all the narcotic properties of the seed, and it would soon become an economical question, in case of its production on a large scale,—What shall we do with it? If it met the fate of the cotton seed and the pea-nut cakes, it would be mixed in large proportion with the linseed cake of commerce, in which form it would find ready purchasers both at home and abroad. I have not spoken of the leaves, which plucked at the time of their maturity, are very mucilaginous, and extensively used in the treatment of some complaints of children.

[Mr. Parrish is wrong in assuming this to be the Ben oil of English commerce. There is very little oil sold under this name at all. The watchmaker's ben oil is generally attributed to the seeds of the *Moringa*, but it is very doubtful whether any of this is ever imported. We have

given a detailed account of the culture of this oil plant in India, in the "Commercial Products of the Vegetable Kingdom," but the following condensed particulars, taken from Drury's "Useful Plants of India" may be appended with advantage to the foregoing statement.—EDITOR.]

The oil known as the gingilic oil is expressed from the seeds of the *Sesamum Indicum*, and is one of the most valuable of Indian vegetable oils. It will keep for many years without becoming rancid either in smell or taste ; after a time it becomes so mild as to be used as a substitute for sweet oil in salads. In Japan, where they have no butter, they use the oil for frying fish and other things, also as a varnish, and medicinally as a resolvant and emollient. Besides its economic uses, the oil and preparations made from it are in use as medicines and cosmetics among the Egyptians. The women consider there is nothing so well calculated to cleanse the skin, and give it a bloom and lustre ; to preserve the beauty of the hair, and to increase the quantity of milk when they become mothers. The Egyptian physicians use it as a cure in ophthalmia, and inflammatory humours of the eyes, but no confidence can be placed in its curative virtues. Sesamum oil is insoluble in alcohol, readily saponifies with the alkalies, and combines with the oxide of lead. Dr. O'Shaughnessy says for all purposes of medicine and pharmacy it is, when well prepared, equal to the best olive oil. The oil cake mixed with honey and preserved citron, is esteemed an oriental luxury, and the cake alone has been recommended as a food for bees.

The plant is cultivated to a great extent in most parts of India, especially in the Peninsula. The following mode of preparing the oil was given in the Jury reports of the Madras Exhibition of 1855 :

"The method sometimes adopted is that of throwing the fresh seed without any cleansing process into the common mill, and pressing it in the usual way. The oil thus becomes mixed with a large portion of the colouring matter of the epidermis of the seed, and is neither so pleasant to the eye, nor so agreeable to the taste, as that obtained by first repeatedly washing the seeds in cold water, or by boiling them for a short time until the whole of the reddish-brown colouring matter is removed, and the seeds have become perfectly white. They are then dried in the sun, and the oil expressed as usual. This process yields 40 to 44 per cent. of a very pale straw-coloured sweet-smelling oil, an excellent substitute for olive oil."

There are two varieties of seed known in commerce, one white and the other black. The plant bearing the white seeds is not so common as the other one. The *Kala-til*, or black seed, must not be confounded with that of the *Guizotia oleifera*, to which the same name is applied. It is said that the fragrance is much weaker when the plant has been sown in too moist a soil. The plant has a very general distribution, and the oil is procured and used in Egypt, China, Cashmere, and the West Indies. In the Rajahmundry district, the seed is sown in the month of March, after the rice crop, and is irrigated twice, once at

sowing, and once afterwards. The seed, which is black, is called first sort gingelly, from the fact of its yielding the largest per centage of oil, ripens in May, and sells at the rate of 60 rupees per candy of 500 lbs. Second sort gingelly is sown in June, and produces a red seed. The plant, although a little larger, resembles in most respects the former; it has, however, a somewhat longer leaf, and the flower differs a shade or two in colour. A candy of 500 lbs. of this seed sells at 57½ rupees. The price of this oil is the same as that of gingelly. The fixed or expressed oil, besides being eaten by the natives, is used medicinally, and considered to possess emenagogue virtues. It possesses such qualities as fairly entitle it to more general introduction into Europe, and if divested of its mucilage, it might, perhaps, compete with olive oil, at least for medicinal purposes, and could be raised in any quantity in British India. It is sufficiently free from smell to admit of being made the medium for extracting the perfume of the jasmine, tuberose, narcissus, camomile, and yellow rose. The process is managed by adding one weight of flowers to three weights of oil in a bottle, which, being corked, is exposed to the rays of the sun for 40 days, when the oil is supposed to be sufficiently impregnated for use. This oil, under the name of gingelly oil, is used in India to adulterate oil of almonds. The seeds are roasted, and ground into meal, and so eaten by the Hindoos. It is used externally in rheumatism, also in the process of dyeing silk a pale orange colour. Sesamum seed often contains about 45 or 46 per cent. of oil; the Ram-til seeds only 34 per cent. The price of the oil varies in different districts, but the average is from 3 to 4 rupees a maund. In England its value is about 50*l.* per ton.

ON COCA LEAVES—FROM *ERYTHROXYLON COCA.*

BY HENRY F. FISH.

Coca, according to Herndon, is a bush about four feet high, with a small light-green leaf. The flower is white, and the fruit a small red berry. The seed is sown in beds, at the expiration of the rainy season—about March 1st. Arbors of palm trees are frequently built over the young shoots, to protect them from the sun, and they are watered, if it continues clear, for a week or so. It is transplanted in September, a year and a-half after planting, and gives its first crop in one year from that time, and a crop every four months after.

The bush, if not destroyed by ants, will give crops many years. Some times, but rarely, the leaves wither, and the crop fails. It is necessary to dry the leaves, when gathered, as quickly as possible, and to avoid

any moisture or dampness when storing them. Every 100 plants furnish an *arroba* 21 lbs. of leaves, worth, in Lima, about 7 dols., or 30c. a pound The leaf of this plant is to the Indian of Peru what tobacco is to the labouring classes of the southern states, a luxury.

Supplied with an abundance of it, he sometimes performs prodigies of labour, and can go without food for several days. Without it he is miserable, and will not work. It is said to be a powerful stimulant to the nervous system, and, like strong tea or coffee, to take away sleep; but, unlike tobacco and some other stimulants, no one has known it to be injurious to health. The *hacienda* (estate) of Montana Carabaya produces three crops a-year. It is situated on a stream near San Mateo, on a square inclosed with one-story buildings, a mill for grinding the silver ore, &c.

About forty hands are employed—Indians of the Sierra, strong hardy-looking fellows, though generally low in stature and stupid in expression. They are silent and patient, and, having coca enough to chew, will do an extraordinary quantity of work.

They breakfast and commence work at 8 o'clock; at 11 o'clock they have a recess of half an hour, when they sit down near their place of work, and chew coca mixed with lime, which each one carries in a small gourd, putting it on the mass of coca leaves in his mouth, with a wire pin attached to the stopper of the gourd. They then go to work again till 5 o'clock, when they finish up for the day and dine.

I have seen them puddling with their naked legs a mass of mud and quicksilver, in water, with the thermometer at 38 deg. (Herndon's Expedition, 1853).

It is said that, by taking a sufficient quantity of coca, a man is capable of dispensing with food for five days without any material inconvenience, even though he is engaged in rapid travelling on foot the whole time. Dr. Von Tschudi, in his travels, relates that a Cholo of Huari, named Hatun Huamang, was employed by him in very laborious digging. During the whole time he was in his service, five days and nights, he never tasted any food, and took only two hours' sleep nightly; but at intervals of two and a-half or three hours he regularly masticated about half-an-ounce of coca-leaves, and he kept an *acullico* continually in his mouth.

Dr. Von Tschudi was constantly beside him, and, therefore, had opportunity to observe him closely. The work for which he had engaged him being finished, he accompanied him on a two days' journey of twenty-three leagues across the level heights. Although on foot, he kept pace with the Doctor's mule, and halted only for the Chaechar.

On leaving, he declared that he would willingly engage himself again for the same amount of work, and that he would go through it without food if he were but allowed a sufficient amount of coca. The village priest said this man was 62 years of age, and he had never known him to be ill in his life. The aboriginal Peruvians, who have been so

barbarously enslaved by the Spaniards in their own country, and so inhumanly overtasked and otherwise ill-treated, use coca.

In their circumstances, it is really a necessary analeptic, or restorative, without which they would hardly be able to tolerate the labour imposed upon them. Travellers tell us that the only thing that prevents despair and revolt among those employed in the mines, is their being allowed a free use of coca.

It would hardly be correct to say that they use it as a matter of sensuality. (*Tully's Mat. Med.* Article "Euphrenics").

But by far the most extended notice yet published on coca is one given at Milan by Dr. Mantegazza, a translation of which appeared in the 'Lond. Pharm. Jour.' June, 1860, and is as follows :—

The *Erythroxylon Coca*, a plant which grows in moist and woody regions, on the eastern slopes of the Andes, is highly valued by the inhabitants of Peru, Chili, and Bolivia, not only as a medicine, but also as an article of food ; and serves with them as a substitute for the tea, coffee, betel, tobacco, hasehish, and opium used by other nations. Its culture, upon which, since the time of Pizarro's conquest, much attention has been bestowed, has recently increased to such a degree, that in the year 1836 the revenue of the republic of Bolivia from the sale of this herb amounted to 2,470,000 dollars, a very large sum when compared with the population (only 800,000), but it is likely that some of the crop is exported.

According to the account of M. Pöppiz, and of other well-known travellers, the natives use the dried leaves of the Coca either by themselves, or in combination with a highly attractive substance called Clipta, which is prepared from roasted potatoes and the ashes of other plants ; they masticate it as the Malays do betel. The use of this, considered there as a great delicacy, is not however, confined to the rich ; on the contrary, it is particularly among the hard-working Indians that the Coca enjoys a high reputation as a nutritient restorative, and its use is considered absolutely requisite to the comfortable endurance of fatigue and exertion, so that a labourer in making his contract has a view not only to his wages, but to the amount of Coca furnished.

The Inca who lives at a height ranging from 7,000 to 15,000 feet above the sea level, and whose meagre fare consists only of maize, dried meat, and inferior potatoes, believes that he can sustain his strength solely by the use of coca. The peon who carries the mail, and who accompanies the traveller over the roughest roads, at the quick pace of the mule, invigorates and strengthens himself by the use of coca. The Indian who works half naked in the various mines looks upon this plant as an ambrosia capable of imparting new life and stimulating to new exertion. It is not surprising under such circumstances that the use of this article should be very much abused, and that the evil of intemperance in the consumption of coca, known as *Coquiar*, should be quite as prevailing among the natives of those districts as intemperance in the

use of tobacco, alcoholic liquors, and opium among other nations. They often intoxicate themselves for several weeks, hide in the deepest forests, in order not to be disturbed in their enjoyment, and not rarely return home to their families suffering from delirium or decided idiocy. (This last sentence does not agree entirely with other authorities, who assert that coca, unlike opium or alcohol, leaves no debility supervening from its free use ; and it may well be questioned whether or no a delirious or an idiotic Indian would, as a general rule, be successful in finding his way home from "the deepest forests.") The child and the feeble old man seize with equal eagerness the leaves of this wonderful herb, and find in it indemnification from all suffering and misery. Be it that the praised efficacy of the plant is merely the effect of fancy or tradition, or that the plant really contains a powerful principle unknown to science, the solution of the mystery is certainly a theme worthy of scientific inquiry, and the investigations of Dr. Mantegazza deserve, therefore, our full attention.

Dr. Mantegazza observed that the chewing of a drachm of the leaves of the coca increased salivation, giving at first a somewhat bitter, and afterwards an aromatic taste in the mouth, and *a feeling of comfort in the stomach*, as after a frugal meal, eaten with a good appetite ; after a second and third dose, a slight burning sensation in the mouth and pharynx, and an increase of thirst, were noticed; digestion seemed to be more rapidly performed, and the fæces lost their stercoraceous smell, the peculiar odour of the juice of the coca becoming perceptible in them.

On using the coca for several days, the author observed on himself, as well as on other individuals, a circumscribed erythema, an eruption around the eyelids resembling pityrias ; from time to time a not unpleasant prickling or itching was felt. An infusion of the leaves taken internally was found to increase the frequency of the pulse to a very considerable degree. In making his observation upon this point, Dr. Mantegazza was very careful to consider all the varying influences ; he found that the temperature of the air being the same, and the liquids being heated to an equal degree, an infusion of coca will increase the action of the heart (and arteries ?) four times its normal standard, while cacao, tea, coffee, and warm water only double it. By taking an infusion prepared from ʒiij. of the leaves, a feverish condition was produced, with increased heat of the skin, palpitation of the heart, seeing of flashes, head-ache, and vertigo : the pulse rose from 70 beats to 134. A peculiar roaring noise in the ear, a desire to run about at large, and an apparent enlargement of the intellectual horizon, indicated that its specific influence on the brain had commenced. A peculiar hardly-describable feeling of increased strength, agility, and impulse to exertion follows ; it is the first symptom of the intoxication, which is, however, quite different from the exaltation produced by alcohol. While the latter manifests itself by increased but irregular action of the muscles, the individual intoxicated by coca feels but a gradually augmented vigour, and a desire

to spend his newly-acquired strength in active labour. After some time the intellectual sphere participates in this general exaltation, while the sensibility seems hardly influenced; the effect is thus quite different from that produced by coffee, and resembles in some degree that of opium.

Dr. Mantegazza could in this excited condition write with ease and regularity. After he had taken ʒiv, he was seized with the peculiar feeling of being isolated from the external world, and with an irresistible inclination to gymnastic exercise, so that he who in his normal condition carefully avoided the latter, jumped upon the writing table easily without breaking the lamp on it. After this a state of torpidity came on, accompanied by a feeling of intense comfort, consciousness being all the time perfectly clear, and by an instinctive wish not to move a limb the whole day—not even a finger. During this sensation sleep sets in accompanied by odd and rapidly changing dreams; it may last an entire day without leaving a feeling of debility or of indisposition of any kind. The Doctor finally increased the dose to ʒxviij. in one day; his pulse rose in consequence to 134 beats, and in the moment when his exaltation was most intense, he described his feelings to several of his colleagues.

After three hours' sleep, he recovered completely from this intoxication, and could immediately follow his daily occupation without any indisposition; on the contrary, even with unusual facility. He had abstained forty hours from food of any kind, and the meals then taken were well digested. From this fact the author finds it explainable that the Indians employed as carriers of the mail are able to do without food for three or four days, provided they are supplied with coca.

From these experiments made repeatedly on himself and others, Dr. Mantegazza draws the following conclusions:—

The leaves of coca, chewed or taken in weak infusion, have a stimulating effect on the nerves of the stomach, and thereby greatly facilitate digestion. In a large dose coca increases the animal heat, and augments the frequency of the pulse, and consequently of respiration. In a medium dose three or four drachms excited the nervous system in such a manner that muscular exertion is made with great ease, then it produces a calming effect. Used in larger doses it causes delirium, hallucination, and finally congestion of the brain.

Since this paper was written, announcement has been made of the discovery and isolation of a proximate principle from coca by a German chemist, said to possess all the peculiar properties that characterise the plant itself. For a very minute and interesting detail of the use of coca among the Indians, reference may be made to a small but attractive work by Captain Mayne Reid, entitled *The Forest Exiles.*

WOODS AND MANUFACTURES OF WOOD SHOWN AT THE INTERNATIONAL EXHIBITION.

We take from the Report of the Jury on Class IV. the following details on the manufactures of wood. The section included specimens of timber and other woods, turnery, and small wares in wood, or wood and other materials, the wood being essential; wood carvings, coopery, basket-work, sticks and canes, bark-work, &c.

At no previous exhibition in this or any other country has so splendid and valuable a display of the products of forests and plantations been exhibited, not only when we consider the magnitude of the various collections sent from almost every country, but also in regard to the admirable care which in almost all cases has been shown in the preparation of the specimens of which they were composed. Science and commercial enterprise have gone hand in hand, and we have no longer to regret that absence of correct information respecting the producing plants and other important particulars, which rendered so much that was sent to the Exhibition of 1851 comparatively valueless. Most of the collections now exhibited are labelled correctly; and not only do we find the scientific names of the trees attached, but in many cases valuable information respecting the qualities and quantities of the timber are given.

In the British Department but little of the raw material is exhibited. Three exhibitors show very choice selections of the hard woods, which are imported for ornamental purposes; these are the eminent firms of R. Fauntleroy and Sons, Messrs. W. Oliver and Sons, and R. Fauntleroy and Co., each of which exhibit remarkable specimens of the most beautiful of the ornamental woods, and good veneers, knife-cut, are exhibited by Blache and Co., of Finsbury. Of the other descriptions of wood goods entitled to notice, we have :—

Excellent turnery and carving for dairy and other domestic purposes, by J. Duffield, of Great Chapel street, Oxford street; and by J. Bailey, of King's Cliffe. These are for ordinary use; but similar articles of much finer finish and greater artistic merit are shown by H. Bridges, 406 Oxford street. Good specimens are also shown by W. Bollans, of King's Cliffe, Northamptonshire. The only specimens of the well-known Tunbridge ware or wood-mosaic are shown by J. R. Clarke, of Walworth; they are varied and tasteful both in design and application to articles of ornament and utility.

As specimens of masterly turning the arm-clubs and skittles of W. Camp, 81 Tottenham-court road, are excellent.

The carved plates and potato-bowls of R. E. Farrant, of Queen's row, Buckingham gate, are of excellent workmanship, quite equalling the best Swiss carvings of the same kind. The jury regretted that the limitation in the number of medals prevented one being awarded to these artistic carvings.

A very important application of turnery is shown in the admirable manufactures of J. Howard, Luton, consisting of wooden blocks for the bonnet and hat makers.

The bog-oak ornaments of C. Goggin, of Dublin, exhibit the average amount of skill and taste usually found in those articles; but the vegetable ivory turnery of B. Taylor, of 169 St. John street road, show great excellence, and a more extended application of the material than has hitherto been seen.

The beautiful boxes and other articles known as Mauchline or Tartan work, or "Ecossais," which are now so well known, are exhibited in great variety, and of very excellent manufacture, by the celebrated firm, W. and A. Smith, of Mauchline, to which locality this curious manufacture is confined. It employs about 280 persons, of whom 170 work for the Messrs. Smith, all natives of the neighbourhood. Excellent wooden boxes of a cylindrical shape, intended for gentlemen's collars, &c., and for samples of such goods as are generally sent in canisters, are exhibited by A. Robertson, of Holloway Mills. This useful invention combines great lightness, strength, and neatness.

An interesting collection, showing the indigenous woods of Hampshire, and their applications, is shown by H. Raynbird, of Basingstoke, in which are very excellent hoops for coopers' purposes. Two admirable specimens of coopers' work are shown in the machine-made casks of T. S. Cressey, of Burton-on-Trent; this manufacture is quite unique, the staves being not only made, but also put together, by machinery. These casks are very perfect, and are now used extensively by Messrs. Bass and Co., the Burton brewers, and by the Lords of the Admiralty.

Canes and walking-sticks are not very largely exhibited, except by B. Meyers, of Mill lane, Tooley street, whose collection is very interesting, from its great variety both in the raw and finished states. C. Cohen also shows a large number and variety of canes, walking-sticks, and umbrella-sticks.

Basket-work is exhibited in great variety, some showing great taste in ornamental designs, and others strength and neatness for purposes of mere utility. Of the former may be mentioned the beautiful and original works of R. Cosser, the wicker chair, and baskets of R. Giehr, those of R. Lenton, those of T. and J. Toplis, and the very elegant wicker picture-frames of A. Mackay, Edinburgh. Of the latter kind may be specified the well-made fruit and flower-baskets of R. Adamson, the plain wicker-work of M. H. Heeks, the excellent strong basket-work of T. Smith and Sons, of Herstmonceaux, and those of S. J. Walden.

Cork and its applications are not extensively exhibited: good corks for bottles are shown by H. Clemence, and T. C. Clarkson; also by A. B. Seithen (but these last were artificially dressed); and an ingenious application of cork for lining the upper part as well as the soles of boots is exhibited by W. F. Coles.

The carvings in wood in the British department are remarkable for

their great beauty and high artistic excellence. Those of Mr. Wallis, of Louth, are in the most masterly style, both of design and finish. Messrs. Rogers, of Soho square; Mr. W. H. Baylis, Mr. Bryer, of Southampton; Mr. T. H. Kendall; Mr. W. Perry, of North Audley street; and Mr. R J. Tudsbury, of Edwinstowe, have all exhibited works of great beauty and admirable execution, showing that in this branch of art a fair amount of real talent is not wanting in our artists.

Austria presents a large display of timber specimens and wood goods.

The Imperial Royal Ministries for the Direction of the I. R. Finances at Gratz, Lemberg, Pressburg; for the I. R. Direction of Forests, Vienna, and Montana, in Istria; and for the I. R. Direction of Salterns and Forests at Gumunden in Upper Austria, and at Saltzburg, of Kutjevo in Sclavonia, and Radauz in the Bukowina, have collectively brought together a finer collection of the forest products under their care, than in all probability was ever brought together before by one country. They are principally large and carefully-selected blocks of the various kinds of timber shown in different states, as cross-cuts (with the bark on), squared, logs, planks, rough and planed, scantling, palings, sleepers, staves, &c.; and the barks of fir, larch, and oak, prepared for tanners' use in rolls, and crushed.

Matthew Bauer, of Warasdin, shows examples of Croatian oak-staves of excellent grain, the prices of which are remarkably low. We were informed by the Imperial Commissioner that they are supplied in large quantities to the French coopers for claret and brandy hogsheads at the rate of 3*l.* 10s. per 1,000. Cross-cut sections of the trees are also sent by the exhibitor; they show a clean, compact, and sound growth.

Count Ernest Hoyos-Sprinzenstein, of Stixenstein and Gutenstein, has made an admirable display of the timber produce of his estates. The following will show the varieties, price per cubic foot, soil on which grown, and the altitude. The price is expressed in Austrian convention Munz kreutzers:—

Black fir (*Pinus Austriaca*, Poir); Alpine chalk: Northern; altitude, 1,600 feet; price per cubic foot, 60 kreuzer.

Spruce (*Abies excelsa*, D.C.).

Silver pine (*Abies pectinata*, D.C.); Gray-wacke: Bottom of Valley; altitude, 3,000 feet; price per cubic foot, 30 kreuzer.

Scotch fir (*Pinus sylvestris*, L.); Dolomite: Northern; altitude, 1,600 feet; price per cubic feet, 30 kreuzer.

Beech (*Fagus sylvatica*, L.); Alpine chalk: Southern; altitude, 2,000; price per cubic foot, 18 kreuzer.

Count Munch-Bellinghausen shows the stem of a black fir (*Pinus Austriaca*) with the incisions made for collecting resin, and the implements illustrating the process. The same nobleman also exhibits a most remarkable specimen of the hazel-tree of Austria (*Corylus Colurna*); it is a transverse section with one surface polished to show its beautiful

rich brown colour. This section measures three feet six inches in diameter, and is perfectly sound throughout. The tree from which it was cut was known to be 280 years old, and had reached the height of seventy feet; many similar trees are said to be growing on the same estate.

The Prince Schaumburg-Lippe exhibits very excellent oaken-staves for wine casks, with the statement that he has 150,000,000 Austrian cubic feet of similar wood at his disposal, from trees which have been standing from 200 to 250 years.

Emil Raikem, steward of the estates of Wsetin, sends a very remarkable cut, or transverse section of an immense stem of the silver pine (*Abies pectinata*). This stem when cut and trimmed was 143 feet in length, with a diameter of six inches at the top, and contained 1,500 cubic feet of timber.

Excellent specimens of various kinds of timber from the estates of Prince Esterhazy in the Comitat of Somogy, are exhibited by the farmers of the estate, Messrs. Freistadtler and Co. And the Count Nicholas Esterhazy also sends equally good specimens from his estates in the Comitat of Romarom; and another excellent series is exhibited by Gabriel Varady, Chairman of the Exhibition committee for the Comitat of Máramarvas. An ingenious and beautiful method of showing the varieties of elegant curls found in the native wood has been adopted by Professor Henry Engl, who has had twenty-nine specimens inlaid in a table-top, so artistically as to produce an excellent representation of the arms of Austria.

Good collections are also shown by the Agricultural Society of Goritz; Prince John of Lichtenstein, Bernard Pollak, jun. (chiefly for carriage builders, wheelwrights, and coopers' uses), Hugel and Co. of Bistritz, Peter Barabas of Arad, Stephen Kazy of Nemes-Orozi, in the Comitat of Bars, the Town Council of Kremnitz, and M. D. Rombaner of Szkleno, in the Comitat of Bars.

A very fine series of ship timber, oak for railway and artillery carriages, and coopers' staves, is shown by the Baron Hilleprand Gustavus Prandau of Valpo, Slavonia.

Of wood prepared for various purposes, the following exhibits are entitled to notice:—

The fir and pine telegraph poles, impregnated with sulphate of copper by Boucherie's process, sent by Francis Kreuter, of Vienna, whose works are said to produce 20,000 poles per annum.

An important production of the Austrian forests is the fine, smooth-grained, soft, and sonorous wood of the silver-pine, which in that country yields the material which supplies to the rest of Europe the best sounding-boards for pianos and other musical instruments. The smaller portions of this wood also enables the Austrians to make the best matches, the choicer kinds of which, as shown in the case of Anthony Sartyni, of Smorce, in Galicia, are remarkable for the elegance of their manufacture and the extraordinary cheapness at which they can be produced, the

price stated for match sticks two feet in length is one penny per 4,000, and this manufacture gives employment to nearly 700 persons.

Of the sounding-boards an excellent exhibition is made by D. Bienert and Son, of Maderhauser, in Bohemia, who supplied the Messrs. Broadwood as early as 1827 with piano sounding-boards.

The annual produce exported by this firm is very remarkable; it comprises:—

		Pieces.		
Cut sounding-boards - - - -	from	35,000	to	40,000
Cleft sounding-boards - - -	„	6,000	„	8,000
Tops (36 ft. square each) - - -	„	2,500	„	3,000
Key-wood (18 in. to 32 in. long and 9 to 15½ sq. ft.) - - - -	„	18,000	„	20,000
Rips - - - - - - - - - -				300
Frame-wood - - - - - - - -				2,400
Violoncello and double-bass tops - - - -				50
Violin and bass-viol tops - - - - - -				500
Guitar tops - - - - - - - -				500

The value is estimated at 17,000*l.* sterling, and gives employment to more than 100 persons, the mills being worked by water-power.

Another exhibitor, John Reif, of Kuschwarda, in Bohemia, also sends sounding-boards of the very first quality, together with a variety of prepared wood goods, as hatchet-handles, sieve-hoops, pencil-casings, piano keys, covers, and frames, &c.

Excellently prepared wood for joiners' purposes is also shown by Samuel Ramoosa, of Pesth, and by Francis Stemdl, jun., of Pesth.

Veneers and gunstocks are exhibited of excellent quality by the Veneer Cutting Company of Bistritz. The veneers are of walnut and ash roots and knots, showing good curl. The gunstocks are of walnut wood, and are offered at very low prices.

Nothing more remarkable is shown than the really wonderful marquetry veneers of Francis and Matthew Podany, of Vienna, which rival tissue-paper in thinness, and are so remarkably perfect that not even the smallest hole is seen in any of the specimens exhibited.

The manufacture of pegs for boot and shoe makers is now extensively carried on in Austria, and the pegs are exhibited in great variety and of excellent make by Messrs. Zeidler and Menzel, of Schönau, in Bohemia, who employ one hundred men and twenty-nine machines worked by water-power; they produce annually 200 tons of these pegs, which are all used by the Austrian, German, and Russian shoemakers.

Excellent pegs are also shown by John Rattich and Son, of Kumaur, and by A. Perner, of Budweis, in Bohemia. The wood of the maple (*Acer campestre*) is used in this manufacture.

The manufacture of the celebrated agriot, or cherry-sticks for pipes, is peculiar to Austria; these pipe-sticks are the stems of the perfumed

cherry (*Ceraus Mahaleb*), a native of Austria ; for this purpose the young trees are grown in large pots in order that they may be turned round, so as to receive equal exposure to the sun and air on all sides. This is done with great regularity, and the utmost care is bestowed upon them in order to secure perfect straightness of growth, and an equal diameter throughout of about an inch or an inch and a half.

Some of those shown in the collection which received the medal (Michael Biondek, of Baden), in Lower Austria, were eight feet in length and perfectly straight ; the bark, which is of a dark purple brown colour, is deliciously perfumed. Besides Biondek's, there is a very fine collection by William Germer and Co., of Baden, near Vienna, and also Joseph Trenner, sen. and jun., of the same place, and Andrew Burshik, of Wieden, Vienna.

Another kind of pipe-sticks is shown by Ferdinand Barany, of Pesth ; they are about eighteen inches in length, and are made of the shoots of *Philadelphus coronarius*, which is remarkable for its quality of absorbing the oil of tobacco, and for nice flexibility.

Of turnery and fancy articles in wood there is a choice display. A large and very tasteful selection of useful and ornamental articles is shown by Anthony J. Krebs, of Vienna ; and good specimens are shown by Francis Theyer, of Vienna, and John Hillinger, of Vienna.

A remarkably pleasing application of the wood of the hazel of the country (*Corylus Colurna*) is shown in the clever imitations of leather articles, such as caskets, &c., shown by Charles Stenzel at very moderate prices ; and numerous fancy boxes and other articles of very tasteful design in wood are shown by Joseph Schüpler, of Vienna.

In wood carving we have to notice a very beautiful work in high relief, representing a scene in a Tyrolese inn, by Peter Nocker, sculptor, of Botzen, in the Tyrol ; and some clock-cases of great beauty in design and nice finish by J. Oberleitner, from the establishment for the education of deaf and dumb persons at Halle, in the Tyrol.

The exhibitors of basket-work and straw-work are few, but the ornamental basket-work and wicker furniture of Frederick Afh, Vienna, is exceedingly tasteful in design, and of very excellent workmanship.

The rush and cane basket-work of M. L. Hanning, of Debreczin, is worthy of notice, in consequence of its cheapness. It is made entirely by the peasants in the neighbourhood of Debreczin from the common rush (*Scirpus lacustris*), with small quantities of rattan cane for strength.

The only exhibitor of straw work is Maria Petry, of Vienna, who shows a number of very elegant bouquets, for bonnet trimmings, made of various kinds of straw ; they are of novel and tasteful design.

The woods and forests of the ZOLLVEREIN have scarcely furnished anything for this Exhibition.

A few specimens of ornamental woods, most of them exotic, are sent from Ladenburg, in the Grand Duchy of Baden, by a manufacturer named Seifarth, who also exhibits some very good veneers made from

the woods. Match-sticks, or wood prepared for lucifer-matches, of good quality, are shown by Heidenreich, a manufacturer of Affolterbach, in the Grand Duchy of Hesse; and toothpicks of great excellence, made of the Spindle-tree wood (*Euonymus Europæus*), are exhibited by Carl Wölfert, of Dresden; there are four kinds, with the prices attached. No. 6 is 2s. per 1,000; No. 7½ is 3s. per 1,000; No. 10, 4s. per 1,000; and No. 15, 4s. 6d. per 1,000. This manufacture is said to employ large numbers of the peasantry during the winter evenings. Wilhelm Geyer, of Plauen, Saxony, has shown a large assortment of carved picture-frames and fancy boxes, which, as very cheap manufactures, are worthy of notice; and a large collection of very well made shoe-lasts and boot-trees are exhibited by C. Behrens, of Alfeld, in Hanover; the last range in price from 2s. 3d. to 11s. 6d. per dozen.

Several exhibitors have sent wicker-work in great variety, chiefly in the shape of ornamental chairs, perambulators, &c. The principal are—Samuel Zinn and Co., of Red-witz, in Upper Franconia; Walter, Ernst, and Son, basket-makers to the Court, Brunswick; F. Fuhrberg, Berlin; Auguste Herbst, Bonn; Johann Friedrich Reichardt, Erfurt; Herrmann Winckler, of Berlin; and Oscar Merz, jun., of Dresden. All of them display more or less of taste as well as good workmanship.

Of manufactured corks, one exhibitor, B. H. Lurssen, of Delmenhorst, in the Grand Duchy of Oldenburg, makes a large display; he shows sixteen sorts, all well made, and of excellent material, varying from 1s. 10d. to 60s. per 1,000.

The Hanse Towns exhibit only wicker-work and walking-sticks in this division. The wicker-work is in the form of chairs, tables, &c., and is very good and tasteful. The principal exhibitors are Henning Ahrens, of Hamburg; C. Lampe, of Bremen; and Meyer Brothers, of Hamburg. The exhibition of walking-sticks, by H. C. Meyer, of Hamburg, is very remarkable, both for its extent and the great variety and excellence of the goods shown.

France shows but little in this division, if we except the admirable collections of Vilmorin-Andrieux and Co., M. Leopold Javal, M. P. Chambrelent, and Dr. Eugene Robert. That of Vilmorin and Co. contains a most perfect series of forest woods, and many of their applications are also shown. Nothing can surpass the very admirable arrangement of this collection; the specimens are so prepared as to illustrate every peculiarity of the material, and, besides the wood specimens, there are collateral series showing the foliage and the fruits of the trees, all prepared and named with the greatest care and scientific accuracy. This is the only collection in the Exhibition which reminds us of the magnificent exhibition of similar products by Messrs. Lawson of Edinburgh, in 1851.

The collection of M. Javal is a very remarkable one; it is intended to illustrate the extraordinary results which he has realised by a systematic cultivation of the previously barren district called the "Landes"

of Gascony, the soil of which is very little more than loose sand, similar to that of the dunes along the shores of the Bay of Biscay. Upon this unpromising land M. Javal has encouraged the growth of such plants as fern (*Pteris aquilina*), rushes, heather, gorse, &c., and has thus added to the vegetable mould; he has, of the land so improved, planted nearly 80,000 acres with seedlings of the sea-side pine (*Pinus maritima*, W.), and these, when large enough, are cut for various purposes, as railway sleepers, wood pavement, palings, &c., or they are treated, on the principle of Boucherie, with solution of sulphate of copper, and are used for telegraphic poles and other purposes, while great numbers are tapped and the turpentine is collected in large quantities and distilled on the estate; the fuel used is the loppings of the trees and refuse of the saw-mills. The produce of turpentine, resin, and other products of distillation is very considerable, and the quality is excellent, as seen by the specimens exhibited.

M. Chambrelent's collection is of a similar kind, but on a much smaller scale; still it is a gigantic effort to subdue the vast desert of the "Landes," and it is pleasing to witness these monuments of successful enterprise shown by MM. Javal and Chambrelent.

The collection of Dr. Eugene Robert is one of great importance to the forester, for it indicates a valuable course of investigation. The specimens he has exhibited are collected for the purpose of showing the ravages of insects, and the methods he proposes for destroying them, and restoring the vigour of the tree. As this depends upon a sort of surgical treatment of the tree, the jury can only recommend it for trial, the specimens exhibited seeming to prove that it is very beneficial. Dr. Robert's plan consists in making horizontal and longitudinal incisions in the bark of the infected trees, these incisions being determined by experience. One of the curious results of his experiments, as shown in the specimens exhibited, is to entirely alter the form of the stem almost at will, the future growth being greatly modified by the direction of the cuts in the bark; thus four equidistant longitudinal cuts in the bark, by relieving the pressure, admit of a greater expansion of the wood below the cuts, and the tree thus assumes the square instead of the round form. Many other highly interesting results are shown by the specimens in this very curious collection.

Amongst the curious applications of wood exhibited in the French department may be mentioned the "Bois durci," or preparation of the finely-powdered sawdust and turnings of hardwoods, such as rosewood ebony, mahogany, &c., with blood. The paste formed of these materials is pressed into moulds or dies, and receives most beautiful impressions; when hard it will take a polish equal to jet, which it much resembles; the exhibitors, Latry, Sen., and Co., of Paris, have a beautiful series of medallions and other interesting objects in bois durci. Very elegant snuff-boxes and pipe bowls, made of the root of the tree-heath (*Erica arborea*), are shown in the case of Hochapfel Brothers of Strasbourg.

Similar applications of the root of this plant are also found in the collection of M. Javal, previously alluded to; they constitute another of the products obtained from his plantations.

Amongst the heterogeneous materials submitted to this jury were fans for ladies' use, in consequence of their having some portions of wood (bois d'eventail). In this department the fans of P. Duvelleroy are most beautiful; the carving of the handles is exquisite, and the general decorations of the finest specimen are in the highest style of art. M. Duvelleroy exhibits fans varying in price from nearly 2,000 francs to one sous each.

The French Colonies are rich in illustrations of forest products.

In Algeria very beautiful specimens of the wens of the Algerian Thuya (*Callitris quadrivalvis*, Vent.) rivalling the beautifully mottled Kyabouca wood of the East, are exhibited by Henri Costerisan (Oran), Dufour and Co. (Algiers), Amadeuf (Oran), and Dr. Warnier (Algiers). These enormons wens, in some cases over two feet in diameter, are cut for veneers, which are used by the Parisian manufacturers in the construction of various elegant *objets d'ebénisterie*, choice examples of which are shown in the collection of this colony from Messrs. Becker and Otto, M. Duthoit, Messrs. Jouby and Guibert of Paris, and M. Maréchal.

M. Lambert, Inspecteur des Forêts à Bôna (Constantine), exhibits a remarkable collection of 104 specimens of wood, representing very completely the products of the Algerian forests, both as regards the ligneous and sub-ligneous plants. The woods are labelled with French and scientific names, which we give below, and they are accompanied by other series, showing the twigs, leaves, flowers, &c., giving perfect means for the identification of the species. The following is the list:

Mauve arborescente (*Lavatera Olbia*).
Erable napolitain (*Acer opulifolium*).
Margoutier, lilas des Indes (*Melia azedarach*).
Citronier (*Citrus medica*).
Oranger (*Citrus aurantium*).
Vigne commune (*Vitis vinifera*).
Houx commun (*Ilex aquifolium*).
Nerprun alaterne (*Rhamnus alaternus*).
Nerprun des Alpes (*Rhamnus Alpina*).
Jujubier commun (*Zizyphus vulgaris*).
Jujubier lotus (*Zizyphus lotus*).
Pistachier térébinthe (*Pistacia Terebinthus*).
Pistachier de l'Atlas (*Pistacia atlantica*).
Pistachier lentisque (*Pistacia Lentiscus*).
Sumac des corroyeurs (*Rhus coriaria*).
Sumac à cinq feuilles (*Rhus pentaphylla*).
Faux poivrier (*Schinus molle*).
Anagyre fétide (*Anagyris fœtida*).
Baguenaudier arborescent (*Coluteà arborescens*).
Colycotome épineux (*Colycotome spinea*).
Spartier d'Espagne (*Spartium junceum*).
Caroubier commun (*Ceratonia siliqua*).
Amandier commun (*Amygdalus communis*).
Cerisier merisier (*Cerasus avium*).
Prunier domestique (*Prunus domestica*).
Prunier sauvage (*Prunus insititia*).
Prunier épineux (*Prunus spinosa*).
Abricotier commun (*Armeniaca vulgaris*).
Coignassier commun (*Cydonia vulgaris*).
Poirier commun (*Pyrus communis*).
Poirier longipède (*Pyrus longipes*).
Aubépine monogyne (*Cratægus monogyna*).
Aubépine épineuse (*Cratægus oxycantha*).

Aubépine azérolier (*Cratægus azarolus*).
Amelanchier commun (*Amelanchus vulgaris*).
Alisier blanc (*Sorbus aria*).
Alisier terminal (*Sorbus terminalis*).
Sorbier domestique (*Sorbus domestica*).
Grenadier commun (*Punica granatum*).
Tamarix de France (*Tamarix gallica*).
Tamarix d'Afrique (*Tamarix africana*).
Myrte commun (*Myrtus communis*).
Myrte à fruit blanc (*Myrtus communis*).
Lierre grimpant (*Hedera helix*).
Viorne flexible (*Viburnum lantana*).
Viorne tin (*Viburnum tinus*).
Sureau noir (*Sambucus nigra*).
Chèvrefeuille en arbre (*Lonicera arborea*).
Arbousier commun (*Arbutus unedo*).
Bruyère en arbre (*Erica arborea*).
Bruyère multiflore (*Erica multiflora*).
Frêne austral (*Fraxinus excelsior*).
Frêne à feuilles étroites (*Fraxinus angustifolia*).
Frêne dimorphe (*Fraxinus dimorpha*).
Olivier d'Europe (*Olea Europea*).
Genévrier oxycèdre (*Juniperus oxycedrus*).
Philaria dressé, Philaria à larges feuilles (*Phillyrea stricta*).
Jasmin arbrisseau (*Jasminum fruticans*).
Nérion (*Nerium oleander*)
Tabac glauque (*Nicotiana glauca*).
Romarin officinal (*Rosmarinus officinalis*).
Gatilier agneau chaste (*Vitex agnus castus*).
Laurier commun (*Laurus nobilis*).
Osyris quadrangulaire (*Osyris alba*).
Ricin commun (*Ricinus communis*).
Buis commun (*Buxus sempervirens*).
Figuier commun (*Ficus carica*).
Murier blanc (*Morus alba*).
Micocoulier de Provence (*Celtis Australis*).
Orme champêtre (*Ulmus campestris*).
Noyer commun (*Juglans regia*).
Châtaignier commun (*Castanea vesca*).
Chêne zéen (*Quercus Mirbeckii*).
Chêne commun à larges feuilles (*Quercus sessiliflora* : var., *platyphylla*).
Chêne faux cerris, faux chevelu (*Quercus pseudo-cerris*).
Chêne faux liége (*Quercus pseudo-suber*)
Chêne yeuse (*Quercus Ilex*).
Chêne à gland doux (*Quercus Ballota*).
Chêne liége (*Quercus Suber*).
Chêne-liége avec écorce de reproduction (liége femelle), from one to fifteen years.
Chêne kermès (*Quercus coccifera*).
Chêne faux kermès (*Quercus pseudo coccifera*).
Plantane d'Orient (*Plantanus orientalis*).
Saule pourpre (*Salix purpurea*).
Saule helice (*Salix helix*).
Saule pédicellé (*Salix pedicillata*).
Saule fragile (*Salix fragilis*).
Saule blanc (*Salix alba*).
Peuplier blanc (*Populus alba*).
Peuplier noir (*Populus nigra*).
Aune glutineux (*Alnus glutinosa*).
Ephedra de Barberie (*Ephedra altissima*).
Ephedra fragile (*Ephedra fragilis*).
If commun (*Taxus baccata*).
Philaria intermédiaire (*Phillyrea media*).
Genévrier de Phénicie (*Juniperus phœnicea*).
Genévrier thurifère (*Juniperus thurifera*).
Thuya articulé (*Callitris quadrivalvis*).
Cypres pyramidal (*Cupressus sempervirens*).
Sapin pinsapo (*Abies pinsapo*).
Cèdre de l'Atlas (*Cedrus Atlantica*).
Pin d'Alep (*Pinus halepensis*).
Pin pinier (*Pinus pinea*).
Pin maritime (*Pinus maritima*).

Besides these, M. Lambert's collection comprises fifteen specimens of cork, seventy-five specimens of charcoal, each prepared from a different species of wood ; and in addition a herbarium containing 215 specimens of the flora of the Algerian forests.

An excellent but small collection of building woods is shown by M. Leturc of Lambessa (Constantine). M. Lichtlin, Chef du Service des Forêts à Constantine, besides showing a most admirable series of prepared corks for various purposes, and several remarkable samples of cork of fine quality and extraordinary thickness, also shows the following sixty-seven specimens of the woods of Constantine, with French and scientific names :—

Azêrolier (*Cratægus azarolus*, Linnée).
Amandier (*Amygdalus communis*).
Alizier à feuilles d'érable (*Sorbus acerifolius*).
Alizier commun (*Sorbus communis*).
Aubépine (*Mespilus oxyacantha*, Jacq.)
Arbousier (*Arbutus unedo*).
Aune commun (*Alnus glutinosa*, Gærtn.).
Blanc de Hollande, ou Tremble (*Populus tremula*).
Bourdoine
Bruyère étalée (*Erica multiflora*, Lin.)
Bruyère arborescente (*Erica arborea*, Lin.).
Buis (*Buxus sempervirens*, Lin.).
Caroubier (*Ceratonia siliqua*).
Chataignier (*Fagus castanea*).
Chêne à feuilles de chataignier (*Quercus castaneæfolia*).
Chêne-liege, reproduction de 1 à 10 ans (*Quercus suber*), 10 échantillons.
Chêne-liege de 13 ans, 1 échantillon.
Chêne-liege mâle, avec l'écorce, 1 échantillon.
Chêne à glands doux (*Quercus ballota*, Desf.).
Chêne vert (*Quercus Ilex*).
Chêne zéen (*Quercus Mirbeckii*).
Citronnier (*Citrus medica*).
Cyprès (*Cupressus disticha*).
Cytise.
Cèdre (*Pinus cædrus*, Lin.).
Erable champêtre (*Acer campestre*).
Erable napolitain (*Acer napolitanum*, Ter.).
Figuier (*Ficus carica*, Lin.).
Frêne de l'Aurès, petites feuilles.
Frêne des marais.
Frêne éléve (*Fraxinus excelsior*, Lin.).
Genêt commun.
Genêt d'Espagne.
Grenadier (*Punica granatum*).
Genévrier commun.
Genévrier cédrille.
Genévrier de Phénicie (*Juniperus phœnicea*, Lin.).
Houx commun (*Ilex aquifolium*, Lin.)
Jujubier (*Ziziphus vulgaris*, Lam.).
Lentisque.
Lierre (*Hedera helix*, Lin.).
Laurier-rose (*Nerium oleander*, Lin.).
Laurier-sauce (*Laurus nobilis*, Lin.).
Myrte (*Myrtus communis*).
Micocoulier (*Celtis australis*, Lin.).
Mérisier (*Prunus avium*, Lin.).
Nerprun alaterne (*Rhamnus alaternus*, Lin.).
Noyer commun (*Juglans regia*, Lin.).
Ormeau.
Orme.
Oranger (*Citrus aurantium*).
Olivier (*Olea europea*).
Pin pignon (*Pinus pinea*).
Pin d'Alep (*Pinus halepensis*, Mill.).
Peuplier grisard (*Populus canescens*, Smith).
Peuplier noir (*Populus nigra*, Lin.).
Peuplier blanc (*Populus alba*, Lin.).
Prunellier, supposé chêne.
Platane d'Occident (*Planus occidentalis*, Lin.).
Pistachier de l'Atlas (*Pistacia atlantica*, Desf.).
Phyllirea (*Phyllirea latifolia*, Lin.).
Saule marsaula.
Sumac des corroyeurs (*Rhus coriaria*, Lin.).
Sureau.
Tamarix africain (*Tamarix Africana*, Poiret).
Viorne tin (*Viburnum tinus*, Lin.).
Vigne sauvage (*Vitis vinifera*, Lin.)

Excellent cork, and manufactured cork, are also exhibited by Portes, Jun., of Algiers, and Lucy and Falcon, of Jemappes (Constantine), and very valuable and instructive collections of timber wood are displayed by the Service des Forêts de la Province d'Alger ; the Service des Forets de la Province d'Oran ; and the Société L'Union Agricole d'Afrique ; in the last each specimen is marked with the age of the tree from which it is taken.

From MARTINIQUE has been sent an interesting collection of the woods of the colony, the majority of which are exhibited by M. Bélanger ; they are :—

Acajou femelle (*Cedrela odorata*).
Angelin (*Andira inermis*).
Abricotier des Antilles (*Mammea americana*).
Acomat (*Homalium racemosum*).
Amandier du pays (*Terminalia catappa*).
Bois de lézard (*Vitex divaricata*).
Bois de rivière (*Cymarrhis cymosa*).
Bois d'Inde (*Mircia acris*).

Bois tan (*Malpighia spicata*).
Bois de Cypre (*Cordia gerascanthus*).
Bitterash (*Bittera febrifuga*).
Ciroyer (*Rheedia laterifolia*).
Châtaignier coco (*Sloanea*).
Condori ou œil de paon (*Adenanthera pavonina*).
Campèche (*Hæmatoxylon campechianum*).
Catalpa (*Hibiscus populneus*).
Filao placage (*Casuarina equisetifolia*)
Franchipanier (*Plumiera rubra*).
Genipayer (*Genipa americana*).
Galba (*Galophyllum calaba*).
Haïti jaune.
Laurier rose des Antilles (*Podocarpus sp.*).
Mancenillier (*Hippomane mancinella*).
Mille-branches.
Manguier à grappes (*Holigarnia*).
Muscadier à suif (*Myristica laurifolia*).
Noyau (*Prunus spherocarpa*).
Noyer (*Fagara tragodes*).
Palétuvier (*Bruguiera gymnorhiza*).
Poix doux (*Inga dulcis*).
Pelé.
Quinquina de montagne (*Exostemma floribunda*).
Savonnette (*Sapindus saponaria*).
Tendre à caillou (*Acacia Sederoxylon*).

The woods of GUADELOUPE are of considerable importance, and an excellent collection is displayed by M. Charles Ledentu, viz. :—

Acajou à meubles (*Swietenia mahogoni*).
Acajou femelle (*Cedrela odorata*).
Abricotier des Antilles (*Mammea americana*).
Amourette des Antilles.
Acouma (*Homalium racemosum*).
Avocatièr (*Laurus persea*).
Acacia scandens.
Bois chandelle (*Amyris toxifera*).
Bois amer de Saint-Martin (*Bittera febrifuga*).
Bois jaune (*Hopea tinctoria*).
Bois de fer (*Acacia sederoxylon*).
Bois de vinette.
Bursera balsamifera.
Bois graines vertes.
Bois de cracra.
Bonia daphnoïdes.
Campèche (*Hæmatoxylon campèchianum*).
Carapa (*Carapa guianensis*).
Cordia gerascanthus.
Cafeier (*Coffea arabica*).
Clusa venosa.
Comocladia.
Galba (*Calophyllum Calaba*).
Ebène vert-brun (*Excœcaria sp.*).
Epineux jaune (*Zanthoxylon caribœum*).
Epineux blanc(*Zanthoxylon caribœum*).
Guarea trichilioïdes.
Laurier rose des Antilles (*Podocarpus sp.*).
Laurier rose montagne.
Liége des Antilles (*Hibiscus tiliaceus*).
Merisier du pays (*Eugenia barnensis*).
Mancenillier (*Hippomane mancinella*).
Moronobea coccinea.
Noyer des Antilles (*Fagara tragodes*).
Oranger (*Citrus aurantium*).
Petites feuilles (*Eugenia brasiliensis*).
Quinquina piton (*Exostemma floribundum*).
Quinquina caraïbe (*Exostemma caribœum*).
Sapotillier (*Achras sapota*).
Vitex divaricata.

The logwood is of excellent quality and is said to be very abundant in the vicinity of Marie-Galante.

The collection of the woods of FRENCH GUIANA is large, as might be expected from a colony so rich in forest vegetation ; the specimens are the joint contribution of the Local Committee for the Colony, the Direction des Pénitentiares, Colonel Charrière, and M. Riolet Jeune of Paris.

The principal specimens are :—

Angélique (*Dicorynea paraensis*). For ship-building ; is not attacked by the teredo ; abundant.

Acajou femelle (*Cedrela guianensis*). For inside work, lining furniture, &c.

Bagot. For carpentry and cabinet work.

Bois cannelle. For ship-building; very abundant.

Bois balle. Building, carpentry, and carriage building.

Bois gaulette (*Licania sp.?*). For wheelwrights' work; it is easily split.

Bois flambeau. For joinery and cabinet work.

Balata (*Sapota Mulleri*, or *Mimusops*, *sp.?*) Useful for most building purposes; it is free from the attack of white ants, and the tree yields a kind of gutta-percha.

Balata indien, Balata franc., Balata montagne, and Balata saignant.

Bois la morue. Building, carpentry, and wheelwrights' work.

Bois de rose mâle (*Licaria sp.?*). Admirable for building purposes, and free from insect or worm ravages.

Bois de rose femelle. Good for building.

Bois macaque (*Lecythis sapucaia*). Building and wheelwrights' work.

Bourgouny (*Mimosa bourgouni*).

Bois rouge tisane (*Houmiria sp.?*). Good for building.

Bagasse (*Bagassa guianensis*). Excellent for ship-building; large and very straight.

Bois puant. Building and carpenters' and wheel wrights' work.

Bois violet (*Copaifera bracteata*). For cabinet work; very handsome timber, large and sound.

Bois Lemoine. Building, joinery, &c.

Boco (*Bocoa prouacensis*). For block-making; very large and very abundant.

Bois pagayes. Joinery and carriage building.

Bois de lettre moucheté (*Piratinera guianensis*). Very beautiful cabinet wood.

Bois de lettre grandes feuilles. Good for carpentry, &c.

Bois de lettre marbé. Good for cabinet work.

Bois Mary. Building and joinery.

Bois de lettre rouge. Much prized by the Indians for bows.

Bois divin. Building and joinery.

Carapa rouge (*Xylocarpus carapa*). For lattice work and laths; it splits easily.

Cèdre noir (*Laurus surinamensis*). Large for ship planking.

Cèdre jaune (*Aniba guianensis*). Ship-building.

Cèdre blanc. Joiners' work.

Cèdre bagasse (*Icica altissima*). Used by the natives for carving idols.

Coupi (*Acioa dulcis*). Excellent for ship-building, &c.

Cœur dehors (*Diplotropis guianensis*). Excellent for carriage-building.

Cœur dehors blanc. Ditto ditto.

Courbaril (*Hymœnia Courbaril*). Ship building.

Coupaya. Building.

Couaie (*Qualea cœrulea* var.) Excellent for masts for ships.

Cerisier (*Eugenia sp.*) Joiners' work.

Couratarie (*Couratari guianensis*). For piles, &c., in marine construction.

Ebène verte, verte grise, verte noire (*Varieties of Nectandra Rodiæi*). Excellent for ship-building, piles, railway sleepers, &c. ; it is free from the attacks of ants or teredo.

Ebène rouge. Joinery and cabinet work.

Ebène verte soufrée.

Grignon (*Bucida buceras*). Ship-building ; very durable.

Grignon fou (*Qualea cœrulea*). Lining furniture, &c.

Gayac de Cayenne (*Dipterix odorata*). Good for blockmaking.

Jaune d'œuf. Good for carpentry.

Maria congo.

Mahot blanc. Carpentry. Mahot rouge. Mahot couratari. Mahot de marécage.

Mahot noir.

Mincouart (*Minquartia guianensis*). Carpentry and joinery.

Mora.

Moutouchi (*Pterocarpus suber*). For cabinet work.

Nangossy (*Terminalia tanibouea*). Yields good knees for ships.

Panacoco (*Robinia panacoco rubra*). Cabinet work.

Préfontaine. Building ; not common.

Petite-feulle.

Parcouri. Ship-building and cabinet work.

Palétuvier rouge (*Rhizophora mangle*). Ship-building ; the bark for turning.

Palétuvier blanc (*Avicennia nitida*). For various small works.

Schawari (*Caryota tomentosa*). Ship-building, carpentry, &c.

Simarouba. Building.

Sassafras (*Licaria guianensis*). Ship-building.

Saint-Martin. Cabinet work.

Satiné (*Ferolia guianensis*). Cabinet work ; plentiful.

Satiné rouge (*Ferolia guianensis*). Ditto ditto.

Taoub. Ships' planks.

Wapa huileux (*Eperua falcata*). Palings, laths, &c. ; splits easily.

Wacapou (*Wacapoua Americana*). Ship-building ; free from insect ravages.

Yayamadou de Montagne (*Virola sebifera*). Building.

A few woods have been sent by the French colonies on the West Coast of Africa ; they are exhibited by the Local Committees for Gabon and Sénégal, and M. Masurier.

The following are the principal :—

Caïlcedra (*Khaya Senegalensis*).
Detarr (*Detarium Senegalense*).
Gonakie (*Acacia adansonii*).
N'dimb (*Sterculia cordifolia*).
Solum (*Dialium nitidum*).
Vène (*Pterocarpus erinaceus*).
Bois jaune.
Ebène (*Diospyros ebenum*).
Evino.
Garigari (*Avicennia sp. ?*)
Intowo.
Kata.
Ilonda.
Mandji.
Ocoumé.
Ojoli.
Oyamba.
Santal (*Pterocarpus*).
Teck du pays.

An excellent and interesting collection made by Messrs. A. Thibault, J. Godefroy, J. de Cordemoy, P. de Rosemont, Ferrand, J. Fery, H. Dierx, R. de Chazallon, J. B. Hubert-Delisle, of Reunion, is exhibited from that colony ; it consists of :—

Bananier à petites feuillès, *Cascaria fragilis.*
Bassin noir é, *Blackwillia paniculata.*
Benjoin faux, *Terminalia mauritiana.*
Bois noir, *Acacia lebbeck.*
Bois noir de l'Inde, *Adenanthera pavonina.*
Bois de l'Inde, *Murraya exotica.*
Bois blanc, *Hernandia ovigera.*
Camphrier, *Laurus camphora.*
Cannellier marron, *Laurus cupularis.*
Change écorce, *Ludia heterophylla.*
Ebène mélanide, *Diospyros melanida.*
Fer, *Sideroxylon bordonicum.*
Flamboyant, *Poinciana regia.*
Filao, *Casuarina laterifolia.*
Gaulette, *Cupania alternifolia.*
Goyavier sauvage, *Brockia theïformis.*
Judas, *Cossinia borbonica,*
Jacquier, *Artocarpus integrifolia.*
Jaune à grandes feuilles, *Ochrosia borbonica.*
Jam long, *Sixygium jambolanum.*
Lilas Melia azedarach.
Losteau rouge, *Antirrhœa verticillata.*
Millepertuis.
Nèfle, *Jossinia borbonica.*
Natte à petites feuilles, *Imbricaria petiolaris.*
Natte à grandes feuilles, *Imbricaria maxima.*
Olivier blanc, *Olea lancea.*
Olivier noir, *Olea cernua.*
Puant, *Fœtidia mauritiana.*
Patte de poule femelle, *Toddalia paniculata.*
Perroquet, *Fissilia psittacorum.*
Tamarin des hauts, *Acacia heterophylla.*
Tan rouge, *Weinmannia macrostachya,*
Tacamahaca, *Calophyllum spurium.*

The colony of MAYOTTE and NOSSI-BE also sends a collection of woods, but so deficient in real information is the description accompanying the specimens that the list would be useless.

From the FRENCH INDIES a very carefully named series of the native woods is sent by M. Perrotet, of which the following is the list :—

Acacia leucophlea.
Acacia sundras.
Acacia speciosa.
Acacia odoratissima.
Anacardium occidentale ; (*acajou à fruits*).
Anogeissus parvifolius.
Anogeissus latifolius.
Areca catechu.
Artocarpus integrifolia (*jacquier*).
Azadirachta indica.
Bdansonia digitata.
Bassia longifolia.
Bauhinia purpurea.
Bauhinia parvifolia.
Berrya ammonilla
Bombax malabaricum.
Cutea frondosa.
Celtis orientalis.
Chickrassia taburalis.
Cupania canescens (Molinœa canescens).
Cochlospermum gossypium.
Cordia polygama.
Cassia fastigiata.
Casuarina muricata.
Cerbera thevetia.
Cicca emblica.
Clerodendrum phlomoides.
Dalbergia sissoo (*bith.*)
Diospyros sylvatica.
Diospyros ebenaster.
Ficus indica.
Ficus religiosa.
Feroni aelephantum.
Guazuma tomentosa.
Inga dulcis (*poix doux*).
Lagerstrœmia regina.
Morinda macrophylla.
Morinda augustifolia.
Mangifera indica.
Mimosa tomentosa.
Nephelium longan (*longaster*).
Pongamia glabra.
Pterospermum suberifolium.
Pentaptera coriacea.
Pterospermum lanciæfolium.
Pterocarpus marsupium.

Parkia biglandulosa.
Pavetta alba.
Salvadora persica.
Sapindus emarginata.
Spathodea.
Spathodea chelonoides.
Spathodea crispa.
Spondias mangifera.
Syzygium jambolanum.
Sterculia fætida.
Tectona grandis.
Tamarindus indica.
Terminalia bellerica.
Terminalia catappa.
Thespesia populnea.
Ulmus integrifolia.
Uvaira longifolia.
Vitex trifolia.

From Cochin China Vice-Admiral Charner has sent a few specimens; they are only five in number, viz. :—

Ebony (*Diospyros melanida*); Musk Sandal wood (*Santalum sp.*); Red Sandal wood; Sappan wood; Aloe wood (*Aquilaria agallochia*).

We close this list of the French colonial woods with those of New Caledonia, which are by no means the least interesting. They have been collected and named most carefully by M. Pancher, botanist to the Government.

Lumnitzera racemosa.
Malaleuca viridiflora.
Morinda citrifolia.
Olivier du pays.
Cupania paniculata.
Acacia laurifolia.
Salisia rubra.
Acronichia ligustroides.
Codia.
Catha ? viridiflora ?
Syzygium venosum ?
Arillastrum stellatum.
Belaghia drupacea.
Doga macrogemma.
Blackburnia pinnata.
Myrtus coriaceus.
Phyllanthus baccatus ?
Cupania ? uniglandulosa ?
Berchremia ? crenulata ?
Pleurostylis ? decipiens ?
Ternstœmiacée ?
Hartighsea Billardieri.
Eugenia littoralis.
Acacia myriadena.
Xylocarpus obovatus.
Eugenia arborea.
Maba à feuilles lisses.
Intsia Testardii.
Bruguiera.
Elœodendron.
Terminalia littoralis.
Casuarina nodiflora.
Daoxylon ? undulatum.
Chrysophillum.
Acacia spirorbis.
Ardisiacée.
Ebénacée laiteuse.
Avicennia.
Apocynée moyenne.
Cordia sebestana.
Salisia rugosa.
Elœocarpus.
Ochrosia.
Sanda odorant (Santalum austra-caledonicum).
Ardisiacée ?
Verbenacée ligneuse.
Cupania juliflora.
Acacia granulosa.
Ximenia elliptica.
Rhizophora mucronata.
Catha ? ungulata ?
Bruguiera gymnorhiza.
Dodonea dioica.
Maba a feuilles velules
Evodia triphylla.
Tricocée.
Milnea.
Acmena floribunda.
Araucaria intermedia.
Araucaria cookii.
Ormocarpum sennoides.
Pomaderris.
Pin de la Nouvelle-Caledonie.
Croton collinum ?
Pittosporum.
Apocynée.
Figuier glaucescent.
Geissois racemosa.
Guttifère.
Heritiera ferruginea.
Coffea triflora.
Hunga rhamnoides ?
Ilex mucronulata.

ITALY.—From Italy we have a great number of collections representing the various kinds of timber woods grown in the different districts of that country; generally speaking, they are carefully prepared and named. One of the most interesting is that shown by Professor Giocomo Arnaudon of Turin, which is especially remarkable for an exceedingly ingenious way of showing, by the size of the specimen, its specific gravity. Each is made to weigh 200 grammes, and the specific gravity is indicated inversely by its length, a method of exhibiting this important character which would become very valuable if generally adopted in museums.

The other principal collections are those sent by the Count Pietro Beltrami, of Cagliari, which are accompanied with a series of charcoals prepared from some of them, and excellent cork cultivated on his estate; by Professor Filippo Calandrini, of Florence, consisting of 185 specimens of the native and acclimatized woods of Tuscany; by Niccolo Cherici, of Borgo San Sepolcro;* by Cavalier Niccolo Maffei, of Volterra; by the Majorana Brothers, from Catania; by the Ravenna Sub-Committee for the Exhibition, which, in addition to the specimens of woods grown in the district, is further illustrated by an interesting series of the products of the common Italian pine (*Pinus pinea*), consisting of the cones, the nuts, the seeds, cakes made of the seeds, resin frum the tree, &c.; by the Administration of the Forests of Sondrio, an excellent collection of large and characteristic specimens of the timber woods of the Valtellinar accompanied by a diagram in which the history of the trees and their chief economic characteristics are cleverly shown; by the Reggio Agricultural Association, an exceedingly interesting collection, classified according to the uses of the woods, thus:—

For building and naval architecture.—Several species of oak.

For building and domestic utensils.—Chesnut, elm, hazel, pine, &c.

For coopers' work, domestic utensils, and oars.—Beech and poplar.

For furniture, utensils, and turning.—Cherry, box, and service tree.

For cooperage and domestic utensils.—Willow, juniper, mulberry, and chestnut.

Excellent elm, beech, and hazel hoops, oak bark, staves, &c., accompany this collection, still further illustrating the economic products of the forests of Reggio; and by the Agricultural Academy of Pesaro, which, in addition to the woods of its district, exhibits other economic products gathered from the forests, especially excellent tinder (Amadou). The Italians also exhibit exceedingly beautiful preparations of willow plait and the prepared willow. That sent by Tito Benzi, of Carpi, by the Modena Sub-Committee for the Exhibition, and by Michele Finzi, of Carpi, are very fine, especially the first. Carpi in Modena is the head-

* This is a small collection, but the very admirable manner in which the specimens are prepared for exhibition, as well as the excellence of the materials, were highly commended by the jury. They are those of the common oak (*Quercus rubra*), the Adriatic oak (*Quercus serris*), chestnut (*Castanea vesca*), walnut (*Juglans regia*), and cypress (*Cupressus fastigiata*).

quarters of this manufacture, which is an important export, especially to England. It is a matter of regret that the samples sent are so exceedingly small.

In a small collection of the wood of exotic trees acclimatized in the vicinity of Cagliari is one remarkable specimen of the wood of *Medicago arborea*, resembling a block of Cocus wood, five inches in diameter. Walnut wood veneers, cut by circular saw, very thin and of fine quality, are sent by Gaspare Pasquini, of Florence.

The more artistic productions of wood which come under this section were not numerous, but were of very superior quality. The carvings of P. Giusti, of Sienna, and of Luigi Frullini, of Florence, are exceedingly beautiful and in the best style of art. Beautiful marquetry and Sorrento-work is exhibited by Michele Grandville, of Sorrento, and exquisite inlaying with woods, &c., by Frederico Lancetti, of Perugia.

The inlaid work (marquetry) made of Italian woods by Luigi Gargiulo, of Sorrento, and the carved cornices, brackets, and picture and looking-glass frames, shown by Emilio Franceschi, of Florence, are very fine specimens of art in wood work.

ON THE CASCARILLA, AND OTHER SPECIES OF CROTON, OF THE BAHAMA AND WEST INDIA ISLANDS.

BY WILLIAM F. DANIELL, M.D., F.L.S.

Although much of the confusion which formerly prevailed, respecting the sources of the Cascarilla barks of the West Indies, have been dissipated by the researches of Woodville, Lindley, and other pharmaceutical authorities, nevertheless, considerable doubt existed with reference to the species of Croton, that originally supplied the markets of Europe, and to which the term Cascarilla was first applicable. That the plant yielding the article of commerce, during the last century was also unknown, is evident from the discrepancy of opinion, that pervades the statements of comparatively recent writers. This obscurity, never entirely dispelled, has continued up to the present date. Some apparent inconsistencies in their descriptive account, requiring elucidation, I was induced during a tour of service in the Bahama islands in 1857-8, to make inquiries into the general history of the medicinal Crotons indigenous to the group ; the results of which were placed in the hands of my friend Mr. Bennett, and published by him in the Journal of the proceedings of the Linnean Society. From his careful revision of their botanical characters, intricate synonyms, and other specific details, I have been enabled to rectify many important inaccuracies, perpetuated in the works of Materia Medica.

Any attempt to trace the aboriginal uses of the Cascarilla barks, can only terminate in disappointment, owing to the rapid extinction of the Carib races, that from an early epoch populated these and other islands of the West Indian archipelago. These primitive inhabitants, according to report, were fully cognisant of their remedial and other economic properties, which they rendered subservient to the treatment of diseases, and other necessary purposes. If we may credit local traditions, the native priests or doctors, resorted to the dried plants for fumigations and in religious ceremonies ; and while the fresh leaves were infused in their medicinal baths, the cortical portions were more exclusively reserved for internal administration. The dried bark also was reduced to a powder, and mixed with their tobacco previous to smoking. The inhalation of this mixture was reputed to act as a powerful stimulant, and to induce effects analogous to those of intoxication.*

The European colonists who first settled in the Bahamas apparently obtained a partial knowledge of these appliances, in the course of time from the natives, and hence their practical value has been derived, and handed down to the present period. The famous Buccaneers who infested the secret Cayes, or islets of the Bahamas, and inspired such terror by their piratical excursions in former centuries, appear to have held these products in high esteem. Selecting the fresh cortex, they infused it either in wine, or ardent spirits, and this constituted not only an agreeable bitter, but a prophylactic agent, for the preservation of health. Dried in the sun, and subsequently pounded into small fragments, it was smoked mixed with tobacco : and this method of employment, independently of the agreeable flavour inhaled, was equally considered to be an antidote against the attacks of febrile, and other local maladies. The system of conjoining these barks with tobacco, partly introduced into England and other countries of Europe towards the close of the seventeenth century, may be traced to these seafaring usages, which, again, were adopted from those of the Carib tribes. For the information which led to their appropriation, as one of the chief ingredients in the composition of incense, and other fumigating compounds, we are indebted to the labours of the early Spanish missionaries, who during their sojourn among the West India islands, gained a practical illustration of this aboriginal mode of employment.

I. Sweetwood Bark, or Bahama Cascarilla.

(*Croton Eluteria*, Benn.)

Elutheria Providentiæ, folio cordato subtus argenteo. Sweet Bark, s. cortex bene olens, *Petiver Collect*, 4 *u.* 276.

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* The conjunction of other substances in the smoking of tobacco, with the view of modifying or improving its flavour, appears also to prevail among several of the Indian tribes of North America. During the late overland transit of the troops through Canada, powdered Willow-bark, an article much used for this object, by the Indians, was freely offered for sale, and it is stated that on trial, a peculiar taste and odour was imparted to the smoke.

Eluteria, *Linn. Hort. Cliffort.*, p. 486.

Clutia Eluteria, *Linn. Spec. Plant*, ed. I. *p*, 1042 (*excl. synon. omn præter Hort. Cliff.*)

Clutia Eluteria, s. Cascarilla, *Woodville*, *Med. Botany*, *ed.* 1, *vol.* iv., *sup. fig.* 2 (1794.)

Clutia Eluteria, s. Cascarilla Clutia, *Woodville*, *Med. Bot. ed.* 3, *p.* 633, *pl.* 223, *fig.* 2.

Croton Eluteria, *Benn. Journ. Proceed Linn. Soc.*, vol. iv. p. 29.

From this plant the ordinary Cascarilla bark of commerce is procured. The species is tolerably abundant in the Bahamas, especially in the larger islands of Andros, Long, and Elutheria, from the latter of which its appellation has been derived, owing to the great supply it formerly yielded. In New Providence, it flourishes only to a very limited extent, having become nearly extinct from previous demands. A number of small shrubs and young trees may yet be found, within the track of brushwood to the rear of Fort Chariotte, adjoining the town of Nassau, and a few isolated bushes in other districts of the isle.

Except a few local traditions referring to the use of the cortex for smoking, or fumigating purposes, in the religious or state ceremonies of the ancient Caribs, the data requisite to determine the various native preparations of this plant, are lost in obscurity. The custom of smoking the powdered bark conjoined with tobacco, in vogue with the earlier European colonists in these and the Caribbean islands, either to disguise the flavour of the herb, or as a prophylactic agent to avert attacks of sickness, may evidently be ascribed to their primitive usages. It is somewhat remarkable that Catesby, who visited the Bahama islands about 1722, should include a specimen of this shrub in his collection without name or other explanatory remarks, a fact that would lead to the inference this product had not at that period acquired sufficient importance to constitute an article of export. Moreover, the mere descriptive outline of "*Elutheria Providentiæ folio cordato, subtus argenteo*, with the sole annotation of *Sweet bark, s. cortex bene olens*," in Petiver's collection of plants, will tend to confirm the opinion, that the bark had not been brought into popular request, otherwise such a special event would have been recorded.

Linnæus first briefly, but incompletely, described this species under the true synonym of *Cortex Ilitheria*, in the 'Hortus Cliffortianus' of the British Museum: but subsequently forgetting this detailed fragment, and quoting a series of discordant synonyms in his works, contributed greatly to complicate the identification of later specimens. In the first edition of his 'Species Plantarum,' under the name of *Clutia Eluteria*, he correctly refers to the *Eluteria* of the 'Hortus Cliffortianus,' but in the following editions improperly inserts other Crotons, obviously distinct. Linnæus also classed several of these species by the generic title of *Clutiai*; later botanists have however defined them to be true Crotons in the most comprehensive sense of the term. To Woodville, although he

indiscriminately confounded the Jamaica (*C. Sloanei.* Benn.) and Bahama (*C. Eluteria*, Benn.) plants together, under the general designation of *Clutia Eluteria's Cascarilla*, may be attributed the merit of having pointed out the plant producing the Cascarilla bark of modern commerce, at the same time truly stating the locality from whence it was imported. The difference and contemptible character of the specimens he figured in illustration, indicated such apparent inconsistencies as to induce Pereira and other authorities to doubt whether he had clearly established the source of the drug in common use. Lindley finally decided the question, by obtaining from New Providence authentic specimens of this species of Croton, fully confirming the accuracy of Woodville relative to its local origin. The shrub is stated to have been introduced into England by P. Miller, but not being a showy plant, it probably became neglected, and was ultimately suffered to decay, as no traces of its existence could subsequently be discovered.

Under the aspect of a young tree, this species may sometimes be noticed, with a stem from 4 to 8 inches in diameter; the usual growth however is that of a small, compact-branched, scanty-leaved shrub, from 3-5 feet in height. The inferior portion of the stem is devoid of branches, erect, marked at irregular intervals by epidermoid greyish, or white rugous stains, and covered by a variety of parasitical lichens. The leaves are petiolate, at the base varying from slightly cordate to acute, obtusely acuminate, or frequently abruptly acuminate, as if the apex had been cut off, pale or greyish green, sparingly clothed with peltate scales above; beneath, densely clothed with shining and silvery scales, which in the distance present a white colour. They alter in size, in proportion to age; for it is a singular fact the younger the plants the greater are their dimensions. They average from 2-3 inches in length, and 1-1½ inches in breadth. In the arborescent form they become more narrow and elongated, lose their cordate base and are considerably reduced in dimensions, being only ½-1 inch long, and from ¼-½ inch wide. As the plant gains in growth the leaves fall from the lower branches, and are permanently collated at the summits of the younger branchlets. The inflorescence consists of numerous small, closely set white petiolate flowers, male and female, attached to a simple spike, either terminal or axillary. They appear in March and April, and then diffuse around a most exquisite perfume. In the arborescent shrub, the spike is, however uniformly terminal. The fruit, a small, roundish oblong, smooth, lobated capsule, is about the size of a pea, of a greyish or silvery hue. It is divided into three cells, each containing a small dark brown, oblong, shining seed, convex externally, with flattened sides, converging to a ridge, and about 2-2½ lines in length. The pericarp is covered with numerous silvery peltate scales, somewhat resembling those on the leaves. These capsules attain maturity in May and June. The cortical layers change from a pale, to dull red, according to age or dimensions of the plant.

In the late and previous editions of Pereira's 'Materia Medica,' this species has been denominated the sea-side Balsam, a name by which the *C. basami-ferum*, Linn., is recognised in the West Indian and Bahama islands. This title was conferred by Browne on a plant he considered to be identical with the *Croton Eluteria* of Swartz. The latter botanist however had apparently his doubts whether it was the same product, as he has not adduced it as a synonym in his descriptive account. From the circumstance of a thick balsamic liquor exuding from the younger branches, whenever wounded or broken, with other structural peculiarities, it is probable that the Crotons of Browne and Linnæus may be nearly allied, if indeed they are not synonymous. The *Croton Sloanei*, Benn. (*C Eluteria*, Swartz), however, clearly differs from both.

Woodville quotes a German author, who states that the bark comprised one of the principal exports of the Bahamas, and could be purchased at the low rate of 10s. 6d. per cwt. He may therefore be presumed to have visited these islands towards the end of the last century. During my residence in New Providence in 1857-8, the prices ranged from nine to twelve shillings per cwt. ; but at some periods, owing to the cessation of any demand, were almost nominal. The subjoined table, from official sources, will indicate the quantity exported from these islands from 1850-58, at the estimated value of 10*l.* 10s. per ton.

	Tons.	Cwt.		Tons.	Cwt.
1850	46	3	1855	16	1
1851	50	4	1856	16	2
1852	10	13	1857	68	8
1853	24	13	1858	21	14
1854	25	15			

The parts of the plant employed for remedial purposes by the inhabitants of the Bahamas, are chiefly the cortex and tender shoots, which are administered in the form of a decoction or infusion, in cases of dyspepsia, loss of appetite, and other visceral derangements occurring as the sequel of acute endemic diseases. The leaves are selected chiefly to medicate their warm baths. Doubtless from being viewed more in the light of a mercantile product, than as a medicinal agent, it has of recent years fallen somewhat into disrepute, and is less frequently resorted to in the treatment of these maladies. It would not come within the scope of this paper to enter into the comprehensive details connected with the appliances of this drug in Europe. I may, however remark, in addition to other uses, that I have found an infusion of the fresh bark, combined with ammonia or other stimulants, to prove of benefit in the latter stages of yellow fever, where, from the results of previous febrile excitement, the stomach has assumed an atonic or depraved condition, rendering it barely capable of exercising its ordinary functions.

II. The Jamaica, or Caribbean Cascarilla.

(*Croton Sloanei*, Benn.)

Mali folio arbor, artemiesæ odore et flore, *Sloane, Jamaica, vol.* ii. *p.* 30, *t.* 174, *fig.* 2.

Clutia Eluteria, *Linn. Amœnit. Academ. vol.* v. *p.* 411.

Croton fruticosum ; foliis subrotundo-ovatis, subtus subincanis alternis, spicillis alaribus ? *Browne, Hist. Jamaica, p.* 348.

Croton Eluteria, *Swartz, Flor. Ind. Oc. p.* 1183.

Croton Elutheria, *Wright, Lond. Med. Jour., vol.* viii. *p.* 3.

Cluytia Eluteria, *Woodville, Med. Botany,* 1 *ed. t.* 211, *f.* 1. *p.* 2.

Croton Eluteria, *Sw. Nees v. Esenbeck, Plantœ Medicinales, Band* 1.

Croton Eluteria, *Sw. Hayne, Getreue Darstellung und Beschreibung der in der Arzneykunde,* etc., *vol.* xiv. *t.* 1. *p.* 1.

Croton Eluteria, *Sw. Guibourt, Histoire Nat. des Drogues, ed.* 4. *vol.* ii. *p.* 340.

Croton Eluteria, *Sw. Pereira, El. Mat. Medica, ed.* 4, *vol.* ii. *part* 1, *p.* 412.

Croton Eluteria, *Wood & Bache, Dispensatory of United States, ed.* 11, *p.* 198.

Croton Sloanei, *Benn. Journ. Proceed. Linn. Soc. vol.* iv. *p.* 30.

This plant appears to be indigenous to Jamaica, and has not hitherto been discovered in any of the Bahama islands. It was introduced into notice by Dr. Wright, who not only confounded it with the *Clutia Eluteria* of Linnæus (*C. Eluteria*, Benn.), but also stated that it constituted the source from whence the Cascarilla bark of the shops was obtained. His remarks are as follow : " This tree is common near the sea-shore, and rises to about twenty feet. The leaves are from two to three inches long and of a proportional breadth. On the upper side they are waved and of a rusty colour, on the under, ribbed and of a fine glossy or silvery appearance. From the axillæ they have numerous small spikes, with a great quantity of white, small, and fragrant flowers. The capsule is tricoccous like other Crotons. The bark is the same as the Cascarilla and Elutheria of the shops." Pereira, however, proved the fallacy of several of these statements ; for on an examination of the customs' entries, he ascertained these imports were brought from the Bahamas, and that the two supposed distinct barks retailed in the shops were in fact identical, and procured from the same plant. He also observed that two circumstances threw great doubt over the validity of Dr. Wright's conclusions—viz., that it was very unlikely that Cascarilla and Eluteria barks should be vended as distinct substances, if they were identical, and that it was possible they might be, or were nearly allied, but their identity was impossible ; moreover, if Cascarilla was the produce of *C. Eluteria*, how was it that none of the bark was imported from Jamaica, where, as Dr. Wright stated, the tree was very common ? Nevertheless both this and the Bahama species (*C. Eluteria*, Benn.) were

considered to be synonymous, by botanical and pharmaceutical authors until the present time.

Sloane, in his work on Jamaica, was the first to notice this plant under the descriptive outline of "Mali folio arbor, artemisiæ odore et flore," a dried specimen of which, exists in the Linnæan herbarium of the British Museum, in a good state of preservation. In the fifth volume of 'Amœnitates Academica,' Linnæus, under the same designation of *Clutia Eluteria*, confused it with the Bahama Cascarilla (*C. Eluteria*, Benn.): Swartz, in his Flor. Indiæ Occidentalis,' described the tree with ovate acuminate leaves, silvery beneath, and composite axillary racemes, by the name of *Croton Eluteria*, under the impression it furnished the ordinary bark of commerce; and this mistake has subsequently been continued in most of the works of Materia Medica.

Woodville, in the several editions of his 'Medical Botany,' gives a bad delineation of both this and the Bahamian Cascarilla, evidently viewing them to be identical. Nees von Esenbeck, in his 'Plantæ Medicinales,' has also incorrectly stated this species to constitute the officinal Cascarilla bark. His figure has apparently been taken from the plant in the Herbarium of the British Museum. Hayne also, in his 'Arzneycunde,' adheres to the same mistake; and Pereira, in his elaborate work, labouring under the impression that Swartz's and the Bahama plants were identical, has also erroneously represented the former, with its connected descriptive details, as supplying the modern drug of the markets. Guibourt, in his 'Histoire des Drogues,' has also considered it to yield the same article.

This species, though commonly met with as a low bushy shrub, from four to six feet in height, often assumes an arborescent form, and attains an elevation of twenty feet or more. The trunk is more or less covered with a whitish wrinkled epidermis, as in the preceding plant. The leaves are petiolate, broadly ovate, blunt or with a blunt point, perforated with transparent dots, thinly sprinkled on the upper surface with peltate scales, beneath, more numerous, and of a whitish or silvery hue. A marked distinction may be observed in the character of the inflorescence compared with other species, the compound spikes, or rather racemes, being more frequently axillary than terminal, and densely clothed with small, subsessile, white, and fragrant flowers. The fruit consists of the usual tricoccous capsule, indicative of the genus, about the magnitude of a pea, each cell containing a small brown ovoid seed. The pericarp is minutely warted (Swartz), and studded with peltate scales. There are grounds for supposition that the employment of the cortex of this plant by the colonists of Jamaica for various medicinal uses, may have led Dr. Wright into the belief that it was identical with the Cascarilla bark of the shops, and the warm aromatic taste and agreeable flavour of all parts of the shrub would tend to confirm this opinion. Although it is stated to be applied to the cure of disease by the negro inhabitants of the island, I have not been able to obtain any detailed account of the mode of administration, or of the affections, for the treatment of which it is exhibited.

III. The Smooth-leaved, or False Bahama Cascarilla.

(*Croton lucidum*, Linn.)

Croton fruticosum, *Miller*, *Gard. Dictionary.*

Croton lucidum, *Linn. Species Plant. n.* 1426; *Amœnitat. Acad., vol.* v. *p.* 410.

Croton spicatum, *Bergius*, *Philosophical Transact., vol.* lviii. *t.* 7. *p.* 132.

Croton erectum glabrum, foliis ovatis oppositis vel ternatis, spicis terminalibus, *Browne*, *Hist. Jamaica*, *p.* 347.

Croton lucidum, *Swartz*, *Flor. Ind. Oc. vol.* ii. *p.* 1193.

Croton (Astræopsis) Hookerianus, *Baillon*, *Euphorb. p.* 363.

Croton lucidus, *L. Griesebach*, *Flor. Brit. W. India Islands*, *vol.* i. *p.* 40.

In several of the districts of New Providence, the negro settlers were in the habit of collecting the cortex of this plant, with the object of boiling it with that of the *C. Eluteria*, Benn., under the notion it exerted a more favourable influence in the modification of its curative powers, and I found on inquiry that it was recognized by the specific term of *False sweetwood bark*. Elsewhere, however, these supposed remedial virtues are either apparently unknown, or not so much appreciated.

The species occurs in the Bahamas usually as a low dwarfish shrub, from 3 to 4 feet in height, and is common throughout the group, and in most of the West India Islands. The stem is erect, with epidermis more or less stained by white or greyish rugous blotches, branches smooth or rarely lepidote, leaves long, petiolated (the petiole and midrib frequently of a pinkish hue), elliptical, perforated by transparent dots, with plain or slightly undulated margins, glabrous on upper surface, or sparingly covered with minute stellate hairy scales; devoid beneath. Spikes abbreviated, simple, terminal, clothed with long petiolated white flowers, which emit a fragrant odour. They are produced in March and April, male and female on the same spike. The capsule is oblong, or ovate-oblong, partially embedded in persistent calyx, three celled, with a solitary seed in each. Pericarp glabrous, or sprinkled with a few stellated hairs. Seeds 2 to $2\frac{1}{4}$ lines long, ovoid oblong, pale brown, shining, convex externally, with flattened sides. Fruit ripens about May or June.

The cortical layers of the bark are of a dull red colour, and, in their fresh state, have a slight bitter and somewhat astringent flavour; they are much less spicy and aromatic than the true Cascarilla. Under the preparation of a decoction it appears to be administered conjoined with that of the *C. Eluteria*, Benn., in cases of mild or ephemeral fevers, disorders of the chylopoietic viscera, and slight constitutional debility.

IV. The Willow-leaved Cascarilla.

(*Croton Cascarilla*, Benn.)

Ricinoides elæagni folio, *Plumier*, *Iconies*, *p.* 236, *t.* 240, *f.* 1, *spec.* 20

Ricinoides elæagni folio, *Catesby*, *History*, *Carolina*, *vol.* ii. *t.* 46.

Clutia Cascarilla, *Linn. Species Plant. ed.* 1. *p.* 1042.

Croton Cascarilla, *Benn. Journ. Proc. Linn. Soc., vol.* iv. *p.* 30.

This species, indigenous to Elutheria, Long, and other large islands of the Bahamas, and formerly equally abundant in that of New Providence, became almost extirpated in the latter during the last century, a few plants now only existing at the eastern extremity of the isle. The same product appears to be also common to several districts in St. Domingo, but I am not aware that it has ever been found in Jamaica, as asserted by some writers. That this species originally yielded the Cascarilla bark of commerce, until superseded by the *Croton Eluteria*, Benn. (*Clutia Eluteria*, Linn.), there can be little doubt; for though unknown to the inhabitants of Nassau, several from Eleuteria had a faint recollection of it constituting an article of export many years since. The dried cortex was also denominated Ilatheria or Eleutheria bark, and employed by the people in the treatment of diseases, incidental to different localities of the island.

Dr. Wood, of America, and the late Dr. Pereira were both of opinion that the ordinary Cascarilla bark of the shops may have been procured from this plant, and there are sufficient grounds for belief that their conjectures would have proved well-founded had they assigned the origin to a less modern date. But I was assured by one of the wood-cutters of Eleutheria, that even recently, the bark of this Croton when met with, is collected, and incorporated with that of the *C. Eleuteria*, Benn., for exportation. This statement, however, requires confirmation.

Plumier was the first who described this Croton in his 'Species,' etc., under the title of *Ricinoides elæagni folio*, and gave a figure of it in the "Icones, etc." Catesby, in his History of Carolina, mentions it by that of *Ilatheria bark* or *La Chachrille*, and observes that the shrub "grew plentifully in most of the Bahama Islands, seldom above ten feet high, and rarely so big as a man's leg, though it is probable that before these islands were exhausted of so much of it, that it grew to a larger size; the leaves are long, narrow, and sharp-pointed, and of a very pale light-green colour; at the ends of the smaller branches grow spikes of small hexapetalous white flowers, with yellow apices, which are succeeded by tricapsular pale-green berries of the size of peas, each berry containing three small black seeds, one in every capsule. The bark of this tree being burnt, yields a fine perfume; and infused in either wine or water, gives a fine aromatic bitter." The result of my inquiries tends to substantiate the accuracy of these statements, so far as they relate to the general history. The custom of smoking certain portions of this plant conjoined with tobacco, adopted by the earlier European settlers, either to impart an agreeable flavour, or as a stimulant and prophylactic to avert the attacks of disease, is evidently to be traced to the usages of the preceding Carib population. The term 'Ilatheria,' is merely a vernacular corruption of Elutheria. Catesby's plant is the *Clutia Cascarilla* of the first edition of Linnæus's 'Species Plantarum,' who misstated the habitat of

Carolina for that of the Bahamas. Nicolson, in his "Essai sur l'Histoire Naturelle de St. Dominique," evidently alludes to this or a similar production under the synonym of "*Ricinoides;*" and by the creole appellation of Sauge du Port de Paix.—Chaumeton, in his 'Flore Medicale' gives a tolerable illustration of it, remarking that the shrub flourished so extensively on the northern coasts of the island, as to form large forests occupying an extensive arid track of country, in the neighbourhood of Cape La Grange, and the immediate vicinity of the town of Port du Paix. It is there known by the name of "Thé du Port de Paix," from an infusion made by the inhabitants from the leaves. He adds, in a note, that it was very plentiful in the island of Eleutheria, and was distinguished by certain pharmacologists by the term Cortex Eleutheriæ."

The comparative rarity of this species of Croton, with the difficulty of obtaining authentic specimens, has rendered it very imperfectly understood; a wide diversity of opinion existing among botanical writers, with reference to it constituting a distinct species, or only a variety of the *Croton lineare* of Jacquin. The delineation of the plant in Catesby's work is of such an indifferent character as to lead Lindley to question to what Croton it could belong.* By the majority it has been confounded with Jacquin's plant. The general habit, form of leaves, and other peculiar characters however, obviously separate it from this and all other species of *Croton;* so much so, that when placed in comparison no question could arise about the recognition of their specific differences. The following remarks by Pereira indicated the doubt and obscurity in which these details were involved. He observes that the plant called by Linnæus "*Croton Cascarilla* was regarded for many years as the source of our Cascarilla bark. In 1787, Dr. Wright declared that Linnæus's *Croton Cascarilla* is the wild Rosemary shrub of Jamaica the bark of which has none of the sensible qualities of Cascarilla. It appears however that the wild Rosemary shrub of Jamaica is the *Croton lineare* of Jacquin, and that some botanists are not quite decided whether we ought to regard it as a variety merely of, or a distinct species from, the *Croton Cascarilla* of Linnæus. Willdenow considered it to be a variety; Sprengel a distinct species; Don says it is identical with Linnæus's plant. It is remarkable, however, that the specimen in the Linnæan Herbarium is, according to Mr. Don, *C. lineare,* and we are therefore in want of a good botanical description of the plant alluded to by Catesby." This desideratum has lately been supplied by the excellent Paper of Mr. Bennett, in the Journal of the Proceedings of the Linnean Society.'

Guibourt, in his 'Histoire des Drogues,' appears to incline to the opinion that this species was the one formerly supposed to supply the

* It is also to be noticed that it is impossible to say what the plant is, that Catesby figured; for I know of no Croton, nor indeed any other plant, to which it can belong. ('Flora Medica,' p. 170.)

markets with the article of commerce, although he considers it now to be chiefly yielded by the *C. Eluteria* of Swartz, the production from which, however, as I have previously remarked, was not the case.

Of this Croton, a few plants only were discovered growing at the eastern extremity of the island of New Providence, among the interstices, of lime-stone rocks skirting the beach, it apparently delighting in dry localities, exposed to the influence of the regular sea breezes. With a solitary exception, all partook of the habit of bushy shrubs, from 4–6 feet in height, much branched, with a peculiar pale or greyish-green stem. The epidermis was destitute of lichens, and the white rugous patches, so frequently met with in other species. The branchlets were of a pale or orange-yellow, clothed with pubescence similar to that on the leaves. The inflorescence consisted of numerous simple spikes, invariably terminal, with male and female subsessile flowers on each spike, the small white petals of which were sometimes tinged by a faint yellow hue. They generally appeared in March and April, and when fully evolved emitted a very fragrant perfume. The fruit, a tricoccous capsule, deeply furrowed, about the dimensions of a pea, with a pale yellow more or less rugous, pubescent pericarp, clothed by minute stellate hairy scales, is divided into the ordinary number of cells, each containing a small brown shining seed of variable proportions (1–2½ lines long), externally convex and flattened on each side, so as to form an angular ridge. They attain maturity in May and June. The leaves are petiolate, glandular at base, narrow-lanceolate, sharp-pointed, flat or slightly waved at the margins, tapering towards both extremities, smooth, yellowish or rusty green on their upper surface, pale yellow beneath, and densely tomentose, being covered with numerous intricate stellate hairs.

The cortical layers in the younger shrubs are of a pale, or greyish-green colour, but in those of an arborescent size become changed to a dull red. The dried bark is deficient in the warm aromatic flavour of the *C. Eluteria*, Benn., but appears to be endowed with more bitter extractive matter. The absence of the whitish epidermoid stains, and parasitical cryptogams, the peculiar nodulate character of the stems and greyish-coloured inner bark, will serve to distinguish it from that of *C. Eluteria*, Benn.

According to local traditions the Carib populations highly valued the entire plant, and also that of the *Crotom lineare*, Jacq., both of which exhaled a grateful spicy odour, qualities that invariably command the regard and esteem of most barbarous tribes. These products they rendered subservient to a variety of useful purposes, of which the process of fumigating, comprised one of their favourite modes of appliance. European colonists subsequently obtained the knowledge of their medicinal virtues from these sources. They macerated the fresh cortex in wine or spirits, and thus prepared a palatable and pleasant tonic for the relief of dyspepsia, and loss of appetite. In St. Domingo the negro

inhabitants have designated the shrub by the name of Port de Paix Sage. The beverage termed "Thé du Port de Paix is made by infusing the fresh leaves in boiling water, which, previous to use, required to be well strained, otherwise irritation of the throat would be induced. The agreeable aromatic taste of this infusion had doubtless suggested its employment as a stimulant and stomachic in functional derangements of the stomach and bowels, and the nervous lassitude or debility, that so frequently ensues as the sequel of endemic febrile affections.

V. The Rosemary-leaved Cascarilla.

(*Croton lineare*, Jacq.)

Ricino affinis odorifera fruticosa major rosmarini folio, fructu tricocco albido, *Sloane, Hist, Jamaica*, 1. *p.* 133, *t.* 86, *f.* 1.

Croton fruticulosum ; foliis longis, angustis, subtus incanis, margine reflexis, *Browne, Hist, Jamaica, p.* 347.

Clutia Cascarilla, *Linn. Amœnitat, Acad. vol.* v. *p.* 411.

Croton lineare, *Jacquin, Stirp. American. p.* 256, *t.* 162, *f.* 4 ; *Pict. p.* 124, *t.* 263, *f.* 80.

Croton Cascarilla, *Woodville, Med. Botany, ed.* 1, *vol.* iii. *p.* 116, *t.* 41

Croton lineare, *Benn. Journ. Proc. Linn. Soc., vol.* iv. *p.* 30.

This species is indigenous to most of the Bahama and West India islands, where it is known by the title of Spanish or wild Rosemary bush, from the leaves and other portions of the shrub resembling those of the common Rosemary (*Rosmarinus officinalis*, Linn.) ; although every sweet-scented plant of the genus was formerly so designated in Jamaica, irrespective of this supposed similarity. It is also indigenous to the southern provinces of North America, whence specimens collected by Michaux were transmitted to the British Museum, under the erroneous title of *Croton Cascarilla.* Among the Creole population it enjoyed a wide repute for its efficiency in the cure of various maladies. In the Bahamas it is met with under the form of a low scrubby bush, seldom exceeding 3–4 feet in height, growing in waste, arid places, or by the roadsides. The stems, sometimes white, or of a peculiar greyish-brown colour, occasionally marked by white rugous stains on the epidermis, are always more or less shrubby and branched, seldom assuming an arborescent character, although stated to attain an altitude of seven or eight feet in Jamaica. The branchlets are white, or of a pale or orange-yellow hue, partially covered with stellate hairs. The leaves $\frac{1}{6}$–$\frac{1}{3}$ inch broad, and from 1–2$\frac{1}{2}$ inches long, are nearly sessile, linear, blunt, more or less reflected at the margins, deeply channelled green and smooth above, beneath white or pale-yellow, very densely pubescent, being clothed by numerous intricate stellate hairs. The inflorescence is axillary and terminal. Odoriferous, subsessile white flowers, occasionally tinged by yellow-green at their apices, are sparingly attached to simple spikes, the male and female being set on distinct spikes. The fruit, the ordinary trilobular capsule of the genus, containing three small, deep-brown,

ovoid seeds, is about half the size of the common pea. The pericarp, of an orange-yellow hue, is rugous, and thickly studded with stellate hairy scales. The fruit ripens in May and June. Similar to the preceding species, the entire plant, when rubbed between the hands, imparts a pleasant aromatic fragrance, which continues for some time. The cortical layers of the bark are of a greyish-brown colour, and of an agreeable bitter flavour, but do not possess the warm aromatic aroma of those of the *Croton Eluteria*, Benn., and are also much inferior in quality to the cortex of the *C. Cascarilla*, Benn. According to Swartz, the leaves become more largely developed in the inland districts, than in those adjoining the seacoast. Sloane, in his 'History of Jamaica,' first noticed this plant under the description of "*Ricino affinis odorifera fruticosa major rosmarini folio;*" and Patrick Browne, in his work on Jamaica, by that of *Croton fruticulosm.* In the fifth volume of the 'Amœnitates Academicæ' of Linnæus, it was termed *Clutia Cascarilla.* Jacquin, however, conferred upon it the more appropriate title of *Croton lineare*, having both described and figured it in his work on American plants. By many authorities this species has been confounded with the *Croton Cascarilla* of Bennett, a product widely dissimilar in every respect, not only as regards the habit, arborescent stem, but in the distinctive character of the petiolate, lanceolate and sharp-pointed leaves of the latter. Wright, in the 'London Medical Journal,' has incorrectly referred it to the *C. Cascarilla* of Linnæus, which designation Mr. Bennett has clearly pointed out was originally founded on Catesby's representation of the Bahama specimen. Woodville has also committed the same mistake, and erroneously delineated it under the name of *Croton Cascarilla*, in his 'Medical Botany.' Under the article *Croton*, in 'Rees's Cyclopædia,' the diagnoses of these two species has, however, been clearly defined, as would appear by the following statement :—"Lamarck was justified, by well preserved specimens, in the herbarium of Jussieu, that this plant (*C. lineare*) was specifically distinct from the preceding (*C. Cascarilla*), though they have been confounded by Linnæus. The author of 'Hortus Kewensis' (Aiton) appears to have been of the same opinion, by his excluding the synonyms of Catesby and Plumier." Grisebach, the most recent authority on this subject, however, describes this plant as a mere variety of the *C. Cascarilla*, Linn.

Under the form of an infusion or decoction, different portions of this Croton appear to have been employed as medicinal agents by European colonists at an early date. Barham considered the dried leaves in powder, to constitute a specific in colic, and to equal in virtue, as a stimulant and stomachic, those of our common Rosemary. The young branchlets and leaves, under the form of a decoction, were used as fomentations in painful tumours, neuralgia, and muscular rheumatism, and likewise entered as a principal ingredient into the composition of the warm medicated baths in popular usance. During my residence in New Providence, I was informed that an infusion of this plant was deemed a successful

remedy in the treatment of ulcers and other cutaneous affections, and administered internally in copious warm draughts to promote diaphoresis in the first stages of febrile and other inflammatory complaints, both by the creole negro soldiers, and the inhabitants of the island. This species appears to have been introduced into England by Dr. Houston prior to 1733, and was subsequently cultivated in some of the public gardens.

VI. Sea-side Balsam or Sage.

(*Croton balsamiferum*, Linn.)

Croton balsamiferum, *Linn. Mant.* 125.

Croton balsamiferum, *Jacquin*, *American t.* 162, *f.* 3; *Pict. p.* 124-242. *Hort. Botan. Vindob. vol.* iii. *t.* 46.

Croton fruticosum erectum, et subvillosum, foliis cordato-acuminatis spicif terminalibus, *Browne*, *Hist. Jam.*, *p.* 347.

Croton balsamifer *Grisebach Flor. Brit. W. I. Isl. vol.* i. *p.* 38.

This well-marked species flourishes in many of the West India islands, as also in several of the Bahamas. In that of New Providence it is usually found, more or less under cultivation in the gardens, or on the outskirts of the town of Nassau; hence, probably it has been introduced and naturalised from other localities. Tradition also asserts that this comprehended one, among other favourite plants, resorted to by the Caribs for remedial purposes. Its reputation as a medicine has not declined since their extinction, for manifold preparations from the shrub still attest the popular esteem in which it is held by the various populations of the above islands.

Owing either to its odoriferous qualities, or from an imaginary resemblance to the rugose leaves of our garden Sage (*Salvia officinalis*), this and some other Crotons have received the title of Sage or Sea-side Sage. Hence an infusion of the leaves, prepared in a similar manner to that from the *Salvia* in England and America, is also termed Sage-tea. The designation of Balsam, frequently conjoined with it, appears to have been derived from the circumstance of a thick, yellowish aromatic sap exuding from the extremities of the broken branches, or wherever the stem has been wounded. Jacquin has furnished brief detailed outlines of this species in several of his works, remarking that it was called in Martinique by the name of *Petit Beaume*, or Little Balsam.

The stem is erect, with a grey or pale-brown epidermis. Branchlets pale-yellow, more or less clothed with stellate hairs. Leaves long-petiolate, broad, ovate-lanceolate, pointed, perforated by pellucid dots, pale-green, smooth, or partially covered with stellate down on upper surface, pale-yellow, hoary, densely studded with intricate stellate hairs with two urceolate glands at the base beneath. Spike simple. Inflorescence terminal, flowers white, sometimes faintly tinged with yellow. Male and female on same spike. Fruit consists of an oblong, roundish capsule, one-third less in size than that of the *C. Eluteria*, Benn. Peri-

carp rugose, covered with numerous stellate hairs. Seeds 1–2½ lines long, ovoid, deep-brown, and shining, one in each cell. Fruit becomes mature about May or June.

In several of the West India and Bahama islands, different parts of this product are rendered applicable to the cure of endemic diseases. The yonng leaves and branchlets introduced into warm baths are supposed to communicate their agreeable fragrance and medicinal virtues to the water, and these act in a remedial mode through the cutaneous system, while a decoction of the same is employed as a fomentation in arthritic swellings of the joints, and as a stimulant lotion to indolent sores, and chronic ulcers of the legs. Similar to the Sage-tea, in English and American use an infusion made from the tender leaves, and drunk in copious warm draughts, is administered to procure diaphoresis in fevers, and local inflammatory complaints. Probably their stimulant, aromatic qualities render them more agreeable to the stomach, and consequently allay the nausea and gastric irritation that often accompanies the invasion of these tropical affections.

In New Providence the bruised branches and balsamic exudation, conjoined with the infused leaves, have been found beneficial in bronchitis, and as a gargle in some morbid conditions of the pharynx and mouth. A cordial liquor termed *Eau de Mantes*, is said to be distilled from the yellow, glutinous sap, with spirits of wine, in Martinique, and valued as a medicine in the treatment of certain uterine irregularities, independently of its appropriation as an article for domestic use. Neither the bark of this species, nor that of the *C. lineare*, Jacq., are apparently held in any esteem as curative agents in the Bahamas, and therefore are never diverted to these purposes.

THE WINES OF ITALY.

Wine, next to cereals, is the most important production of the Italian soil.

In a superficies of about 32,000,000 of hectares, containing forests, lakes, rivers, and roads, the peninsula produces annually 28,340,000 hectolitres of wine, that is to say, every proportion duly kept, 10·34 per cent. more than France, which gives 45,000,000 hectolitres from a superficies of 53,000,000 hectares.

In estimating the average price of the hectolitre at 16s., wine represents in Italy a value of 22,640,000.

The fruit of the vine ripes in all parts of Italy, in the plains as well as on the hills and mountains, and even close to the limit of the chestnut trees.

The varieties of vines are almost innumerable. There are some adapted to certain localities, and of limited cultivation, and others which are almost invariably grown in every district. The greater part are indigenous, and of very ancient origin; others, having been originally transplanted from Italy, have been reintroduced with new properties from Hungary, the banks of the Rhine, the South of France and Spain, from the Cape of Good Hope, and the Canary Islands. There are some varieties from America of the Labruscan or Isabella (*Vitis Labrusca*), remaining in the gardens up to a recent period objects of curiosity, but their cultivation is rapidly increasing, because it has been observed that their grapes have not been affected by *Oidium.*

The methods followed in dressing and planting the vine are equally various. In the southern countries, and in the plains, the vine is trained up high trees, such as elms, poplars, and walnut trees, and the branches which reach to the tops are interwoven among themselves, forming garlands and festoons. In other places props are used, arranged in such a manner as to support the shoots of the vine, which are lengthened or shortened in various ways. The vine is also cultivated on trellis work, in espalier, also separate and without props. This last system, which is rather unusual, is chiefly employed on the heights, and is the best method in the dry soils of the small islands.

In every part, unfortunately, but little attention is paid to the choice of the vines best fitted for cultivation. Various qualities of grapes are all promiscuously gathered in the same vintage—white, black, sweet and sour—after a more or less perfect maturity, without much care being paid to the proportions to be observed amongst them during the process they undergo in the making. Sometimes, the most intelligent vine-growers separate the grapes, according to their qualities and their different degrees of ripeness, and thus obtain wines more esteemed, more equal in character, and capable of keeping longer. A small number plant separately the various qualities of vines, afterwards mixing the grapes and the must in the proportions which experience has indicated to them as being the best. This last method is much extending in Piedmont.

The process generally used in making wine consists in treading the grapes in tubs (tini), which are left open in the wine cellars; and the liquor being drained off, as soon as the active fermentation has ceased, it is transferred to the tuns, where the action of the second fermentation takes place, in which the wine is clarified and completely made.

Nevertheless, the grapes are sometimes left in the open air during some time; they are then pressed, and the must is carried away and placed in barrels to ferment. This is the process followed, especially in the making of full-bodied wines, like the *Vin santo.*

The black wines are obtained by crushing the grapes, and leaving the husks and stems in contact with the must; there are white wines, less valued by drinkers, made either from white grapes, put into tubs separately from the black wines, or from the liquor, which ferments separate from the husks.

Machines for picking grapes or crushing them are not generally known, but everything is prepared by manual labour. Nevertheless, the common presses—that is, mechanical presses—are employed to obtain the wine from the residue, which is called *stretto.*

Some wine producers have constructed vats, others have cisterns, closed hermetically as soon as the fermentation has subsided, wherein the wine is kept for an indefinite period.

The wine being placed in the tubs and cellars, there undergoes its last vinous change in a natural way, which does not fail to superinduce sensible differences in the article, caused by the position of the cellars themselves, their temperature, and other extrinsic circumstances, and by the variation of seasons.

But a mixing or doctoring of wines is also practised, by adding at one or successive times to the wines in the tuns, either a quantity of concentrated must, produced by boiling, which is called *cotto*, or of grape-juice thickened by exposure to the open air, and made from the sweetest and best coloured fruit; this gives a tint and flavour to the wine much appreciated by consumers, but which certainly does not improve the natural body of the wine itself. For this reason, although the wine-growers succeed in raising the price of some wines, the expedients resorted to, as above described, ought to be condemned rather than approved. The practice of sulphuring wines is well known and resorted to; not equally so is clarification; but some wine-growers attempt to improve their wines by clearing them as much as possible from all extraneous matters. The process of changing the liquor from one vessel to another in the month of March is adopted, from which a remarkable clearing of the wine results.

Considering the natural elements possessed by Italy, and the mode practised of making wine, of which we have just given a brief sketch, it is easy to comprehend what an enormous production of wine there is in ordinary times, and the augmentation of which it is susceptible.

It is easy to conceive the infinite variety of wines produced, and which depend upon natural circumstances, or upon the system adopted in preparing the wines, in which a uniformity in the early stages of the process being disregarded, the chances of a variation of the produce are greatly augmented. This will fully account for the variation in the produce of the wines of Italy, and leaves the field open for immense improvement.

It is useless, in the present day, to seek those wines which formerly gave such delight to connoisseurs, those wines of Falerno, of Opiniano, which slowly maturing, and with their spirit preserved for a century, inspired the poets of antiquity. But we have still the wines of Asti, the Montepulciano, the Orvieto, the Lachryma Christi, the muscats of Syracuse, and other exquisite productions, which, with the Marsala, are appreciated wherever they are introduced. There are amongst the wines of Italy sufficient to satisfy whatever demands may spring up from abroad, and the present resources can be indefinitely augmented.

The Italian producers will not neglect to improve their system of making and keeping wines; and the prospects opened to them by foreign commerce will be embraced with a conviction of their competency to meet any demand, still reserving to the produce of different places, the original distinctions which attach to them from the circumstances which have made them famous.

The determination of various elements of the wines of Italy, which were made by M. Fausto Sestini and M. Attilio Fabrini, subsequently to the Italian Exhibition, upon specimens which leave no doubt of their genuineness and the completeness of the selection, have, on that account, an especial value. The Royal Commission of the Italian Exhibition of 1861, upon the requisition of M. A. Targioni Tozzetti, inspector and reporter of the fifth class of the above Exhibition, ordered these experiments to be made, and this duty was performed, together with a number of others of the same sort, in the laboratory of the Agricultural Institution in Florence, by the young and able chemists who have been so favourably mentioned, under the supervision of M. Targioni himself, who has recently presided at the inauguration of that institution dedicated to agricultural experiments of all sorts. M. Cozzi and M. de Luca have given some analyses of the wines of Italy, which ought to be consulted concurrently with the above, however partially they may be.

The analyses of M. Cozzi, inserted in the proceedings of the Royal Academy of Georgofiles of Florence (1848), give for the maximum of alcohol 9·80, the minimum 5·83, the average being 7·81. Those of M. De Luca, inserted in the *Nuovo Cimento*, fourth year, with reference also to those of M. Cozzi on the wines of Tuscany, give

	Maximum.	Minimum.	Average.
Alcohol	14·0	4·0	9·00
Fixed organic matters	5·0	1·0	2·62
Inorganic mattter	0·6	0·1	0·24

Alcohol is always fixed at 1,000, whilst in the analyses made by Brande of the wines of Marsala and Syracuse it is 0·825.

The acidity is estimated collectively, supposing that it proceeds from tartaric acid.

The sulphurous smell of the grape wine, which has been treated with brimstone on account of the vine disease, has stimulated other researches; which, being completed, together with those by M. Sestini, under the supervision of M. Targoni, have discovered that the sulphuretted hydrogen is a product of the decomposition of sugar, which, in presence of sulphur, and the act of fermentation, undergoes partially a lactic fermentation and gives out a quantity of hydrogen, which, being evolved under the above conditions, combines with the sulphur suspended in the must. Amongst all the processes employed to get rid of the smell of sulphuretted hydrogen, there is nothing better than ex-

posure to the air, when changing the wine in the casks, or sulphuring the wines with the vapour of burnt sulphur.

Previously to the vine disease, wine held an important position in the manufacture of vinegar. Vinegar is still obtained in the ordinary way in farm and other households, where in general the proprietors are satisfied with allowing wine to become vinegar in large open casks, which already contain some vinegar or the lees of vinegar.

There are in Piedmont two extensive vinegar yards, one at Turin, the other at Verduno, where the conversion of wine into vinegar is effected upon a large scale, a particular process, based on scientific principles, being economically practised. Vinegar from these establishments contains from 0·030 to 0·045 of acetic acid, and is sold at 2½d. to 4d. per litre.

An establishment exists in Venice for making vinegar from spirit distilled from corn, conducted on the method of Wigemann and Schutzembach, which annually produces vinegar to the amount of 40,000*l.* This vinegar contains from 0·055 to 0·100 of acetic acid, and is sold at 1½d. to 3d. the litre.

The balsamic vinegars of Modena are a special production, obtained from the must of grapes, concentrated by heat, and to which a small quantity of old vinegar is added every year. At the same time a quantity of vinegar, equal to the quantity of must which is added, is drawn off, and the portion so drawn off is mixed with vinegar a year older, which in its turn is transferred to another tun, older still, and so on regularly, by which means vinegar from a hundred to a hundred and fifty and even two hundred years old is obtained in the last cask of the series. These vinegar houses are the property of ancient families; that of the ducal house enjoys a distinguished reputation.

This vinegar is of a brown colour, rather thick, very fragrant, and possesses no quality in common with ordinary vinegar, except the acidity, which is, however, not so strong. It is esteemed in proportion to its age, is expensive, and is used as an article of luxury, as a perfume, either by itself, or by communicating its fragrance to common vinegar. Its chemical composition is not as yet ascertained, but propably it contains many combinations.

Vinegar is also obtained from certain fruits in Italy.

THE TECHNOLOGIST.

ON THE BORACIC ACID OF CENTRAL ITALY.

BY W. P. JERVIS, F.G.S.,
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Of all the mineral resources of Central Italy, none have been developed of late in so remarkable a manner as that of boracic acid, the very existence of which in Europe was unknown a century ago, while now 100,000*l.* worth of crude acid are annually exported from Leghorn to England alone, besides a considerable quantity sent to France. It will not be without interest to trace the history of the discovery of boracic acid in Italy as a scientific curiosity, and to follow its introduction into the manufactures, detailing the various steps taken to improve the method of collecting it, until it may be said to have almost reached perfection.

In 1742, Giovanni Targioni Tozzetti, a scientific Tuscan traveller, and one of the earliest geologists of Central Italy, visited the salt works of Volterra (Pisa) in his rambles through the Maremme, and proceeded southward through Pomarance to Monte Cerboli, in order to examine the curious phenomenon of hot vapours which abounded in the neighbourhood. He relates how he took a stroll through the valley which stretches south-east from Monte Cerboli, and reached the little torrent Possera: all around him was a scene of desolation, well fitted to strike dismay on the ignorant, but eminently suited to the contemplative mind of the naturalist, to whom the most dreary plains and barren rocks yield ample subject for useful and agreeable study. Targioni's attention, was attracted to the examination of the strange scene around him; he stood close to a yawning gulf, from which issued rumbling noises and disagreeable odours; he wished to look down and peep into the mysterious chasm to learn something of its nature, but his temerity was rewarded by a surly growl from within, and his guide told him

that the noise sometimes resembled a hundred bellows, as if Vulcan himself were hard at work, while flames issued forth at night after very hot days. Though he saw no fire, the vapour served as a warning to him to keep at a considerable distance; but before long he came upon more vapour vents, or *soffioni*, and little *lagoni*, or ponds of muddy blue waters, boiling vehemently, the imprisoned gases producing bubbles increasing in size till sufficiently large to cause them to burst. Dense vapours smelling strongly of rotten eggs, rose from the *lagoni*, and ascended to a considerable height into the atmosphere. The ground on which he stood was soft and crumbled under his feet; the decomposed rocks, as well as some of the efflorescent minerals, were new to him, and became the subject of many curious speculations. The whole of the valley was apparently studded with such lagoons, an attempt to define the number of which would be impossible, connected as they were in many places by cross fissures and superficial cracks. Not a tree was visible throughout the extent of the valley; the opening of a new fissure would be the signal for the destruction of all neighbouring shrubs, scorched by the subterranean heat. Occasionally, he was told, the *lagoni* would be overcharged by the rain, and their contents flow into the Possera, where the heat would immediately kill all the fish for a considerable distance down its course, the density of the atmosphere in cloudy weather pressing on the columns of vapour, causing them to lie closer to the ground and spread themselves horizontally, while the grumbling sounds in the bowels of the earth redoubled in fury. Passing on towards Castelnuovo the same lagoons were abundant, but of smaller dimensions, and according to tradition they had increased in number; on the other hand old lagoons dried up, only emitting steam at intervals.

A farm house near Castelnuovo, built 200 years before, had been suddenly undermined, a *fumacchio*, or incipient lagoon, having unceremoniously made its appearance in the kitchen, rapidly assuming the dimensions of a true lagoon. The inhabitants were utterly defenceless, and bade adieu to their ancestral tenement, the stone walls of which were soon attacked by the corroding influence of the vapours, and speedily destined, as our traveller truly predicted, to crumble to pieces. Within certain limits fertile fields were subject to be laid waste, and poisonous gases escaped, which had on several occasions proved fatal; thus he relates how a swineherd in charge of forty pigs had been overtaken by the noxious gases; all the poor animals were killed but one. Another man, who was working in an alabaster pit, was suddenly overpowered by the escape of mephitic gas through the marls, and cried loudly for help to his fellow at the mouth of the shaft; while he was being hauled up he was stifled by oppression of the lungs, and fell lifeless to the bottom. Should any luckless wight approach a lagoon too closely he would stand a chance of sinking into a quagmire, or losing

a leg. Sheep occasionally fell victims when rushing too carelessly along, and after remaining a short time in the water, nothing but a bleached skeleton remained. Though this picture is perhaps rather overdrawn, the temperature being very considerably above the boiling point of pure water, very serious and generally fatal accidents must have frequently resulted.

It would be untrue to say that the *soffioni* were utterly useless. The skilled peasants would cleverly manage to roast their chestnuts in sacks placed over these vapour vents; no small convenience in a district where this article is a substitute for bread; birds, game, and cattle made the *lagoni* their winter resort, in order to take refuge from the cold snowy ground; cattle, indeed, occasionally frequented the neighbourhood to rid themselves of gad-flies and musquitoes. Our traveller traced the various crevices along the course of the rivulet, where they found their way out from beneath huge masses of rock; in their vicinity a hole made with a stick would frequently originate a little pool or *lagoncello*, from whence sulphurous vapours poured forth. As to the noxious vapours, which were chiefly carbonic acid gas, he was told that the introduction of a copious supply of water into the vents destroyed their power.

The origin of these remarkable fissures, the account of which I have borrowed from Targioni Tozzetti, was first pointed out by Sir Roderick Murchison, who proved them to have the same lineal direction as the axis of the Appennines and the serpentine eruptions of Central Italy, and to be closely connected with recent earthquakes. As the fissures would be easily blocked up by detritus, &c., I consider that they did not exist before the Deluge, at which time they would have been completely choked up and destroyed. Earthquakes, however, are common there, one having occurred within the last year. In the *Codice della Gaddiana* it is mentioned that in 1320 a fissure was produced by an earthquake, near Velieno (Vegliani ?) in the Volterrano, whence water rushed out in large quantities, great heat being also evolved, and a lake was soon formed, which finally attained the depth of 80 feet. Ugolino di Monte Catini, quoted by Repetti, while speaking of the neighbourhood of Monte Cerboli, makes no mention of lagoons, although he dwells in detail on those of Castelnuovo, whence Repetti concludes that in the middle ages, when Ugolino lived, there were no fissures or lagoons in the former place.

In 1777, Hœffer, the chemist of the Grand Duke of Tuscany, found boracic acid at Monte Rotondo and Castelnuovo, a fact confirmed two years subsequently at Monte Rotondo, by Prof. Mascagni, well-known for his researches on the lymphatic system.

Gazzeri made some attempt to utilize the boracic acid in these waters in 1808 and again in 1816; Hœffer and Mascagni proposed to make borax from them, the latter in 1812. Mascagni, however, was too much

engaged in his scientific labours to carry out his idea, for which he even obtained a patent during Napoleon's rule in Italy; he therefore ceded his right to Fossi, to whom he communicated his proposition for placing cauldrons of the solution of acid in the lagoons, as in a water bath, in order to concentrate it. Fossi was the first to obtain boracic acid in any quantity from Monte Rotondo; and we learn from the *Atti dei Georgofil* (tom. xvii., Firenze, 1839), that he exhibited white glass in Florence as early as 1818, prepared with borax made from these lagoons. Messrs. Gazzeri and Brouzet worked the lagoons of Monte Rotondo from 1815 to 1818, employing as their engineer Sig. Ciaschi, who made further improvements by constructing artificial lagoons round the dry *soffioni*, to utilize the hitherto waste vapours. The poor fellow was one day superintending an operation of this nature, in 1816, when he fell into a fissure: he was dragged out half dead, and only lingered for a few days, during which time he suffered the most excruciating torture from violent spasms and frightful burns. Gazzeri and Brouzet with great difficulty managed to export to France 3 tons $5\frac{1}{2}$ cwt. of very impure crude boracic acid in the nine and a half months ending April 1, 1818. A small quantity of these mineral waters had been for many years employed in pharmacy, under the name of *Sale Sedativo di Hombourg*, borax being considered to possess calming properties.

Thus, for 40 years, little or nothing was done, when in 1818, M. François Lardarel, a French gentleman, then staying in Italy, resolved on the formation of a small establishment for the collection and extraction of the boracic acid. For many years his labours were attended with small success. The sale of the acid was steady, but the profits were inconsiderable. He was thus induced to study a more economical means of evaporation, the expense of firewood used for that purpose up to 1827 having swallowed up the greater part of his proceeds, the more so as it was particularly scarce in that neighbourhood, where not a blade of grass was to be seen, and road communication for bringing it had all to be made by the proprietor of the works.

After much thought the brilliant idea struck M. Lardarel that by some method he might take advantage of the natural steam jets or *soffioni* arising so plentifully from the soil; and at the period I have mentioned he devised the plan for imprisoning and turning them to account, which I shall describe. The process was a triumph for those days, when, let us remember, steam was little known as an element in manufacturing industry. From that moment the produce of the works rapidly increased, and the uses to which the boracic acid was applied became equally numerous.

At the present time there are no less than nine separate establishments belonging to Count Lardarel, all situated within a few miles of Castelnuovo (*Leghorn*), a little town half-way between Volterra and Massa Marittima (Grosseto), viz.: Lustignano, Lardarello, Lago, Sasso, Monte

Rotondo, Serrazzano, San Federigo, San Edoardo, and Castelnuovo. M. Durval has one establishment at the Lake of Monte Rotondo, and a new company has just been established at Travale, near Volterra. All these places are in close proximity to eruptions of *gabbro* or Miocene serpentine, as at Monte Cerboli, Serrazzano, Monte Rotondo, and numerous other localities, where that rock has pierced the sedimentary strata. No one can call in question the existence of deep-seated subterranean fire in this neighbourhood; though during the present century no flames have been seen at the surface. I cannot help thinking that these insignificant vents can only be subsidiary to the more capacious craters of the volcanoes in the South of Italy, where more ample space is provided for the escape of the gases produced by the decomposition of mineral matter. In support of this theory I will presently give a comparison between the two localities.

The works are so similar that it will be quite sufficient to describe in detail that of Lardarello, which is highly interesting. This thriving little colony is entirely the creation of Count Lardarel, and is situated on the torrent Possera, below the village of Monte Cerboli, three miles from Serrazzano, and six from Pomarance. A group of half-a-dozen or more *lagoni* are seen on the slope of the hill, about half a mile from the main road, from which they are completely hidden by rising ground. Some of these *lagoni* are those described by Targioni Tozzetti, but the vapour-vents—the *soffioni* of which he speaks—no longer exist, as they have been artificially converted into *lagoni*.

Singularly enough, boracic acid has never been found here in the solid state at any depth to which search has been made, with the exception of such places in which it has sublimed; it is probably either the result of the double decomposition of water and a volatile salt of boron, according to Dumas' theory; sulphide of boron and water producing boracic acid and sulphuretted hydrogen, thus :—

$$\mathrm{Bo\,S^2 + 2\,HO = BoO^2 + 2\,HS.}$$

or simply chloride of boron and water producing boracic and hydrochloric acids, thus :—

$$\mathrm{BoCl^2 + 2\,HO = BoO^2 + 2\,HCl.}$$

in support of which supposition we only find the boracic acid appear when there is water present; or it may be caused by the reaction of sulphuric acid on borates, such as tourmaline, the granite found not very far off being so rich in this mineral as to bear the name of tourmaliniferous granite. The theory I advance is tenable, provided we assume the heat to be very great. Though sulphuric acid is one of the most powerful, and boracic acid the weakest, next to carbonic acid, at ordinary temperatures, they exhibit the reverse phenomena at very elevated temperatures; in fact, under such circumstances, boracic acid will

actually decompose sulphates formed by the action of sulphuric acid on borates. Before water is introduced into the fissures they are mere *soffioni;* borates of several bases are most probably abundant at great depth, and are uninjured by the constant passage of sulphurous vapours, and even sulphuric acid, on their way to the surface, whence the latter escape, but boracic acid is not to be detected. Water being now introduced lowers the temperature, and the balance of affinities is altered, the powerfully corroding influence of the sulphuric acid on the borates is set in operation, whence the boracic acid is liberated, and ascends in solution with the ejected water and steam.

The following is the analysis of the dry gases issuing from a *soffione* examined by Payen :—

Carbonic acid	57·30
Nitrogen	34·81
Oxygen	6·57
Sulphuretted hydrogen	1·32
	100·00

Respecting the temperature of the fissures, none have satisfactorily treated the question, though it has excited much attention from Pilla, Murchison, Lardarel, &c. I think that some light is thrown on the subject by the presence of an instructive mineral round the lagoons,—viz., Anhydrite ($Ca\,O.\,SO^3$), evidently formed at a temperature at which water could not combine with the sulphate of lime to produce ordinary gypsum. When gypsum ($CaO.\,SO^3 + 2\,HO$) is heated to 260° Fah., it loses its water of crystallization, and becomes plaster of Paris; but on cooling it again absorbs the original quantity of water. When it is heated to redness this does not take place, but the mass melts into an enamel, which, according to Regnault, is identical with anhydrite. The heat, on the other hand, could not be very much above redness, provided my theory of the borates be correct.

The first care of the manufacturer is the removal of a certain quantity of clay, and the formation of a *Lagone* or condensing basin, of more or less circular form, the sides of which have to be strengthened by rough stones to prevent them from falling in, the tenacity of the clay sufficing for the bottom. The usual depth of a *lagone* is from 4 to 6 feet, more rarely as many yards; the capacity and depth have to be regulated with the utmost care, according to the force of the vapour in that particular vent. During the period that the workmen are employed in digging a *lagone,* the steam is conveyed away into the atmosphere, far above their heads, by means of a tall wooden chimney, which protects them from being scalded. A stream of water has been brought to the uppermost lagoon at Lardarello, from near the Bagno del Morbo, not a quarter of a mile off; this lagoon is about 15 or 20 yards in diameter, with a jet of steam

in the centre. Forcing its way through the fissures by its specific gravity, the water comes in contact with the highly-heated gases and rocks, and is immediately converted into steam, which, from its elasticity and enormous increase in volume, is ejected with great force, but is condensed as soon as it reaches the surface of the basin by the colder water around. This incessant vaporization of the water and its subsequent liquefaction produce a great commotion in the lagoon, a turbulent little fountain rising to the height of a foot, and causing a succession of concentric ripples. All this time there is a copious discharge of sulphuretted hydrogen, which in one case I distinctly perceived at night-time full a quarter of a mile from a lagoon, and before I knew of its existence there.

Having remained twenty-four hours subject to continual agitation, the water, which has assumed a slate-blue colour, is let out of the lagoon and passes into a canal, through which it is conducted into a second basin at a lower level; thence it passes through several more, of similar construction, each lower than the preceding one. In this manner the water dissolves the boracic acid in the fissures, and brings it up mechanically mixed with it. No other object appears to be attained by making all the water pass through the chain of *lagoni* than to obtain boracic acid of uniform density, though Dumas expressed to Count Lardarel the opinion that probably, by some ingenious device, it might be brought to a saturation of 15 to 16 per cent.—a great desideratum. The temperature of the liquid is considerably above 212° Fahr., and dense vapours rise for many yards above the ground, heating the air so much as to render it unpleasant to remain long near them. Efflorescent minerals and decomposed rock, ejected with the steam, lie scattered all round on the heated surface of the ground, along with sulphur incrustations and many sulphates, such as gypsum, alum, and sulphate of ammonia, besides iron pyrites in minute veins in the fragments of rocks.

The water passes at stated intervals, while still boiling, into the *Vasco*, a tank sixty feet square, covered by a tiled roof supported at the sides by slight brick pillars. Here the greater part of the mechanical impurities, clay, and the more insoluble sulphates, sink to the bottom, and the water regains its limpidity. The next operation is to concentrate the solution of acid, which is effected in the adjoining building containing the evaporating pans: these are so exceedingly ingenious and simple as to merit particular consideration; Count Lardarel, who invented them, has given them the name of Adrian evaporators. Three parallel series of shallow leaden divisions, called *Scanelli*, are placed in a line, each being a third of an inch lower than the one before it, from which it is only separated by a leaden partition half an inch broad, and as deep. The *scanelli* are placed transversely, and are six feet long by twenty-two inches wide; they are arranged under a roof, to keep off the rain, but the evaporation is not in any way impeded, since the sides are open, and only

a few brick pillars of the lightest construction are employed to support the roof. The length of the building is often several hundred feet. At the commencement of the operation a man turns a tap, which lets the water flow in regulated quantities from the *vasco* into the first *scanello*, everything depending on this precaution ; it now flows on from one division of these diaphragm pans to another, until, arriving at the end of the building, it passes along the second row of divisions, and finally back through the last series into the diagonal corner, where there is a large and deep reservoir called the *Caldaja a sale*. In its progress the water gradually evaporates. As I mentioned before, when it entered the building, it only contained $1\frac{1}{2}$ or 2 per cent. of boracic acid, but after having passed through fifty or sixty divisions, it assumes a decidedly yellow tinge, increasing in intensity until finally it becomes a bright golden yellow fluid, having a characteristic odour. The internal arrangements of the evaporators, though they may appear simple enough, were the result of much thought. The leaden pans are supported by beams over a low vaulted steam-passage, lined with hydraulic cement, to protect the stone-work and keep in the heat. For this purpose a *soffione* is vaulted over with a stone dome, about ten feet high, firmly bound with wrought-iron bars water is admitted, and the imprisoned high-pressure steam thereby produced acquires immense power, and thumping loudly against the dome, the jets of water seem ready at every moment to undermine the structure. The steam passes thence through the vaulted passage into the lower chamber of the evaporators, and, having traversed it from end to end, finds its way out into the open air through a chimney at the opposite end. What formerly took 62 hours to evaporate, is performed by this beautiful contrivance in 12, the expense being also proportionately diminished.

From the *caldaja a sale* the syrupy liquor is periodically conducted along a wooden pipe to the *Bollajo*, or crystallizing house, in which a series of large barrels, 3 or $3\frac{1}{2}$ feet in diameter, are ranged in a line. When it is desired to fill them, all that is necessary to be done is to remove a plug placed over the centre of each barrel in the pipe which runs round the building : the liquor remains four days in the barrels, during which time it has crystallized at the sides and bottom to the thickness of several inches, the liquid portion is then withdrawn by removing a plug, and finds its way along a longitudinal drain, by which means it is all saved for future use. No one could fail to admire these beautiful processes, whose characteristic merit is that they do not necessitate anything being lost.

The boracic acid crystallizes in hexagonal plates, about the size and thickness of a wafer, having a waxy appearance and pearly lustre. From their peculiar form they naturally retain much water mechanically mixed, so that they are first put in large wicker baskets, *Corbelli*, to drain, and then emptied out on the floor of a large airy chamber, called the *Asciugatojo*, or drying house. The brick floor is heated, like the

evaporators, by steam passing through an underground chamber. The boracic acid being spread out in thin layers on the floor, is stirred from time to time with a wooden rake, and the crystals, while losing their sharp angles, separate in great measure from each other. When dry nothing remains to be done but to shovel up the mass of crystals and remove them to the warehouse, where the produce of all the establishments is mixed, to ensure its being all of uniform quality. It is then put in large barrels, containing 2,000 Tuscan lbs., or 13½ cwt., and conveyed to Leghorn, whence the greater portion is exported to England.

The first impression produced on my mind, when I first went through the establishment, was the marvellous simplicity of the successive processes, almost everything being performed by Nature: little has to be affected by human agency but to convey water to the *lagoni* and regulate the supply in the various operations, to empty the barrels and spread out the crystals on the floor to dry. Such is the work allotted to the 40 men who are employed at Lardarello on ordinary occasions. They commence at four a.m. in summer, and at sun-rise in winter, and only work on an average *four or five* hours daily: thus I arrived at ten a.m., but they had finished for the day! The art of procuring boracic acid is, however, very harassing; sometimes the sides of a lagoon break in, or there is not sufficient water; perhaps through carelessness on the part of the men the steam supply diminishes at a particular spot, as is liable to occur, unless they regulate the quantity of water accordingly; the inevitable consequence is that the lagoon becomes useless, and the steam seeks an easier vent for itself elsewhere. In some cases it forms a new *soffione* a hundred yards off, or else, unable to force an immediate passage to the surface, it is necessary to have recourse to boring, and a perfectly new lagoon is constructed. This operation is by no means an enviable task; the ground feels so hot near fissures which do not quite reach the surface, but from which steam issues out in minute jets, that one's feet are scorched through a very thick pair of shoes, and one is warned to retreat, since a few steps further on would probably cause a person to sink into a hidden cauldron, or steam-bath. Around this place are fragments of *alberese* limestone, the gradual metamorphoses of which are very visible; first the rock, which has a dirty-brown discolouration, is shivered and rendered friable, and in other places absolutely converted into gypsum, as has been described by Savi and Meneghini; besides these there are clays and marls of the Eocene, Miocene, and Pleiocene formations.

PRODUCE OF BORACIC ACID FROM COUNT LARDAREL'S LAGOONS.

From	Tons.	cwts.		Tons.	cwts.
1818 to 1828 (ten years)	521	16	1842	923	15
1829 to 1838 (ten years)	4,870	6	1843	923	16
1839	948	13	1844	923	16
1840	878	13	1845	923	15
1841	886	6	1846	1,043	13

	Tons. cwt.		Tons. cwt.
1847 ...	... 1,043 13	1854 ...	... 1,319 7
1848 ...	... 1,043 13	1855 ...	... 1,332 19
1849 ...	... 1,043 13	1856 ...	... 1,427 1
1850 ...	... 1,043 13	1857 ...	... 1,711 4
1851 ...	... 1,040 0	1858 ...	... 2,026 10
1852 ...	... 1,156 19	1859 ...	... 1,830 18
1853 ...	... 1,208 19		
	Total ...	...	... 29,972, 18

In 1861, more than 1,800 tons.

I should not consider my description of the lagoons complete without being permitted to turn the attention of the reader to the character of Count Lardarel, the originator of the works, who died in 1858. Endowed with great enthusiasm, combined with indomitable perseverance, he carried out many grand ideas ; his mind seems ever to have been bent on some useful project. He became the master of a truly colossal fortune by his well-merited and praiseworthy exertions ; and by giving employment to a great number of the working-classes in Leghorn and other towns, as well as on his establishments, he rendered great public service. Italy, his adopted country, will ever be grateful for the oasis which he has planted in the midst of the most sterile lands of the Maremme. A picture of the *Piazza dell'Industria*, at Lardarello, will convey some idea of the man.

On one side is a handsome block of buildings, including the necessary offices, a laboratory, museum of mineralogy, apothecary's shop, philharmonic society, boys' and girls' schools, and weaving looms for the wives and daughters of the workmen. In the centre of this terrace is a very handsome church, the priest also performing the office of schoolmaster. Opposite is a neat and spacious hospital, to which are attached a physician and surgeon, as is the case in all the other establishments. On another side is the house in which the count lived when he came to inspect the works, and a neat little theatre, where the men amuse themselves by getting up plays. In the centre of two large squares are the marble statues of the late Grand Duke Leopold I., and an allegorical figure of Industry. I might mention the establishment of road communication, by means of a bridge which cost 20,000*l.*, over ground very unfavourable for its erection ; the space under one of the archways having been made into a paper manufactory. I must not forget the shops where the men may purchase necessary commodities, nor the model lodging-houses, where they have apartments for themselves and families. Who can view these institutions, so well calculated to advance the social condition of the still too ignorant working classes in Italy, without being pardoned for digressing for a moment from the more beaten track of technological description ?

The count established a fund, by which the men, relinquishing a day's wages per month, are free to the enjoyment of the whole of these liberal

institutions, including house rent. As might be anticipated, the apothecary's shop is largely frequented by villagers from the neighbourhood, who obtain drugs free of expense. The late Grand Duke of Tuscany, alive to the good which M. Lardarel had done and was doing, ennobled him with the title of Count of Monte Cerboli. If I were asked to erect a monument to him at Lardarello, I would place no statue, but simply copy the beautiful epitaph applied to Sir Christopher Wren, in St. Paul's Cathedral, London, "*Si monumentum quæris, circumspice.*"

The lake of MONTE ROTONDO, belonging to M. Durval, contains $\frac{1}{600}$ of boracic acid in solution, the maximum of impurities being 15 per cent., chiefly sulphates of lime, ammonia, alumina, and magnesia, hydrochloric acid, and free sulphuric acid, with traces of organic matter. The area of the lake is about 18 acres. M. Durval produced from it 64 tons in 1854 and 142 tons in 1855.

Within the last year Prof. De Luca has analyzed two specimens of boracic acid from M. Durval's works; these he kindly communicated to me, and not having been published before, they are additionally valuable, and are as follows :—

	No. 1.	No. 2.
Anhydrous boracic acid	50·7	46.6
Water	36·9	40·4
Sulphuric acid	9·1	9·5
Chlorine	0·2	0·1
Silica	1.0	1·2
Magnesia	1.1	1·3
Lime	0·5	0·6
Ammonia	0·3	0·4
Potash, soda, alumina, oxide of iron, and organic matter . . .	traces.	traces.
Total	99·8	100·1
Impurities in the above . . .	12·2	13·1
100 parts give of crystallized boracic acid	89·0	84·3

TRAVALE.—Within the last two or three years a new company, called the "Società Anonima di Travale," has commenced operations near Montieri (*Pisa*), for extracting the boracic acid which is there found in small quantities, associated with a large proportion of sulphate of ammonia. The locality is north of the fracture we have been describing, and it remains to be proved whether it offers such a brilliant future as the other lagoons.

The remarkable analogy between the lagoons and volcanic craters will be best seen by a comparison of the products found in these respective places.

The following is a list of some of the gases and minerals from the

Tuscan boracic acid lagoons, compared principally with those from Vulcano, in the Lipari Islands, &c., which will show their intimate connection with volcanic action :—

1. Sulphuretted hydrogen is found in large quantities, as at Vulcano. Pilla remarks that Vesuvius emits hydrochloric acid in great abundance, as do Etna and all other active volcanoes, while quiescent ones pour forth chiefly sulphuretted hydrogen, which is disengaged at lower temperatures than is necessary to liberate the former. (*Trattato di Geologia*, tom. i., p. 244.)

2. Sassoline, Boracic acid, BO^3, 3 HO ; also in Vulcano :—

Boracic acid . . .	56·4
Water	43·6
	100·0

3. Hayesine, Borate of lime, CaO, 2 BO^3 + 3 HO ; also at Iquique, Peru :—

Lime	20·85
Boracic acid . . .	51·13
Water	26·25
Silica, Alumina, and Magnesia . . .	1·75
	99·98

4. Lagonite, Borate of iron, $Fe^2 O^3$, 3 BO^3 + 3 HO ; as incrustations :—

Sesquioxide of iron .	36·26
Water	14·02
Boracic acid . . .	47·95
Magnesia and loss .	1·77
	100·00

5. Lardarellite, Borate of ammonia, NH^4O, 4 BO^3 + 4 HO :—

Ammonia . . .	12·73
Water	18·32
Boracic acid . . .	68·56
	99·61

6. Borax? NaO, 2BO^3 + 6 HO :—

Soda	19·25
Water	37·19
Boracic acid . . .	43·56
	100·00

(Ordinary borax contains 10 atoms of water.)

7. Mascagnine, NH^4O, SO^3 + 2 HO ; also in the Lipari Islands :—

Ammonia	34·67
Sulphuric acid . .	52·33
Water	12·00
	99·00

8. Gypsum, CaO, SO^3 + 2 HO (Impure).

9. Selenite, CaO, SO^3 + 2 HO.

10. Anhydrite, CaO, SO^3 :—

Lime	41·2
Sulphuric acid . .	58·8
	100·0

11. Alum (probably ammonia and iron alums).

12. Sulphate of Magnesia (rare), MgO, SO^3.

13. Sulphate of ammonia.

14. Iron pyrites, Fe S^2.

15. Sulphur incrustations, S ; also in the Lipari Islands.

16. Resinous quartz, SiO^2.

17. Common salt :—Na Cl.

The connection between the *soffioni* and volcanic craters has been corroborated in a remarkable manner by the discovery of boracic acid crystals in the minor crevasses produced near the Torre del Greco during the eruption of Vesuvius in the winter of 1861, and I have a firm conviction that a very considerable quantity of boron, combined in some way or another, exists in Vesuvius, but that its occasional ejection is purely a matter of affinities and temperature, so that even here it may be one day possible to establish boracic acid establishments, profiting by certain barometrical and thermometrical conditions of the atmosphere.

The boracic acid crystals from the lagoons are far from pure, con-

taining a small quantity of numerous sulphates, mechanically mixed. In 1842, Wittstein (*Rapp. ann. de Berzelius*), published the following analysis:—

Crystallized boracic acid (3 HO BO)		76·494
Sulphate of	Iron	0·365
	Alumina	0·320
	Lime	1·018
	Magnesia	2·632
	Ammonia	8·508
	Soda	0·917
	Potash	0·369
Chloride of ammonium		0·298
Water of crystallisation of the above salts		6·557
Silicic acid		1·200
Sulphuric acid combined with boracic acid		1·322
Organic matter and sulphate of iron		traces.
		100·000

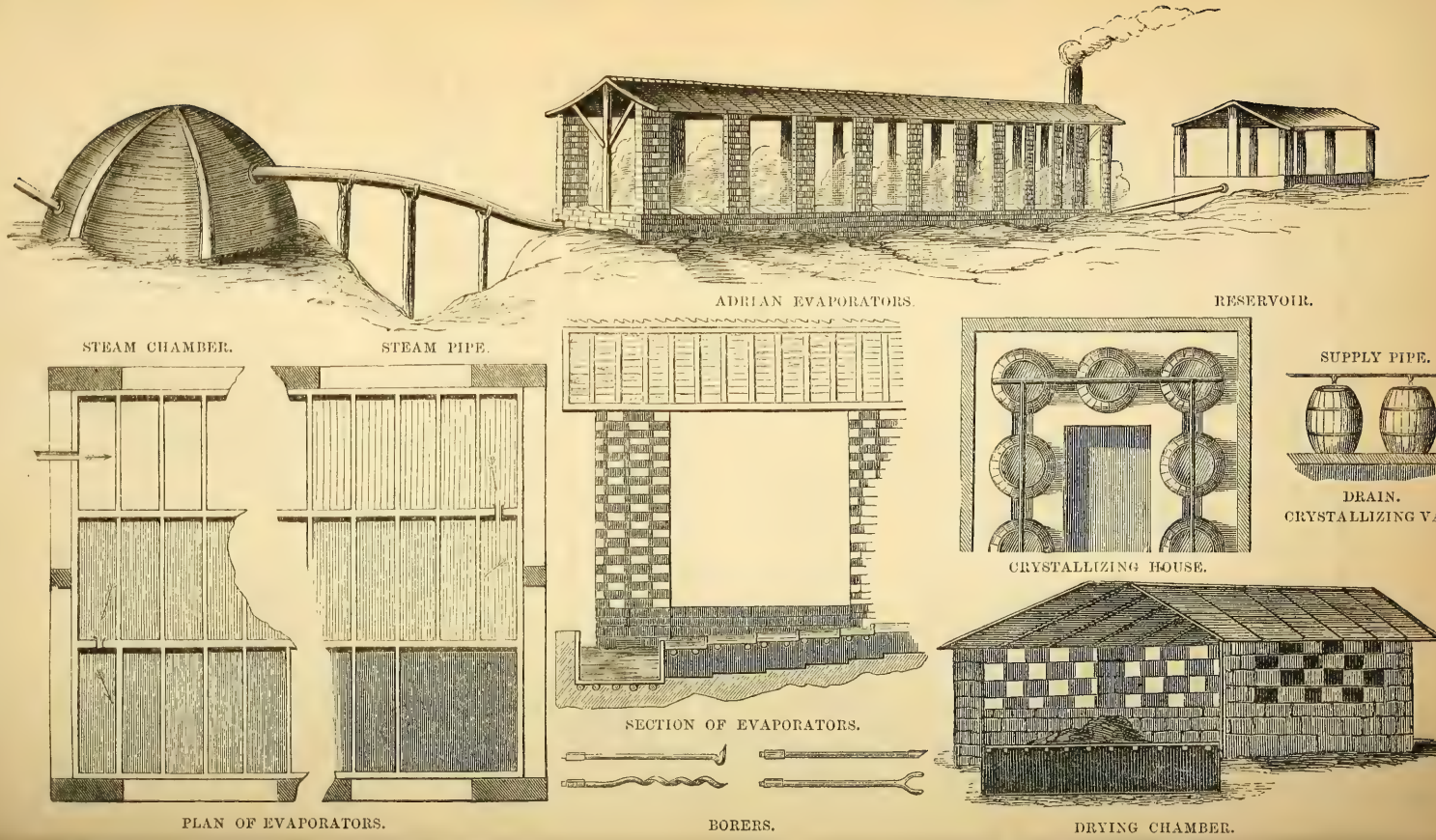
The amount of foreign salts has very considerably diminished since the *lagoni* were first made use of; I believe it is not more than 13 per cent. at this time. In order to purify the crude produce, which is not done in Italy, nothing further is necessary but to re-crystallize it once or twice.

It will suffice to mention that the uses of boracic acid are only limited by the supply. The greater part of what Count Lardarel produces is exported to England, that of M. Durval supplying the necessities of the French market.

The British Custom-house returns show that the importation of the boracic acid produced by Count Lardarel and M. Durval, from Central Italy into England, has been as follows; the quantity of olive oil is given for the sake of comparison, as being better known to the public.

Years.	Boracic Acid.			Value of Olive Oil imported from Tuscany during the same period.	Total imports from Tuscany.
	Quantities.		Value.		
	tons.	cwt.	£	£	£
1852	935	1	...	...	...
1853	1,038	8	...	...	...
1854	1,185	9	106,691	68,853	751,595
1855	1,338	16	121,163	142,893	747,967
1856	1,253	0	110,264	130,711	554,437
1857	1,245	12	87,192	103,914	534,494
1858	1,156	15	73,157	123,892	538,500
1859	1,785	17	94,846	117,398	648,460
1860	1,406	0	77,336	148,751	575,064
Totals	.....		£670,649	£836,412	£4,350,517

DETAILS OF BORACIC ACID MANUFACTURE.



Thus the seventh part of the imports from Tuscan provinces into England, *representing* 80,000*l. per annum*, *is derived from the evaporation of mineral waters*, an item second only in value to the celebrated oils of Lucca and other parts of the country.

Mr. Wood, of Stoke-upon-Trent, applied boracic acid to glazing pottery in 1820, and for that branch of industry an enormous quantity is consumed.

The glaze for common English porcelain differs only from that employed for figures and ornaments in the amount of borax and silica. Their respective composition is :—

Felspar . . .	45 — 45	Flint Glass . .	20 — 20
Silica	9 — 12	Nickel . . .	4 — 4
Borax . . .	21 — 15	Minium . . .	12 — 12

— Dumas, *Traité de Chimie*, tom. ii., p. 265.

With silicates of the alkalies and various metallic oxides, it forms that beautiful and brilliant greenish-yellowish glass, made at Sèvres, of which the composition is given below :—

Silica	19·23	Oxide of zinc	2·99
Protoxide of lead .	57·64	Antimonic acid . .	3·41
Soda	3·08	Potash	0·44
Boracic acid . . .	7·00		
Peroxide of iron . .	6·12		100·00

—Salvetat, *Annales de Chimie et de Physique*, 3ieme Série, tom. 15, p. 122.

M. Maës, of Clichy la Garenne, near Paris, manufactures glass of boro-silicates of potash and zinc, boro-silicates of soda and zinc, and boro-silicates of potash and baryta.

I was informed by several persons that the vines in the neighbourhood of the lagoons do not get the Oidium disease, which may possibly be attributable to the sulphurous vapours which arise so plentifully and pervade the atmosphere—perhaps even in a less degree to the sulphuretted hydrogen ; hence this locality is well adapted for the growth of vines, wherever the soil in the lower valleys admits of their cultivation. May not this continual vapour of sulphurous acid account in some degree for the excellence of the celebrated wines of Vesuvius? For a similar reason, it is possible that the superiority of the Canary wines may be partly attributable to the sulphurous bath to which they are subjected, as well to the richness of the soil, though that also is incontestable.

[An article "On the Nitrate of Soda and Borate Districts of Peru," by Wm. Bollaert, F.R.G.S., appeared in Vol. I. of the TECHNOLOGIST, p. 115, and one "On the Uses of the Tincal of Asia and its Applications," by Arthur Robottom, p. 370 in the same volume.—EDITOR.]

NATA, THE BONDUC NUT, AND ITS PROPERTIES.

Attention has recently been drawn in some of the continental and English periodicals, to the medical uses of these seeds, the produce of *Guilandina Bonduc*, Linn.; *Cæsalpinia Bonduc*, Roxb. Flor. Ind. II. 362, *C. Bonducella*, Fleming. Rheede II. t. 22. As. Researches II. 159, "The Sociéte d'Acclimatation," so the paragraph runs "has just received a letter from India, accompanied with a box containing a quantity of seeds of the *Cæsalpinia Bonducella*, a plant which, according to Mr. Hayes, the writer of the letter, is much used there as a specific for intermittent fevers. The Bengalee name for this plant is Nata. It is a small creeper producing a nut, the kernel of which is exceedingly bitter, and possesses the quality of Jesuit's bark in an eminent degree, with this exception that it is aperient rather than the contrary, a valuable property in a tropical climate where the bilious system is so generally affected. It is singular that the remarkable properties of this plant should have remained so long unnoticed, offering as it does a cheap and powerful substitute for Jesuit's bark, which, as every one knows, commands a high price. As the plant thrives in Egypt, Mr. Hayes thinks that it might prosper in Algeria, and even in the south of France."

Thus far the paragraph. Now, let us see how far it may be relied on. There is certainly nothing new in the statements put forth; for so far from being unnoticed, the properties pointed out have been alluded to by almost every leading writer. Lindley (Vegetable Kingdom, 550) says, "Some (of the *Cæsalpinieæ*) are reported to produce powerfully bitter and tonic effects. The bark and seeds of *Guilandina Bonduc* are of this class; the latter are very bitter; when pounded small and mixed with castor oil, they form a valuable external application in incipient hydrocele. The leaves are a valuable discutient, fried with a little castor oil in cases of hernia humoralis." But he adds that the seeds are emetic.

Our correspondent, Mr. Jackson, of the Kew Museum, in his papers "On the Products of the Pea Family," in TECHNOLOGIST, vol. II., p. 310, pointed out some of the uses of the plant.

Dr. O'Shaughnessy, (*Bengal Dispensatory*, Calcutta,) so far back as 1842, states, "The seeds are a powerful tonic, and very valuable febrifuge. The kernels are very bitter, when reduced to powder and mixed with black pepper, they are used in 3 to 6 gr. doses in ague, with the best results; powdered small with castor oil, they are applied externally in hydrocele. The seeds yield oil, starch, sugar, and resin. Mr. Piddington published an analysis in the Trans. Medical and Physical Society of Calcutta, in which these principles were described. Nitric acid reddens the nut, and subsequently gives it a yellow colour. The root is described in Amboyna to be a good tonic."

Dr. Hogg in his "Vegetable Kingdom" (London, 1858,) and Major

Drury, in his "Useful Plants of India," (Madras, 1858,) have also published these and similar details, so that there is nothing very new in the accounts put forth. The oil from the leaves is said to be useful in convulsions, palsy, &c. In Barbados the plant is known as the horse nicker or chick stone. Ornaments made of the seeds are common in most museums. We have baskets, bracelets, rosaries, &c., formed of the Bonduc nuts. There is no doubt it would readily grow in Algeria, and probably in the South of Europe and the Mediterranean Islands. It is often used as a fence plant in the West Indies, the curved thorns on the branches serving to keep off trespassers.

The Bunduc nuts appear to be used in India in combination with the Cheretta (*Agatha chirayta*,) all the parts of which plant are extremely bitter. P. L. S.

ON DYEING AND CALICO PRINTING.

BY DR. F. CRACE CALVERT, F.R.S.*

To give a comprehensive view of the present state of the arts of dyeing and calico printing, it will be more convenient to divide the subject under two general heads.

I. Dyeing.—I shall commence my observations on dyeing by referring especially to the remarkable and beautiful colours derived from coal-tar, the introduction of which into this art may be said to constitute the chief distinction, as far as dyeing is concerned, between the present and former Exhibition—creating, in fact, a new era in the tinctorial art. As it is intended that this report should comprise, besides a description of the distinctive excellence of the goods exhibited, some useful information to the public respecting the means by which the results have been obtained, I shall detail some of the steps which preceded the discovery of these beautiful colours, and show how they have been successfully adapted to the art of dyeing. I may, *en passant*, state the interesting fact that a substance which was originally, and so recently as 1826, a purely scientific product, has become, by a series of discoveries, one of the most valuable of dye-stuffs. Thus in 1825, Faraday obtained for the first time benzine from coal gas. In 1826, Unverdorben discovered a substance which was ultimately named aniline by Fritsche and subsequently found by Dr. A. W. Hofmann to be a product of coal tar; and further by the researches of eminent chemists, the benzine of Faraday has become the aniline of Hofmann. To effect this, the fol-

* From the Jury Reports.

lowing simple and ingenious method has been devised. Benzine, one of the most volatile products of coal-tar, and now well known, is treated with strong nitric acid, when a violent action ensues, which gives rise to a substance called nitro-benzine; this is then mixed with acetic acid and iron filings, and the result of the chemical action is to convert the nitro-benzine into aniline, which is easily separated from the iron filings and other impurities by careful distillation. It is this substance which Mr. W. A. Perkin took in 1856, mixed with sulphuric acid and bichromate of potash, and successfully converted into the well-known dye called *aniline purple*, the applications of which in the late Exhibition were so beautiful and endless. To obtain this colour in the state required by the dyer it is necessary to extract it from the mass resulting from the action of sulphuric acid and bichromate of potash, by washing it with coal naphtha, which removes various useless tarry products, and then with alcohol, which dissolves the colour and renders it fit for use. Shortly after Mr. Perkin's mauve was introduced to the trade, Messrs. Renard Frères, of Lyons, obtained from aniline another colour, since well known under the name of *magenta*. This colour, which was first observed by Mr. Natanson, in 1856, and produced by Dr. W. A. Hofmann, in 1857, was commercially made in 1859 by M. Verguin, and successfully introduced into commerce by Messrs. Renard Frères. To prepare their magenta, or, as they called it, fuchsine, they heated for about twenty minutes at a temperature of 392°, a mixture of aniline and bichloride of tin. The dark mass so obtained was left to cool, and then boiled with hot water, and the solution of fuchsine filtered off. It was then only necessary to throw down the fuchsine from the solution by common salt, and to re-dissolve it in slightly acidulated water to render it fit for the dyer. This colour is now prepared in England most successfully, and in a high state of purity by Messrs. Simpson, Maule, and Nicholson. Their process consists in heating aniline with arsenic acid, and treating the mass when cold with boiling water. The colour is then purified and combined with acetic acid, which compound, being soluble in water, is ready for the dyer.

Whilst dwelling on aniline, a blue colour also obtained from it should be noticed. It was first produced by Messrs. Persoz, De Luynes, and Salvétat, and subsequently manufactured commercially by Messrs. Renard Frères. This firm employs Girard's method, which consists in mixing magenta with aniline, and heating the whole for several hours at a temperature of 359°, when the "Bleu de Lyon" is produced, and it is brought to a state of purity by acting on the mass at a boiling temperature, with a weak solution of hydrochloric acid.

It would not be conveying a correct idea of the present state of knowledge respecting the aniline colours if I omitted to mention the interesting discovery recently made and published by Dr. A. W. Hofmann, F.R.S., showing that the substance which gives the magenta

colour is itself perfectly colourless, until it is combined with an acid and becomes red; thus when the colourless substance, named rosaniline, or

$$C_{20}H_{10}N_3H^2O$$

combines with acetic acid, acetate of rosaniline or magenta is formed, and constitutes the beautiful crowns of roseine exhibited by Messrs Simpson and Co. It is easy to prove by Dr. Hofmann's extremely ingenious process, that roseine is an acetate of rosaniline, for by boiling roseine with ammonia, colourless crystals of ammonia are liberated. There is no doubt that the aniline purples and blues will be also traced to a colourless alkaloid, and it would not be surprising if this should prove to be isomeric or homologous with that producing roseine.

Messrs. Laurent and Casthelaz, of France, have exhibited a red colour from coal-tar which deserves attention, as it is produced by a new and highly interesting chemical reaction, directly from nitro-benzine without the intermediate process of converting the latter into aniline. This product will be found under the name of *erythro-benzine* in their case.

Messrs. Simpson, Maule, and Nicholson have also exhibited a beautiful yellow from aniline, which they call *phosphéine*, and a superb purple called *regina purple*, which is obtained by carefully heating roseine in a suitable apparatus at a temperature of about 400°. The mass obtained is heated with acetic acid and alcohol, when the regina purple is dissolved.

Put to describe only the colours obtained from aniline would give an inadequate idea of the fertility which enables coal-tar to yield to the researches of the chemist such a variety of splendid dyes. Thus, for example, in 1860, Messrs. Guinon, Marnas, and Bonnet, of Lyons, introduced a beautiful brilliant blue colour from coal-tar products, under the name of *azuline*, obtained from phenyc acid. These gentlemen, as well as Messrs. W. Adshead and Co., also exhibit specimens of silk dyed with another coal-tar product called picric acid, which is obtained by the action of nitric acid on carbolic acid. This beautiful yellow dye well known in 1851, has been extensively used with the coal-tar blues for the production of excellent greens, which possess the property of remaining green by artificial light. But the best examples of dyed-green silk-skeins in the Exhibition are those dyed with picric acid and then with very pure sulphate of indigo The dyer, however, replaces the sulphate of indigo by Prussian blue, when his object is to produce a green which shall appear as such by artificial light.

These observations should not be brought to a conclusion without remarking that the coal-tar colours deserve attention for their power as well as for the facility with which they may be applied, for one grain will deeply tint half a gallon of water, and little or no skill is required

for their application. It is not intended in this short report to give a description of the numerous methods adopted to produce these new dyes, but only to mention those which are illustrated in the Exhibition by their application to fabrics.

Since 1851 and even since 1855, a most valuable improvement has been made in the manufacture of an important dye-stuff known under the name of orchil. Though this material yielded beautiful purple and violet dyes, they had the disadvantage of being extremely fugitive, the acid vapours of our large cities causing them to become red, and to fade rapidly. But the important desideratum of giving fastness to these brilliant colours was obtained in 1856 by M. Marnas, of the firm of Guinon, Marnas, and Bonnet, who arrived at this valuable result by treating lichens, as suggested by Dr. Stenhouse, with milk of lime, filtering off the lime liquor, and precipitating the colour-giving principles from it with hydrochloric acid, gathering these on a filter, and after having properly washed them, dissolving them in caustic ammonia, and keeping this ammoniacal liquor at a temperature of 153° to 160° for twenty to twenty-five days. Under the influence of that temperature the colour-giving principles fix ammonia and oxygen, and are transformed into a new series of products which M. Marnas separates from the coloured liquor by adding chloride of calcium, causing a fine purple lake to be deposited, this, after being well washed and dried, is sold under the name of French purple. It is easy to understand that the chloride of calcium can be replaced by salts of alumina, tin, &c. What distinguishes this orchil colour from those previously known is, that it dyes animal fibres with greater facility than the common orchil, that it gives directly mauve colours, which can be modified with carmine of indigo, roseine, &c.; but the essential difference between these purples and those from common orchil is—that while the latter are destroyed by acids and light, those of M. Marnas, on the contrary, withstand these influences. To dye silk or wool with French purple it is simply necessary to to mix the lake with its weight of oxalic acid, boil with water, and then filter, the oxalate of lime remaining on the filter while the colour passes into the filtrate. This liquor is then added to a slightly ammoniacal liquor, contained in the dye-beck, and all that is now necessary is to dip in the beck silk, wool, cotton mordanted with albumen, or cotton prepared as for Turkey-red, when any of these materials will become dyed with magnificent fast shades of purple or mauve.

It is to be regretted that there is not a larger number of examples of fabrics dyed with a most splendid colour, viz., murexide, or Roman purple, which was so extensively used in 1856 and 1857 by some of our largest dyers and printers. As this colour furnishes one more remarkable instance of the great assistance derived by practical art from the researches of science, I cannot refrain from giving here a short sketch of its history. In 1776, the illustrious Swedish chemist Scheele, dis-

covered in human urine, uric acid. In 1817, Brugnatelli found that nitric acid transformed uric acid into a substance which he called *erythric acid*, but which was subsequently called by Wöhler and Liebig *alloxan*. In 1818, Dr. Prout found that the latter substance gave, when in contact with ammonia, a beautiful purple-red colour, which he called purpurate of ammonia—the product known by the name of *murexide* since the researches of Liebig and Wöhler, published about 1837. These discoveries remained dormant in the field of pure science until the year 1851, when Dr. Saac observed that when alloxan came into contact with the hand, it tinged it red. This led him to infer that alloxan might be employed to dye woollens red, and further experiments convinced him that if woollen cloth were prepared with a salt of tin, passed through a solution of alloxan, and then submitted to a gentle heat, a most beautiful and delicate pink colour resulted. In 1856, MM. Depouilly, Lauth, Meister, Petersen, and Albert Schlumberger, applied it as a dyeing material to silk and wool, and succeeded in obtaining red and purple colours, by mixing the murexide with corrosive sublimate, acetate of soda, and acetic acid. It will naturally be wondered where the supplies of uric acid or murexide could be found to supply such a demand as at one time existed. The production of the colour from uric acid is in itself interesting, but still more so is the fact that chemical investigation has opened up a source of uric acid so unexpected and so extensive as that of Peruvian guano. To extract uric acid from guano, the latter is treated repeatedly with hydrochloric acid, until all soluble matters are removed by heat and washing. The insoluble mass, consisting chiefly of sand and uric acid, is carefully treated with nitric acid of specific gravity 1.40. When the action of the acid is completed, the mass is treated with warm water, and thrown on a filter. The filtrate, which has a yellowish colour, and contains alloxan, &c., is evaporated carefully to such a degree that when left to cool, it becomes a brownish-red, or violet solid, called by the inventor *carmin de pourpre*.

In the French department, M. Charvin, of Lyons, has shown some specimens of silk dyed with the interesting green dye extracted by him from the *Rhamnus catharticus*, which is perfectly identical with the curious dye imported from China, and used in this country and in France in 1855 and 1856, known by the name of *La-kao*.

The attention of the public is called to fine specimens of dyed black silk skeins in the English, Prussian, and French departments, but especially in the latter, where M. Gilet of Lyons exhibits a new black from the substance *le Hennée des Arabes*, which he imports from Algeria, and which he applies with great advantage to obtain a superior weighted black silk.

With reference to dyed woollen yarns, there are some excellent displays in the French, Prussian, and Hesse Cassel departments, but the beautiful collection of clouded woollen yarns of M. N. Rave, senior, of

Brussels, deserves special notice, as they are remarkable for the neatness and precision of the junction of the colours.

If the dyed cotton yarns exhibited do not illustrate any new discoveries, still the attention of the observer is strongly drawn to one class of yarns, of which a very extensive and varied assortment is shown and in which great excellence is attained, that is in Turkey-red dyed yarns. It is, therefore, desirable to give a slight description of this ancient (but frequently improved) process, which gives shades of such brilliancy and fastness. Without entering into a full detail of the numerous and tedious manipulations undergone by the yarn in the course of its preparation for fixing the colouring principles of madder, it may be stated that the chief characteristic of Turkey-red dyeing, is the use of olive or gallipoli oil as a fixing agent. The bleached yarn is first soaked in a peculiar quality of this oil—I say peculiar, because the oil used must, when mixed with a small quantity of an alkaline carbonate, form a white emulsion ; this is due, as we now known from M. Pelouze's researches, to a ferment which the oil, as it is liberated from the berry, carries with it, and which resolves the oil into its component parts, viz., glycerine and fatty acids ; and it is the oils so modified which are adapted for Turkey-red dyeing, The yarns saturated with these acids are dipped into a solution of carbonate of soda, and then exposed to the action of the air, or air and steam in a warm room. After this treatment has been repeated a sufficient number of times, the yarns are passed through a solution of nut-galls, then into a solution of a salt of alumina, called red mordant, and the yarn so prepared is ready for dyeing, to effect which it is boiled for two or three hours in a bath to which madder-root has been added. Lastly, the brilliancy of the colour is completed by boiling the yarns in a strong solution of soap. This method of preparing cotton for dyeing has enabled dyers to apply with success the aniline purple.

The dyed fabrics exhibited in the Indian department will be examined with great interest, and, considering the limited means at the disposal of the dyer, the goods are deserving of public notice, especially with reference to the beauty and brilliancy of some of the dyes, which are well illustrated by the exhibitors, Rao Venkata and Rao Papana ; there are also several displays amongst the manufactured goods which are worth examination. It may be here suggested, that great advantage to these arts might be obtained if the Indian government were to take steps to forward to this country some of the dyestuffs used by the Indian dyers, in quantities sufficient for practical trials. For if we consider the wonderful progress which Turkey-red dyeing has made with European appliances, and with the assistance of chemistry, as compared with the mode in which it was carried on for centuries in India, it is impossible to say what advantages might result to India ; if, for instance, the new green of Dr. Thompson, the Jack-

wood, (*artocarpus integrifolia*) A., or the *Kayu Kudrang*, &c., of which specimens are exhibited in this department, were imported into this country in such quantities as to receive some practical applications.

II. Calico Printing.—The printers of Great Britain, though comparatively few, have shown by many examples that they are well able to avail themselves of the mechanical and chemical means at their disposal for producing a large variety of goods fitted, both by design and execution, for this as well as for numerous foreign markets ; and there can be little doubt that the close observer of the goods exhibited, even by a few only of our best printers, will form the opinion that no country surpasses, if it equals Great Britain in the class of goods called " cheap and fast prints," which class, after all, forms the great staple of our production, supplying, as it does, the great demands of the million. It should be kept in mind in estimating the comparative merits of different styles of printing, that the great aim of the British manufacturer is to find cheap methods of producing in large quantities good, but at the same time low-priced prints ; for some of our printers will turn out as many as a million or a million and a half of pieces in a single year. It follows, therefore, that the printers of Great Britain, as well as those of several other countries, are obliged to cultivate both precision and rapidity of execution, impossible of attainment with methods which may well remunerate the foreigner who aims at extreme delicacy and finish of workmanship, but whose interest, at the same time, is to produce only in limited quantity. For instance, several of the leading French houses exhibit goods which, at a short distance, appear like embroidery, instead of, as they are, merely prints ; this effect is obtained by pasting the entire piece on a long table or frame, and then skilfully applying the colour with blocks. When the piece has been removed, washed, and finished, the colours have a body, and at the some time, through not having penetrated the substance of the cloth, they acquire a transparency which produces on the eye an effect as if the pattern were in relievo.

Before entering into the details of the various styles of printing exhibited, and of the methods by which they are produced, it is desirable to make a few remarks on the distinguishing characteristics of other European countries.

Austria has never appeared to equal advantage in any previous Exhibition ; the designs are varied and in good taste, and the quality of colour and neatness of impression are alike excellent.

Though the Zollverein shows no printed calico, there is a good collection of printed silk handkerchiefs, and a fine collection of cheap printed shawls and carpets from Saxony.

Russia has displayed, as already noticed, some goods specimens of Turkey-red dyeing, especially those obtained with the species of madder known by the name of *Marena ;* also a good collection of goods well suited for Eastern markets, especially in the style called *Lapis*.

It is to be regretted that the best printers of Belgium and Switzerland, like those of Great Britain and the Zollverein, have abstained from exhibiting, and it is therefore impossible to form a correct idea of the progress of calico printing in those countries.

It may be as well to state here, though there are no prints of native production in the Indian Department worth notice, the Cotton Supply Association has exhibited, through Mr. Cheetham, some fine specimens of goods printed in England on Surat cotton ; and although the details of the processes used are not sufficiently known for a close comparison of these goods with similar ones printed on American cotton, still the results are so good as to be highly satisfactory, and warrant the belief that Surat cotton may be very extensively substituted for American.

What has been already said will doubtless have led to the anticipation that the printed goods exhibited in the French department are, generally speaking, of a very high class, and justify the reputation which the best printers of France have long since acquired, especially in those fashionable styles known popularly by the name of *haute nouveauté.* In this class of prints elegance of design, beauty of colour, and delicacy of execution stand unrivalled by those of any other nation, and they have applied the new tar colours with a perfection of skill which leaves nothing to be desired. It will also be seen in the course of this report that they have exhibited several original improvements.

III. Pigment Printing.—This style of printing has been developed to such an extent within a few years as to demand a slight historical sketch of successive phases through which it has passed. Pigment printing made but little progress for many years, owing to the insufficient variety of pigments, and the difficulty of finding a proper fixing agent which would give the pigment the required consistency, and at the same time cause it to adhere to the cloth. Artificial ultramarine was the first pigment attempted to be printed, and in 1843 india-rubber dissolved in naphtha was proposed as the fixing agent; but from the danger of fire, and other reasons, this was abandoned. In 1847, egg albumen was introduced into this country for the same purpose, but owing to the coarseness of the ultramarine, and its high price (about 8*l.* per pound, which is now 1s. 3d.), the progress of this mode of printing was much retarded. In 1849, Mr. R. T. Paterson, of Glasgow, patented the use of caseine from milk, which he called lactarine, and thereby promoted the use of ultramarine, buff, and stone pigments in shawl printing. About the same period another fixing agent was introduced, viz., albumen obtained from blood. The style of pigment printing, however, received an extraordinary impetus in the spring of 1859, when the purple aniline of Mr. Perkin, and the French purple of Messrs. Guinon, Marnas, and Bonnet were introduced to the trade, and led to the production of those splendid mauves and purples which astonished the world by their beauty and brilliancy. These were obtained by

printing albumen or lactarine on muslin, and fixing the same by coagulating it by the action of steam. The pieces were then passed into the dye-beck, containing in solution either aniline purple, or French purple, when the albumen or lactarine took up the colour, and fixed it on the cloth, after which the pieces were thoroughly washed, to remove any excess of colour. In the middle of the same year a beautiful green pigment, which had been patented in 1859 by Mr. Guignet, was introduced; and as it is extensively employed, it may be interesting to know how this green oxide of chrome is produced. Three parts of boracic acid are intimately mixed with one part of bichromate of potash, and a sufficient quantity of water to form the whole into a thick paste. It is then introduced into a furnace, and heated to a dull red heat, when a borate of potash, and a borate of oxide of chrome are produced. The mass is allowed to cool, and is then thrown into cold water, when the borate of potash dissolves, and the borate of oxide of chrome is decomposed. The hydrate of oxide of chromium, $Cr_2O_3 + 3\,HO$, falls to the bottom as a magnificent green powder, requiring only to be well washed and drained to be ready for use.

The peculiarity of this green, as well as of one prepared by M. Arnaudon, of Turin, from phosphate of ammonia and bichromate of potash, is that, besides being of a brilliant green, it maintains this colour by artificial light. In November, 1859, the magenta colour, or fuchsine, of Messrs. Renard Frères, was introduced to the printing trade, and fixed by the above-described method. The beautiful pinks thus produced were soon followed by the application of roseine, azaléine, and other aniline reds. In May, 1859, a further improvement was made which reduced the cost of applying these colours to muslins, by Mr Walter Crum, who made the curious observation, that if the gluten of wheat flour is allowed, by exposure to the atmosphere, to fall into a semi-fluid condition, it dissolves easily in a weak solution of caustic soda, which solution he used as a substitute for albumen or lactarine. About the same time Mr. Scheurer Kestner also introduced the use of gluten by the aid of weak acids; and Messrs. W. A. Perkin and Matthew Gray, of the Dalmarnock Printing Company, proposed to fix the coal-tar colours on fabrics by means of a lead-soap.

Early in 1860, calico printers succeeded in printing the aniline colours directly with the animal mordants, instead of dyeing the mordants after the latter were printed and fixed, and thus were enabled not only to print a variety of colours on the same piece, but also to effect a great saving and simplicity in the operation. By this means the pigment style was fully developed, and an entirely new class of prints was introduced.

Owing to the great extension of this style, the cost of the animal mordants employed became such a serious consideration as to cause anxious search for other means of fixing the colours; and Messrs. Cal-

vert and Lowe having observed, in 1856, that tanning matters would precipitate and render insoluble certain coal-tar colours, further observed, at the end of 1859, that tannin, when printed on prepared cloth, and submitted to the action of the steam, would become fixed, and serve as a mordant for the coal-tar colours. But it was only in 1860 that this result was practically carried out by Mr. Gratrix, and although the aniline purples so fixed are faster against soap than those printed with albumen, they do not so perfectly resist the action of light. The process preferred by Mr. Gratrix consisted in making cloth prepared with oxide of tin, such as is generally used for steam colours, and after having prepared it with a gall-nut solution, submitting it to the action of steam, when the tannin becomes fixed and insoluble : the pieces are then passed through a dunging liquor, washed, and then into a beck containing aniline purple, mixed with a little acetic acid. As the bath is gradually carried to the boil, the colour fixes itself on the tannin, and thus produces the print ; but, as the whites are rather soiled, the pieces are passed into a weak acid bath, or through a weak solution of printing clearing liquor, such as used for garancine.

In 1861, Messrs. Nathaniel Lloyd and E. G. Dale introduced a process, the leading feature of which is the use of tartar-emetic as the agent for fixing aniline purple.

Although it has been long known to chemists that aniline would yield a green colour under certain oxidizing agents, up to the present time all efforts to dye silk or wool commercially with it have failed, but in 1860, Messrs. Calvert, Clift, and Lowe introduced a most easy and practical method of producing it under the name of *emeraldine*, on cotton fabrics. The process consists in printing an acid chloride of aniline on a cotton fabric prepared with chlorate of potash, and in a few hours a beautiful bright green gradually appears, which only requires to be washed. If the green fabric is passed through a solution of bichromate of potash, this colour is transformed into a dark indigo blue, called *azurine*. The production of this colour directly on the fabric is most important, and it will probably lead to the similar production of the other coal-tar colours, without previous treatment, directly on the cloth. By this means not only the great loss of aniline in the original production of the colour will be avoided, but a considerable economy of mordants will be effected.

It is by availing themselves extensively of the pigment style of printing that the French have given such an attractive appearance to their display of printed fabrics in the Exhibition ; and by the aid of the remarkable talent possessed by this people for combining various contrivances, such as the block, perrotine, and roller, they have succeeded not only in producing beautiful effects, but also in perfectly imitating madder and steam chintz styles, in which the colours simultaneously printed by these various modes are adjusted one to the other with perfect accuracy.

It should be observed that the great facility which attends the application of the tar colours and pigments generally, as compared with madder styles, reduces printing (apart from design) nearer to the level of a mechanical art than would at first sight appear. In a word, thanks to the brilliancy of those colours, their affinity for animal matters, and the facility of using several pigments at the same time, the execution of complicated designs on fabrics is no longer beset with what were formerly insuperable difficulties.

A most interesting and valuable method of applying aniline colours in fabrics has been devised by M. Onfroy, of Paris. It consists in printing the aniline red, purple, or blue, on a solid black or brown ground, in which gallic acid has been used instead of the ordinary tanning matters, the result of which is, that the black or brown ground is more easily reduced, so that if he mixes with the aniline colours and animal mordants some acid, such as oxalic acid, the black or brown is destroyed, and the aniline colour fixed. This produces a new effect. While speaking of this important improvement, it may be as well to allude to two other inventions introduced by the same gentleman. One of these, called by him *Tireur mécanique*, is a great improvement on the old Tobby sieve, or the other mechanical means which have been devised to enable the block-printer to carry on his block several colours at once. M. Onfroy has succeeded in enabling the block-printer, by simply moving his feet, to feed the surface of his sieve with a great variety of colours, and to level them with a brush, also mechanically moved, so that whilst he is applying the block to the fabric the machine is preparing the colour for feeding it afresh. M. Onfroy has also invented a mechanical contrivance which may be very useful to the calico-printer, and which he calls a *résiste tambour*. It consists of a large cylinder, three or four feet in circumference, covered with folds of cloth, which are made to adhere by a solution of caoutchouc ; over this is placed a layer of felt, in which the blanks in the pattern to be printed are cut out. The roller is so placed in the machine as to print the resists required.

It is highly probable that the style of pigment printing will receive a great impulse from the introduction of lakes generally ; and this opinion is supported by the beautiful specimens of cotton printed with alumina lakes, of the colouring principle of madder exhibited in the French department, as well as by the varied collection of lakes, especially of barwood lake, prepared with oxide of tin, by Messrs. Roberts, Dale, and Company.

Steam Colours.—Though no marked improvement has occurred of late years in this branch of calico printing, still it is so largely used at the present day, especially in producing furniture prints, that it is desirable to give an outline of its chief characteristics. Either the colour is mixed with a mordant and then printed on the cloth and submitted to the action

of steam in a close chamber or over a perforated cylinder, or the pieces are passed through a tin solution, the oxide of tin being precipitated on the fabric by a chemical process, when the colour, properly thickened, is printed and afterwards submitted to the action of steam. It is chiefly by this style of printing that such fine effects are produced upon mixed fabrics of cotton and wool.

Since 1855, the production of furniture prints by machinery has undergone a great development, owing to several important improvements; firstly, to the great advances in the art of engraving rollers; secondly, to the manufacture and employment of very large rollers, some of which have a circumference of forty-three inches, and a length of forty-four; thirdly, to the easy application of the gum roller, which resulted in the production of a class of goods first noticed at the Paris Exhibition of 1855. The gum roller deserves notice because of the extensive use now made of it by the printers of furniture goods. It is, of course, understood that, to produce light shades of colour, the darker ones are diluted with gum-water or reducing liquid: this was the work of the colour mixer, and, therefore, to print four colours and four shades of each colour, sixteen rollers would be necessary. Mr. Burch's gum-roller reduces the colour upon the cloth during the process of printing. The pattern of the paler shades of each colour in a chintz design being engraved upon one roller, an impression of reducing liquid is first given off upon the cloth, then that of the other rollers following in the usual order; where the various colours fall upon the gum-water a lighter shade is produced, owing to the dilution of the colour on those parts, which effect may be still further heightened by lightly engraving the corresponding parts of the colouring roller, so that a less quantity of colours shall be given off.

The introduction of the tar colours has enabled the woollen and silk printers to obtain, with the aid of steam, most excellent effects, by which many of them, chiefly foreigners, have displayed a great variety of very beautiful goods.

There was in the French department, exhibited by Mr. Brunet Lecomte, a most interesting display of printed silks obtained by a new mode of printing silk warps, by which the woven fabric has all the appearance of having been printed, though it is well known that when this is done in the usual way the patterns have always a clouded and *chiné* appearance.

Madder Styles.—The improvements which have occurred in this, the most important branch of calico printing, since 1851, have tended to facilitate, and consequently to cheapen production rather than to give us finer or more brilliant-coloured goods. Improvements, more or less considerable, have taken place in nearly every stage of the manufacture, but it is not proposed in this report to enter into their details except into those of one important improvement. Madder and its derivatives, however, play such a conspicuous part in calico printing, that this report

would be incomplete without some information respecting this style, which still occupies the foremost rank in the printing art.

To obtain prints of this important style, white calico, bleached with especial care, is printed by engraved copper rollers with one or more mordants, such as the pyrolignites or acetates of iron and alumina, which, under the influence of "ageing" (to be presently noticed), are so decomposed or modified by the oxygen and moisture of the atmosphere as to leave on the cloth either an insoluble oxide or a subsalt, and these become the intermediate agent for fixing on the fabric the colouring matters called alizarine or purpurine ; iron giving from a dark purple to a light lilac, alumina from a dark red to a pink, and mixtures of the two mordants a variety of chocolate tints. After the process of "ageing," the pieces are passed through a hot solution of the double phosphates of soda and lime, the arsenite and arseniate of soda or the silicate of soda, which "dung substitutes" have completely superseded the use of cow-dung in the process of "dunging," the object of which is to fix thoroughly the mordant on the cloth, and to remove any excess that may have been used without allowing it to fix itself on the white or unmordanted parts. By the introduction of these dung substitutes and improved dunging vats, a great saving of time, labour, and expense, has been effected, thousands of pieces being now done in the same vat where formerly hundreds only could have been treated.

The pieces, after having been well washed, are ready for the dye-beck, in which the mordants assume the colours for which they are adapted. Here also a slight improvement has been made, the advantage of which is a saving of time, the mordants becoming saturated with alizarine and purpurine in one hour and a quarter, or with the colouring principles of madder in two hours. After leaving the dye-becks, the pieces are thoroughly washed in the improved washing machines, but as the white parts (or those not mordanted) are still soiled, and the colours dim, it is necessary to place the pieces for half an hour into a rather strong soap solution heated to 180°, by which the loose dye is removed both from the white parts and those on which colour has been fixed. To finally brighten the colours and completely clean the white portions, the pieces are passed into a weak solution of a mixture called "chymic," or an alkaline hypochlorite of soda with a little sulphate of zinc, until the desired effect is obtained ; but latterly this process has been improved by passing the goods rapidly into chymic and then through a steam chest. As they have not yet, however, a commercial appearance, they further undergo what is called "finishing," that is, the pieces are passed through a solution of flour which has been fermented for several weeks, starch, farina, &c., and then between rollers ; after which they are dried and passed through calenders, the object of these last operations being to fill up the interstices of the cloth and give it a glossy appearance.

Though it is thought advisable to abstain here from entering into the details of the numerous improvements which have found their way into

every step of madder printing, still there is one process so pre-eminently important in its practical results, and so interesting in a scientific point of view, as to exact a more extended notice.

The process of "ageing" in calico printing is that by which a mordant, after being applied to a cotton fabric, is placed in circumstances favourable to its being completely incorporated with and fixed in the fibre. Thus it has generally been found necessary that calico printed with a mordant should, before dyeing, be exposed in single folds to the atmosphere for several days in the ageing room; the object being to liberate the acetic acid from the acetates of iron or sulpho-acetate of alumina, and to oxidize the oxide of iron. It was for many years believed that oxygen was the only necessary agent, and though some printers had observed that moisture facilitated the process, the fact was not generally known until Mr. John Thom suggested the introduction of moisture as an important agent in the phenomena of ageing. The first printer, however, who, as far as I am aware, practically applied this discovery was Mr. Walter Crum, F.R.S.; and the great saving effected by the judicious employment of steam in this process cannot be better stated than by giving, in Mr. Crum's own words, the particulars of the plan adopted at Thornliebank Print Works:—

"A building is employed, forty-eight feet long inside, and forty feet high, with a mid wall from bottom to top running lengthwise, so as to form two apartments, each eleven feet wide.

"In one of these apartments the goods first receive the moisture they require. Besides the ground floor, it has two open sparred floors twenty-six feet apart, upon each of which is fixed a row of tin rollers, all long enough to contain two pieces of cloth at their breadth. The rollers being threaded, are set in motion by a small steam engine, and the goods to be aged, which are first placed in the ground floor, are drawn into the chamber above, where they are made to pass over and under each roller, issuing at last at the opposite end, where they are folded into bundles on one (at a time) of the three stages that are placed there. These stages are partially separated from the rest of the chamber by woollen cloths.

"While the goods are traversing these rollers, they are exposed to heat and moisture, furnished to them by steam, which is made to issue gently from three rows of trumpet-mouth openings. The temperature is raised from 80 deg. to 100 deg. or more—a wet-bulb thermometer indicating at the same time 76 deg. to 96 deg., or always 4 deg. less than the dry bulb thermometer. In this arrangement fifty pieces, of twenty yards, are exposed at one time, and as each piece is a quarter of an hour under the influence of the steam, 200 pieces pass through in an hour. Although workpeople need scarcely ever enter the warmest part of this chamber, a ventilator in the roof is opened when there is any considerable evolution of acetic acid.

"The mordant, as already explained, does not become fully "aged"

by this process alone, although as much so as if it had hung a whole day in cold air. It has received, however, the requisite quantity of moisture (about seven per cent. of the weight of the printed piece), and is thereby enabled, if an iron mordant, to take oxygen from the air, and to become changed (with time) into the sexquiacetate and sesquihydrate of iron. In order to be sufficiently aged it must be left one or two, or even three days in an atmosphere still warm and moist.

"It had fortunately been ascertained long before, at Thornliebank, that exposure in single folds after moistening was not necessary. Mr. Graham's experiments on the diffusion of gases through small apertures had served to suggest that for the absorption of the small quantity of oxygen required, the goods might as well be wrapped up and laid in heaps. Accordingly in the operation in question, the moistened goods are carried in bundles into the building on the opposite side of the mid wall already mentioned, and deposited there on the sparred floors, which are placed there at heights corresponding with the stages in the first apartment on which the goods are folded down. Upon these floors seven or eight thousand pieces may be laid at a time, and as each piece is twenty-five yards long, 100 miles is therefore the quantity that can be stored at once. It is necessary, of course, that an elevated temaerature, and a corresponding degree of moisture be preserved in the storing departments day and night, and 80 deg. of Fahrenheit is sufficient with the wet-bulb at 76 deg. To effect that object a large iron pipe is placed along the ground floor underneath, and moderately heated by steam, while a row of small jets in the same position are made to project steam directly into the air of the apartment. The whole building is defended from external cold, and consequently from condensation of steam, by a warmed entrance room, and by double windows and double roofs. Small steam pipes are also placed at other points where they seem to be required; and the apartment with rollers is specially heated when not in use, by a couple of steam pipes, which are placed under the ceiling of the ground floor.

"The process of ageing, as thus detailed, was in operation at Thornliebank in the autumn of 1856. About a year afterwards it began to be adopted by other printers, and now it is already in use in at least sixteen different printing extablishments in Scotland and Lancashire."

One of the greatest benefits which chemistry has conferred upon manufactures is that of finding profitable employment for refuse materials. Thus it was for a long time considered that madder when removed from the dyebecks was exhausted, or to use the technical term, "spent." It was, however, discovered in 1843, by M. Schwartz, that if this refuse was mixed with sulphuric acid, and heated for several hours by steam, a considerable quantity of colouring matter was liberated, and after the spent madder was well washed, and all trace of acid removed, a product was obtained to which he gave the name of

gurancux, and which could be used for producing colours, if not so fast as those of madder, still a good imitation of them. This process is now adopted at all print works, especially for obtaining various shades of red and chocolate.

When, instead of spent madder, fresh madder root is treated by the above process, the result is a substance called *garancine*, the use of which has very greatly extended since 1851. The advantage obtained by converting madder into garancine instead of using it in its original form, is that it saves the printer much expense, as goods dyed with garancine do not require soaping to obtain good whites, a slight chymic and good washing being sufficient.

The defect presented by this class of goods, viz., their inability to resist the action of soap, led Messrs. Pincoff and Schunck to search for a substitute, which they discovered in 1853, and called "commercial alizarine." This material, which has been of late years most extensively employed by several printing firms, is obtained by taking principally garancine prepared as above, thoroughly depriving it of acid, and submitting it to the action of high-pressure steam, when the substance called verantine is decomposed or modified, so as to stain the whites less, and not to interfere with the purple-dying power of alizarine. The advantages possessed by this product are :—the production of good lilacs economically and without soaping ; great promptitude and regularity in the production ; facility of producing combination of lilacs with catechu and lilac with chocolate, which results cannot be so satisfactorily obtained with madder or garancine ; production of lilac shades graduated *ad libitum* as to cost ; lastly, economy of mordants.

Mr. Higgins has lately devised a method of preparing commercial alizarine which differs from that of Messrs. Pincoff and Schunck, in that he boils garancine, and carbonate of soda, and a little ammonia. The liquor, which is alkaline at starting, becomes acid after being boiled twenty-four hours, and converts the garancine into alizarine.

Another preparation of madder, known under the name of *flower of madder*, which is now extensively used by continental printers, was introduced to the trade in 1852, by MM. Julian and Roquer. It is obtained by allowing madder to ferment, and then washing it thoroughly, which removes from it not only all soluble matters, such as sugar, mucilaginous substances, acids, &c., which interfere with the fixation of the alizarine on the various mordants, but also (in accordance with Dr. Schunk's researches, on the influence of the ferment erythrozym on rubian) increases the quantity of the colour-giving principles,—alizarine and purpurine. It is found by experience that 100 parts of flower of madder are equal to about 200 parts of ordinary ground roots, and that the shades are finer, the pinks and reds also having greater solidity. Mr. Mucklow has recently introduced a process similar to the above, which consists in alternately macerating and pressing madder roots, so

as to expel from them various substances which, as above stated, interfere with the dyeing of the fabrics.

PURPURINE AND GREEN ALIZARINE.—Messrs. Schaaff and Lauth exhibited in the French department, most beautiful commercial preparations obtained from madder, and called purpurine and green alizarine ; and as these substances are now applied by continental printers, and as the process for obtaining them (devised by Mr. Emile Kopp, a most eminent chemist) is very interesting, it is deemed advisable to give here a short notice of it. Six hundred pounds of ground madder are allowed to macerate for ten hours in a vat containing 800 to 1000 gallons of a solution of sulphurous acid, and after running off this liquor, the madder is again treated with 200 to 250 gallons of the same acid solution. These liquors are then mixed with three per cent of sulphuric acid, specific gravity 1·60, and the whole heated to about 100 deg. by means of steam, when the purpurine separates itself under the form of large red flakes, which, in a few hours settle at the bottom of the vat. The liquors are then run off, and carried to ebullition for three or four hours, when a new substance called green alizarine is liberated and precipitates. Both these products require only washing to be ready for the printer. The dyeing power of these new substances is remarkable, that of purpurine being equal to forty or fifty times the same quantity of madder, and the green alizarine to thirty-eight times that of madder. The 600 lbs. of madder yield about 4 lbs. of purpurine and about 16lbs of alizarine. The madder treated as above described, can be converted into garancine, the dyeing power of which is equal to half that of ordinary garancine. Green alizarine can be employed for the same purposes as commercial alizarine. Purpurine gives magnificient reds and pinks with alumina mordants, but no purple with iron mordants. Purpurine, however, will probably be chiefly employed as a pigment or in steam printing.

PRINTED AND PLAIN TURKEY-RED FABRICS.—The process for producing Turkey-red on fabrics being identical with that followed for yarns, it is unnecessary to repeat here the details of the process. But besides the intricate and difficult manipulation which Turkey-red goods have to undergo, there is another peculiarity connected with them, viz., the method by which the whites are obtained, which is the reverse of that followed with madder goods, in which the whites are preserved, whilst in the case of Turkey-red the whites are obtained by destroying the colour after it has been fixed. This is done by printing tartaric acid on the cloth, and then bringing it into contact with bleaching liquor (or hypochloric of lime), or by forcing a weak solution of sulphuric acid and bleaching powder through perforated plates, the result being that the red is destroyed on those parts where the acid bleaching liquor has come in contact with the fabric.

In conclusion, it should be stated that the business of calico printing

has enormously increased since 1851, and that many of the printing establishments in this country, and also, no doubt, on the Continent, have doubled their productions ; and it may be added, on the authority of Mr. E. Potter, M.P., that the quantity of printed goods exported, which, in 1851, was about six and a half millions of pieces, had risen, in 1857, to about twenty-seven millions of pieces.

ADULTERATION OF WAX.

BY BARNARD S. PROCTOR.

Wax, both in its bleached and unbleached conditions, is much subject to adulteration, so much so, that the purity of foreign yellow wax is always considered as very doubtful, and the *impurity* of white cake wax is generally looked upon as almost certain. The foreign matters fraudulently occurring in either variety may be divided into two classes : those which are fusible or soluble in melted wax, at water-bath temperature, and those which remain solid or unmixed with the melted wax under these circumstances. The latter, being so easily detected, are much less frequently present, and require no special notice at present. Resin, fat, and spermaceti are the principal materials to be looked for in the former class. Christison and Pereira both refer to all these materials, and instruct us to examine for resin by the action of cold alcohol, which they say removes nothing from pure wax ; this, however, will be looked upon with doubt, since recent analyses of wax show that one of its principles (cerolein) is soluble in cold alcohol. It constitutes four or five per cent. of the wax ; it is of a greasy nature, and imparts colour, odour, and tenacity, which are wanting in the other two constituents (cerotic acid, the amount of which varies from 22 per cent. downwards, and myricin, which forms the great bulk of the material).

Fatty matters are to be detected, according to the above authors, by the softness, stickiness, the odour and the taste which they impart. Spermaceti, which we are informed is constantly added to white wax to improve its colour, is passed over without any means for its detection being suggested ; this, no doubt, arises from the analogy in the chemical characters of the two materials affording no ready means by which to recognise an admixture, and from the fact that, pharmaceutically and therapeutically, there is no great difference in the properties and value of the two.

It is a deception, however, which is only tolerated, either in pharmacy or commerce, from the difficulty of obtaining any decided results from any examination not too complicated for the purposes of the retail trader.

A close attention to the physical properties of the sample probably affords the only means of determining its quality, which is suitable as a guide to the tradesman in making his purchases from the wholesale dealer. The following results will be found useful as a guide to the presence and probable quantity of the above adulterants. Good samples of yellow wax and genuine white block wax were melted in a water-bath, with spermaceti, pale amber resin, and lard, in various proportions, as below :—

No. 1.	Yellow wax	8	Spermaceti	1
„ 2.	„	8	„	2
„ 3.	„	8	Lard	2
„ 4.	„	8	Resin	2
„ 5.	„	8	„	1
„ 6.	Block white wax	8 ;	Spermaceti	2
„ 7.	„	8	„	1
			Resin	1
8.	„	8	Lard	1
„ 9.	„	8	Spermaceti	8
„ 10.	„	8	„	24
„ 11.	„	8	„	8
			Lard	4

All these additions detracted from the hardness and toughness of the wax. The yellow wax was "improved in appearance" by all the additions ; its odour was not perceptibly affected by the spermaceti ; the lard gave it a slightly greasy smell ; the resin was distinctly perceptible in the larger proportion, barely so in the smaller. The white wax was improved in appearance by the spermaceti and lard, but injured by the resin. The odours of the lard and resin were more readily detected in the white than in the yellow wax. In both cases the odour of the lard was more readily detected by rubbing the sample upon a plaster spatula heated a little above 212°, but not so hot as to make vapours rise from the wax, the odour of the resin was very distinct when sought in this way, and not less so when the heat was raised to the smoking point.

The rough mealy fracture of pure wax is rendered finer-grained, smoother, and duller, by the addition of lard or spermaceti, and becomes sparkling and more granular by the addition of resin.

Pure wax becomes kneadable at about 85°, and its behaviour, while worked between the finger and thumb, is characteristic. A piece the size of a pea being worked in the hand till tough with the warmth, then placed upon the thumb, and forcibly stroked down with the forefinger, curls up, following the finger, and is marked by it with longitudinal streaks The samples Nos. 1 and 2, when worked in the same manner, are softer, curl less by the stroke of the finger, and instead of longitudinal streaks

have a granular or flaky surface. No. 3 spreads on the thumb like cerate. No. 4 is softer than the pure wax, more sticky, spreads more readily, curls less, but takes the longitudinal streaks. No. 5, very similar to No. 4. No. 6 is like Nos. 1 and 2 in consistence. No. 7, soft, sticky, and of a bad colour. No. 8 spreads like cerate. No. 9, softer than pure wax, capable of being spread with the finger, curls less than pure wax, and takes a granular, mealy surface. No. 10 crumbles into a mealy condition when kneaded. No. 11 spreads like cerate. Perhaps new yellow soap affords the best comparison for the sticky feeling of the samples containing lard, and also of the manner of their spreading on the thumb when rubbed.

From a comparison of the samples Nos. 9 and 10 with white cake wax, as supplied by wholesale houses of the highest reputation, I am satisfied that in many cases it is half spermaceti, and in some as much as two-thirds spermaceti to one of wax, which is supplied to us under this name.*

OILS AND FATS SHOWN AT THE INTERNATIONAL EXHIBITION.

BY THE EDITOR.

A very large number of oils, some of them quite new to commerce, were shown at the International Exhibition, and as many of these probably never came under the notice of persons interested, a few notes upon them may be found of practical use in many quarters, accompanied by some descriptive and statistical details.

I.—Animal Oils.

The animal oils and fats are not nearly so numerous as those derived from the vegetable kingdom.

The principal ones are horse grease, lard, and tallow; cod, skate, shark, sperm, train, and seal oil, &c.

Some of these are found in the cellular tissue immediately beneath the skin and between the folds of the lining membrane of the abdomen, others in the liver; and in the sperm whale, in a triangular cavity in the head. The oil in all the above cases is contained in distinct cells, and each cell has its blood vessels.

In the case of lard, tallow, and other animal fats, the general mode of extraction is to boil the cellular tissue containing the oil in water,

* From the 'Chemist and Druggist.'

the heat and moisture rupture the cells, and the oil escapes, floating on the top liquefied by the heat, sometimes a little sulphurous acid is added to facilitate the destruction of the membrane forming the oil-cells.

Another process is to enclose the cellular tissue in bags made of horse hair, or of some other strong material. These bags are warmed and subjected to powerful pressure by machinery. The fat oils contained in the liver are obtained by cutting the liver into small pieces and boiling, the oil rises to the top and is skimmed off; it is afterwards purified by filtration. This is far the better way of procuring the oil than to allow the liver to putrefy, and the oil to exude from disintegration of the cells by putrefaction.

There are some oils and fats which are obtained in such small quantities as to be more matters of scientific curiosity than commercial use, such are tiger fat, deer's lard, gorilla fat, serpents oil, frog's fat, peacock fat, &c. A very fine oil has been obtained from the fat of the iguana; some was shown from Queensland, where it is said to be used by the fishermen for sprains, &c.

Dog's Fat.—Dr. M. Sterry states that among the poor German inhabitants of the United States, it has become not uncommon to consume, with advantage, dog's fat in affections where other classes would take cod-liver oil. This accounts for the killing a great number of dogs, which had been attributed, by the uninitiated to their being wanted for sausage meat. ('American Journal of Medical Science.')

Probably this may also account for the slaughter of dogs by the German Legion in Kaffraria, the subject of remark in the South African papers in the close of 1858, and then believed to be for food.

American Lard.—The imports of lard from all quarters in 1860 were 198,030 cwt., of the value of 587,979*l.* The great bulk—130,871 cwt. —came from the United States. Austria, Italy, and Hamburg, supply nearly all the rest.

The average amount of lard obtained from each hog is said to be about 32 pounds. England and Cuba take most of the American lard. In the West Indies lard is very generally used as a substitute for butter.

About 50,000 tons of lard are stated to be used annually in the States. Lard oil is made principally in Cincinnatti. The average exports from that city a few years ago were:

Lard	barrels	40,000	8,000,000 lbs.
Lard	kegs	110,000	4,400,000 lbs.
Lard oil... ...	barrels	28,000	7,000,000 lbs.
			19,400,000 lbs.

There are in Cincinnatti, forty manufacturers of lard oil. These consume on an average, each week, the year round, 1,000 packages of 300 lbs. each; equal to 52,000 packages, or 15,000,000 lbs. per annum From this is to be deducted for stearine, one-third or 5,120,000 lbs.,

leaving 10,480,000 lbs., equal (allowing 8 lbs. to the gallon) to 1,110,000 gallons. This may be considered as a fair average of the amount manufactured and consumed yearly in Cincinnatti. To the latter account must be set its five large candle factories, which consume the stearine in combination with tallow. As manufacturers are unwilling to divulge the quantity of candles made, we are left to infer it from the large amount of stearine which enters into their composition—two pounds being consumed for each pound of candles. It is to be remembered that the stearine after blending with, has to be extracted from, the tallow.

Lard Oil.—It is but a few years since that the manufacture of lard oil was looked upon as very unimportant, or, to use the words of a manufacturer, "almost as nothing." Now it occupies a prominent position, and determines, to a great extent, the value of the hog. In quality, except in temperature, which will always be higher, it is beginning to outrival any fish oil, and is superior to the best sperm for lubricating the surface of machinery. Through the entire southwest and north the amount employed for this purpose is immense. And as to the manufacture of the article out of Cincinnatti, almost every place where it can be readily and cheaply obtained has its manufactory. The manufacture has this rare advantage, that a ready sale is always found for the sterine and for the oil, wherever sent to.

Professor Olmstead, of New Haven, states that, by adding one pound of powdered rosin to three pounds of lard, well stirred together, the mass becomes a semifluid at 72 degrees Fahrenheit, and on being melted (which it does at 90 degrees, notwithstanding if melted alone the rosin requires 300 degrees and the lard 97 degrees of heat), the compound will remain transparent and limpid at that temperature. As it cools, a pellicle begins to form on the surface at 87 deg.; and at 76 deg. it remains a dense semi-fluid.

The discovery of the above named fact is of great importance to those who use lard-oil lamps, as the lard is rendered more fluid by the rosin, and the power of illumination increased two fifths; yet, after two hours burning, it loses its brilliancy on account of the wick becoming clogged. This will not be a material objection in families, while in point of economy the gain is considerable, for lard is worth three or four times as much as rosin.

To machinists, the discovery is also important, as it enables them to make use of lard instead of oil, which is not only a saving in cost, but what is of far more importance, the addition of the rosin completely neutralises the quality of acidity in the lard, which corrodes metals, particularly brass and copper, to such a degree as to render lard unfit to be applied to anything not in constant use. Professor Olmstead says, a thin coating of the compound laid upon a grate or sheet iron stove with a brush, as thin as possible, will keep it free from rust all the summer, although stored in a damp place.

To soap makers, the discovery is also important. If one pound of the compound is added to two pounds of common Windsor soap, the quality is greatly improved, and the tendency that soap has to grow rancid, when in use, or keep moist, is thus entirely prevented.

The same compound applied to boots and shoes renders them nearly impervious to water, and if applied to the soles will not soil the floor. The uppers will be soft and pliable, and not prevented from receiving a blacking polish. For oiling carriages, the mixture of lard and rosin will be valuable; and when wanted for heavy wheels, a proper consistency may be given to it by adding wheat flour, or, if greatly preferred, black lead.

Alpaca Tallow, from New South Wales.—Mr. C. Ledger, speaking of the alpaca tallow, says, "It it unquestionably of superior quality. Perfumers will soon find out its valuable properties, and I believe that ere many years have elapsed, 'Alpaca pomade' will be held in high estimation. I do not pretend to a knowledge of pomade composition, but I have prepared and now forward a small quantity, which may be deemed worthy of notice. In South America, where the pomade is much used, the luxuriant and beautiful hair of the ladies is proverbial."

Tallow Oil or Oleane and Tallow from Russia and Australia.—The number of cattle and sheep slaughtered for their tallow alone in Australia is very large, especially in some years. In the nine years ending with 1852, the following numbers were boiled down:—Sheep, 1,785,960; Horned cattle, 340,353. From 200 to 300lbs. of tallow is obtained from cattle, and 18 to 25lbs. from sheep according to condition. Everybody has heard of a boiling-down establishment, but very few have any idea what it is, beyond the fact of its being a place where a number of bullocks or sheep are converted into tallow. We will give a description of one belonging to Messrs. Russell and Co. of Sydney. The "plant" is capable of boiling down one hundred bullocks a day. There are six iron cylinders (all capable of bearing high pressure steam,) each of which will hold eight large bullocks. The meat being put into these, they are supplied with steam at a pressure of thirty-five pounds to the inch. which is generated in a large boiler at one end of the establishment. To this heat, which is more than double that of boiling water, the meat is subjected for ten hours, when all the fat is converted into tallow, this is run off by a series of cocks and pipes into a clarifier, which is a large open pan, where it is made very hot, in order to drive off any watery particles, it is then run into a cooler, and is ready for market. A small engine is attached, which pumps up water, and does other work, by which much labour is spared.

In a country like Southern Russia, where the greatest part of the land is yet untilled, and the population by no means numerous, pasture of course abounds, and the breeding of cattle must necessarily be very pro-

fitable. The inhabitants of that country are, in fact, always engaged in this branch of industry, and for many years the butchers of the capital have been indebted to them for their principal supplies. Ever since the opening of the Black Sea, an active trade in tallow has been carried on from its ports, and more especially with England. Generally speaking, the merchants who are engaged in the exportation of tallow, make their contracts during the winter with the dealers in the interior, and advance them a part of the cost, or even the whole sum. In the spring, these latter make use of these advances for the purchase of cattle at the different fairs of the country. The price of cattle varies considerably. The slaughter-houses of Odessa, of Nicolaoff and of Kherson, are in full activity from September to November. The ports of the Baltic cannot compete with Southern Russia in this article; and the demand at the Black Sea ports invariably exceeds the supply.

Tallow at Galatz is divided into two qualities, called tallow and chervice. The latter is the clean fat of the carcase and marrow boiled, and is much used in Constantinople for culinary purposes; tallow is the fat of the intestines, feet, &c., boiled. It is generally sold in parcels, consisting of two-thirds chervice, and one-third tallow. For the Constantinople market chervice is worth 10 per cent. more than tallow; but for other European markets tallow is worth as much as chervice.

Japanese Fish Oil—Four qualities.—The fish from which this oil is obtained is not known to us.

Black Fish Oil—Three qualities from Tasmania.—Sperm Oil, Train Oil, and Southern Whale Oil from New South Wales.

Up to within the last few years a large portion of the export trade of New South Wales was derived from the whale fisheries of the Southern and Pacific Oceans. A great number of vessels engaged in this pursuit either belonged to Sydney, or were accustomed to call at that port for supplies. From a variety of causes, the principal of which was, perhaps, the increasing value and dearth of labour, the number of ships thus employed has lessened, and the trade proportionably declined; the article of oil now occupies a very low position in the list of colonial exports.

There has been a great decrease of late years in the value of the Australian whale fisheries. A return of the vessels, British, colonial, and foreign, engaged in this trade that have visited Port Jackson during the last ten years, shows that the number of these in the year 1846 was 80, but in the year 1852 had diminished to 29, the amount of tonnage of which during the several periods amounted to 20,288 and 7,534 tons. Owing to the long and uncertain periods occupied in whaling voyages it would be impossible to ascertain the amount of oil obtained during any particular period by vessels belonging to the colony.

The official statistics show that in 1853, 329 tons of sperm whale oil

and 55 tuns of black whale oil were shipped from Sydney, being a less export than during any previous year. In 1840, no fewer than 6,151 tuns of the two descriptions of oil were exported, since which time the produce has gradually dwindled to its present low amount. The export of whalebone and seal skins has also, during that period, lessened in the same proportions. The declension in the value of the export may be seen by noticing that while in 1850 the total value of the export of oil, whalebone, and seal skins from New South Wales, was 224,144*l.*, in 1853 it was only 25,490*l.*, the export of the intervening years displaying a regular gradation.

Whale oil is frequently mixed with sperm oil to adulterate it, as the former is a drying oil, attracting oxygen from the atmosphere, and hardening ultimately into a horn-like substance, the smallest quantity mixed with sperm oil injures it irretrievably for lubricating purposes.

The various oils shown from British North America were—pale, straw, and brown seal oil, cod oil, whale oil, porpoise oil, and dog-fish oil.

The export of fish oils from Newfoundland averages about 2,750,000 gallons, worth 320,000*l.*, and about 10,600*l.* worth is used in the colony.

The principal whale fishery is now carried on by the Americans, for statistics see vol. 1, p. 363. The imports of oil to the United States were as follows in barrels :—

	Whale Oil.	Sperm Oil.
1850	201,000	93,000
1860	140,000	73,708

A polar whale yields, on an average, 120 brls. (25 impl. galls.) of oil.

Seal Oil.—The oil from the seals is extracted partly by compression, by which the cold-drawn oil is obtained ; resort is then had to boiling the blubber in large pans, cauldrons.

The same method, and the same apparatus, might be used for extracting the oil from seal-blubber as from cod-livers ; and when the difference in the value of the oil made by the different methods is considered, it is curious it has not been carried into effect.

The quantity of oil wasted, partly by volatilization in boiling in the cauldrons, and the inferior value given to the rest by its becoming carbonized or browned is considerable. Were the whole extracted by steam, the advantage would be very great. The expense of fuel may be quoted against the method, but the number of vessels that go to the cod-fishery with no cargo but the salt for their fish would render the transport of coal cheap.

The exports of seal oil during the five years ending 1850 averaged 4,921 tuns annually ; the average for the five years ending 1855, 6,353 tuns. The total produce of seal and whale oil obtained by British vessels in the Greenland fishery in the years 1849—58 was 23,636 tuns.

Fish oils have been largely supplanted the last few years by mineral oils for burning.

East India Fish Oil.—Among the various Indian fishes from which oil is obtained are the following, but being only known by the native names, it is impossible to specifically describe them :—Karahmanoo, Chadoo pareeger, Cooawanoo, Goodee, Valager, Moosoo, Bochee, Muthi Yeno, Frictzi, Karitze malu, Seri nei (shark-liver), Chellei nei.

There is an active demand now at all the sea-ports of the western coast of the Indian Peninsula for fish oil, and the product has been of great importance, 721,095 gallons, valued at 20,685*l.*, having been exported from the Madras territories by sea last year.

The oil seems to be obtained from various fishes, drawings and details of which would be most useful and interesting. Specimens of fine quality from Mangalore, Tellicherry, Masulipatam, and Pondicherry, collected by the Madras committee, were sent. These fish oils appear to be used in India in cases of rheumatism, atrophy, phthisis, glandular swellings, and all diseases of a strumous nature. A coarse kind of fish oil has been used by the natives from time immemorial in chest complaints, and specially as a remedy for spitting of blood. The attention of chemists was directed to the article in 1851, from a knowledge of this fact, since which it has been brought into very general use.

Fish liver oil is now prepared in large quantities on the Western and Malabar coasts of India for exportation. That supplied to hospitals for the use of troops is prepared from the liver of the skate, seer, and white shark, indiscriminately. From analysis and experiments made in England, it has been found to equal in its medicinal properties the best Cod-liver oil ; but, from its extremely disagreeable taste and odour, it can never supersede the oil of Newfoundland. A more agreeable kind of oil may be prepared from the skate or seer fish ; but when the liver of the shark is also used with the livers of the other fish, the oil so obtained has a very offensive odour and unpleasant taste, and which cannot by any mechanical or chemical process be removed, however carefully it may be prepared.

Providence provides for the relief of humanity by multifarious means. The earth, the air, the waters, all supply his wants. Thus, in more ways than one, his necessities are variously supplied. Cod-liver oil is one of the best medicines yet discovered for the affection of the lungs and other complaints.

Dr. W. Gray, of Madras, has prepared oil from the liver of a fish frequenting the Indian shores, which has proved equal in every respect to cod-liver oil.

It has long been known that the oil in question is not procurable from the liver of the cod alone, but is to be derived of an equally good quality though not so copiously, from the ling, torsk, skate, and many

other species of white fish, some of which, or individuals nearly allied to them in genus and conformation, are, it is most probable to be found on every sea-coast in the world; and we have no doubt that, of those containing and affording the oil in question, more than one species or family will be found on the shores of India if the investigation should be continued, and the supply from Europe should be deficient, or the native oil can be produced at a more moderate rate. Should our medical and scientific brethren in Madras, however, extend the field of their inquiry, and pursue still further their experimental investigation, we are firmly convinced that, ere long, they will discover fresh sources for supplying this very useful and popular medicine in such quantities as would enable both the Government Medical depôts and the trade to dispense with the necessity of importing it from Europe at a higher price than it can be produced for locally, and besides protect the medical community and the public from the possibility of interrupted or scanty supplies.

Cod-liver Oil was first prepared in Newfoundland from the livers which, being extracted from the fish in the process of cleansing and salting, were thrown aside, and whilst putrifying in the sun, gave out in the process of dissolution the animal oil, now in such high repute, but which was at first prescribed by empirics and administered by ignorant persons, in whose hands, however, although its action was not understood any better than it now is by the educated practitioner, its use was followed by many remarkable cures. It is now more than fifty years since it was first brought to the notice of the profession in England, and about seventy since its name first occurred in medical practice. The oil produced in Newfoundland was possessed, from the process through which it was obtained, of the most nauseous flavour and taste, and on this account it was not long before the attention of persons employed in the English fisheries was directed to the object of extracting it from the material in their hands by a more cleanly process, and one which should afford an oil less repulsive in its manufacture, and consequently in its odour. The fishes from which this oil is obtainable are not confined, in their residence or migrations, to any particular coast or climate, but are most probably to be found in every ocean and on every seaboard on the globe; and we hope that this probability will stimulate scientific persons in all countries to imitate the industrious research of the Madras practitioner already referred to.

The Cod-liver Oil of Commerce is still obtained by the French fishermen at Newfoundland from the decomposition of the liver in casks either in the holds of the fishing vessels or on shore near the dwellings. It is an object of considerable trade, for there are exported annually 500,000 kilos., varying in price from 100f. to 150f. the 100 kilos.

Purified Cod-liver Oil for Medicinal Use. — This new industry promises to attain to considerable importance at St. Pierre. It is in-

creased by the Academy of Medicine, who consider the brown, pale, and white oils of the Newfoundland French Fisheries as rivalling the best products of the British and Norwegian manufactories. That which is made in the months of April, May, and June, is of a superior quality; the livers are then of a lean or thin nature, but earlier they are very fat, and, in a therapeutic point of view, furnish oil of less value and purity.

An excellent descriptive article on the manufacture of cod-liver oil in Norway, and a new method of preparing it for medicinal purposes, by Mr. Peter Moller, was published in the TECHNOLOGIST, vol. ii., p. 376.

OOLACHAN OIL from Vancouver.—At page 48 of this vol. we gave a short account of this new oil; we now append some further details.

The oil obtained from the Hou-li-kun is a common article of food among the northern tribes, and one of which they are very fond. This fish is not unlike a sprat, but somewhat longer and rounder, and is so oily that, when dried, it will burn like a candle. It is not found at the south part of the island, (Vancouver) but is caught in great numbers to the northward. The process of extracting the oil is very primitive indeed. Mr. Duncan gives, in one of his letters, the following description of it, as witnessed by him at Nass River :—" In a general way," he says, " I found each house had a pit near it, about three feet deep, and six or eight inches square, filled with the little fish. I found some Indians making boxes to put the grease in, others cutting firewood, and others (women and children) stringing the fish and hanging them up to dry in the sun, while others, and they the greater number, were making the fish-grease. The process is as follows :—Make a large fire, put four or five heaps of stones as big as your hand in it; while these are heating, fill a few baskets with rather stale fish, and get a tub of water into the house. When the stones are red-hot, bring a box about eighteen inches square (the sides of which are all one piece of wood) near the fire, and put about half a gallon of the fish in it, and as much fresh water; then three or four hot stones, using wooden tongs. Repeat the doses again, then stir the whole up. Repeat them again, stir again, take out the cold stones, and place them in the fire. Proceed in this way until the box is nearly full, then let the whole cool, and commence skimming off the grease. While this is cooking prepare another boxfull in the same way. In doing the third, use instead of fresh water, the liquid from the first box.

On coming to the refuse of the boiled fish in the box, which is still pretty warm, let it be put into a rough willow basket; then let an old woman for the purpose of squeezing the liquid from it, lay it on a wooden grate, sufficiently elevated to let a wooden box stand under; then let her lay her naked chest on it, and press it with all her weight. On no account must a male undertake to do this."* This oil has been

* Captain Mayne's British Columbia.

ascertained by analysis to be equal to cod-liver oil, but it requires more care and skill in the preparation.

PORPOISE OIL.—Small samples of oil of the white porpoise or Beluga, and of the black porpoise of the Gulf of St. Lawrence, were transmitted from Canada. But it is to be regretted that no large specimens of these excellent fat oils, whose extraction constitutes such an important branch of industry in the district of Quebec, should be found in the Exhibition. An account of the fishery of the white porpoise was given in vol. i., p. 107.

DUGONG OIL, from Ceylon, from New South Wales, and Moreton Bay.—A descriptive article on this oil will be found in the TECHNOLOGIST, vol. i., p. 311. The Ceylon oil is of a concrete character; the Australian of a more fluid nature.

Under the name of Peixe boi oil, I exhibited an allied oil from the cowfish or lamentin of Brazil and Guiana (*Manatus Americanus.*) This animal yields from 5 to 25 gallons of oil, which is used for light and for cooking. The layer of fat from which it is boiled out is of a greater or less thickness beneath the skin, generally about an inch.

The fat has a very pleasant smell and tastes like the oil of sweet-almonds. It forms an admirable substitute for butter and does not turn rancid in the sun. The fat of the tail is of a firmer consistence, and when boiled is most delicate eating.

JACARE OIL.—This is a fixed oil of a red colour, extracted from the adipose tissue of the alligator in Brazil, commonly called the Jacare. It is used for burning, although of a nauseous odour, and medicinally for embrocations in rheumatism.

Alligators are killed in great numbers in parts of the river Amazon for their fat, which is rendered into oil. Although the oil has a disagreeable smell it is not worse than train oil.

ANTA OIL.—A liquid crystalline oil, of a yellow colour, obtained from the adipose tissue of the *Tapir Americana* in Brazil. It is used as a therapeutic and an emanagogue, and as a remedy for rheumatics.

SUCURIGU OIL.—This is also extracted from the adipose tissue of a reptile so named in Brazil. The oil is liquid when well prepared, of a yellowish colour, and used for rheumatism.

TURTLE OIL OR BUTTER—In the large collection of oils exhibited by the writer were samples of turtle oil imported from Sydney,—but no doubt the produce of some of the Pacific Islands—and turtle butter from Brazil—samples were also shown in the Brazilian Court under the name of Mantiega Tartaruga. It is stated to be extracted principally from the eggs, but also from the fat, of various species of tortoises by means of fermentation and decoction. It is of a yellowish colour and opaque when well prepared, clear and liquid when purified, with a peculiar flavour. It is much employed for culinary purposes, and is in general use in the province of Para by the lower classes. In medicine it has the

reputation of being useful in rheumatic complaints. Several thousand persons occupy themselves in the season in preparing turtle oil on the banks of the Orinoco, Amazon, Negro, and other rivers of South America. When the waters of the rivers begin to fall about February, millions of tortoises come to deposit their eggs in the sand, and the mean depth of the stratum is about three feet. The harvest of eggs is estimated like the produce of a well cultivated field. An acre of sand has been known to yield eggs sufficient to make 100 pots or jars of oil. The eggs when collected, are thrown into large troughs of water, and being broken and stirred with shovels, they remain exposed to the sun till the yolk, the oily part, is collected on the surface and has time to inspissate; as fast as the oily part rises it is skimmed off and boiled over a quick fire. This turtle grease or oil, when well prepared, is limpid, inodorous, and slightly yellow. It is used not merely to burn in lamps, but in dressing victuals, to which it imparts no disagreeable taste. It is not easy, however, to produce oil of turtles' eggs quite pure; it has generally a putrid smell, owing to the mixture of addled eggs. The total made on the three shores between the junction of the Orinoco and Apur, is said to be about 5,000 jars, and it takes about 5,000 eggs to make one jar of oil. In the Comarca of the Rio Negro there are also about 6,000 jars made, and from the small town of Barra, on the Amazon, nearly 2,000 jars are sent down, most of which is made in Santarem, a mile above the mouth of the Tapajos. Many of the marsh tortoises *(Emydes)*, as well as the marine tortoises contribute their eggs to this annual harvest.

Porcupine Oil.—In the Tasmanian collection under this name was shown an oil obtained from the *Echidna hystrix.*

Emu Oil.—The skin of the Australian emu or New Holland cassowary produces six or seven quarts of a clear, beautiful bright yellow oil, which is esteemed for some medicinal properties in Australia. The method of extracting or "drying" out the oil is to pluck the feathers, cut the skin into pieces, and boil it.

Pirirara Oil, obtained in Brazil from a fish of that name, of which there are quantities in the province of Anazonas. It is a concrete oil, yellowish, and of an unpleasant flavour. It is used as a relief for rheumatism.

(To be continued.)

Reviews.

Mineral Resources of Central Italy, including a Description of the Mines and Marble Quarries. By W. P. Jervis, F.G.S. London: Edward Stanford.

This is a work of great importance and utility at the present moment, in bringing the resources of the Italian kingdom more prominently before the British public. It is the result of a very competent pen, and one which has frequently been employed before the learned Societies of London in describing Italian minerals. Having been delegated by the Royal Italian Commission to travel through the central provinces of the kingdom, in order to aid in procuring products to be forwarded to the International Exhibition, Mr. Jervis took the opportunity of investigating closely the sources and statistics of supply, and we have here the condensed account of an incredible amount of observations and labours upon the stones, and ores, and minerals, including etruscan metal work, and mineral oils and fuel.

The description of the marbles is one that has never before appeared in so complete and reliable a form, whilst the accounts of the quarries and annual produce of the statuary and building marbles, and alabaster and serpentine, are of immense commercial value. The author has kindly prepared and corrected the chapter on boracic acid for appearance in our pages, where it will be read with interest, and naturally lead the reader to consult the work from which it is drawn for other interesting descriptive details of Italian mineral produce. The work is embellished with numerous illustrations, which further add to interest and completeness as a reliable book of reference on the special subject on which it treats. We hope to see it have a large circulation throughout the country.

British Botany; or, Coloured Figures of British Plants. Third Edition. No. 1. London: Robert Hardwicke.

The re-issue of so important a work enlarged, re-arranged according to the natural order, and entirely revised under the editorship of Mr. Syme, demands a word of notice at our hands. It is a marvel of cheapness, each part is to contain twenty-four beautifully hand-coloured plates, and twenty-four pages of letter-press. The figures, by the Messrs. Sowerby, have been carefully examined, and any errors in the outline or colour corrected. Mrs. Lankester furnishes popular descriptions of the plants and their uses, properties, and peculiarities. Such a work, to prove in any way remunerative to the publisher for the heavy outlay incurred on it, must have a very large sale. This, however, its beauty and merits are sure to command.

On the Cultivation of Cotton in Italy. Report to the Minister of Agriculture, Industry, and Commerce in the Kingdom of Italy. By G. Devincenzi, Member of the Italian Parliament, General Italian Commissioner at the International Exhibition. London: W. Trounce.

We may say with truth that no foreign country which took part in the late Exhibition displayed more industry and zeal, and attended with such beneficial results as Italy. The information diffused of all kinds respecting its manufactures, products, and capabilities, was most ample and exhaustive, whether on its mineral or vegetable resources. Its official cata-

logue was a model of completeness, and full of valuable description, contributed by men of talent and ability. The Chief Commissioner was himself most active, and took part in every discussion where he could either afford or receive information. The question of our future supply of cotton being a prominent one, and one much under discussion. Cav. Devincenzi has here shown the capabilities of Italy for producing cotton on an extensive scale, and at as low a rate as 4d. per lb. At a recent meeting of the executive committee of the Manchester Cotton Supply Association, it was resolved, that having examined the collection of samples of cotton grown in Italy, and submitted from the Royal Italian Commission, the Committee is of opinion that they are of a good useful class of cottons, some of them being, indeed, superior to middling American, but with careful attention and cleansing, the aggregate production of Italian cotton may be rendered equally as desirable for the spinner and manufacturer as the best samples of the United States.

The practical information on cotton cultivation here brought together might be usefully diffused elsewhere than in Italy.

THE INDUSTRY, SCIENCE, AND ART OF THE AGE, &c. By John Timbs. Lockwood and Co.

This is one of Mr. Timbs' series of useful and painstaking compilations, which, from a careful perusal, we can strongly recommend as a most valuable compendium of all descriptions of information relating to the International Exhibition of last year. Having been so long intimately identified with that Exhibition officially, and written and read so much in connection with it, few are, perhaps, more competent to form an accurate opinion of Mr. Timbs' labours in this direction. A good photograph of the nave, from the western dome, forms the frontispiece to the volume.

THE RECORD OF THE INTERNATIONAL EXHIBITION. Edited by Robert Mallet, C.E., F.R.S. Longman and Co.

This one of the best works that has yet been issued in connection with the Exhibition, is now brought to a close, having been issued in serial parts. It comprises able descriptions of all the sections of objects, by the most eminent men in the several departments, and is lavishly illustrated whenever requisite. Those who wish to possess a good descriptive account of the exhibitors and of their merits, and the progress made in the arts and manufactures since 1851, should certainly secure this work.

EVERY MANS' OWN LAWYER. By a Barrister. Lockwood and Co.

There is a proverbial saying that the man who acts as his own lawyer is a fool, and we believe there is much truth in the remark, for it is quite impossible for any man who has not mastered the rules of the profession or studied the numberless and varying cases and decisions that daily arise, to be able to master any legal question. While we have no wish that any of our readers should go to law, and certainly would never advise them to dispense with a skilled advocate, there is no reason why they shoud not master sufficiently the ordinary abstract principles of law and equity, so as to save them many a consultation fee, on trivial points and questions. With this view, they may study with advantage this barrister's book, who tells them quite enough on all points to guide them in ordinary matters of business.

PUBLICATIONS RECEIVED.—Medical Psychology. by Robert Dunn, F.R.C.S. Churchill. The Pharmaceutical Journal. Chemist and Druggist. Paris Technologiste, &c.

THE TECHNOLOGIST.

OILS AND FATS SHOWN AT THE INTERNATIONAL EXHIBITION.

BY THE EDITOR.

(Continued from page 334.)

II.—Vegetable Oils.

Olive Oil.—The collection of olive oils from Italy was very fine, whether used for soap manufacture, or food. Some of the superior can be purchased at 5½d. a pound, and the common at 4½d. a pound. 1s. 10d. per gallon seemed about the medium price.

Messrs. Danielli and Philippi, of Pisa, exhibited an interesting series of olives preserved in spirits, dried olives, pickled olives, olive oil, washed olive oil, olive kernels, residium of the kernels after expression of oil for burning, and more for fattening cattle.

The other oils shown in the Italian collection were purified grape stone oil, and purified nut oil for burning rape oil used for food by the peasants, linseed oil, laurel oil, and hazel nut oil, oil from the ground pistachio (*Arachis hypogœa*) for burning, and pine seed oil.

The olive tree, from the fruit of which the oil is obtained, grows naturally in the woods and copses near the coast on the southern parts of the Peninsula and the Italian Islands, as also in Greece and Asia Minor, and in the southern parts of France and Spain, and on the coasts of Africa. Wild olive trees are sometimes of gigantic size, having a very thick foliage, particularly in the islands. A temperature of seven or eight degrees centigrade below zero being prejudicial to their growth, wild olive trees, like those which are cultivated, require a mild winter, with a hot summer and autumn to ripen the fruit ; olive oil, however, is obtained from cultivated olive-trees, of which there are many sorts, the *frantoio*, the *morajolo*, the *leccino*, and others more or less esteemed

for the quantity and quality of their fruit. The best olive oils come from the coast of Nice, Genoa, Lucca, and Tuscany. Excellent oils are also obtained from Naples and Sicily, and they are at all times a source of great wealth for certain parts of the country. The total production is estimated at 1,767,000 hectolitres, of which 124,000 are from Liguria. The province of Lucca alone derives nearly 40,000*l.* annually from it; and even exports to America. Tuscany exports olive oil to the value of nearly 80,000*l.* a-year; and the Neapolitan provinces to the extent of about 740,000*l.*

The different kinds of oils are distinguished according to their quality and the mode of preparation. The finest and the most esteemed is fluid, of a yellow straw, or citron colour, rarely white, colourless, sweetish, sometimes greenish, almost always clear, without any smell, in taste insipid, or at least slightly bitter, with a fruity flavour. It is obtained from perfectly sound and fresh olives, after being crushed and squeezed, without previous fermentation. This is what is called virgin oil, oil of first quality; this oil is used pre-eminently for seasoning food, and is known in commerce under the denomination of Oil of Nice, Lucca Oil, or Italian Oil.

The paste of olives, passed through a mill after the first squeezing, and allowed to remain undisturbed for some time, then pressed again, produces a fresh quantity of oil, inferior in quality to the above, and which may be designated as second quality. Treated with boiling water the paste furnishes a further quantity of oil, inferior to the above. This oil is clear, of a rather strong citron colour, but sometimes quite colourless, of a fatty flavour, slightly rancid, and sometimes also it has a little sulphurous taste. It is used for burning, or for making soap.

The residuary matter, treated again with water, by means of machines called *frullini*, yields a further quantity of highly-coloured thick cloudy oil, used for manufacturing purposes, and which is called oil of frullino.

In order to extract the whole quantity from the residue it is treated with sulphur of carbon, which succeeds in extracting a still further yield. Recently, Messrs. Danielli, of Buti, have offered for sale an oil of lotis green, in a half concrete state, which nevertheless is capable of becoming limpid and inflammable, and which they obtain by a process of their own, utilising about 1 per cent. of the matter treated.

In places where the extraction of the oil is less carefully attended to than in Italy, and amongst oil-growers who are not so particular about the quality of their produce, very little virgin, or first quality oil, is made, as it is much more easy to obtain olive oil fermented, or artificially treated, and this with some appearance of a much larger yield, but then they only produce inferior oil.

The consumption of olive oil in Italy forms an important item in the wants of the table, and for lighting purposes and soap-making. The Venetians were the first to use oil in making soap, which was pre-

viously made from fatty matters. The best oil sells at from 1s. 2d. to 1s. 4d. the kilo, according to the year. An oil of an inferior quality, for lighting purposes, is extracted from olive nuts. The marc or cake is used for feeding cattle.

WALNUT OIL.—In the provinces of the Peninsula where the olive does not grow spontaneously, and cannot be cultivated except in certain places having an equal temperature, as on the banks of the lakes, walnut trees have been planted from time immemorial; they yield an oil which, when fresh, is used for food and lighting purposes, or for painting when it becomes rancid. In the north of Italy, in the valleys of the Alps, and also of the Apennines, the walnut-tree forms, and gives its name to a special botanical region.

OTHER OILS.—The importance of nut-oil has diminished since the introduction of the turnip (*Brassica Napus*, L.) and of the Colza (*Brassica campestris*, L.), the seeds of which yield a good oil, and which are used for culinary and for lighting purposes.

For the same objects the *Camelina sativa* is also cultivated, but in less quantities; and in the Novarese, in the Vicentino, and elsewhere, an attempt has been made to cultivate the ground-nut (*Arachis hypogœa*), a small plant which conceals its husks under ground, and which in hot countries, and in fresh soils, yields more than half the weight of its seed in oil, of sufficient good quality to bear a comparison with the best olive oil. M. Filippo Majorana has persevered in developing the cultivation of this vegetable in Sicily, the merit of which, appertaining to him, cannot be better appropriated.

SESAME OIL.—Another important oleaginous plant is cultivated in Sicily, that of the Sesame (*Sesamum orientale*, L.), commonly called *Giuggiolena*. It is a small annual plant, which sown at the end of May, yields its produce during the summer. The inhabitants strew their bread with its seeds, which impart to it a pungent flavour. They also make comfits or *turroni* of it. They extract very little oil from it, but in consequence of the bad crops of olive during the last few years, the trade has been compelled to have recourse to the Sesame, and we hope to see a great increase in the cultivation of this plant in Sicily, which will rival the olive both in the quality and quantity of its oil. At Leghorn and at Turin there are already large manufactories of Sesame oil.

LINSEED OIL.—The extraction of linseed oil has given rise to extensive manufactories. The establishment of M. Giovanni Battista Menotti, of Pistoja, produces annually about seventy-thousand kilogrammes of linseed and rape oil by the employment of very powerful mechanical presses.

The Association of the New Industry at Leghorn, which has at work eight hydraulic presses and a steam-engine of 15 horse-power, produces nearly 550,000 kilogrammes of oil. This oil is scarcely ever used for culinary purposes; it is of great use for painting, for lighting, and for

varnishes suitable for cabinet makers. M. Ombroni, upon Lake Como has also a large establishment for the extraction of different oils.

At Port St. Stefano, in Tuscany, there is a manufactory of oil of *Pistacia Lentiscus*, which is commonly used for lighting, and even for culinary purposes. When thus applied it is deprived of its offensive smell by heating it with crumbs of bread. Apulia carries on a large trade of Lentiscus oil with Egypt. A large trade in castor oil is carried on to supply the demands of pharmacy and soap-making. Many other oils are used for different economical or industrial purposes—as almond oil for medicine, nuts, beech mast (*Fagus sylvatica*, L.), juniper (*Juniperus communis*, L.), laurel (*Laurus nobilis*), cotton seed (*Gossypium herbaceum*), and grapestones for lighting purposes. This last oil, which presents a new product of the grape, is extracted principally in Modena, in which it is an old source of profit.

Castor Oil.—In the northern part of Italy, around Legrano and Verona, the castor oil plant has been grown since 1816; and recently the produce of seed and oil has been considerably increased. Messrs. Valine and Co. owns a large establishment containing hydraulic presses, machines for cleansing and sorting the seed, and a particular filtering process is employed for purifying the expressed oil. About 45 tons of oil are produced by them annually from about 120 tons of seed. The cake remaining after the seed has been expressed is in great demand as a manure for hemp growers.

Russia exhibited refined hemp seed oil first quality, at 5¼d. per lb., raw ditto second quality cold pressure, and warm pressure, and fourth quality mixed cold and warm pressure, all at 4d. per lb.; raw and refined linseed oil, train and seal oil, egg oil, and sunflower oil.

Sunflower Oil.—The sunflower is largely cultivated in Kiers and Podolia eastward on the black soil lands. The stalks are used for fuel.

From the seeds of the sun-flower (white, grey, striped, and black) is expressed a palatable, clear, and flavourless oil, the demand for which is very great. It is exported from St. Petersburg at the average price of 10s. 6d. per cwt., and is said to be very extensively used, after undergoing a certain amount of purifying, for the adulteration of salad oil.

Illipie Oil (*Bassia longifolia*).—The oil extracted from the Bassia seeds in India, solidifies at a temperature of 22 deg. or 23 deg.; at 30 deg. it is semi-solid. It does not become liquid under 35 deg. It is an admirable oil for soap manufacture. If this oil were better known in Europe, a very extended commerce might be carried on in it with advantage.

Cocoa-nut Oil.—This oil is well known in Europe, and a large trade is carried on in it from Cochin and Ceylon. It is said to be a good deal adulterated in some quarters with other oils.

Some very fine samples of this oil were shown from the islands of the Pacific, and also from Tahiti. The principal commerce of Tahiti and its dependencies consists in the preparation of

oil from the cocoa-nut, with which the Pomotau Islands are covered. The export of this oil, which now reaches 600 tons, might easily be doubled in two years, and increased to several thousand tons in ten years. Chili consumes about one-half of the whole quantity produced, and the rest is shipped to Liverpool, Havre, and Bordeaux, either direct or by the way of Valparaiso. The price is about 750 francs the ton. This commerce has of late years greatly altered the affairs of the country, and now supplies freights to many vessels.

The GROUND NUT (*Arachis hypogæa*), a native of America, is now grown on a large scale in India, and a considerable quantity of the oil expressed from the seed is exported. A special article on this oil-plant appears in the present number.

KOOSUM OR SAFFLOWER OIL (*Carthamus tinctorius*, Linn.), is employed for burning, and has been suggested for alimentary uses.

CASTOR OIL.—A single species only of *Ricinus* is usually recognised, of which there are two admitted varieties, one with large and one with small seeds. It would appear, however, that these two varieties are perpetuated by culture, and the marked characters would seem to warrant the formation of two distinct species. If extracted cold a colourless oil is obtained, while the application of heat darkens the oil and renders it bitter and more fitted for burning in lamps than use in medicine. A large commerce is carried on in this oil from India.

From Martinique the following varieties of seeds were sent:—*Ricinus sanguineus, rutilans, Americanus, lividus, spectabilis, viridus.*

The CASHEW NUT contains in its pericarp an oily viscous juice, of an acrid and caustic character. The kernel, on the contrary, is white, oleaginous, and of an agreeable flavour, and is eaten in the place of the almond. It furnishes an oil which is considered superior to olive oil.

The seeds of the white poppy in India furnish about 36 per cent. of oil, which is useful for food purposes. In Europe, from the seeds of the black poppy is extracted an oil known under the name of "oeillette."

The seeds of the *Cucurbita maxima* and of *Cucumis melo* and *sativa* yield a bland oil, which could be used for alimentary purposes; but as these plants are cultivated for their fleshy fruits, it is not likely that their seeds will be largely available for oil purposes.

GALBA OIL (*Calophyllum calaba*).—The nuts of this tree, very abundant in the West Indies, furnish a good burning oil.

AOURA GREASE (*Astrocaryum vulgare*), is from a tree very common in the forests of Guiana and the island of Cayenne. The oil is obtained from the fleshy pericarp of the fruit, which is macerated some time after being submitted to the action of a pestle to disengage the nuts. The pulp or mass is then left a couple of days and

afterwards prepared, when twelve to fifteen per cent. of oil is obtained, which is used for food by the lower classes, and is fit for soap-making.

Ben-aile (*Moringa pterigosperma*).—This tree, which was introduced into Martinique in 1784, now grows wild and plentiful, and it is stated considerable quantities of the seed could be obtained at 4 francs the barrel. A very fluid oil, which does not turn rancid, is obtained from the seeds, which is in demand by perfumers and watchmakers.

Bancoul Oil (*Aleurites triloba*).—This tree is common in Tahiti. The nuts yield 50 per cent. of a drying oil, useful for varnish, and of a density of ·923. It is employed as a purgative in doses of twenty-five to thirty grammes and for soap-making.

Tamanu Oil (*Calophyllum inophyllum*).—The seeds of this tree give an excellent oil for soap-making, and for the treatment of rheumatism.

Yamadou Oil, Oil Nutmeg (*Virola sebifera*).—The seeds bruised and pressed by heat, give 26 per cent. of a substance entirely soluble in potash water, fusible at 34·5, and composed of two parts of oil, one neutral and the other acid, the last forming about three-fourths of the mass. The neutral part having glycerine for its base, forms a solid soap with soda. This oil is well adapted for candles ; it is very abundant in Guiana, and deserves the attention of business men.

Carapa Oil (*Xylocarpus carapa*).—The forests of Guiana contains an enormous quantity of these trees. In the district of Cachipour, after the ripening of the fruit the ground is covered several inches deep with the nuts. The district and the right bank of the Courouaie is stated to be capable of furnishing the soap factories of Marseilles with all the oil they now work up.

Comou Fat (*Œnocarpus bacaba*).—This tree is very common in Guiana, especially in virgin forests. The pulp of the fruit furnishes 18 per cent of a limpid edible oil, and from the kernels a fat is obtained well suited to soap-making.

Ouabe Oil (*Omphalea diandra*).—From the seeds of this plant an excellent oil for lubricating machinery is produced.

All the vegetable oils and fats of British India, which were shown in the Exhibition, have already been fully described by Mr. Cooke, Technologist, vol. ii., pp. 1 and 41.

The specific characteristics of the Indian oils enumerated in the table on the following page, are given by M. Jules Lepine, of Pondicherry. These differ materially from the character given by other authors, but M. Lepine has had opportunities of judging authoritatively on the spot of the origin of the oil, the mode of extraction, and clarification, influenced by other circumstances.

TABLE OF SPECIFIC CHARACTERISTICS OF INDIAN OILS.

Name.	Colour, &c.	Density	Colour given to the Oil by a drop of Sulphuric Acid.
Linum usitatissimum	Amber	0.929	Clear chesnut.
Pongamia glabra . .	Saffron yellow . .	0.937	Orange, with rays of sulphur yellow.
Cassuvium pomiferum	Pale yellow . . .	0.915	Citron yellow.
Papaver somniferum .	,,	0.923	Do., afterwards orange
Cucurbita maxima .	,,	0.918	Citron yellow.
Butea frondosa . . .	Pale, bitter . . .	0.928	Citron yellow, turning to marone.
Argemone Mexicana .	Orange yellow . .	0.928	Deep yellow, turning to red.
Cucumis melo . . .	Pale yellow . . .	0.926	Brown, passing to marone.
Cucumis sativus . .	,,	0.926	Marone, changing to brown.
Hibiscus cannabinus .	,,	0.926	Citron yellow, passing to orange.
Jatropha montana .	Orange yellow, thick	0.960	Yellow, passing to marone.
Eriodendron anfractuosum	Clear yellow . . .	0.926	Orange yellow.
Buchanania latifolia .	White, when at rest deposits stearine .	0.913	Deep yellow, changing to marone.
Feronia elephantum .	Clear yellow . . .	0.923	Marone.
Nicotiana tabacum .	,,	0.926	Marone, passing to black.
Calophyllum inophyllum	Clear yellow with a green shade, thick .	0.937	Orange, passing to red.
Sinapis sp.	Yellow, with an alliaceous odour . .	0.915	Orange, passing to marone.
Carthamus tinctorius .	Clear yellow, with a brown deposit . .	0.923	Citron yellow, passing to marone.
Azadirachta indica .	Deep yellow, with an alliaceous odour .	0.923	Yellow, passing to marone.
Curcas purgans . .	Deep yellow, viscous	0.918	Citron yellow, passing to orange.
Bassia longifolia . .	Clear yellow, depositing stearine . .	0.912	Pale yellow, afterwards citron.
Cocos nucifera . . .	White	0.926	Slightly coloured, greyish yellow.
Arachis hypogea . .	Yellow	0.922	Clear yellow, passing to citron.

OILS SHOWN FROM BRAZIL.—Oil of St. Ignacius bean (*Feuillea cordifolia* and *monosperma*, Vell.)

Oil of Castanha de Jabota (*Feuillea passiflora*, Vell. ; *Anisosperma passiflora*, Mart).

Melon-seed Oil (*Cucurbita citrullus*, Lin).

Oil of the seeds of Mamono do mate (*Mabea fistuligna*, Mart).

Oil of Carocos of Anda-acu (*Anda Gomesu*, or *Andiscus pentaphyllus*).

Purging nut oil (*Jatropha curcas*, Lin).

Cashew Nut Oil (*Anacardium occidentale*, Lin).

Oil of the Becuiba Fruit (*Myristica Bicuhiba*, Schott).

Oil of Sapucainha Seeds (*Carpotroche Braziliensis*, Endl).

Oil of Castanhas de Sapucaia (*Lecythis urnigera*, Mart).

Mandobi, or Amendoim Oil (*Arachis hypogea*, Lin.), used for rheumatic affections.

Capaivi Balsam (*Copaifera nitida*, Mart).

Andiroba Oil, extracted from the fruit of the *Carapa guyanensis*, a fixed, extremely bitter oil, of a yellowish colour when purified. It is employed externally as a deobstruent; and, as an illuminating oil is equal to any other known. The tree is abundant in the province of Para. This is the Carapa oil as before spoken of, p. 342.

Bacaba Oil, from the fruit of the palm *Œnocarpus bacaba*, also abundant in Para, a solid oil of a greenish colour, when well made and purified, employed in cooking and for illumination.

Castanha Oil, obtained from the well-known Brazil nut of commerce (*Bertholletia excelsa*), of a clear yellow colour, possessing more or less of the flavour of the nut, with a strong tendency to turn rancid. When fresh it is employed for culinary purposes, and can be made into soap, or used for lamps. It is possible to obtain almost an unlimited quantity, the tree being extremely abundant in the province of Para.

Cumaru Oil, obtained from the seeds of the *Dipteryx odorata*, of a clear yellow colour, used in perfumery, as a therapeutic in medicine, and for ulcerations of the throat.

Butter of Cacao, a concrete white oil, obtained from the seeds of *Theobroma Cacao*.

Mucaja Oil, extracted from the fruit of the *Acrocomia sclerocarpa*, a palm which is abundant in the province. The oil is concrete, and of a yellow colour.

Pataua Oil, extracted by decoction from the fruit of the *Œnocarpus pataua*, or *distichus*, a palm of which there are great quantities in Para. It is a clear yellow transparent oil, which, when well purified, is inodourous. It is employed for culinary purposes, and is a perfect substitute for olive oil.

Piquia Oil, a concrete, brownish oil, extracted by decoction and expression of the pulp of the fruit of *Caryocar brasiliensis*. It retains the flavour of the fruit from which it is extracted.

Palm Oil was shown from Liberia, and by the writer.

The *Elais guineensis* locally called mchikichi, which is known by the Arabs to grow in the islands of Zanzibar and Pemba, and more rarely in the mountains of Usagara, springs apparently uncultivated in large dark groves on the shores of the Tanganyika, where it hugs the margin, rarely growing at any distance inland. The bright yellow drupe with shiny purple-bark point, though nauseous to the taste is eaten by the people. The mawize or palm oil of the consistency of honey, rudely

extracted, forms an article of considerable traffic in the regions about the Lake. This is the celebrated extract, whose various officinal uses in Europe have already begun to work a social reformation in Western Africa. The people of Ujiji separate by pounding the oily sarcocarpium from the one seed of the drupe, boil it for some hours, allow the floating substance to coagulate, and collect it in large earthen pots.

The price is usually about one doti of white cotton for thirty-five pounds, and the people generally demand salt in exchange for it from caravans. This is the "oil of a red colour," which, according to Mr. Cooley, is brought by the Wanyamwezi "from the opposite or south-western side of the Lake." Despite its sickly flavour, it is universally used in cooking, and it forms the only unguent and lamp oil in the country. This fine Guinea palm is also tapped, as the date is in Western India, for toddy, and the cheapness of this timbo—the *sura* of West Africa—accounts for the prevalence of intoxication, and the consequent demoralisation of the Lakist tribes.*

Palm oil factories on the West Coast are very numerous. The process of extracting the oil is simple. The nuts are gathered by men; from one to four or five women separate them from the integuments; they are then passed on to other women, who boil them in large earthen pots. Another set crush their fibre in mortars. This done, they are placed in large clay vats, filled with water, and two or three women tread out the semi-liquid oil, which comes to the surface as disengaged from the fibre, when it is collected and again boiled, to get rid of the water which mechanically adheres to it. The inner surface of these clay vats, having at first absorbed a small quantity of oil, is not afterwards affected either by the water or oil.

No part of the palm-nut is wasted. The hard shell or pericarp is burnt for charcoal, and used by the native blacksmiths. The oil being extracted, the fibre which still retains oil, is dried or used for kindling. The kernel is used for making another oil called *adi* locally, which is excellent for burning in lamps and making native soap. In British commerce it is called palm kernel oil.

Mr. Cole, in his "Life on the Niger," says: The palm nuts grow in clusters or bunches, containing as many as 4,000, and when gathered are thrown indiscriminately into a trench or pit. They are there covered over with leaves, and so left until they become somewhat decayed. The manufacturer then jumps upon the nuts, and by so doing presses out the oil; the refuse is then parted, and the oil placed in pots containing from three to twenty gallons.

The kernels of the nuts also contain oil of the most transparent nature, but so tedious is the popular mode of extraction, that it is but seldom obtainable, otherwise than boiled, and then its colour is very

* Burton's Lake Regions of Central Africa.

dark, and the taste unsavoury. Palm oil is also used for food, and the mode of making it is very superior to that of making the trader's oil.

The fruit is pounded in a mortar, and when sufficiently bruised, is thrown into a pot containing water; this is then allowed to boil, and the oil, rising to the surface, is skimmed off gently and suffered to cool, and I must say a nicer relish is seldom required to render the yam palatable.

The principal ports in the Bight of Benin, from which palm oil is exported, are Badagry, Porto Novo, Whydah, Aliquah, Lagos, and Palmas. The progress of the export trade from Lagos in palm oil has been as follows:—

	Tons.
1856 . . .	3,884
1857 . . .	4,942
1858 . . .	4,612

There is still a formidable opposition to the palm oil trade exercised by native chiefs, who desire a return to the slave trade.

From Liberia there was exported to the United States in—

		Gallons.	Value $
	1854	538,902	179,634
	1856	1,149,547	416,317
To Great Britain—			
	1856		113,193
To Hamburg—			
	1856		30,456

In 1856 the exports of palm oil from various localities were as follows:

	Tons	£
Benin River	2,500	102,500
Palmas, and vicinity	2,250	101,250
Badagry	1,250	96,250
Lagos	3,864	174,784
Porto Novo, and vicinity . . .	4,400	180,000
Whydah	2,580	112,000
Aliquah	1,500	67,000
To the United States	300	13,500
	18,644	847,284

The Cincinnatti candle manufacturers have recently been purchasing palm oil to make their "star" candles. The cost being about 11 cents. per pound was far cheaper than lard, and hence the production of the forests of Africa has come into successful competition with the product of the hog.

Palm oil is exported from the following rivers:—

Brass, New Kalabar, and Bonny, Old Kalabar, Bimbia, Kameroons, and Fernando Po.

Independent of these in the rivers Malemba, Boreah, and Kampo, palm oil is bought by coasting vessels, chiefly American and French, and some oil is taken by each of the African Steam Company's vessels. At Porto Novo, Onim and Ajuda, the shipments sometimes reach 4,000 tons yearly.

The palm nut tree grows as far up in the interior as Zheru, a distance of 400 miles from the sea, or the mouth of the Min, one of the embouchures of the Niger.

Bonny supplies the largest amount of palm oil that is brought from any river in Western Africa. There are generally from 12 to 15 vessels in the stream, and these comprise an average tonnage of 9 to 12,000 tons.

In 1836, only 13,850 tons of palm oil were imported into England from Western Africa; in 1861, upwards of 37,000 tons were received here.

Egga and Rabba, up the Niger, are the chief places of the manufacture of shea butter, a fat from the Bassia palm-nut already described, TECHNOLOGIST, vol. i. p. 217. But abundance of the trees from which it is produced are met with up the Shadda.

A superior kind of oil for cooking, used in Eastern Africa, is the "uto" extracted from the infuta simsim (*Sesamum*), which grows everywhere on the coast, and extends far into the interior. The process of pressing is managed by pounding the seed dry in a huge mortar; when the oil begins to appear, a little hot water is poured in, and the mass is forcibly squeezed with huge pestles; all that floats is then ladled out into pots and gourds. Oil is extracted from the two varieties of the castor-plant, and in spite of its unsavoury smell, it is extensively used as an unguent by the people. At Unyanyembe, and other places where the cucumber grows almost wild, the Arabs derive from its seed an admirable salad oil, which, in flavour, equals and perhaps, surpasses, the finest produce of the olive.

PETROLEUM OILS.—Specimens of these oils were shown in the United States and Canada collections, and two samples made from Barbados tar. This oozes out of the ground, and is skimmed off the surface of a small pool of water in the island of Barbados.

Mr. Charles Humfrey gives the following report of an analysis he made of it:

"This tar was of a dark brown colour, very viscid, with a faint pleasant smell, its specific gravity ·940.

Ten ounces distilled gave:—

½ oz. water.
5 oz. crude oil, No. 1, sp. gr. ·912.
4 oz. crude oil, No. 2, sp. gr. ·927.
½ oz. coke, left in crucible.

—
10

The crude oil, No. 1, when refined, gave 4 oz. fine oil, pale colour, and very sweet, sp. gr. ·908.

The crude oil, No. 2, refined, gave 2½ oz. fine oil, dark colour, with some empyreumatic smell, sp. gr. ·918.

Wood Oil.—This oil is a brownish yellow limpid oil, with a considerable deposit and sediment—density ·982. The true source of some of these wood oils is not well defined. According to Roxburgh they are the product of *Dipterocarpus turbinatus*, *incanus*, *alatus*, and *contatus*.

In the *Journal de Pharmacie*, Sept., 1856, M. Guibourt published an interesting account of this oil. These wood oils, when held between the eye and the light appear transparent, and more or less red ; viewed by reflection, they are opaque, and of a greenish brown tint. Dr. O'Shaughnessy recommended wood oil as a substitute for balsam of capivi, and Mr. Hanbury has since drawn attention to its medicinal use in the 'Pharmaceutical Journal.'

This tree is known in the Straits under the name of Pune. It is exceedingly plentiful, and is admirably adapted for masts and spars, as such it is much employed in the above localities The Siamese and Cambodians, however, use the tree for a different purpose, that is for the production of the oil, commonly known under the name of "wood oil." It is a drying oil, and used for caulking and varnishing vessels, and the manufacture of the torches so generally used by the Siamese. The method of extracting the oil is to make a deep incision in the trunk of the tree, a few feet from its base, in this a fire is kindled, and allowed to burn for some time, after which it is cleared out. The oil then commences to drop into the incision, which serves as a receptacle. T mean yield of the best trees is 80 to 90 gallons.

THE GROUND-NUT AND ITS OIL.

The plant which produces this fruit, entering into commerce under the popular name of the ground-nut is a little annual, with oblong leaves, growing in fours, and rather large yellow flowers, rising a little way above ground. Botanists call it *Arachis hypogæa*. The plant is one of a class which bury their pods in the earth where they ripen, instead of raising them into the free air. In order to effect this, the flower-stalk, after the flower has passed away, gradually curves downwards, and at length forces its end perpendicularly into the soil, along with the very young pod which is seated there. Having buried itself sufficiently deep, the pod then begins to swell, and when ripe becomes an oblong, rugged, pale brown fruit, containing about two seeds, as large as the kernel of a hazel-nut. Such pods are common in collections of unusual fruits ; the

French call them *Pistache de terre*, in allusion to their resemblance to Pistachio-nuts.

At the present day, the arachis is found in a state of cultivation all over the hottest part of the tropics. It is, nevertheless, almost certain that, like maize, tobacco, and pine-apples, it was unknown till the discovery of America, and that every region in the old world where it is now grown owed it to Brazil ; so that we have in this plant a further example of the rapidity with which vegetables will take possession of soils where the climate is suitable. In Brazil it is known under the name of "Mindoubi," and has long been used there parched for food, and to extract oil from. The roasted seeds are sometimes used as a substitute for chocolate. The nut, according to Dr. Davy, abounds with starch as well as oil, and a large proportion of albuminous matter, and in no other instance had he found so large a proportion of starch mixed with oil.

Although the ground-nut is sometimes eaten, we agree with M. Poiteau, who has lately published an account of the plant, in regarding it as a very indifferent variety of the nut kind, whether raw or roasted. Its great value is caused by the abundance of oil which it contains. Olive oil, largely employed in dressing woollen cloths, has become too dear for manufacturing purposes. Olive trees have of late years been unproductive, and are disappearing from some of the Italian states ; they are now, moreover, reported to be attacked by some kind of mildew, so that a good substitute has become a matter of first necessity. Such a substitute has been found in ground-nut oil. According to Dumas, it was a house at Marseilles that first thought of importing this substitute. About twenty years ago, four or five kilos were imported by way of experiment, and so great was the success which attended it, that in 1852 the imports into France amounted to the enormous quantity of 70,000 tons, a figure beyond even that of sugar.

The chief places of export for ground-nuts from the west coast are Senegal and its dependencies, Sierra Leone, and Gambia. But it is also produced on the east coast, at Natal and Zanzibar, although not at present for shipment.

Captain Burton, in his "Lake Regions of Central Africa," says the common oil of Eastern Africa is that of the karanga, or ground-nut. When ghee (fluid butter) is not procurable, the Arabs eat it, like cocoa-nut oil, with beans, manioc, sweet potato, and other vegetables.

The prepared oil expressed from the ground-nut is admitted by all to be of the purest quality, and fit for some of the most delicate purposes to which oil is put.

"There is no reason (observes the 'Natal Mercury') why this colony, and especially the coast districts, with their grease-craving machinery, should not be wholly supplied from its internal resources, or why the article should not be produced in sufficient quantity for exportation to the Cape town and home markets.

"We have been favoured with the subjoined statement regarding the past years' local crop, prepared by a firm which is entirely devoted to the manufacture of the nuts on a large scale, and which we believe has recently received complete and extensive machinery for carrying on operations.

"The ground-nut harvest is just over, and this year's crop has proved an exceedingly fine one, the yield most abundant, and the nuts themselves heavy and well developed.

"In the absence of actual tabular reports, we are only able to make the following return :—2,200 muids ground nuts have been harvested; 900 muids ground nuts left in the ground from want of sufficient hands to pick them out; total, 3,100. This amounts, in fact, to a loss on the whole crop of nearly thirty per cent. The muid is $2\frac{3}{4}$ bushels.

"The yield this season has been great, and is variously estimated by different growers, and in different soils, at from forty to eighty muids per acre; fifty muids per acre has been considered the average yield of the season. The whole of the present crop has been grown by European colonists. In only three or four instances have natives purchased seed, although we believe many kraals are growing small patches of the ground-nut expressly for seed."

Senegal and its dependencies, which exported, in 1840, but 1,210 kilogrammes of ground nuts, now produce more than 10,000,000 kilogrammes. Cayor and Casamance furnish the largest quantities; but some cargoes are also sent from Galam, which are more esteemed than from the other localities, on account of the thickness of the husk or shell and the superior yield of oil. It is one of the principal resources of the country, and the production is annually more and more extended, notwithstanding the impediments which the Moors throw in the way of its traffic, under the dread that their gums will be neglected. The principal market for Senegal proper is the large village of Gandiole. About Goree, the centre of supply is Rufisque, lower down Sedhiou and Carabane in Casamance, and Albreda, on the Gambia. At the Gaboon, where the population is thinly scattered, and little agricultural, all that is produced is locally consumed. The mean price at Senegal for ground nuts is 20 to 25 francs the 100 kilogrammes (8s. to 10s. the cwt).

The Governor of the Gambia, in a despatch under date May 1st, 1851, stated the demand for ground-nuts had led to the cultivation of large tracts of land; and if the trade were to extend every ten years as rapidly as it had done since its commencement—viz., 43 tons exported in 1837, to 8,636 tons exported in 1847,—whole tracts of country at present covered with jungle or traversed by rude and savage tribes would then be cultivated and reclaimed, whilst all the blessings which spring from agriculture, bringing with them peace and plenty, industry, civilization, and improvement would necessarily follow. Although the exports did nearly double again in the following ten years, this increased

production has been scarcely maintained. The exports from the Gambia were :—

	Tons.	Value.
1858	15,729	£188,747
1859	8,593	68,745
1860	9,951	79,612

The greater part of these go to France, the shipments to that country in 1860 having been 8,206 tons. Our imports into the United Kingdom in the four years ending 1861 averaged 1,400 tons per annum.

Our direct imports of ground-nuts from Sierra Leone, which used to average about 1,000 tons annually, have ceased altogether, as they go now entirely to France. The exports from that colony were :—

	Bushels.	Value.
1858	147,750	£14,449
1859	262,846	25,576
1860	471,509	34,514

Besides about 1,000 bushels shelled.

The ground-nut is now cultivated on a large scale in India, where the seeds form a considerable article of commerce, and there is also a quantity of the oil exported.

From Pondicherry there was exported in 1858, 8,155 sacks, in 1859, 3,269, and in 1860, 4,739 sacks of ground-nuts, and of the oil, 45,634 veltes, in 1858, 72,369, ditto in 1859, and 99,330 veltes in 1860.

Ground-nut oil is used in parts of India for alimentary purposes; in some countries it is sold for olive oil; in North Arcot, it serves to adulterate gingelie or sesame oil, and at Pondicherry it is mixed with cocoa-nut oil. It is chiefly used for the manufacture of soap, and for lubricating machinery. As an illuminating oil, it burns longer than olive oil, although its illuminating power is less. Compared with ordinary burning oils its power is feeble. It has the advantage, however, of keeping a long time without becoming rancid.

Under favourable circumstances, the nuts will produce half their weight of oil, and the quantity is much increased by heat and pressure. In India the mean yield of oil is only 37 per cent. at Pondicherry, and 43 per cent. in Madras. In Europe it is usually found that a bushel of ground-nuts produces one gallon of oil when expressed cold; if heat be applied a larger quantity is obtained, but of inferior quantity. A great quantity of oil is annually exported from the Madras presidency. The plant is cultivated in the neighbourhood of Calcutta, the oil being used for pharmaceutical purposes, and especially for lamps and machinery. The wide extent of the culture was evidenced in ground-nuts being shown in the International Exhibition from China, Siam, Cochin-China, Australia, India, the South of Europe, different parts of Africa, Brazil, and the West Indies.

We know little of the cultivation of this plant, except that it requires a temperature much above that of any country north of Lyons. According to Girardin and Dubreuil it requires good, alluvial soil, or even sandy soil which is well watered, and has been heavily manured. In the month of May in Spain it is dibbled in lines so as to leave the plants a foot apart in all directions. As soon as the flowers appear, the plants are earthed up, and this is continued as long as growth continues. When the temperature falls to 58° the Arachis ceases to grow, its leaves turn yellow, and it may then be dug. Each acre should yield about half a ton of seed. These produce from 34 to 60 per cent. of good oil, fit for burning or for cloth dressing. The cake is very rich in nitrogen, and makes excellent manure or cattle food, but it is poor in phosphates. The leaves or haulm of the plant may be used for fodder.

We notice the plant thus at length in the belief that it may prove a profitable crop in all our tropical colonies where there is moisture enough to suit it. In Spain and Algeria it is found to rank among the more advantageous objects of field cultivation. S.

GUM OLIBANUM.

BY M. C. COOKE.

The question of the varieties and sources of Olibanum has again been opened up by the enquiries of Dr. Birdwood, of Bombay, who adverts, in the first instance, to the researches of Dr. Vaughan, the results of which are recorded in vol. xii. of the *Pharmaceutical Journal.* Dr. Vaughan states that the following are the different kinds of *Lubân* imported for sale into the Aden Bazaar :—

I. "*Lubân Mattee,* so called from Bunder Mattee, the port whence it comes. This gum is collected chiefly by the Agardagahala tribe of Somalis. The season for piercing the trees, from which it is procured, is during the north-east monsoon in the months of July and August." In a note to this, Mr. Hanbury states that the specimen which accompanied it "is very dissimilar to any resin known in England as olibanum. It is in stalactitic masses, which have evidently been the produce of a very copious flow of the peculiar secretion of the tree. These pieces, whose weight varies from one to three ounces, are in parts white or yellowish and highly opaque, in other parts brightly transparent. A thin, brown, paper-like bark is occasionally adherent. The *Lubân Mattee* possesses a strong, agreeable, somewhat citron-like odour, and but little taste. It is closely allied in its characters to the *Tacamaque jaune huileuse* of Guibourt, which is the *Resina anime* of the German

pharmacologists. It also nearly approaches, as Professor Guibourt informs me, the *Résine de Madagascar* of his Hist. des Drogues."

II. The second kind named by Dr. Vaughan is *Lubân Hunkur*, or *Aungure*, from the country of Dour Mahamed and Abardagahala Somalis, is so called from Bunder Aungure, whence it is principally exported. Large quantities of this description of frankincense are brought to Aden; when picked and garbled, it sells in the market for one and a half dollars the maund of 28 lbs. Ungarbled, the usual price for the same quantity is three-quarters of a dollar.

III. *Lubân Mâkur*, from the seaports of Ras Kurree, Khor Bunder, Alholu, Murya, and Bunder Khasoom, in the country of the Worsungali and Meggertein, tribes of Somalis, who inhabit the extreme North-east Coast of Africa, about Cape Gardafui. The natives collect this gum in the months of May, June, and July. When picked, it realizes one and a half dollars per maund; if not picked, about half that sum. Very little of this quality of gum finds its way to Aden; almost all is taken to Maculla and Shehr, on the Arabian coast, from whence it is shipped direct to Bombay. The note appended to this describes the sample to be inseparate, opaque, yellowish, rather small tears, to which bark is frequently attached.

IV. *Lubân Berbera*, or *Mustika*, so called from the place whence it is exported. It is collected in the district inhabited by the Ayil Yunis and Ayil Hamed Soumali tribes, and upwards of 3,000 maunds are annually sent out of the country. This quality of gum is generally garbled before it is exported, and is largely used by the Arabs in their religious services. Its price in Aden is from three-quarters to one dollar per maund.

V. Arabian *Lubân*, commonly called *Morbat*, or *Shaharree Lubân*. A large quantity of Olibanum is also collected in the Southern and South-eastern districts of Arabia, and exported from several towns on the coast between Ras Fartak and Marbat.

The note to Nos. 4 and 5 describes these samples as consisting of tears loosely agglomerated together into darkish masses, many of the tears having a vitreous appearance when fractured.

We have ventured upon giving the above descriptions entire, lest the volume of the valuable journal whence it is quoted should not be in the possession of our readers.

The above being known to Dr. Birdwood, he did not rest satisfied that the botanical sources should remain undetermined, and therefore communicated with Captain Playfair to obtain through him specimens of all the Olibanum trees found in the Soumali country. Through this channel he learnt that there are at least three trees in that district:

1. Yegaar, yielding *Lubân Mattee*.
2. Mohr Add, } yielding *Lubân Sheheri*.
3. Mohr Madow, }

The latter product being so called, writes Captain Playfair, "possibly

because it is principally taken to the Shehr and Makulla market from the African coast." The *Lubân Mattee* and *Lubân Sheheri* of Captain Playfair would at first seem to correspond with Vaughan's *Lubân Mattee* (No. 1), and *Luban Shaharree* or *Morbat* (No. 5), but there is difficulty in reconciling Captain Playfair's remark on *Lubân Sheheri* with those of Dr. Vaughan, who states that the *Lubân Makur* is "almost all taken to Maculla and Shehr on the Arabian coast," and that the *Lubân Shaharree* is collected in the Southern and South-eastern districts of Arabia.

"Each of the three specimens collected by Captain Playfair, 'writes Dr. Birdwood,' so far as can be judged from the leaves, is distinct from the plant described and figured by Carter, (vol. ii., 'Journal of Bombay Branch of Asiatic Society,') as *Boswellia thurifera* (?) and afterwards, as believed, identified by Stocks with *B. papyrifera.* No plant amongst those sent by Captain Playfair being like his plant, which, moreover, he found in Arabia, Dr. Carter began to doubt Stock's reference, and expressed the opinion that *Mohr Madow* would prove to be Hochstetter's plant, of which there can be little doubt, judging from the leaves. There are then three known African Olibanum trees :

Mohr Madow, *Boswellia papyrifera*, Hoch.
Mohr Add (undetermined).
Yegaar (undetermined).

And one Arabian plant described in 1847 by Carter, but not yet named. Captain Playfair says there are other species in Africa, but he has never been able to get at them."

If the *Lubân Sheheri* of Captain Playfair is proved to be the *Lubân Mâkur* of Vaughan, by the fact of its being the kind sent to the Maculla and Shehr markets, then it is the produce, in part, of the *Mohr Madow* (*Boswellia papyrifera*, Hoch.), and the Arabian *Lubân* or *Lubân Shaharree* of Vaughan, in part, the produce of Carter's tree, which may be called provisionally *Boswellia Carteri.* Unfortunately, however, there is still too much of doubt, arising from the discrepancy in native names alluded to, to permit of our accepting this conclusion as matter of fact, but this little additional information may indicate the course of future enquiry.

The Arabian plant, which is certainly not *Boswellia thurifera*, Colebrook, is thus described by Carter, with the exception of the name—

BOSWELLIA CARTERI.

"In the Arabian tree, the leaflets are oval, of a deep green colour, glossy, and sparsely pilose, in both it and *B. serrata** they are crenate, serrated and wavy ; they average six pairs, an inch in length, and, with the confluence of the terminal leaflets, amounting to double, and frequently treble the size of any of the others. The pericarp is pear-shaped and about half the size of an olive ; indeed, the tree throughout appears to average half the size of *B. serrata.* The new cuticle is of a bright hazel

* This is the *B. thurifera* of Colebrooke.

brown colour, peeling off in large deciduous flakes from the bases of the principal branches and trunk, and none but the oldest portions are cinereous. The racemes are fascicled and as long as the leaves."

The gum is procured by making longitudinal incisions through the bark in the months of May and December, when the cuticle glistens with intumescence from the distended state of the parts beneath: the operation is simple, and requires no skill on the part of the operator. On its first appearance the gum comes forth as white as milk, and according to its degree of fluidity, finds its way to the ground, or concretes on the branch near the place from which it first issued, from whence it is collected by men and boys, employed to look after the trees by the different families who possess the land on which they grow.

Dr. Carter's specimens were collected in 1846 at Rakhcote, a small village close to Ras Sajar, on the South-east Coast of Arabia.

The *Boswellia glabra*, Roxb., which inhabits Coromandel, yields the fragrant resin *Goondricum*, or as it is called on the Malabar coast *Koonthrekum*, the *Googola* of the Telingas. The *Boswellia thurifera*, Colebr., is also found in the same locality, and at Nagpore, but the true *Salai*, which is the produce of this tree, is almost a curiosity in India, for only a small fragment is contained in the Bombay Museum. Olibanum, the produce of India, is therefore not an article of commerce. Dr. Birdwood has carefully collected the vernacular names by which Olibanum is known in India, *Sallaci*, *Sillaci*, *Cunduruci*, *Amduri*, *Surabhi*, and *Suvana*, being the Sanscrit; *Salai*, *Sale*, *Sila*, *Sala*, *Sajuvan*, *Gundabarosa*, *Dhoop*, *Esus*, and *Luban*, Hindustani (*Dhoop* is also applied to the resin of *Canarium strictum*). In Guzerat, Olibanum is called *Koondur-zuchir*, in the Deccan, *Awul-goondur*, and the Tamul synonym is *Paranghi-sambrani*.

ON MAIZE PAPER.

BY DR. ALOIS RITTER AUER VON WELSBACH,

Imperial Royal Aulic Counsellor, Chief Director of the Imperial State Printing Establishment in Vienna, and of the Imperial Paper Mill, at Schlogelmuhle, Member of the Imperial Academy of Sciences.

"Where shall we in future get our paper from?" is at the present time a stereotype question among paper-makers. And they have indeed reason to ask the question, for it is a well known fact that the consumption of paper is enormously increasing in all civilised States. The explanation of this is not only the increased productive activity of literature in general, and the periodical press especially, but also the quicker pulsation of public and private commercial life, caused by the freer

institutions of States, the stimulus of competition, increased communication, &c. A great quantity of paper is also now used for other purposes than for printing and writing on, such as for paper hangings, cartridge, packing paper, &c.

The consequences of this enormous paper consumption are felt more and more, because the paper manufacturers meet every day with greater difficulties in procuring a sufficient supply of the raw material necessary for the working of their factories. The rags which are mostly used for the paper pulp cannot be produced at will, like other raw material ; the supply is, as well in regard to quality as quantity, to a certain limit influenced by the activity of the rag gatherers.

It is therefore evident, that the moment must come, sooner or later, when it will be absolutely impossible for the paper manufacturers to keep pace with the paper consumption—if they should not succeed in discovering a suitable substitute for rags. To this end their exertions have been directed for years, and experiments tried with different degrees of success have proved the existence of many substances containing fibre which might serve as a substitute for rags. Few, however, are adapted for manufacturing purposes, either because they are too costly, or because they cannot be obtained in sufficient quantity. Culture or food plants are those which are produced in the greatest quantity, and of these the maize plant seems one of the best adapted for paper-making. This fact was ascertained long ago, and hence it has been tried on several occasions. According to Dr. Schaeffers "Sammutliche Papierversuche" (Reginsburg, 1772), two maize straw paper factories existed in Italy in the last century. But the process in use by the makers seems to have been lost with the decay of the paper mills. A certain Montz Diamant, from Bohemia, recently again drew attention to the maize plant as a substitute for linen rags, and indicated a process for the transformation of maize fibre into paper pulp. He submitted in 1856 to Baron Bruck, the Austrian Minister of Finance, a project with regard to it. The Imperial paper manufactory at Schlogelmuhle, near Gloggnitz, was consequently authorised to make, under Diamant's direction, paper out of a certain quantity of maize straw. The paper so produced was not satisfactory in regard to quality, and the cost of making it also proved to be much higher than that of rag paper. The Minister of Finance therefore gave orders to stop further experiments.

In consequence of a recommendation from experienced men whose opinions had been taken, Baron Bruck consented to have a second trial made in the Imperial paper mill, under Diamant's direction. The mill was at that time under my superintendence, and I interested myself very warmly in the experiments. Different kinds of paper, writing and printing, were manufactured, which were not entirely satisfactory as far as quality was concerned. The cost of producing the paper was still, in spite of all exertions to reduce the manufacturing expenses, considerably higher than that of rag paper, consequently the director of the Imperial

paper mill could not recommend the manufacture of maize paper on a large scale.

As the bulk of the expenditure arose from the great distance of transport of the raw material, it was proposed to undertake the manufacture in a locality where maize was raised in sufficient quantity to have the straw at hand available. It was further resolved to erect an experimental factory for reducing it into half stuff, so that instead of the bulky straw only the compressed substance adapted for manufacturing paper should be delivered at the paper mills.

The half-stuff factory was erected at Roman Szt-Mitaaly, near Temesvar, where the maize cultivation is extensive, and on the 6th March, 1860, it commenced to work under Diamant's provisional direction. The restricted time for experiments was one year. Diamant promised to manufacture in that period 4,500 cwt. of half stuff out of maize straw, but not the seventh part of this quantity was reached.

The half stuff made was also so poor that further experiments, and the working of the factory were suspended at Diamant's own suggestion before the stipulated time had expired. Diamant was then released from his position, absented himself, and left the question unsettled. The experiments cost more than 30,000 florins, which had been advanced by the Imperial paper mill, according to orders from the late Baron Bruck. With this, the past operations of maize straw paper were closed as far as the experiments were conducted under Diamant's direction. Diamant did not participate in subsequent experiments.

The Imperial paper mill had now to rely on itself. The exertions of the direction under whose superintendence the experiments were continued, aimed principally at two things ; first, to reduce the cost of production by improvements in the mode of manufacture—secondly, to ascertain what the expenses would be, if, instead of the whole straw, only the envelope of the grain cob (the sheathing leaves enclosing the corn head), containing fibres of the best and finest quality were used for making paper.

If these industriously continued experiments did not lead directly to the desired result, that of making paper as cheap out of maize straw as out of rags, they led at least indirectly to improvements, and what is of greater weight, to a very important result—the discovery of a new fibre capable of being spun and woven, and the waste of which fibre furnishes a cheap paper.

The origin of this discovery was somewhat as follows :—

It was known that the basis of all paper is vegetable fibre. The rags are but the fibres, produced out of the flax, hemp, or cotton plants, and used up by wearing. If those fibres were used for making paper before they were converted into textures, the paper would be certainly better, but at the same time more costly.

Paper of maize straw is paper of unworn plant fibres. After the idea had once run in this direction, the question arose—cannot the fibres of

the maize plant before they are delivered to the paper machine, just as well be worn as the fibres of flax and hemp are first reduced by wear and tear? In other words, cannot the maize fibre be spun and woven. All that was necessary was a trial. It was made, and succeeded. It was found that the maize fibre could be extracted from the plant in a form like flax, by a process very simple, and at the same time requiring but little apparatus and auxiliary means; that it could be spun like flax, and woven like flax thread. The process which I have invented and brought into use, is protected by patents in all the great European States, so as to secure for Austria the priority of the invention.

That the spinning and weaving of the maize fibre is not yet so far advanced as to make paper out of it, is not to be wondered at, for it must be borne in mind that the last-named process has been tried for several years, while the invention of spinning and weaving it has only recently been experimented on, and is consequently yet in its infancy. The textiles of maize flax will look very different in a short time, when practical men have taken it in hand, and the spinning and weaving machinery have been adapted to the maize fibre. No invention has come out of the brain of its author thoroughly complete, all require time to bring them to perfection, so has it been with this. But this much can be stated with confidence, that the adaptability of maize fibre for spinning and weaving is of the greatest consequence in a commercial point of view, for the cultivation of this plant constitutes one of the most profitable branches of agriculture known, especially in America, and parts of Europe. Without taking the corn into consideration, which already pays for its cultivation, the various parts of the plants can be utilised in many ways.

By the process employed for producing the maize fibre, the components of the plant are separated into three different parts—fibre, flour-dough, and gluten. The fibres are spun and woven; the nutritive substance (flour-dough) which has the peculiarity of remaining fresh for months in the open air, and, unlike other organic substances, resisting putrefaction, gives a pleasant tasting, nutritive, healthy flour dough.

All the fibre and gluten *wastes* of the maize plant which are precipitated during the process of extracting the fibres, are used for manufacturing paper. The catalogues of the Austrian collection at the London International Exhibition in 1862 in German, French and English, were printed either wholly on maize paper, or on paper made partly of maize fibre and of linen or cotton rags.

The entire maize plant can be brought into use. The ear and the maize stuff extract furnish food for man. The fibres are woven into clothing, and the shorter fibre and gluten stuff is converted into beautiful paper. After the fibre has served for clothing, it is recovered as rags and manufactured into paper. What plant can boast of such general qualities as maize.

The most remarkable thing in regard to the process is its simplicity.

The humblest labourer can adopt it when once instructed, and is enabled to produce the above-named article in the field itself without the slightest expense. Where wood is scarce, the lower part of the stalk will supply him with fuel; owners of large farms or manufacturers can produce hundreds of cwts. per day in steam boilers. The material may be bought for cash from the smallest farmer or the largest planter, and brought into the markets of the world.

Austria will endeavour first to acquire enough to supply its own consumption, and then realise a large foreign export. The other countries where maize is grown will follow in the train of this useful application, and the whole world will derive millions of profit by this new branch of industry.

I may close with the following summary: 160 pounds of rags, valued here at about 16 florins, are required for the production of 100lbs. of foolscap, which paper sells for about 33 florins. Four florins have been paid up to this time at Schlogelmuhle, for one hundred weight of the maize paper material. From 3 to 3½ cwts. of lischen (head leaves), yield 100lbs. of paper.

According to official accounts there are in the Austrian dominions more than 2,800,000 yokes (1½ English acres = 1 yoke) of ground planted with maize. The produce of lischen or head leaves (grain sheath) may therefore be estimated at 2½ cwt. of lischen at the lowest computation. We may thus take it for granted that 1,200,000 cwt. of rags can be substituted by maize leaves.

One cwt. of head leaves yields, on an average, one-third substance for spinning, one-third for paper, and one-third for food, there is, therefore, scarcely an atom of waste.

If the whole of the fibrous substances were worked up into paper there would be produced about 1,500,000 cwts. of paper from the lischen collected in the Austrian monarchy. There is no doubt whatever that paper made from pure maize substance far surpasses the best rag paper in strength, toughness, durability, and power of bearing. Experiments made in my own room and before my own eyes, showed that one sheet of bleached maize paper chosen from the portfolio, sustained a weight of 460 Vienna pounds.

If the substance is ground short, on which the transparency depends, maize paper can probably be used as an excellent substitute for glass, owing partly to its natural transparency. It may further be remarked that factories for the extraction of fibre and substance for bread, require no expensive machinery, and but little additional material.

Thus far, our German contributor. The quality of the mixed maize and rag paper we have seen resembles that of fine Indian wove, which is made for taking impressions of steel engravings. There is no country in the world where the raw material for maize paper can be obtained in such abundance and perfection as in the United States, where 830 million

bushels of this grain are produced annually. The fibre of maize, unlike that of cotton, is not free, but is connected and embedded in vegetable gluten and albumen, which require to be removed by chemical and manufacturing processes before it is fit for making paper. What the expense of these processes are Dr. Von Welsback does not tell us ; but the present high price of cotton rags warrants us in urging experiments elsewhere with the material, in the confident hope that it may be economically and generally employed in the manufacture of paper.

One of the great objects of commercial men belonging to certain departments of trade is the production of cheap paper. This useful article is now employed in so many different ways, and is in such constant and increasing demand, that like cotton, its price is rising beyond all precedent, unless some discovery of a paper cheaper and more suitable than rags is made, or the public choose to submit to an inferior article, the prices of many material necessaries of civilised life will undoubtedly rise. Paper for printing purposes must be possessed of certain properties, such as strength, smoothness, pliability, tenacity, and a uniform colour, whether pure white, delicate cream or rose, purple or blue, it matters not the colour must be uniform, the surface smooth, and the material strong, or the public will not be satisfied.

If any person examines some of the publications now daily or weekly issuing from the press he will find that the paper used is often delicately tinted. The 'Illustrated London News,' for instance, is printed on paper possessing a very beautiful pink hue when viewed in a proper light. Many of the best description of new works are printed on straw or cream-coloured paper, but elastic and perfectly uniform in texture. Colour conceals many defects, and is much used for this purpose. The number of substances which have been used for the manufacture of paper with different degrees of success is almost incredible.

Nearly every kind of plant has been experimented upon ; shavings, sawdust, hay, straw, rushes, &c., are all even now used, more or less, for the production of printing paper, when mixed with a certain proportion of rags, and alone or mixed together, to form the coarser wrapping and room paper. Even the mineral world has been searched for materials for paper, and in 1853 a patent was taken out for the preparation and use of asbestos for this purpose. The pulp was mixed with alum and an indestructible paper produced.

The 'Mechanics' Magazine,' probably unaware of the patent just named, introduced the following paragraph respecting this new paper material :—" In the Northern States of America asbestos is found in rather large quantities, in fine, long, silky threads. The low price of this mineral, its power of resisting heat, and its low heat-conducting power, have led to experiments for using it in paper-making. This paper contains about one-third of its weight of asbestos.

" The paper burns with a flame, and leaves a white residue, which

keeps the shape of the sheet if carefully handled. Any writing in common ink is perceptible, even after the organic substance of the paper is consumed."

The machinery for the manufacture of this important material from rags may be said to be almost perfect, but this perfection has been gained at the expense of much labour, time, and money.

Paper in more senses than one has ruined many an industrious and honest man. The very machine which now supplies the world with an endless sheet of paper, invented by Louis Robert, proved the ruin of the liberal and once wealthy firm of Messrs. Fourdrinier of London. They spent 60,000*l.* in giving form and power to this beautiful piece of mechanism, which, with the improvements it has since received, has culminated in the astonishing results which may be now witnessed in certain printing establishments in Europe. Waste cotton or rags, or, for the sake of experimental illustration, a number of old shirts or pocket-handkerchiefs may be put in at one extremity of the machine, and traced through each step in the changes and processes to which they are subjected, until, after a comparatively few minutes, they fall into the hands of the wondering experimentalists, a printed sheet of paper, containing the latest news of the day, or a stereotyped engraving of the interior of the late International Exhibition.

By the agency of the paper machine the old common process of manufacturing this article by hand, which occupied about *three weeks*, is now reduced to *about three minutes*. In all the details of the manufacture, after the pulp is produced, the modern complete paper machine may be said to be perfect. The distance the material has to travel in a large machine, from the time the rags are introduced to the moment when it becomes fit to print on, sometimes exceeds 1,000 feet; and fine writing paper is now made seventy inches in breadth, at the rate of sixty feet a minute. The operation of sizing, drying, and cutting into sheets is included in the time stated. It is the material from which the pulp is made that is the grand desideratum of the day among paper manufacturers. Next to rags, straw is generally acknowledged to be the best available material for this purpose. It is largely used for newspapers when mixed with a certain portion of rags, and the proportion of straw used in connection with rags or paper shavings varies from 50 to 80 per cent.

NOTES ON THE ECONOMIC APPLICATION OF BARKS.

BY JOHN R. JACKSON.

To produce a complete history of barks, and the various uses to which they are applied, would be a work of infinite research, if not entire impossibility. The number of plants known to us as furnishing useful barks is very great, but hidden treasures in this field, as in all others, remain to be brought to light. Barks frequently come under our notice as of reputed efficacy in various complaints, or usefulness in the rude arts of savage tribes, but for want of confirmatory evidence, brought out in experiments conducted by competent men, and a knowledge of their source, little or nothing can be said about them. The uses of barks are infinite; they furnish us with medicines, dyes, and tanning substances, clothing, and other necessaries and luxuries. It would be difficult to say from which branch of their application we derive the most benefit—the scientific or the manufacturing; in other words, as medicine or clothing. The properties and uses of some of the barks which are invaluable to us in these our own days were equally well known to the ancients, and perhaps none more so than Cork, for this appears not only to have been known in times of remote antiquity, but also for like purposes to that for which we use it now. It is mentioned by Theophrastus and Pliny, the last writer especially describing the use of it amongst the Romans for stopping vessels of every description, and also for floats for fishing nets, as well as for many other purposes. Of the barks of British plants comparatively few are made use of in any way whatever. The oak is the chief exception, for it is extensively grown for the sake of its bark, which is superior to all others for the tanning of leather. I have endeavoured to make the following list as perfect as possible by including all the barks which have come under my notice as having any special property, whether real or reputed, and in this I have not given too much attention to those barks in common use, and which are so well known. Where it happens that any individual bark has more than one application, I have dwelt more particularly upon it in the division to which its use gives it the greatest claim.

Medicinal Barks.

In this section, undoubtedly the most important is the Peruvian, or Cinchona barks, to the cultivation of which so much attention has of late been directed, and upon which so much has been written by skilful chemists and botanists. An account of the introduction of this invaluable plant into the East and West Indies will be found at page 181, vol. ii., Technologist. Although one of our most valued and important medicines is procured from this plant, it will be needless to give more than passing notice here, as the subject has been

thoroughly and skilfully treated by most able men. The precise date of the discovery of this invaluable febrifuge has not been recorded, but the period of its introduction into Europe is said to be about 1640. The appellation of Jesuit's bark, by which it has been known, was not acquired till some years after, upon being taken to Rome by the Jesuits, and distributed amongst their order. It afterwards fell into disuse, but was revived in France in the time of Louis XIV., and has maintained its celebrity as a febrifugal and strengthening medicine down to our own day. Indeed it is of more importance now than even then, its uses and applications being more fully developed. The commercial varieties of Cinchona barks are almost numberless, and the species yielding them are not very satisfactorily known. The clearest elucidation of this point is probably to be found in Mr. Howard's new work, "The Nueva Quinologia of Pavon." As is well known, the trees producing these barks are natives of the Andes and the eastern side of the Cordilleras; but experiments have of late been tried as to their cultivation in both the East and West Indies, where we have hopes of their eventually succeeding, so that our supplies of this invaluable remedy may not be curtailed by a continual draining of its native habitat.

Drimys Winteri, Dec. Winter's bark, a native of the Straits of Magellan, Peru, Chili, &c.—It is named in honour of Captain Winter, who accompanied Sir Francis Drake in his voyage round the world, and who brought some of the bark with him from the Straits of Magellan. "He had found it to be very useful to his ships' crew, both instead of other spices to their meat, and as a medicine very powerful against the scurvy." It has been confounded with the bark of *Canella Alba*, having similar properties, but is seldom employed in practice at the present time. The tree grows to about 40 feet high, the bark occurring in rolled pieces about two inches in diameter, and frequently about 12 inches long, in colour of a reddish grey. It has a pungent taste, and an aromatic smell.

Drimys Granatensis, Lin. fil., called Canelo bark in Venezuela, is a native of New Grenada, growing about 20 feet high. The bark having much the same odour and taste as the preceding. It is much used by the people in the provinces of the mines as a tonic in the cure of colics, and is in general reputation as a spice for the seasoning of their food. It has not found a place in the English Materia Medica.

Xylopia glabra, L., Bitter Wood of Jamaica.—This is a tree growing to a height of about 40 feet. All parts of the plant have an agreeable bitter taste; a decoction of the wood and bark is said to have been given with success in colic cases for the purpose of creating appetite. The berries have the same bitter properties, imparting to the flesh of the wild pigeons which feed upon them a grateful bitter flavour. The bark is thin, of a greyish brown colour.

Guatteria longifolia, Wall. A native of Ceylon, Java, &c.—It is a

small tree or shrub, the bark having tonic and diuretic properties, and is used in Ceylon in the cure of fevers and dropsy. It is of a dull reddish grey colour, nearly a quarter of an inch in thickness

Cœlocline polycarpa, Hook, fil. A native of West Africa, where it is called "Yellow Gbeyido bark."—It is thin and fibrous, of a dull greyish brown colour, with a yellowish fracture, and is applied by the natives as a specific in ulcers ; a yellow dye is also obtained from it.

Guazuma (probably *ulmifolia*), known in the markets of Caraccas and La Guayra as "Guásima blanco." It abounds in mucilage, and is used in decoction. It is considered salutary in cases of irritation. The bark is usually about the sixteenth of an inch thick, of a dusky brown colour, with a reddish fracture. The tree grows abundantly in the valley of the River Tuy.

Guazuma tomentosa, H.B.K.—This is a small tree, about 12 or 14 feet high, and very abundant in the same districts as the former. This bark is also found in the markets of Caraccas and La Guayra, under the name of "Guásima colorado." It is of a reddish brown colour, thin and fibrous, and is in great repute in the cure of dysentery and similar diseases.

Ægle Marmelos, Corr.—This tree is a native of Coromandel, Malabar, &c., and grows to a tolerably large size. The bark is of an ashy grey colour, and is used in decoction for palpitation of the heart, bilious fevers, &c., though seldom alone, but in combination with other ingredients. It is the root bark which has the greatest reputation, and which is mostly used. All parts of the plant are considered refrigerant in Malabar.

Cinnamodendron corticosum, Miers.—This is a small tree or shrub, 10 to 15 feet high, native of Jamaica. The bark is about a quarter of an inch in thickness, the outer surface of a clear reddish grey tint, the inner of a dusky white, and much resembles the bark of *Canella alba*, having also similar properties.

Canella alba, Sw.—A tree growing to about 50 feet high, native of the West Indies. Its bark is similar in colour to the foregoing, but perhaps rather lighter on the inner surface, the fracture having a whitish granular appearance. It is aromatic, stimulant, and tonic. Its use in this country is chiefly as a medicinal agent. In the West Indies it is occasionally employed as a condiment. This bark has often been confounded with winter's bark. See *Drimys Winteri.*

Azadirachta Indica, Juss.—A tolerably-sized tree, native of the East Indies, where the bark is much used by the natives as a tonic in intermittent fevers. It is stimulant and anti-spasmodic, and is likewise employed in cholera, chronic rheumatism, &c., applied either in decoction or powder. A gum obtained from the bark is used in native practice as a stimulant.

Galipea cusparia, St. Hil.—A native of the forests of tropical America, where the tree grows 70 or 80 feet high. The bark is of a light ash

colour, intensely bitter and aromatic, having tonic and stimulant properties. According to Humboldt and Bonpland, the Angostura bark of commerce is furnished by this tree, but Dr. Hancock, who was resident in the district for some months, considers it to be the produce of a distinct species, that of *G. officinalis*, Han. This is a smaller tree than the former, seldom found attaining a greater height than 20 feet, with a bark much resembling that of the former species. It grows in the neighbourhood of the Orinoco, Alta Gracia, &c., and is known to the natives as the "Orayura." It is considered by Dr. Hancock as one of the most valuable febrifuges produced in that country, being adapted to the worst and most malignant bilious fevers. The natives use the bark when bruised for the purpose of intoxicating fish. Its use in this country is not very extensive, but an infusion of it is sometimes prescribed in bilious diarrhœa, dysentery, dyspepsia &c. It arrives here either direct from South America or indirect by the West Indies, the largest quantity being imported from those islands, where it is packed in cases for transmission to England. The bark occurs in pieces of various sizes, some nearly flat, others more or less quilled. When fractured, it is brittle and resinous, and has a strong odour. Its introduction into England dates from about 1788.

Evodia febrifuga, St. Hil.—A tree about 40 feet high, native of Brazil, where the bark is used with great success for the same purposes as cinchona.

Ticorea febrifuga, St. Hil.—This is a small tree about 20 feet high, growing in the province of Minas Geraes, Brazil. The bark is very bitter, astringent, and febrifugal, as its specific name indicates.

Xanthoxylon fraxineum, Willd.—Known as the American Prickly Ash—though no ash at all—is a small tree about 10 or 15 feet high, growing in the woods and shady parts near rivers of South America. The bark is in great repute in the United States. As a remedy in chronic rheumatism, and reduced to powder it is occasionally employed as a topical irritant. It is likewise chewed as a cure for toothache, for which it is a popular remedy. It is somewhat aromatic and very pungent. The bark as found in commerce is in small quills, not very thick, in colour of a darkish grey, with occasional lightish patches.

X. Clava Hercules, L.—A tree growing from 20 to 50 feet high, native of the West Indies, where its bark is extensively employed, both externally and internally as a remedy in malignant ulcers. The tincture is reputed to be a valuable febrifuge, and an infusion antispasmodic. The bark is of a dusky brown, with nipple-like protuberances, the remains of the spines.

Cerasus serotina, Dec.—This is a tree about 20 feet high, native of North America, where the bark is considered one of the most valuable indigenous remedies for calming irritation, and diminishing nervous excitement; it is also efficacious in dyspepsia, intermittent fever, &c. It is known as wild cherry bark, and is obtained alike from the trunk

and branches, though that from the root is considered to be the most active. It is found in trade, in pieces of various sizes, of a reddish brown colour, rather brittle, showing a reddish grey fracture. It has a pleasant aromatic and bitter taste.

Prinos verticillatus, Lin.—The black alder of North America, where it grows abundantly in damp, moist places, or swamps, all through the States. It is a shrub, growing 8 to 10 feet high. The bark occurs in pieces of irregular length, more or less quilled. The under surface of a dingy or greenish white. It has a bitterish and astringent taste; is used in the United States as a remedy in diarrhœa, intermittent fever, &c., and is likewise considered useful in cutaneous diseases, both for internal and external application.

Cornus florida, L.—Also a North American tree, where it is called Dogwood. It grows to a height of about 15 to 20 feet. The bark is obtained from all parts of the tree, the most valued being that from the root which appears in commerce in various sized pieces, partially rolled. Of a reddish grey colour, and very brittle, having a bitter astringent and somewhat aromatic taste. Its uses in American practice have been chiefly as a tonic, and as a substitute for cinchona bark. Two other species of this genus *C. sericea*, Herit., and *C. circinata*, Herit., furnish barks having similar properties, though not used in practice to the extent of the former species.

Chrysophyllum buranhetm, Riedd.—A Brazilian tree, growing in the neighbourhood of Rio Janeiro. The bark is known as Monesia Bark, and was introduced into France at the early part of the present century, where it has been employed, as well as in Germany, in cases of atonic diarrhœa, leucorrhœa, &c., though it has now fallen into disuse. The Brazilians still use it for like purposes. It has an astringent bitter taste, in colour of a lightish dusky brown, very thick and heavy, in pieces of various sizes and shapes.

Ardisia paniculata, Roxb.—An East Indian shrub, growing 10 or 12 feet high, producing a bark having tonic and astringent properties, which is used in Ceylon in fevers and bowel complaints, and for external application in the cure of ulcers, &c. The bark is rather thin, of a greyish brown colour, in pieces of various sizes.

Strychnos nux vomica, L. — A native of Coromandel, Ceylon, and other parts of the East Indies, growing to a moderate sized tree, with a rather short, crooked stem. This bark was formerly confounded with Angostura Bark, but is now generally known as False Angostura. Its appearance is greatly altered by age, the young bark being of an ashy grey colour, and somewhat resembling true angostura. At a more advanced age, it becomes partially covered with a soft, spongy surface, of a rusty appearance. It is found in pieces of an irregular size, hard and close, with an exceedingly bitter taste. This bark has been sold in the shops in Calcutta under the name of "Rohun," the true "Rohun" being the bark of *Soymida febrifuga*, which is per-

fectly harmless, and used as a febrifuge, while the strychnos bark is of a poisonous nature. Drs. Pereira and Christison discovered, upon examination, the difference between the two barks, but not till it had been employed on the Continent, and its use prohibited on account of the fatal cases which occurred.

Bignonia chelonoides, L.—A large East Indian tree, the bark of which is tonic, and employed in Ceylon in fevers and puerperal inflammations. It is rather a thickish bark, the outer surface of a lightish brown colour, the under of a bright yellowish grey.

Sassafras officinale, Nees.—A tree of North America, sometimes growing to a height of from 30 to 50 feet, but varying much in size, according to the favourable or unfavourable situation in which it is found; thus, in the northern parts, it is seldom more than a shrub. The flowers, and nearly every part of the plant have a slightly aromatic odour; but the root and bark are the parts which are employed in medicine, the bark of the root being in greater reputation than that of the trunk or branches. It is considered powerfully sudorific, and is employed in combination with sarsaparilla and guaiacum, in chronic rheumatism and cutaneous diseases, in this country as well as in North America. The root bark is found in commerce in small pieces, the outer surface, or epidermis being of a brownish grey, while the inner side is of a dusky red brown, the bark is of a corky, or spongy, consistence.

Nectandra Rodiœi, Schomb.—A large forest tree of British Guiana, the timber of which is known and much valued under the name of Greenheart. The tree grows to 80 and sometimes even 100 feet in height. The first notice of the valuable qualities of this wood was made by Bancroft, in 1769. Dr. Roder afterwards, in 1834, discovered the chemical properties of the bark, which he proposed as a substitute for cinchona. He also found that the bark and fruit contained an alkaloid, to which he gave the name of Bebeerine, the tree being called the "Bebeeru." An interesting account of this alkaloid and its effects will be found at p. 140, Vol. III. of the TECHNOLOGIST. Its properties are tonic, astringent, and febrifugal. The bark, as it occurs in commerce, is in large pieces of about 1 to 2 feet long, and from 3 to 6 inches broad, and about 4 lines thick. Externally, it is of a dusky greyish colour, the inner surface of a cinnamon brown.

Daphne mezereum, L. (Mezereon or Spurge Laurel).—This is a well known medicinal agent, though in this country seldom employed alone. It is produced by an indigenous plant, and is collected for its medicinal properties both in the counties of Kent and Hampshire. It is a bushy shrub 4 to 5 feet high, producing sweet scented pink blossoms in the spring months when destitute of leaves. The earliest authentic notice we have of the plant dates from about 1530. Its properties are sudorific and alterative, stimulating, and diuretic, preserved in scrofulous and chronic cutaneous affections, rheumatism, &c., and is frequently used in England as a remedy for toothache. In this country the bark of the

root is considered the most valuable, and commands a much higher price than that from the stem. In Germany the bark is collected in the spring from the stem and larger branches, and folded and dried in bundles for medicinal purposes. In appearance the root bark is usually somewhat darker than that from the stem ; but both are of a fibrous tough and limp nature, of a brownish corrugated exterior, with a yellowish or whitish cottony appearance on the inner surface. It is found in commerce in strips several inches long. The taste of the bark when chewed is sweetish, changing to an acrid burning flavour.

Croton Eleuteria, Sw.—From this, and probably other allied species, the bark known as Cascarilla is procured, but much confusion exists as to the identity of the plants producing it. The name of Cascarilla has been given by the Spaniards to several varieties of Cinchona barks, but when found in our Pharmacopœia is always intended for the bark furnished by the genus Croton. The first notice of Cascarilla appears to have been made in the year 1692 by a Spaniard named Vincent Garcias Salat, soon after its introduction ; it was thought to be produced either by a species of cinchona, or frankincense (*Boswellia*), but Catesby, in 1754, in his Nat. Hist. of Carolina, described the plant, stating it grew abundantly in the Bahamas. From this and other sources botanists were enabled to determine the genus as that of *Croton* and the species probably *Eleuteria*, but it is very probable that the Cascarilla bark, as found in commerce, is the produce of other species as well as this. The *Croton Eleuteria* is a small tree or shrub growing in some parts only 4 to 6 feet high, but to a height of 20 feet in Jamaica, where it is found, as well as in the other West Indian Islands, growing abundantly in thickets. The chemical properties of the bark are stimulant, tonic and febrifugal. It has been employed as a substitute for cinchona, but is chiefly used in dyspepsia and general debility. In Germany it is largely employed for various complaints, as low and intermittent fevers, dysentery, diarrhœa, &c. The bark as met with in commerce is in small quills, a few inches long, of a dull brown exterior, but nearly covered with a whitish cuticle, the inside being of a dull cinnamon brown. It has a brittle resinous fracture.

Croton pseudo-China, Schiede. — From this species the Copalchi bark of Mexico is said to be obtained. It has been asserted that the *Croton Cascarilla* of Linnæus yields both the Copalchi bark of Mexico and also a bark known in Chili and Peru as "Natra." But there appears little doubt that the true Copalchi bark is produced by the former species, that is if we take the small variety of Copalchi as the true bark, for it comes in two distinct forms—viz., in small and slender quills of an ashy colour, and also in quills of five or six times the circumference, with a thickish and somewhat cork-like epidermis. This latter has been referred to *Croton Suberosum*, H.B.K., but with doubt. The medicinal properties of this bark resemble those of Cascarilla. In Mexico it is in great esteem as a tonic, and largely used as a

substitute for cinchona. A paper on the Cascarilla Barks will be found in the present volume of the TECHNOLOGIST, p. 270.

Aralia spinosa, L. — Called in North America Angelica, or Toothache tree. It is an arborescent shrub, indigenous to the United States; growing in the Southern States to a height of 30 or 40 feet. The properties of the bark are stimulant and diaphoretic; an infusion of the fresh bark is considered emetic and cathartic. It is employed in cutaneous eruptions, chronic rheumatism, &c., and the tincture is considered efficacious in toothache, hence one of the popular names of the tree. The bark as found in the shops is in small fine quills, the exterior surface of a greyish colour, with spines or prickles, or the remains of them. It has not a place in the British Pharmacopœia, but is in repute amongst the Americans.

Æsculus Hippocastanum, L.—This tree, the Horse-Chesnut of our gardens, is probably a native of the north of India or Persia. The bark has been employed in Italy with success in intermittent fevers, but has not been adopted as a medicinal agent in this country. In decoction it has been recommended in gangrene. The date of the introduction of the tree in England appears uncertain; but it was not common with us until about the beginning of the last century.

Monnina polystachia. R. et P.—A shrub native of the Andes of Peru, where it is found growing in thickets, and known by the name of "Yalhoi." The fresh bark of the root, pounded and moulded into balls, is used by the Peruvians in place of soap. The medicinal property of this bark is anti-dysenteric, and it is successfully employed by the natives in cases of dysentery and diarrhœa.

Castanea pumila, Mill.—A tree or shrub indigenous to North America, where it is known as Chinquapin. It sometimes grows to a height of 30 or 40 feet. The bark is tonic and astringent, and has been applied in America in the cure of intermittent fevers, but its virtues seem to be hardly sufficient to give it even a place in the Pharmacopœia of that country.

Schleichera trijuga, Willd. — A tree growing about 20 feet high, native of the East Indies, Ceylon, &c. The bark is said to have astringent properties, and is used by the Indians to cure the itch, for which purpose it is pounded and rubbed up with oil.

Swietenia Mahogani, L.—The mahogany tree grows in Cuba, Honduras, St. Domingo, the West Indian Islands, &c., attaining a height of 80 or 90 feet. The bark is employed in the West Indies as a substitute for cinchona, and is said to have been used with success in intermittent fevers, &c., though its effects undoubtedly are not to be compared with Peruvian bark.

Soymida febrifuga, Juss.—This is a native of the East Indies, chiefly the central and southern provinces. It is a tree about sixty feet high. The bark has an astringent bitter taste, and is considered a good tonic in intermittent fevers. It is reputed to be of great efficacy in Jungle

fever, when Peruvian bark has no effect. An infusion or decoction is usually employed, but, if taken in too large quantities, it is apt to cause vertigo and stupor.

Punica Granatum, L. The Pomegranate.—This is a small, shrubby tree, found wild upon the shores of the Mediterranean, Persia, Arabia, India, and China. It has been introduced into the West Indies, and is now very generaly cultivated in all warm climates, for the sake of its fruit. It is the bark of the root that is used in medicine. It abounds in a peculiar acrid principle called punicin. This bark appears to have been known to the ancients, and used by them as a vermifuge, and it is still used by the native practitioners of Hindostan, as a specific against tapeworm. It has a place in our Materia Medica as a valuable anthelmintic, and is usually applied in decoction, but can also be administered in powder. The bark as found in commerce is in small pieces, rather brittle; the entire surface of a yellowish or ashy grey; the inner, of a pale, dusky yellow.

Juglans cinerea, L.—This is a native forest tree of North America, where it is known as Butternut. It varies in size according to the place of its growth; in favourable situations, frequently attaining to fifty or sixty feet high. The inner bark is the medicinal portion, that from the root being considered the most powerful. Its properties are cathartic and rubrufacient, and it has been used in America with success in intermittent and remittent fevers. It is employed in the forms both of extract and decoction. The bark, when fresh, is of a clear, white colour, changing to a deep brown when dry, and besides being employed in medicine, is often used for dyeing wool of a dark, brown colour.

Cratæva tapia, L.—A tree growing about twenty feet high; native of the West Indies and South America. The properties of the bark are bitter and tonic, and it is said to have been employed with success in the cure of intermittent fevers.

Cedrela toona, Roxb.—An East Indian tree, about 60 feet high. The bark is a very powerful astringent, and is considered extremely efficacious in fevers, diarrhœa, dysentery, &c. It also has the repute of being a good substitute for cinchona, especially when combined with the powdered seeds of the *Guilandina bonduc*. In the form of a powder, the bark is applied externally in the cure of ulcers.

Khaya senegalensis, Juss.—A forest tree, common on the banks of the Gambia, attaining a height of from 80 to 100 feet. The bark, which is called "Cail Cedra," is bitter, and is used by the natives either in infusion or decoction, as a febrifuge.

Liriodendron tulipifera, L.—The tulip tree of North America, where it forms one of the handsomest and most noble of forest trees, frequently attaining 100 feet in height. It ranges from New York to Florida, but is found most abundantly in the forests of the middle and western states. The bark has a place in the American Pharmacopœia, its medicinal properties being stimulant and diaphoretic, and it has been used suc-

cessfully in intermittent fevers, dyspepsia, chronic rheumatism, &c. It is usually administered in the form of a powder, the decoction and infusion being less powerful. The bark is obtained from the trunk, branches, and root; the latter is considered the most active. It seems to lose some of its aroma and pungency by being kept. As met with in commerce, it is of a yellowish, or dirty white colour, rather light, and very brittle.

Magnolia glauca, L.—Another North American plant, sometimes found in the Southern States, growing to a height of 40 feet, while in the northern it is seldom more than a shrub. It is common in the swamps, and on the shores of the Atlantic, from Massachusetts to the Mexican Gulf. It is known in the Northern States by the name of Magnolia; in the Southern, by white, or sweet bay, swamp sassafras, &c. The bark is considered diaphoretic, stimulant, and tonic, and has been employed in chronic rheumatism, intermittent and remittent fevers. The fresh bark, macerated and steeped in brandy, is a popular remedy for rheumatism. This bark has a bitter, spicy taste, and an aromatic odour, and is usually administered in powder, being more powerful than when given in infusion. The barks of *M. acuminata* and *M. tripetala* have properties similar to the preceding, and are used for like purposes. They are both natives of North America, *M. acuminata* growing to a large size—70 or 80 feet, while *M. tripetala* rarely exceeds 30 feet.

Zizyphus jujuba, Lam.—A small tree, about 16 feet high, native of various parts of the East Indies and China. The bark is employed in the Moluccas as a remedy in diarrhœa, and in India that from the root, powdered and mixed with oil, is used to cure ulcers.

Emblica officinalis, Gaertn.—A small tree, native of the East Indies. The bark is astringent, and is given in diarrhœa; it is also used for tanning purposes. The bark of the root when mixed with honey is applied to apthous inflammations of the mouth. In colour it is of an ash grey.

Elæodendron Roxburghii, W. et A.—This is a small tree, native of the mountainous parts of India. The bark of the roots is a very powerful astringent, and when fresh is rubbed with water and applied externally to swellings of all kinds.

Byrsonima crassifolia, Dc.—A tree about 20 feet high, native of Guiana, where the bark is employed as a febrifuge. It is also reputed as very efficacious in the cure of abscesses in the lungs. An infusion under the name of "Chapara manteca" is given as an antidote for rattlesnake bites.

Andira inermis, H. B.—A tree about 20 or 30 feet high, native of Jamaica, Trinidad, and other West Indian Islands, where it is known as the "Cabbage tree." The medicinal properties of the bark are cathartic and emetic, and it is considered in the West Indies an efficient vermifuge, but care has to be taken in its administration, as an overdose produces vomiting, fever, delirium, and frequently death. It has a

sweetish mucilaginous taste, but a disagreeable smell, and is administered in the form either of decoction, extract, syrup, or in powder. Its properties are extracted by boiling water. It is found in long, thick, fibrous pieces, the outer surface of an ashy brown colour, frequently covered with small lichens, the under surface is of a yellowish colour, and has a short brittle resinous fracture.

Simaruba amara, Aubl.—A large tree, 60 feet high, native of Guiana, and other parts of South America, also in some of the West Indian Islands. In Jamaica it is called the Mountain Damson. It is the root bark that is employed medicinally, and has a place in our Materia Medica. Its properties were first made known in Europe in the year 1713, some of the bark being sent from Guiana to Paris with the information that it was successfully employed by the natives in dysentery. Dr. Wright afterwards published a botanical description of the tree producing it. Its chief use is as a tonic, but in large doses it is said to cause purging and vomiting. It is usually administered in infusion, its virtues being easily taken in water and alcohol. It arrives in this country in bales from Jamaica, and occurs in pieces several feet long, rather broad and somewhat flexible and fibrous. The exterior is rough and marked with transverse ridges, internally it is of a pale yellow. It has a bitterish taste; but is without smell. An article on the "Commercial Quassia," by Dr. Bowerbank of Jamaica, vol. ii., p. 250, TECHNOLOGIST, describes this bark fully.

Toddalia aculeata, Pers.—A common hedge bush in many parts of India. The bark of the roots when fresh is employed by the Telinga physicians as a cure for the remittent fever, known as jungle fever. The whole of the plant is considered to possess powerful stimulating properties.

(To be continued.)

THE CORAL FISHERY OF THE MEDITERRANEAN.

BY THE EDITOR.

In the second volume of the TECHNOLOGIST, at page 20, we drew attention generally to the "Coral of Commerce," and we now proceed to furnish some more special, descriptive, and recent details respecting the fishery off the Algerian and Italian shores.

Coral is one of the handsomest and most valuable productions obtained from the sea. Naturalists range it in the animal kingdom at the head of zoophytes, or animal plants. It presents to the fishermen the appearance of a branching shrub without leaves, of a red or rose colour

hard, compact, and solid. Coral has the hardness and brilliancy of the agate ; it polishes like gems, and shines like garnet, with the tints of the ruby. It is found almost on the whole length of the Mediterranean Sea ; but that obtained at great depths is the handsomest and the most diffused. But little is found near rivers. It is not found, according to M. Bory de St. Vincent, at less than 100 feet ; but the small forests which it forms descend to a depth of 650 feet.

Since the sixteenth century, when the merchants of Marseilles began to fish for coral in the Gulf of Stora, this industry has been nurtured by the French Government, and with varied success to the profit of the trade and commerce of Marseilles.

In 1750, the French company which prosecuted this fishery employed 25 boats, which brought in annually from 30 to 35,000 kilogrammes of coral of the value of more than 1,000,000 francs. This coral was re-sold by the manufacturers of Marseilles at the price of five millions, thus bringing in a profit of four million francs to the workers. The suppression of the exclusive privilege of the fishery in 1791 led to the decline of the fishing for and manufacture of coral in France, which passed into the hands of foreigners.

Naples, Genoa, and Leghorn, took up the advantages which France had enjoyed, and for the last quarter of a century it is chiefly these foreign boats which have pursued the coral-fishery on the Algerian coast. Notwithstanding all the efforts made by France to recover the principal share of this profitable pursuit, she has not succeeded. According to an official document, the reasons assigned for this ill-success are as follows :—The fishery is not unattended with hardship and peril, and the number of seamen is seldom equal to the ordinary wants of commerce ; they also find more comfort and greater advantages in other maritime operations.

The Neapolitans, the Genoese, the Sardinians, and the Spaniards, accustomed to a more frugal diet, are content with a morsel of bread and a clove of garlic the greater part of the time, fare which would not satisfy the French fishermen. But this is not the sole reason of their numerical superiority in the prosecution of the fishery. The extra cost of the French outfit for the boats is another disadvantage under which they labour, while the fluctuations of price, owing to changes in fashion, gives it a less interest in their eyes.

But notwithstanding the favours accorded to French boats under the ordinance of the 31st of March, 1832, and the efforts of the Administration to nationalise this industry, the Genoese, Sardinian, and Neapolitan fishermen are still almost exclusively in possession of the coral fishery. The number of French boats employed continues very limited. The ordinance of the 9th Nov., 1844, fixed the annual sum payable to the State by foreign boats at 800 francs, without distinction of season. The French boats are free from any payment.

To this day we possess but vague and indistinct accounts of the processes of formation and reproduction of coral.

M. Lacaze du Thiers, Professor of Science at Lille, who was charged with a mission to the Coast of Algeria to report upon this zoophyte, has given us the results of his investigation and curious experience.

The following are extracts from his report presented to the Governor-General :—

"The lower or inferior animals have the power of producing, by buds like vegetables, other individuals of the same kind. From these, again, proceed others endowed with the like properties, which remain connected, and produce, by their aggregation, masses of different forms, according to the species.

"To describe correctly a branch of coral, we must bear in mind this peculiar property of germination which belongs to the immense class of zoophytes, and we can then consider it as a colony of individuals derived from one zoophyte, itself originating from an ovum or egg.

"The stem of the coral is divisible into two constant and distinct parts: a central axis, hard and brittle, like stone, which is the part used in commerce, and a soft covering or epidermis, which easily yields to the nail when it is fresh, but is friable or brittle when dry.

"This epidermis appears indented by small cavities upon its surface, and we can often perceive radiated pores corresponding to these cavities. In observing the live coral, we see that out of these holes protrude the little flowers that the naturalists Maligny and Peissonnel recognised as the animals, and which they compared to small sea-nettles.

"Nothing can equal the delicacy and graceful disposition of these little milk-white rosettes, which contrast admirably with the brilliant red of the coral.

"Their arms which surround their mouths, are ciliated, or covered with fine fringes which, ever moving and agitating the water, create a circular current that carries to the centre, and consequently into their mouths, the minute matters that sustain them.

"The epidermis is composed of a very delicate white tissue, and presents through its whole thickness the long cavities of the polypes. It is traversed by canals, which are very numerous, and establish a solidity between all parts, sprinkled with small calcareous corpuscles, hard, resisting, and all armed with unassailable bundles of points, having a special form.

"The structure of the animals is otherwise very simple; they present the appearance of a pocket or of an open purse. The mouth is surrounded with arms, and conducts to the central or penetrating cavity the food, and there we find eight lamillæ radiating towards the centre.

"We do not remark, as analogous to the organs of circulation, the ramifying vessels which establish an union between the different individuals in carrying into their chief cavity the liquids that digestion has

there prepared for their removal, not only into the whole thickness of the epidermis, but again into a series of parallel tubes that surround the axis.

"One can seldom form an exact idea of the axis. The polype tree—that is to say the solid framework or skeleton of the zoophyte—forms part of the animal in the same way that this froth-like tissue is the bony framework around which the animalculæ are grouped.

"The ends of the branches of coral are generally the thickest parts. This arises from a considerable number of large polypes, with young ones budding from their bases. The epidermis is relatively more developed than the hard axis which scarcely yet exists.

"The intestinal coils, which proceed from the walls of the digestive cavity, without re-uniting upon the centre, bear at their base the ovaries, and in the males the seminal capsules. Some polypes may be found wholly males, and some entirely female; others again are hermaphrodite, but these latter are comparatively few.

"Fecundation must be accomplished in the digestive sac. The egg remains in the sac where it has been produced, and there undergoes the transformation in the centre of the same place where the digestion of the alimentary matter is accomplished.

"This egg is of a fine dead white; it is not at all transparent. It is of a spherical form before fecundation, but afterwards becomes oval, and is covered with that moveable down or fringe which naturalists call vibratile cilia, and which, moving with great rapidity, serves to carry along the body which bears it.

"When the egg has taken this elongated form, and is invested with organs of locomotion, it becomes an embryo: it is a juvenile that goes moving about at full liberty for a certain time, and then settles down and fixes itself to a rock, to become the founder of a colony of similar individuals, or a branch of coral."

The necessary outfit for a boat costs about 6,000 francs. The total receipts of the French boats vary annually between the wide margin of 13,000 to 34,000 francs, or it may be taken at a mean sum of 22,000 to 25,000 francs, being nearly 150 kilogramme of coral per boat, and 400 to 500 kilos for the most successful. The value of coral varies considerably. In 1826, when the use of it by ladies had gone out of fashion, it was estimated by the French custom-house authorities at but 2 francs the kilogramme in the rough. In 1853, when it had again come somewhat into favour, it was valued at 25 francs the kilogramme.

The number of boats employed varies each year, but on the average reaches about 200. As there are about 10 men to each boat, we have a total of 2,000 mariners frequenting yearly the Algerian coasts for fishing coral. In 1850 the fishery was carried on by 204 boats, of which 26 were French, 3 Sardinian, 121 Neapolitan, 28 Tuscan, and 26 Spanish.

According to the Customs returns, these boats obtained nearly 29,000

kilogrammes of coral, valued at about 1½ million francs (60,000*l.*) This was obtained at the following localities :—

	Kilos.	Value francs.
Oran	262	13,000
Mers-el-Kébir	307	15,350
Alger	345	17,250
Djidjelli	236	11,800
Stora	218	10,900
Philippeville	76	3,800
Bône	9,237	416,850
La Calle	19,200	960,000
	29,881	1,448,950

In 1856, the rough coral exported from Algeria, amounted to but 9,557 kilogrammes, of the value of 477,850 francs ; in 1861, it reached 37,118 kilogrammes, of the value of 1,855,900 francs. In 1857, there was sent to France rough coral of the value of 170,000 francs, and in 1858 to the value of 330,000 francs.

The following figures give the value of the exports in the last six years :—

	Francs.
1853	2,152,800
1856	477,850
1857	661,350
1858	1,369,600
1860	1,448,950
1861	1,855,900

The statistics of export show that it is carried for the most part to the same ports from which the fishing boats proceeded.

The coral, after being cut and mounted, is sent from Leghorn, Naples, and Genoa, to Alexandria, Constantinople, and Aleppo, and from thence finds its way to Persia, India, and China ; of late years more has come to England than usual. Thus, in 1861, there was imported of :

	lbs.		£
Coral in fragments	15,639	valued at	5,706
„ Whole	84	„	370
„ Negligees	602	„	2,015
	16,385		8,091

This was more than four times the quantity imported the previous year, and hence the price fell considerably.

We may append to the foregoing some official details respecting the

Italian coral trade, as furnished in the official Exhibition catalogue of that kingdom.

Coral is an important branch of industry and commerce in Italy. Genoa, Leghorn, and Naples, have been from old times the three great centres to which the raw material has been carried, and where skilful artificers have established themselves in order to work at its transformation into ornaments. Coral is obtained in large quantities in the Mediterranean, and at depths ranging from 200 to 600 feet. Four varieties are distinguished: 1st, red, which is subdivided into deep crimson red, pale red, and vermilion, which is very rare; 2nd, black; 3rd, clear white; 4th, dull white, which is the most common. The produce of the fishery varies yearly, and even in the richest spots the fishing should only be carried on at fixed intervals.

The coasts where this valuable zoophyte is found in the greatest abundance are those of Corsica, Sardinia, Provence, Africa, the vicinity of Trepani, and the Straits of Messina. Three hundred and forty Italian barques, manned by 3,400 sailors, are employed in the fishery. The average profits made by each boat are from 280*l.* to 320*l.*, and the total profits may be estimated at 180,000*l.* The raw coral is sold in the markets of Genoa, Leghorn, and Naples, where it receives its first polish, and undergoes its successive manipulations. The price of the raw coral varies according to the size of the pieces. The smallest, called "Ferraglio" of Sardinia, range from 9d. to 10d. the kilogramme. Those called "Barbarie," from 1s. 10d. to 2s. 2d. Medium size "Fanagliatura" of Sardinia, 21s. 6d. to 24s. 2d. Large size "Fanagliatura," 4*l.* 4s. Large size, of Barbary, 4*l.* 12s. 6d. the kilo.

Besides several second rate establishments, there are in the city of Leghorn four principal manufactories for working in coral.

Each of these employs from 250 to 300 workpeople; this branch of industry thus giving occupation to a thousand women. The coral which is annually wrought into little globules, round, egg-shaped, smooth, or cut into facets, &c., amounts to 25,000 kilos. The greater part is sent to the East Indies, by way of Marseilles; a large portion is exported to Germany, especially for necklaces of an inferior quality, destined to serve as funeral ornaments. It is also sent to Russia, where coral is in great demand. The total value of these exports is not less than 20,000*l.* Naples and Sicily derive an annual profit of 88,000*l.* The quantity of coral brought yearly to Genoa, amounts to about 37,000 kilogrammes, worth 480,000*l.* There are twenty-four coral venders in the city, fourteen of whom have their own manufactories.

The greater part of the coral is wrought into beads. This work, which consists of three different operations, cutting, piercing, and rounding, is executed by the country people, and principally by the women of the Val de Bisagno. The manner in which it is distributed among the inhabitants of the different communes of the valley, affords a striking example of the principle of division of labour. All the workmen em-

ployed in cutting belong to about 100 families in the commune of Assio. Those in piercing and rounding, to about 60 families living in other parts of the valley. Each village works exclusively at beads of a fixed size. The inhabitants go to Genoa to procure the raw material from the coral sellers, and to take back the coral which they have wrought. In Genoa, each manufacturer employs from ten to twenty or more women, who submit the coral to a preparatory process before it is given to the workers of Bisagno.

Upwards of thirty men or women are employed in their own homes in cutting coral with facets. There are, perhaps, also thirty engravers of cameos and coral. It may be safely affirmed that, from 5,000 to 6,000 persons in the province of Genoa gain their livelihood either by fishing for, working up, or selling coral, and that this craft produces a revenue of 80,000*l.* Genoa exports its coral to Austria, Hungary, Poland, England, Aleppo, Madras, and Calcutta.

OSTRICH PLUMES.

The most beautiful, the most complex, and the most highly-elaborated of all the coverings of animals, due to the developments of the epidermal system, is the plumage of birds. Well might the eloquent Paley say,—"Every feather is a mechanical wonder; their disposition, all inclined backward, the down about the stem, the overlapping of their tips, their different configuration in different parts, not to mention the variety of their colours, constitute a vestment for the body, so beautiful, and so appropriate to the life which the animal has to lead, as that, I think, we should have had no conception of anything equally perfect, if we had never seen it, or can now imagine anything more so.

A feather consists of the "quill," the "shaft," and the "vane:" the vane consists of "barbs" and "barbules."

The *quill* is pierced by a lower and an upper orifice, and contains a series of light, dry, conical capsules, fitted one upon another, and united together by a central pedicle.

The *shaft* is slightly bent; the concave side is divided into two surfaces by a middle longitudinal line continued from the upper orifice of the quill, the convex side is smooth. Both sides are covered with a horny material, similar to that of the quill; and they inclose a peculiar white, soft, elastic substance, called the "pith."

The *barbs* are attached to the sides of the shaft, and consist of plates, arranged with their flat sides towards each other, and their margins in

the direction of the convex and concave sides of the feathers; consequently they present considerable resistance to being bent out of their plane, although readily yielding to any force acting upon them in the direction of the line of the stem.

The *barbules* are given off from either sides of the barbs, and are sometimes similarly barbed themselves, as may be seen in the barbules of the long feathers of the peacock's tail.

The barbules are commonly short and close-set, and curved in contrary directions, so that two adjoining series of barbules interlock together, and form the mechanism by which the barbs are compacted into the close and resisting vane of the quill, or "feather," properly so called. When the barbules are long and loose, they characterise that form of the feather which is properly called a "plume," and such are the most valuable products of the plumage of birds in a commercial point of view; as, *e. g.* the plumes of the ostrich.

The lower barbs in every kind of feather are usually loose, forming the down, which is increased, in most birds, by what is called the "accessory plume." This is usually a small downy tuft, but varies in different species, and even in the feathers of different parts of the body of the same bird. The value of the feathers, for bed-stuffing depends upon the proportion of loose soft down that enters into their composition; and as the "accessory plume" in the body feathers of the swans, geese and ducks, is almost as long as the feather from which it springs, hence arises the commercial value of the feathers of these aquatic birds.

In the development of plumage, the first covering of the bird is a temporary one, consisting of bundles of long, loosely-barbed filaments, which diverge from a small quill, and on their first appearance are enveloped in a thin sheath, which soon crumbles away after being exposed to the atmosphere. These down-feathers are succeeded by the true feathers; to which they bear the same relation as wool does to hair, or the temporary to the permanent teeth. In most birds a certain proportion of the down-feathers is retained with the true feathers, and this proportion is usually greatest in the aquatic birds.*

Of the various kinds of feathers employed as plumes for head dresses, the most important are those of the ostrich, the *Struthio camelus*, which belongs to a peculiarly African genus of the great wingless birds. If the ostrich ever slips into Asia, it is only a little way into the Arabian side of the Isthmus of Suez.

The feathers on the body of the male bird are black, but on the female dusky; those of the wings and tail are white, sometimes marked with black. The ornamental wings are furnished with loose and flexible plumes. The elegance of these feathers, arising from their slender stems and the disunited barbs has occasioned them to be prized in all ages; and as they still constitute a valuable article of commerce, there is small chance of

* Professor Owen's Lecture on Raw Materials from the Animal Kingdom.

the ostrich being allowed to remain undisturbed, even in the desolate regions which he inhabits. The hunting of this bird is extremely laborious.

Those who hunt the ostrich for the sake of its feathers proceed systematically to their work. They hunt on horseback, and begin the pursuit by a gentle gallop; for should they at the outset, be rashly eager, the ostrich would start off at such a speed as would carry him wholly beyond the reach of his hunters; but when the pace is more steady, the ostrich makes no particular effort to escape. It does not go in a direct line, but wavers from one side to the other; and this enables the hunter to save distance. The chase often continues several days, at the end of which time the strength of the ostrich becomes exhausted, and he yields. The feathers on which value is placed are chiefly those of the tail; and the hunters are careful not to disfigure these in the process of capture.

Ostrich feathers dyed black, are used for making funeral plumes for horses' heads, in sets of eleven for the hearse, and sets of six for the lid or coffin board, which is borne on the head of one of the undertakers. These plumes are made of a number of pieces of feathers, fastened on to supports of stout brass wire, which are bent downwards when used, so as to give the graceful fall to the plume. When not in use they are closed up to the centre stem. A full set of these plumes for a funeral is worth 200*l.* to 300*l.*, and they are let out by the makers to undertakers.

Plumes of white ostrich feathers are sometimes used at the funeral of young females, but such plumes, from their great value, are rarely seen.

In preparing ostrich feathers for use they are first washed in a lather of white soap and water, and subsequently in warm clear water. They are bleached by three successive operations; first with water only, then with a little indigo, and then a little sulphur. The feathers are then dried by hanging upon cords, during which they are shaken from time to time to separate their barbs. To increase their pliancy the ribs are scraped with a bit of glass cut circularly; and to impart the requisite curly form to the barbs or filaments, the edge of a blunt knife is drawn over them.

The fine soft down, which lies under the larger feathers, known in commerce as estridge, is used in the Cape Colony and in France, as a substitute for beaver in the manufacture of hats; and the coarser, or stronger sort, called hair, has been employed in the fabrication of a stuff or list which resembles fine woollen cloth.

At the South Kensington Museum the various ornamental applications of feathers are well displayed, by Messrs Adcock and Co., where are numerous illustrations of ostrich feathers. They are shown white, curled and dressed; dyed blue, black, and green, and white tipped with pink. The feathers as imported undressed, and some with the barbs on each side of the shaft dyed different colours.

Ostrich feathers continue the object of an important commerce. The most esteemed are those of Alep. Those of Barbary, Alexandria, Morocco, the Cape of Good Hope, and Senegal, are also much sought after. The feather dealers set a high value on the feathers of the female ostrich; but those of the male are most prized, being larger, better barbed, and finer than the female ones. They readily take any colours that are given to them in dyeing.

The white feathers are much appreciated. In France they are sold by number, in England by weight. The black feathers sell by weight.

France derives every year, from the above named producing countries, enormous quantities of ostrich feathers, bought in a rough state, which she employs in her industries, or re-exports dressed to other countries, after having given them a very considerable additional value by hand-work, as the following statement will show.

During the space of seven years France has purchased nearly 235,000 kil. of rough ostrich feathers, of all sorts, of a value approximating to 2,800,000fr.; and during the same period she has re-exported to other countries 77,276 kilos of dressed feathers, of a total value of 15½ million francs.

This branch of industry is then considerable, and looking at the enormous benefits which it secures, it is, says a French writer, much to be desired that Algeria, which hardly enters for much more than a hundredth part in the importations of the seven years, should in future take a larger share in this commerce. At present the price of ostrich feathers is high, in consequence of the large consumption of them for *articles de mode* and ornament, also on account of the continually increasing scarcity of the product in all the markets which were formerly abundantly supplied. Thus, that which was worth 25 to 30 fr. in Paris twenty years ago, now costs 400 to 500 francs.

This dearth prejudices Parisian industry which has long held so to speak the monopoly of the fabrication of ornamental feathers, and now also menaces the English industry. It is principally occasioned by the pursuit of the chase in the Sahara beyond all reason, both of the ostrich itself and of the eggs, which the female deposits in the sand, where the heat of the sun incubates them.

Thanks to the absolute security which now reigns in these vast regions, and gives free access to the numerous caravans traversing them in all directions, the places which were formerly solitary and formed the peaceable domain of the ostrich, are now *battues* in all the sense of the word, and especially during winter, at the time of laying. The Arabs who know the value of the eggs, seek them with eagerness, and the birds from which the feathers are stripped have become the object of a lucrative speculation, and are pursued with ardour.

Thus the ostrich, enclosed on all sides, either dies by the hand of the hunters, or emigrates towards more desert regions. To remedy this state of things, and to prevent the complete disappearanceof the ostrich

from the Sahara, the following questions have been agitated, to ascertain if it be not possible ;

1st. To prohibit entirely the sale of ostrich eggs.

2nd. To interdict the chase of young ostriches, otherwise than to take them alive, and keep them in a domestic state for the periodical crop of feathers, and their reproduction.

3rd. To prohibit the chase of the adult ostrich for one or two years.

These regulations would result in promoting greatly the increase of the species, the incubation would not be disturbed, and they would greatly aid the domestication of the ostrich. Experience already shows the great success which has attended experiments at the Jardin d'Acclimatation at Hamma. The Director of that establishment having received the premium of 2,000 fr. offered by M. Chagot, sen., feather florist, member of the commission of valuers to the Ministry of Commerce, who was the first to succeed in getting the ostrich to breed in a domestic state, and this reproduction promises to obtain for commerce the ostrich plumes, which are daily becoming more rare and dear. The problem of the domestication of the ostrich in the temperate regions of Northern Africa, may yet be attended with a satisfactory result, and thus, instead of chasing the bird from its destination, in order to obtain the valuable spoils of its plumage, it may be bred and led to yield its feathers periodically for the wants of fashion.

The following have been the imports of ostrich feathers into the United Kingdom in the past eight years.

	lbs	Value		lbs	Value
1854	10,282	£46,285	1858	18,843	£56,722
1855	10,681	13,821	1859	29,672	78,871
1856	10,797	19,441	1860	25,277	81,425
1857	14,922	102,132	1861	17,873	42,550

The feathers of the American, or three-toed ostrich, *Rhea Americana*, are extensively worn on bonnets and as military plumes. It is of a uniform grey colour, except on the back, which has a brown tint. The back and rump are furnished with long feathers, but not of the same rich and costly kinds as those of the African ostrich. The Indians, however, make plumes, parasols, and many beautiful ornaments of the feathers, which they much value. This bird is met with in the Banda Oriental, in the provinces of Entre Rios, and in the plains of Buenos Ayres.

THE ALKALI TRADE OF GREAT BRITAIN.

The quantity of raw material consumed, the amount of capital employed in the manufacture, the number of hands engaged, and the value of the commercial product, chiefly consisting of carbonate and caustic soda, are truly enormous.

STATISTICS OF THE ALKALI TRADE OF GREAT BRITAIN, 1862.

Annual value of finished products - -	£2,500,000
Weight of dry products - - -	280,000 tons.

Raw Materials consumed per annum.	Tons.
Salt - - - - - - -	254,600
Coals - - - - - - - -	961,000
Limestone and Chalk - - - - -	280,500
Pyrites - - - - - - - -	264,000
Nitrate of Soda - - - - - -	8,300
Manganese - - - - - - -	33,000
Timber for Casks - - - - - -	33,000
Total - -	1,834,500

Capital employed in the Manufacture.	
In Land - - - - - - -	£235,000
In Plant, Buildings, &c. - - - -	950,000
Working Capital - - - - - -	825,000
Total Capital -	£2,010,000

Annual Cost of Material for Repairs.

Stones, bricks, slates, iron, lead, timber, &c. - £135,500

Labour, not including Labour in Transit

	No of Hands.	Souls.	Annual Amount of Wages.
			£
Directly employed - -	10,600	53,000	549,500
Employed in getting coals -	3,110	15,500	112,840
,, making salt -	420	2,100	16,380
Getting and breaking limestone	660	3,300	25,740
Getting pyrites - - -	4,030	20,150	157,150
Felling and sawing timber for casks - - - - - -	330	1,656	10,140
Total labour employed in the manufacture, and in the preparation of raw materials used in it - - - -	19,140	95,700	871,750

Manufactures depending upon the Products of the Alkali Trade.

Soap.	Linen.	All chemical manufactures of any magnitude.
Glass.	Woollen.	
Paper.	Colour making.	
Cotton.		

Scientific Notes.

Albumen from Fish Spawn.—Some years ago La Societé Industrielle, at Mullhausen (Alsace) offered its gold medal for the invention of some substitute for albumen prepared from hen's eggs, and further 17,800 francs as a remuneration for the first manufacture on a large scale of such a substitute. This prize was gained in 1860, by J. G. Leuchs, of Nürnberg. Mr. C. J. Sahlström, of Jonkoping, Sweden, purchased the patent right of manufacture for Sweden, and received a medal at the International Exhibition of 1862, "for novelty and importance of albumen extracted from fish-roe." The albumen thus made is a complete substitute for that of eggs, contains even less water, and is much cheaper, being sold at 2s. 4½d. per lb., avoirdupois. For certain purposes the fat is separated from the albumen, which then no longer retains the smell of raw fish; the fat is used for grease. The residue of the fish spawn, after the albumen is extracted, is used in the manufacture of ammonia, prussiate of potash, &c.

The Oil Trade.—Since the article on the vegetable oils of commerce, in preceding pages, was printed off, the Board of Trade returns for the year 1860 have been issued, and from these we find that, with the exception of cocoa-nut oil, the imports of all kinds were very large last year, as will be seen by the following comparative figures :—

		1861	1862
Train	tons.	19,176	18,264
Palm	cwts.	740,332	865,890
Cocoa-nut	cwts.	274,992	170,485
Olive	tons.	17,325	21,095
Seed oil	tons.	8,873	11,201
Oil of turpentine	cwts.	100,296	66,632

The palm oil imports are larger than in any preceding year, and hence prices are somewhat lower. We may mention incidentally that an enhanced value has been given to palm-nut oil, from the discovery that in the process of soap-making, it has the property of absorbing more "liquor," or water, than other oil used. The price of cocoa-nut oil rules higher than at any period for the last seven years. Ceylon oil fetching 52*l.*, and Cochin 57*l.* per ton.

Petroleum, or rock oil, but imperfectly known twelve months ago, has forced itself into a position of great importance, not only here, but on the Continent, and in our colonies, notwithstanding every impediment thrown in the way of its transit and storage, and large as the trade has already become, we consider it to be still in its infancy. The importation into London last year was 28,335 barrels; to Liverpool, 39,309 barrels, and to Glasgow, 650 barrels. The total exports to Europe from America, 257,914 barrels, or 10,318,658 gallons.

THE TECHNOLOGIST.

ON THE PAPER MANUFACTURE.

BY BENJAMIN LAMBERT.

We question very much whether there be any industry in this country of a more interesting character as regards its antecedents than the manufacture of paper, stretching back as it does into antiquity so remote as to defy the efforts of the most learned antiquarians to discover its origin. It is supposed, however, that the infant manufacture was cradled on the Nile, when Egypt was in the meridian of her dynastic glory, and, at all events, must have occupied a distinguished position as a national industry during the reign of the Emperor Hadrian, who, in a letter speaking of Alexandria, says —" In this rich and opulent city nobody is seen idle; some are employed in the manufacture of cloth, some in that of writing paper;" that it was afterwards practised in Sicily, and carried from thence to Rome. The *Papyrus Antiquorum* of Linn. is universally recognised as the fibre-yielding sedge, from which the Egyptians of old made the rolls which serve still to commemorate the events of that ancient period. And it is rather a singular reflection that, after the lapse of so many centuries, the paper-makers of our own day are looking to the marshes of Southern Europe for a supply of fibre in aid of the refuse of the human wardrobe.

Much learned discussion has arisen on the probable date when the Egyptian papyrus was supplanted as a paper-making material by cotton or linen fibre. That cotton paper was in use in the eleventh century may be inferred from the year 1050 being the date of a manuscript written on cotton paper, and preserved in the Imperial Library at Paris. In the early part of the twelfth century it would appear to have been well known; and in one instance, at all events, its fragile character duly appreciated, as, according to Montfaucon, Roger, King of Sicily, in a diploma written in 1145, says that he had renewed on parchment a

charter which had been written upon cotton paper in the year 1100, and another which was dated twelve years afterwards. The fibre of the cotton paper of this period would seem to have been too soft for advantageous use, and we consequently find that it was superseded either at the end of the twelfth or the beginning of the thirteenth century by paper made from linen. A very much earlier period than that just named has been ascribed by some writers to the introduction of linen as a paper-making material. Preferring, however, the evidence of some very old documents preserved in the libraries of some of the German Universities, the early part of the thirteenth century is as near as history will carry us.

Many countries have contended for the honour of having been foremost in the van of the paper manufacture from rags. China, Persia, Egypt, Italy, and Spain are the principal claimants. Of the five countries named, Italy and Spain would seem to have the balance of testimony on their side, although a learned ecclesiastic, the Abbot Andrez, writing in the eighteenth century, endeavours to accommodate them all by beginning in China with unregistered antiquity, and ending in Germany in the year 1312. Of Italy, however, we know most from authentic data, as it is certain that paper mills dating from 1564 still exist at Fabriano, in Umbria, as well as at Colle, in Tuscany. As regards the establishment of the first paper mill in this country, there is really no reliable evidence. It has been customary to ascribe the honour to a German named Spielman, who, it is stated, erected a mill at Dartford in the year 1588. Mr. Charles Cowan, in the last edition of the 'Encyclopædia Britannica'—article, Paper—adopts this version. Mr. Herring, in his book on 'Paper and Paper-making,' after stating that the erection of the first paper mill in this country is commonly attributed to Spielman, says :—"It is, however, quite certain that paper mills were in existence here long before Spielman's time." Shakespeare, in the second part of his play of Henry the Sixth, the plot of which appears laid at least a century previously, refers to a paper mill. In fact, he introduces it as an additional weight to the charge which Jack Cade is made to bring against Lord Say :—"Thou hast most traitorously corrupted," says he, "the youth of the realm, in erecting a grammar school; and whereas, before, our forefathers had no other books but the score and the tally, thou hast caused printing to be used, and, contrary to the King, his Crown, and dignity, thou hast built a paper mill;" and Mr. Macintosh, in his 'Popular Outlines of the Press,' gives his award in favour of John Tate, whose mill was situated in Hertfordshire; but to whomsoever the honour—for such it undoubtedly is—belongs, it is perfectly clear that until the commencement of the last century, paper-making in this country did not advance with very rapid strides. Fuller, the quaint author of 'The Worthies of England,' enumerates paper among the manufactures of the county of Cambridge, not as being practised in his time, but "because there are mills nigh Sturbridge-fair where

paper was made in the memory of our fathers," and expresses his "pity the making thereof is disused." It will be remembered that Fuller wrote during the first half of the seventeenth century, and as his labours were nearly contemporaneous with the first establishment of paper-making in this country, it may be interesting to note his remarks on the various kinds of paper then in use. He says :—"There are almost as many several kinds of paper as conditions of persons betwixt the Emperor and beggar : Imperial, Royal, Cardinal, and so downwards to that coarse paper called *emporetica*, useful only for chapmen to wrap their wares therein. Paper participates in some sort of the character of the countrymen which make it : the Venetian being neat, subtle, and court like ; the French, light, slight, and slender ; the Dutch, thick, corpulent, and gross, not to say sometimes also *charta bibula*, sucking up the ink with the sponginess thereof."

It is not our purpose in this place to describe in detail the process of paper-making as at present practised. The route of the rags, from the rag-loft to the salle, has been repeatedly traversed by different encyclopædists, and is withal so simple, regarded as a generality, as to come within the easy comprehension of almost any reader. It is only within the last thirty years that paper-making has literally become an art. In the days when all paper was made by hand, and the vatman, or, as the word is still pronounced, "fateman," was the principal skilled hand in the establishment, paper-making was comparatively a very simple operation. Rags were not then the skeleton in the closet which every paper-maker now-a-days is supposed to possess. The limited supply of skilled labour regulated the number of vats, and the size of the moulds the size of the sheet ; and it was not until nearly twenty-five years after the existence of the paper machine was known in this country—viz., June 17th, 1825—that a Bill was introduced and passed the Legislature abolishing the Act by which newspapers were limited in the size of their sheet to 32 inches by 22. Vat-made papers have hitherto been considered to be, without exception, stronger than machine-made paper, owing to the freedom with which the sheet can contract in the process of air-drying. Of this advantage, however, it is nearly deprived by the introduction of hot-air driers on some modern machines. Some descriptions of paper continue necessarily to be made by hand, such as bank note, fine drawing, &c. ; but for all ordinary sorts, the "fateman" and his moulds, the coucher and his felts, the drier and his tribbles, have had to bow before that splendid aggregation of machines known as the paper machine.

The paper machine was invented by M. Louis Robert, in the year 1799. The MM. Didot, at that time the proprietors of the paper works at Essonne, procured an interest in the patent, and they—through a relation, Mr. Gamble—brought the invention under the notice of the English paper-makers. The idea was to make a continuous sheet of paper on an endless wire, couch it between rollers, and wind the sheet

off on reels, to be afterwards dried and finished in the ordinary way. As a model, the machine worked fairly; but in order to bring it into use in a practicable shape, several years and a large sum of money were spent by the Messrs. Fourdrinier, who worked at the machine with the zeal of enthusiasts, and ultimately succeeded. From this time the machine was rapidly improved, until there was no hiatus between the stuff and the cut paper. After this there was another pause. The trade seemed satisfied with what they had got; and a machine capable of making 54 inches on the wire—with two presses, 5 drying cylinders 3 feet in diameter, a set of glaze rolls, and a cutter—and able to run at the rate of 50 feet per minute, was considered rather a good thing than otherwise. Now, however, there are machines as much as 88 inches wide, with 16 drying cylinders 3¼ feet in diameter, running at the rate of 110 feet per minute, making printings, whilst for the manufacture of writings there is a machine with no less than thirty, 36 inch steam-drying cylinders before sizeing, and 272 drying drums after; and such is the extent of surface developed by the latter that, supposing the machine to be running at the rate of 50 feet per minute, the paper would take an hour to go over the whole series. Such machines as those just named are marvels of mechanical skill. The tide of opinion amongst the makers is now turning in favour of large machines and high speeds, but a long time must elapse before anything like a general substitution of the new for the old can be reasonably expected.

A celebrated statesman once electrified the House of Commons by asking the question—What is a pound? And were we asked—What is a paper-maker? the question would not be more embarrassing. To say that a paper-maker is a manufacturer of paper is very well; but that conveys to the mind of the inquirer no definite idea of his acquirements. Speaking of a mechanical engineer, the conclusion is almost inevitable that he is a mechanic, and, as such, conversant with both the science and practice of his business. The same thing cannot, however, be predicated of a paper-maker. All sound and successful paper-making must be based on an intimate acquaintance with the practice of chemistry. This truth is just beginning to obtain recognition, although the fact must have been patent to the old school of makers for a great many years. As a rule, the paper-makers of this country are woefully deficient in chemical knowledge even of the most elementary character, and their loss has in consequence been proportionately great. Even amongst chemists the chemistry of the paper manufacture is regarded as a speciality, involving a facile use of the microscope in determining the structure of fibre. Of all this an ordinary paper-maker of the present day is profoundly ignorant. A pail and a hand bowl are his standards of measure; and this rude system—for there is method in it all—is even used in the most delicate chemical operations in a mill. Take, for example, the making of resin-size. Most descriptions of printing papers are engine-sized—that is, a certain proportion of size, composed of resin digested in carbo-

nate of soda or potash, is put into the beating-engine, and mixed with the stuff before emptying into the chests before the machine,—given a certain weight of resin, a sufficient quantity of water to be added thereto to bring the resin, when incorporated with it, to a certain consistence, and a sufficient weight of alkali to effect the digestion of the resin. To the chemist these are all known quantities, and the result can be predicated with certainty under the ordinary conditions of proper and uniform heat, &c. ; but, in order to arrive at these conclusions, he must ascertain the percentage of real alkali in the ash or crystals he may be required to use ; and he must also ascertain the constitution of the parcel of resin from which he is working. Our paper-maker, on the contrary, puts to so many parts of water so many pounds of resin and so many pails or hand-bowls of crystals of soda, and considers himself fortunate if he get a resulting parcel of very ordinary size indeed. As a rule, it is found that there is a great excess of water as well as excess of alkali in solution, constituting one of the waste products of the paper manufacture. We have seen many parcels of size in different parts of the country, but not one sample made in the manner just described which at all came up to our standard of a perfect size. In order to size paper evenly in the engine a certain weight of resin to a certain weight of paper is, of course, necessary. Our paper-maker, however, is ignorant as to the variations in the constitution of his different parcels of size ; but calling uniformity to his aid, the hand-bowl is brought into requisition for all alike, and he is afterwards puzzled to account for his paper bearing unevenly. In a paper mill, difficulties are of constant occurrence, admitting only of chemical solution ; and although the routine of a well-ordered mill, realizes to the mind of the amateur observer nothing but the greatest simplicity, it is yet one of the most complex and harassing arts in which any person can engage. The amount of intelligence required from the artizan is not extraordinary, but the individual judgment of the director is called into play with a frequency that would astonish the uninitiated : the paper is not bearing well—the paper is breaking most unaccountably on some part of the machine—the colour is not quite up to standard—the engines are frothing ; in short, every contretemp, however insignificant, occurring in a large establishment is brought under the notice of the director ; and wisely so, as they all bear more or less directly on the general operative results.

Two descriptions of size are used in the manufacture of paper—viz., vegetable and animal. The former is mixed with the pulp, by being put in the beating engine when in course of final preparation for the machine, thus becoming directly incorporated with the stuff ; but when the intention is to use gelatine size, the stuff is sent down to the machine either entirely without or with an exceedingly small portion of vegetable size, and in this state is made into paper, termed, from its porosity, water-leaf. After having passed over a complete set of steam-drying cylinders, the web is either conducted through a trough full of warm dilute

gelatine, or is conducted between two perforated tubes which saturate both sides of the web as it passes on. In either case, the superfluous size is removed from the web by a pair of copper rollers; and it is then conducted over a second set of steam cylinders if for printing, or over a set of hot-air drums if for writing. In this country animal size for writing is the rule, although on the Continent of Europe the size in most prevalent use for this class of paper is a well-prepared vegetable size. As a rule, however, the Continental paper-makers use a stronger rag than we do, and, consequently, with careful breaking, capable of carrying a greater quantity of size than a softer material. With us nearly all printing papers are engine-sized. Paper is said to bear well when it resists moderate contact with the tongue; otherwise it will not stand handling after the process of wetting to which it is subjected in order to prepare it for the printer. If printing papers were only partially dried on the machine, and sent direct over the printing machine without the intermediate process of wetting, the difference in the appearance of the work would be extraordinary; the effect as demonstrated is that the paper retains its brightness of surface, instead of acquiring the dulness which results from subsequent wetting, and the whole appearance of the printer's work is materially improved; the practical difficulty would be in determining the weight of water in the paper.

Judicious bleaching is a very important operation in the manufacture of paper. We say judicious; for if great care be not exercised, the integrity of the fibre is more or less damaged. Rags are prepared for bleaching—1st, By being cut into small pieces by hand, or sorted by hand and cut by a machine called a chopper; they are then passed through the duster; then boiled in a partially caustic alkaline ley, under pressure; from thence they are conveyed to a breaking engine, where they are washed and broken into the condition of half-stuff—that being an intermediate step between the rag or textile fabric and the stuff or pulp. Having been sufficiently washed, the half-stuff is drained, and is ready for bleaching. Chlorine is the bleaching agent, and is exhibited in two ways, either in combination with lime as chloride of lime, or as gas applied as such. The former is considered the most scientific method of the two, as well as the most economical, although the latter still retains many influential advocates. Thorough boiling is a necessary condition—1st, In the production of uniform half-stuff; and, 2nd, To effective bleaching, chlorine being inert in the presence of grease. Common printings, and papers of that class, are usually bleached both expeditiously and roughly. After having been broken in, the rags are retained in the breaking engine, into which is put so many pounds of dry chloride of lime, which becomes thoroughly mixed with the half-stuff by the action of the roll. A little sulphuric acid assists the rapid liberation of the chlorine, and by this means the material acquires a very respectable colour in comparatively a short space of time. This, however, is done at the expense of quality, in every sense of the word.

The half-stuff destined for fine papers, after being discharged from the breaking engine, and having parted by drainage with the bulk of its water, is either filled into what is termed a poaching-engine, or is put into the bleaching cisterns direct. In the former case the chemical is thoroughly mixed with the stuff before it reaches the cistern, whilst in the latter the chemical is left to reach the underlying stuff by percolation. It is obviously important that the half-stuff should be brought into regular contact with the chemicals ; and as chlorine is a heavy gas, slow of voluntary evolution, a great deal of difficulty is experienced in getting an average colour in cases where the poaching-engine has been dispensed with. In our opinion, the most scientific method of bleaching is the injection of carbonic acid gas into a circular vessel containing the half-stuff floating in a dilute solution of chloride of lime. By this means the elimination of the gas is regularly effected ; and the stuff being kept in constant motion by means of an agitator, secures the fair distribution of the bleaching agent. The best way to use bleaching powder is in clear solution, the strength of which should be known in order to regulate the quantity applied ; but not less important is its eradication from the stuff when the bleaching process has sufficiently far advanced. Many persons still use sulphuric acid for this purpose, regardless of the danger of its subsequent liability to concentrate, should the smallest quantity remain in the stuff, a solution of Sulphite of soda is the best and most scientific. Gas bleaching is still extensively used, but we are of opinion that the damage done to the fibre more than counterbalances any advantage which may be gained by a saving of time.

In paper mills it is customary to run the machinery night and day ; and the amount of continuous labour the work-people undergo is startling. For example, we have seen men refuse to work during 12 hours and rest the remaining 12, insisting on the privilege of working 24 hours on and 24 hours off. At the rag-engines the men work even longer than this at times, without any visible effect on health. Large quantities of paper are made by some of the large makers—as much as 300 tons per month by one firm alone. An idea would seem to have gained some currency that the process of conversion of rags into paper occupies only a very few minutes of time. Nothing can possibly be more erroneous, as it takes 24 hours, more or less, from the time of unpacking the rags to the appearance of finished paper in the salle. Comparing papers of English manufacture with foreign makes, we are unable to discover any good ground of alarm from excess of importation. Our papers are, somehow, characteristic. Neither the Belgian nor French makers can approach us in quality and price in our market, if we only choose to keep the pas. Hitherto the fear of foreign invasion has certainly acted as an incentive to improvement in almost every branch of the manufacture. Tinting printing sorts is becoming rather general, and we are glad to see anything like an exhibition of taste coming from within. In coloured sorts the foreign makers are rather

distinguished; but if our own makers would pay stricter attention to the absolute purity of their stuff—as well as to height of colour, previous to the addition of colouring materials—they would have no reason to complain of any superiority, whether in brightness or otherwise, on the part of the foreign paper-maker.

In considering the multitude of vegetable fibres suggested for the use of the paper-maker, we are completely bewildered. Their name is legion; and yet we can only point to one out of the whole number as an accomplished fact, viz., the grass called esparto or alfa—a hard, wiry grass, with a rather strong siliceous cuticle. In this country Mr. Routledge, of Eynsham, has, by his diligence and enterprise, monopolised the manufacture, throwing it open to the trade, however, on easy terms; whilst the Baron de Niviere has been doing the same thing in France. The fibre is strong and hard, and, as far as our experience goes, difficult to work, great care being required at the beating-engine, otherwise the stuff is apt to be stringy and impede the working of the machine. Mr. Routledge shows some specimens of esparto paper, remarkably good in texture, and of good colour; but we cannot help thinking that the utility of the fibre is most apparent when used as a mixer with rags. Straw cannot be considered a new material for paper-making, although its extensive use is of comparatively recent date. Neither can straw be considered in the light of a substitute for rags *per se*. For low papers it will, at all events for the present, command a market; and as a mixer, we consider it inferior to esparto, the articulations or knots are so exceedingly troublesome, and cannot be got rid of effectually. The consequence is that, even when used as a mixer at the rate of 10 per cent., should the knotter on the machine be set fine, the plate speedily becomes clogged with knots, and the paper runs immediately uneven. The only remedy for this is to rake the knotter, which almost invariably forces some dirt into the stuff below, and the paper for several yards in length becomes foul and unserviceable, the only alternative being to work with a knotter sufficiently coarse to allow the straw knots to pass, and trust to Providence for the rest. The refuse of the maize manufacture in Austria—an interesting account of which, by Dr. Auer, appeared in the 'Technologist' for March—may become in time an important aid to the paper-maker; but, as far as we can judge, there is no fibre before the public at present which could be accepted as a substitute for rags in every particular.

Any novelty in the paper manufacture is of rare occurrence; but the manufacture of a good printing sort, entirely from waste paper, may be fairly accepted as such. Any kind of old paper that has ever been white—whether plain, printed, or written—is eligible for this process, which was originated by the writer, and was, from its inception to its proof, carried on by a series of laboratory experiments under his direction. The process is the property of the Kennet Paper-making Company, occupying large premises on the river bearing that name. The uses of waste

paper, and of fibrous material suitable for some branches of the paper manufacture, are so multifarious as to defy enumeration. Plastic art annually demands a considerable quantity; and, as a curiosity in its way, we read that in Bergen there is an elegant church, capable of holding 1,000 persons, constructed entirely, statues and all, of papier mâché.

The transformation of water-leaf, or unsized paper, into a material in exact resemblance to parchment, is one of the chemical facts of the last few years. This metamorphosis is effected by dipping the paper in a vat of dilute sulphuric acid, which must be of an exact stated strength, as either an excess or paucity of acid in the vat fails to effect the desired result. Dr. Hofmann reports that the product resembles in every respect animal membrane—"The same peculiar tint, the same degree of translucency" and horn-like condition. "Immersed in water, vegetable parchment exhibits all the character of animal membrane, becoming soft and slippery by the action of water, without, however, in any way losing its strength. Water does not percolate through vegetable parchment, although it slowly traverses the substance like animal membrane by endosmotic action." A set of experiments, conducted by Dr. Hofmann, to test the relative strength of vegetable and animal parchment, resulted as follows:—

Water-leaf paper broke when loaded with

I.	II.	III.	Mean.
17lb.	15lb.	15lb.	15·6lb.

Vegetable parchment broke when loaded with

I.	II.	III.	Mean.
78lb.	75lb.	70lb.	74lb.

Animal parchment broke when loaded with

I.	II.	III.	Mean.
92lb.	78lb.	56lb.	75lb.

And the operator continues to say "The strips of vegetable and animal parchment were selected as nearly as possible of equal thickness, but the strips of the artificial product were somewhat heavier than those of real parchment. On an average the former weighed 18 grains, and the latter only 12.75 grains. Calculated for equal weights the strength of animal parchment as compared with that of artificial parchment is obviously $\frac{18}{12 \cdot 75} \times 75 = 105$, in round numbers, it may be said that vegetable parchment has three-fourths the strength of animal parchment." Under the name of artificial parchment, Captain J. H. Brown, R.N., started a process at Romsey, for making parchment direct by treating the parings of raw hides with alkaline solutions, and succeeded in producing a very capital substitute for parchment. Satisfying all the conditions, even to appearance, specifically belonging to the original article; but on refusing to take out a papermaker's licence, on the plea, as he informed us, that with a paper label attached, the article could not be sold as parchment, realising its proper value, the Excise instituted

a prosecution for penalties. On the trial, the Judge, ruling that it was a question of law and not of fact, caused a verdict to be entered for the prosecution, but allowed the party the unenviable privilege of leave to move for a new trial, on the ground that although it was quite clear to him that the article in question was not parchment, he could not say that it was paper. In consequence of these proceedings the mill was shut up, and we are not aware of the manufacture having been revived.

Particularly facetious persons have more than once informed us that sawdust is a highly nutritious article of diet when properly cooked; but it would appear that uses have been found for it other than gastronomical, one being as a fibre for paper-making. We are informed that wood of any kind or age is equally well adapted for this process, which is being extensively worked in some of the Continental States. At the recent International Exhibition Wurtemberg contributed several samples of paper made from wood pulp mixed with rags, the proportion of the former varying from 10 to 80 per cent; and the paper is reported to be serviceable, although of a low quality. Doubtless the inventor will improve the article as he gains experience in its manipulation. We understand that the wood is simply rubbed down into pulp against the periphery of a wheel prepared with a rough face, so utilizing the enormous waste of the timber-producing forests of the north of Europe.

Since the repeal of the duty on paper the manufacture has barely recovered from the general paralysis occasioned by that Act. The demand for paper both for home consumption and exportation to all parts of the world, the United States excepted, is steady. In the United States there exists at the present moment a paper famine which must, sooner or later, be satisfied by importation from the European markets. So serious is the scarcity that paper has risen in price enormously, and the consumers are clamouring for the repeal of the prohibitory duty fixed by the Federal Government on its import from abroad. When that comes, the prices of all papers here must inevitably rise, but some years must elapse before the balance of trade be again restored.

[The reader will find the following articles bearing on paper making and materials in previous volumes of the TECHNOLOGIST.—EDITOR.

Vol. i, Paper and Rags in China, by Dr. Macgowan, p. 27; Paper Materials Patented since the year 1800, by M. C. Cooke, p. 50; On the Manufacture of Paper in Tasmania, p. 61; Paper from Indian Corn Leaves, p. 109.]

ON THE CULTIVATION OF SILK IN TASMANIA.

BY THE REV. T. J. EWING AND MR. STUTZER.

At the monthly meeting of the Royal Society of Tasmania, held at Hobart Town, on the 4th November, 1862, Mr. Ewing laid before the meeting elaborately executed drawings from his work on Natural History, of most of the silk-spinning moths of the world, and read the following observations in reference to them. Although most of the information is a duplication of the details given by Mr. Moore in our pages, vol. 2, p. 410, we give it entire, as showing the interest taken in the subject at the Antipodes.

Attacus Cynthia (Drury).—First described by Drury in 1773. It was sent from China to Turin by Father Fantoni in 1857, and was introduced into France by Guerin Meneville in 1858. It was figured by Danberton, jun., in his coloured plates, which were published between 1760 and 1765. It was raised for some centuries in China, where its silk clothes the people. The colour of the silk is a fine flax-grey ; and the clothes made of it are not injured by rain or oil. The caterpillar of the silk-worm feeds on the leaves of the *Ailanthus glandulosa.* It has been shown to live as well in Europe as in its native country. More than two thousand amateurs are engaged in efforts to rear this worm ; these experiments have not all resulted satisfactorily, the insect-eating birds having in some places made a war of extermination. Nevertheless, the degree of success is so great that, according to Guerin Meneville, it is now practicable to carry on experiments on a large scale.

The principal obstacle connected with the manufacture, arises from the difficulty of separating (reeling) the silk from the cocoons. This difficulty has at length been overcome by two different methods, one of which was discovered by Madame Vernede, of Corneillan, the other by Dr. Forgend.

Attacus Ricini (Sir W. Jones).—First described by Boisduval, in 1854, and long confounded with the true *Cynthia* of Drury. It is the *arrindy, arria*, or *eria* silkworm, and is reared over a great part of Hindostan, but more especially in the districts of Dinajpur and Ranjpur, in houses in a domesticated state, and feeds chiefly on the leaves of *Ricinus communis.* The silk of this species has hitherto never been wound off, but people spun it like cotton. It is so productive as to give sometimes twelve broods of spun silk in the year, says the late Dr. Helfer, (T.A.S., Bengal, p. 45, 1857).

Dr. Roxburgh states, (Linn. Trans., vol. 7) that it is capable of being reared in the same way as the common silkworm. The cocoons are white or yellowish, of a very soft and delicate texture, in general about two or three inches in length, and three in circumference, and pointed at both ends. In this cocoon the chrysalis remains from ten to twenty days, the moth appearing at one end, the period of its final state not ex-

tending beyond from four to eight days. The moths are quiet, seldom attempting to fly from the apartment in which they are reared. The silk is so exceedingly delicate and glossy that it is impracticable to wind it off, it is therefore spun like cotton, and the thread thus manufactured is woven into a coarse kind of white cloth, of a loose texture, but of surprising durability, the life of one person seldom being sufficient to wear out a garment made from it, the same piece descending from mother to daughter. It is not only used for clothing but for packing light clothes, &c. Some manufacturers in England to whom it was shown, seemed to think that it could be made there into shawls equal to any received from India. For some time it was thought that this species could be acclimatised in France, but at length after many efforts it has been deemed right to abandon the attempt on account of the climate. In fact, this industry only flourishes in warm countries where the *Ricinus* is not killed by frost in winter. After experiments tried upon an extended scale, the culture of this silk-worm has proved successful in the Canary Islands.

Mixed Breed.—Guerin Meneville has succeeded in raising a mixed breed, between *Ricina* and a *Cynthia*, which have partly overcome the early hatching of the former silk-worm, and may in the end prove hardy enough to brave the French climate.

Attacus Hesperus (Linn.)—This species is a native of Cayenne, where it feeds in its natural state on a plant which bears the name of the *cafi diable.* Michlez discovered that the *Ailanthus* suited it still better, and that it developed itself perfectly upon this tree. It does not, however, succeed in France, because it hatches at a season of the year when all vegetation is arrested.

Attacus aurota is also a silk-bearing species from Surinam, where it feeds on the leaves of the orange tree, and there are several other silk-producing moths of this genus from both North and South America, which however have not been domesticated.

Attacus Atlas (Linn. 1767).—This is the largest of all known lepidopterous insects. It inhabits China, North and South India, Ceylon, Burmah, Java, &c. In China the larva feeds on the leaves of the *Molakka* (*Phylanthus Emblica*), and it is said that the Chinese Tusseh silk is obtained from its cocoon.

Attacus Edwardsii (White, 1859) is distinguished from *A. Atlas* by its intensely dark colour.

Attacus Guerini (Moore, 1859) is the only other Eastern species of this genus, and is named in honour of the gentleman who has especially interested himself in the introduction of new silk worms into Europe.

Antheræa paphia (Linn. 1767).—*Saturnea mylitta* (Drury, 1733). This is a native of N. E. India, Silhet, Assam, S. India, Ceylon, and Java. It feeds upon the leaves of the *Rhamnus jujuba* (Byer of the Hindoos) *Terminalia* or *glabra,* Roxb. (Assan of the Hindoos). Colonel Sykes also adds that it feeds also on the teak (*Tectona grandis*) and the

mulberry tree (*Morus Indica*). The cocoons are extensively used by matchlock men, cut into thongs as ligatures for binding the matchlock barrel to the stock; the thongs are more durable than those of leather. It cannot, according to some authors, be domesticated, but is found in such abundance over many parts of Bengal and the adjoining provinces as to have afforded to the natives from time immemorial an abundant supply of a most durable coarse dark coloured silk, commonly called Tusseh silk, which is woven into a kind of cloth called Tusseh doothies, much worn by Brahmins and other sects of Hindoos.

Antheræa pernyi (Guerin, 1855).—Feeds on the oak; a native of China; introduced into France by its describer.

Antheræa yama-mai (Guerin, 1861).—A native of Japan, where it feeds upon the leaves of the oak, and bears the name of *Yama-mai.* The silk which it produces is of a very beautiful quality. It is more solid and more beautiful than that of other species of silkworm which feed upon the oak. It was sent to the Society of Acclimatisation by the French Consul in Japan, M Duchesne de Bellecourt. Two circumstances give peculiar interest to the introduction of this useful insect—viz., the coldness of the country it naturally inhabits, and its feeding upon a species of oak, not mulberry; the oak on which the silkworm feeds is not exactly described, but it has been found by Guerin to feed on two or three species in France, *Quercus castanæfolia, pedunculata, &c.*

Many other species of *Antheræa* are natives of the warmer portions of the Himalaya, Assam, Silhet, &c., &c., also of the West Coast of Africa. One, however, *Antheræa helena* of Adam White, first described in the 12th vol. of the Annals of Natural History, p. 344, is a native of Tasmania, where it feeds on the leaves of the peppermint tree. This is the emperor moth of the colonists, and I have the pleasure of laying before this meeting drawings of the chrysalis, cocoon, and caterpillar, in all its stages, admirably executed by Mrs. Allport, and also specimens of the male and female of this beautiful moth, together with its cocoons in their natural state. I fear that the silk spun by this caterpillar can never be turned to any commercial advantage, because as yet no method has been discovered of reeling, or of carding the material; and also on account of the caterpillar being subject to the attacks of an *ichneumon* which prevents more than one in a hundred from attaining a state of maturity. When, for instance, you are expecting the appearance of the moth, you are astonished by finding a large mass of wool, surrounded by about fifty or a hundred small cocoons of this insect which I now exhibit.

If, however, either the *Antheræa pernyi* from N. China, or the *Antheræa yama-mai* from Japan could be introduced as they are both very closely allied to *Antheræa helena,* and therefore in all probability the *larva* might be induced to feed on the leaves of the *Eucalyptus,* an unbounded field would be opened for making this a silk-producing colony. They have already been introduced into France, after twice

crossing the Line ; there would, therefore, be the less chance of risk in introducing them into Tasmania.

I now pass on to the members of the *Genus Bombyx*, or true Silkworm.

Bombyx religiosæ (Helfer, 1837).—This is a native of Assam, where it feeds on the leaves of the *Ficus religiosæ*. It yields a silk, if not superior, yet certainly equal to the *B. Mori*. The cocoon shows the finest filament, and has very much silky lustre. It is exceedingly smooth to the touch, and very different from the cocoon of the mulberry moth (pure silkworm).

Bombyx Huttoni (Westwood, 1847).—A native of Mussoorie. It feeds on the leaves of the wild mulberry. It cannot be treated like the domestic kinds, but must be reared upon the trees. On the tree it is perfectly free from restlessness, and saves a vast expense in feeding. The worm spins in all weather, whereas the common silkworm is apt to be thrown off work by a passing cloud.

Bombyx Horsfieldi (Moore, 1858), from Java, and *B. subnotata* (Walker, 1859), from Singapore, also belong to India.

Bombyx mori.—From late researches it appears that the disease of the silkworm is caused principally by a disease of the mulberry trees, on the leaves of which the silkworm is fed. This disease can be cured by placing the infected eggs for some time in a box containing a little spirit of turpentine. But this treatment does not prevent the reappearance of the disease upon the worms when they are fed upon the leaves of diseased mulberry trees. The silkworm in France (before this disease broke out) ordinarily produced about 150,000,000 francs worth of raw silk. This silk, after being manufactured at Lyons, Nismes, and St. Etienne, acquired a value of 310,000,000 of francs. The annual average production of cocoons in France from 1846 to 1852 was 53 million pounds ; which had diminished from 1853 to 1861 to 26½ million pounds. The disease, therefore, becomes a perfect scourge, and we can easily imagine of what importance it is considered to discover a remedy.

The following paper was then read by Mr. Stutzer :—

I had intended to have made some observations upon the *Ailanthus*, but fortunately Mr. Ewing has anticipated me, and I will only now notice one or two particulars to which he has not alluded. The cultivation of the *Ailanthus*, which is spreading rapidly in France, has been created by the present Emperor of the French. The merit of its introduction into Tasmania belongs exclusively to Mr. Ewing. In the middle of last year he showed me the articles on the *Ailanthus* in 'All the Year Round,' and finding that there was a full-grown tree in the Botanical Gardens, I obtained a number of suckers from it. About the same time Mr. Ewing received 100 specimens from Professor Mueller, at Melbourne. Of the plants which I have planted out myself a great number have been destroyed by rabbits ; but the rest have thriven most vigorously. They seem to do best in alluvial soil, but those at the Queen's Asylum

are growing, and growing well, in a cold stiff clay. It seems, in fact, as if in any soil, good or bad, the trees would thrive, and it grows so rapidly that Mr. Abbott tells me he thinks that the leaves may be used for silk as early as the third year. Some particulars relating to the *Ailanthus* are contained in a letter from Sir H. E. Young to the Governor, published in the 'Agricultural Journal.'

Passing from the *Ailanthus* to the mulberry silkworm, the remarks which I have the honour to lay before the Society this evening are not intended to apply to the abstract question of the cultivation of silk and its adaptability to Tasmania, so much as to notice briefly what has been actually done in the twelve months which have elapsed since the subject was first publicly mooted. The amount has not been much, but of that nature which justifies us in detailing it to a body whose peculiar mission it is to utilize science. The profitable cultivation of silk in Tasmania depends upon the four conditions of (1) the management of the insect, (2) the cultivation of the tree, (3) the manufacture of the silk, and (4) the amount, quality, and cost of the labour employed. I shall have chiefly to solicit your attention, on this occasion, to the second subject —viz., the progress in the cultivation of the mulberry. With respect to the first, the silkworm itself, there is very little to be said, as the management of the insect is so extremely simple that no one who has attempted, or will attempt it in Tasmania, is likely to encounter any real difficulty until he came to deal with it in very large numbers—say 50,000 to 100,000. The enormous rapidity of its increase renders it practically indestructible, as may be conceived from the fact that the offspring of a single pair will in less than four years greatly exceed the number of human beings living on the globe. For example, I received from Mr. Morton Allport, last year, 500 eggs, and although a good many insects were destroyed in the cocoons, I have already given away more than 12,000, and have a great many on hand. If the eggs of only a portion of these are preserved, there will be many more silkworms round Hobart Town next year than all the present mulberry trees can support. As far as I have seen last year, and this, the insects are peculiarly healthy, and the loss among them almost none. On Italian silk-farms a loss of 20 per cent. is rather a low average. So far, therefore, the Tasmanian climate suits them peculiarly. The degree at which they hatch in Hobart Town is 62. They remained in my room for some days with the thermometer standing steadily at 60 without one of them appearing, but at 62 some hundreds came out at once.

The temperature at which they thrive best, as proved by experiment here, is from 64 to 70· This appears to be about 5 degrees above the average temperature of November, in Hobart Town, and therefore supposing they are kept in quantities of 100,000 and upwards, it would be economical to keep up a fire of incessant warmth to a certain point, as this quickens their growth. They will, however, live healthily at 60, but require a week longer before spinning than at 65. They should be

kept in pure air and sunshine as much as possible, and be steadily fed. Abundance of food is, in fact, the main point, since an insect which in 50 days increases to 1000 times its original bulk, must necessarily be a most voracious feeder. The larger the box in which they are kept, the better, and the dead leaves, of course, require to be soon removed. Observing these few simple facts, they will grow to the cocoon with scarcely any trouble.

The silk from the cocoons raised last year, was sent home to England, by Mr. Wilkins, to have its commercial value properly ascertained. I regret not having by me the letter sent by his correspondent to Mr. Wilkins, but it stated in substance, that the specimen was of unusual fineness and strength and of a quality to command a high price in the market. It was, however, difficult to ascertain its exact market value, owing to the manner in which it had been reeled. Mr. Wilkins is now in England, which is likely to be a considerable assistance, as he understands silk practically, and is a strenuous supporter of its growth in Tasmania. I do not, however, individually lay much stress on reports from home, having seen so much of the Italian silk in masses at Leghorn and elsewhere, as to feel assured of the quality of the Tasmania silk being at least a high average. Anything above this will depend upon the manner of reeling.

I come now to the great point of all, the growth of the mulberry tree. Putting aside the question of labour, the profitable cultivation of silk in Tasmania depends simply upon the supply of leaves. I will briefly notice what in this point has been done.

There are in round numbers at a rather vague calculation, within 20 miles round Hobart Town, from 100 to 150 mulberry trees, about half of which are at New Town. All of these are the black mulberry which is generally assumed to give a rather inferior silk. The Valencian silk, however, which stands well in the market is from the black, and the difference of the two is not likely to be considerable. The only white mulberry in the south side of the island is the one so called in the Botanical gardens. I doubt myself whether this is a real white one, but have not the botanical knowledge to know.

Nearly two years ago, in the beginning of 1861, Mr. Abbott, at my request, took a number of cuttings from this tree, and from the one *Ailanthus* tree in the garden. At the end of the year, Mr. Hill, the gardener at the Queen's Asylum, with some of the boys, was employed in breaking up, trenching, and liming a plot containing an acre and three-quarters, which was hedged in and irrigated for making the first plantation. As this piece, though the best available on the grounds of the Asylum, seemed rather too stiff for young trees, in March last I took on my own account a piece three acres on the New Town Rivulet at the back of the Government land, and broke it up for the young trees. Into these two were put the cuttings from the white mulberry and *Ailanthus* and forty boughs of the black mulberry. At the same time Mr. Abbott

made a number of additional cuttings, which are now in the Society's gardens.

The only result of this, so far as to the mulberry, is that 80 of the white mulberry and 40 boughs of the black have struck, and are flourishing vigorously. More than 100 cuttings of the white mulberry died. The black mulberry which were put in the damp alluvial soil along the creek grew, and their success seems to show that in this way the tree can be easily propagated. In addition to these a number of layers have been made, and are in full leaf in the Society's gardens.

The plantations formed from these sources, and in this manner, would go a very little way towards raising the armies of trees which will be wanted to supply the demand when silk is fairly established in the island. The way to raise mulberry plantations at once, and on a very large scale, is from seed. The difficulty has been that mulberry seed at home hardly ever succeeds. Out of a thousand seeds in England hardly one comes up. I took advantage, however, of Mr. Martelli being in the island, to send, through him, to Genoa for a supply of the genuine Italian seed. In Italy, where the value of the raw silk alone exceeds four times that of the whole collective exports of Tasmania—mulberry seed is sold in immense quantities, and to avoid imposition is regularly examined and stamped. I have distributed the seed very widely, to the Qneen's Asylum, the Botanical Gardens, His Excellency the Governo and above thirty individuals who had land adapted for growing it, but always with considerable doubts as to the results. I am, however, happy to say that it has turned out a great success. At the Botanical Gardens three seeds out of four of the white mulberry tree, came up, and there are now about a thousand plants growing vigorously. If the rest turn out equally well, there will be by the end of the year many thousand plants growing in Tasmania. The seed at the Botanical Gardens was grown in the greenhouse boxes, and will be planted out in the beginning of autumn.

I consider that the real difficulty in producing silk in Tasmania is now solved. I know by experience that the silkworm thrives in this climate, the pure mountain air here as in the Appenines and the Lebanon suiting best the insect and tree. The great point was to raise very large quantities of leaves, and every landowner who likes, can now produce any necessary quantity. But I am still obliged to remind the Society that it is not likely to pay for years to come to employ hired labour in sericulture here. The trouble attending it is not much, and it lasts less than two months in the year, but the profit will arise by employing the spare time of those who are otherwise supported. The children and patients at the Queen's Asylum and New Norfolk, the wives and children of all persons having garden ground enough to grow a few trees will find in it a certain source of profit small or great. The plants, however, cannot be safely stripped till after five years, and in this lies the great advantage of the *Ailanthus* that it grows in any soil, that its insect, the

Attacus Cynthia, requires scarcely any tending, and that the leaves can be used at least two years earlier than those of the mulberry.

An interesting discussion ensued on some of the important topics treated of in Mr. Stutzer's paper.

Mr. Abbott, junr., stated that the *Ailanthus* grew and flourished vigorously in that climate. Leaves could be taken from it in the course of two or three years, and on the whole it was a very hardy and prolific plant. Even the white mulberry did well, and was very easily propagated.

Mr. Ewing remarked after what they had just heard he had no doubt that the growth of silk would eventually be established in Tasmania, and it was evident that the introduction of an article which was likely to become one of great importance as an export, would be due entirely to the indomitable energy and zeal of Mr. Stutzer.

Mr. Stutzer observed that he spoke strongly on the importance of introducing the silkworm because he felt strongly on the subject. At the same time he did not mean to say it would pay a capitalist to hire expensive labour for preparing ground, planting trees, feeding the worm, and attending to the various operations required in the process of silk-culture. If, however, a knowledge of this very easy and simple process could be diffused throughout the colony, as was the case in other countries, and if at the proper season the odd half hours of a few weeks, which would otherwise probably be wasted, were devoted to the silk-worm, the result would necessarily be the production of an article of export not far inferior in value to the oil which is shipped from our ports. Influenced as we are by English experience and prejudice, we are apt to look upon the silk-worm as a sort of toy. But this should not be, and when we consider that Tasmania is admirably adapted for the production of an article, the supply of which from the shores of the Mediterranean alone surpasses in value that of all the gold of the Australias, it is surely incumbent upon us to recognise its great economic importance, and to take action in the matter. Mr. Stutzer remarked that he had still on hand a considerable supply of the finest seed of the white mulberry which he had received direct from Italy, and that he would be very happy to furnish applicants for it with such quantities as he could spare.

ON THE UTILIZATION OF WASTE.*

BY DR. LYON PLAYFAIR, C.B.

Woollen Rags.—Woollen rags have become extensively useful of late years. They cannot be converted into paper, but they can be converted into a great many substances; and, perhaps, some of my lady hearers will not thank me for the information which I am going to give. It is interesting, nevertheless. After garments have been worn and have gone through their common use and wear, they are by no means useless. They possess still a high money value; and these woollen garments, these clippings of the tailor, old rags, and old worn coats, when we have done with them, are all cut up, and torn to pieces. They have a little oil placed upon them, and are blown through a blower to get them into a fine state of division; and then they are sold as wool under the name of "mungo," or of "shoddy." Now, this is sold at about one-third the price of ordinary wool. The wool obtained in this way by breaking up these old rags is sold at from sixpence to a shilling a pound, and it forms excellent cloths. For instance, those light ladies' cloths which they wear as mantles are almost all made from these old rags. It is also employed extensively for mixing with wool, because it gives a greater lustre and a certain fineness to the cloth; and therefore it is often used for mixing in ordinary woollen cloths. The coarser varieties are used for druggets and other purposes; but it is all used up. There is a portion of it which becomes waste, which will not make good wool. This mungo waste, as it is called, cannot be worked up into a cloth; but it is only waste as regards cloth-making. This waste is powdered and dyed with brilliant colours, and is then made use of for making flock-paper such as we have in our ordinary apartments. For that purpose the paper is printed in a pattern with gum or with size. The powdered waste wool which has been dyed and prepared is then sieved over the paper, and it sticks where the gum or size has been printed on. In that way it forms the ordinary flock-paper.

Muslin-de-laines.—As long ago as 1834, in the cotton districts, they learnt how to put a cotton weft with a woollen warp. The cloths thus produced were finer in texture and cheaper than the woollen cloth, and therefore there was a great demand for them. It was, however, scarcely worth while to take these muslin-de-laines as rags after they were worn out and economise them. The reason of that was that you had two fibres of different kinds, one of wool and one of cotton, and you had to sacrifice one in order to get the other. For instance, if you desired to get the wool, you steeped the muslin-de-laines in acids, and converted the cellulose or woody fibre of which the cotton consisted into sugar, and the cotton being converted into sugar was lost, but the

* From Lectures on the Exhibition.

wool was obtained, and used. If, on the other hand, you wished to save the cotton of this mixed fabric, you dipped the material into an alkali and dissolved the wool. The alkali did not dissolve the cotton, but the wool, being dissolved, was separated from the cotton, and the cotton was saved. Now, Mr. F. O. Ward has shown in the Exhibition a pretty process for economising both fibres, or at least for getting a chemical product from both fibres, and it is very simple. Here are the rags as they are presented—the rags containing both of the substances —cotton and wool. They are subjected to a current of steam at three or four atmospheres—that is to say, hotter than ordinary; and when this heated steam passes through the rags it converts the wool into a sort of bituminous or resinous matter which becomes brittle. There is a portion of it which has been acted on by the steam. I agitate it, and the wool separates as a powder, and the cotton is as firm and as strong as it was before. All the wool has gone away from it, because it has been converted into this resinous substance. When this wool becomes dry it can be separated by a kind of combined beating and sieving process; and now there remains the cotton. The cotton in this state is sold as ordinary cotton rags to the bleacher who bleaches it, and it is converted into paper. There is some paper made from the cotton rags bleached in this way. This substance which I have shaken off here, and which has come upon this paper, is the wool and is still valuable. It ontains 12 per cent. of nitrogen, and therefore is in a condition which makes it a good manure, and it is sold as such under the name of "ulmate of ammonia." I ought to tell you that the woollen rags are never too waste to be converted into manure. All the early broccoli which comes up from Cornwall is forced on by being manured with these woollen rags.

Prussiate of Potash.—Attempts have been made to improve the manufacture largely, but without any great success. Still, it is such an interesting application of the waste substances which contain nitrogen, that it would not do to pass it over in a lecture upon waste materials. In the making of prussiate of potash, almost all the things which are too waste and too refuse to be employed for the higher purposes of waste substances, such as I have shown you there, as cloths and paper-hangings, are employed for making this salt. For instance, the horns of cattle, the hoofs of cattle, clippings of leather, the cast-off woollen garments of the Irish peasantry, and all sorts of things which are refuse, are mixed up with pearlash, or carbonate of potash, which, you know, comes from the ashes which remain after the combustion of wood, and with old scraps of iron. Old iron hoops from beer barrels, broken hoops, iron nails, old iron horse shoes, or any old scrap iron which can be obtained, is mixed up with this refuse, pearlash blood, and other substances, and they are all fused together in a pot, and after they are fused together in this way they are dissolved out in water, and then they are transformed from their ugly primary condition to this beautiful salt, which is yellow prussiate of potash. It is a cyanide

of iron and a cyanide of potassium. The nitrogen combines with the carbon and forms cyanogen ; and then the cyanogen combines with the iron and the potassium, and forms this prussiate of potash. This salt is very extensively employed because it is the source of Prussian blue. I have here a solution of iron rust which I add to this solution of the yellow salt. You see immediately that a copious precipitate of Prussian blue is produced—that beautiful colour which we employ so extensively. Now, if you pass chlorine through yellow prussiate of potash, you remove one equivalent of potassium, and then you get this other salt, the red prussiate of potash, which, though it differs from the other merely in containing one equivalent of potassium less, yet is changed in its chemical characters considerably. The yellow salt is not poisonous, but the red salt is intensely poisonous. This also with another salt of iron —a proto-salt of iron—forms Prussian blue. If I put some of this red salt into the water, and add a lower oxide of iron, it forms a Prussian blue of a characteristic brilliancy, which enables it to be used in many cases in preference to that which is produced from the other salt.

White Gunpowder.—If I take 28 parts of that yellow prussiate, 23 parts of cane sugar, 49 parts of chlorate of potash, and then sieve them so as to mix them together, we get a description of gunpowder. This gunpowder has certain advantages even above ordinary gunpowder. Weight for weight, it forms nearly double the volume of gas that common gunpowder yields ; and it leaves less residue behind. Although you may think the ash considerable, it is still less in quantity than the amount which is left by the ordinary gunpowder. But the temperature of the flame on ignition is not so high ; so that, although the white gunpowder produces double the amount of gas, that gas is not heated so much, and therefore does not expand so much as in the case of ordinary gunpowder, and the projectile force of this white gunpowder has not answered the expectations formed of it. Still, it is so exceedingly easily made—by simply taking these materials, prussiate of potash, chlorate of potash, and sugar, sieving them separately so as to get them fine, and then sieving them in their proportions together so as to get them mixed, that it may have some advantages. There is required none of the mechanical appliances necessary in the manufacture of ordinary gunpowder, such as the milling, and glazing, and granulation, which make its manufacture so troublesome and expensive.

Bones.—Rags and bones are naturally associated in one's mind. The same collector collects both ; although I confess I am somewhat sorry for their association to-day, because the chemistry of bones is so extensive that I scarcely know how to handle it in half a lecture. I must therefore pass over their known applications—the applications which are so familiar to you. I can say nothing of their use as a manure, either in the ground or subdivided state, or as they are often used, after being treated with sulphuric acid, under the name of superphosphate of lime. I cannot even, interesting as it is, dwell upon the fact that

within the last few years we have learned actually to take up and apply the bones of extinct animals—of the old reptiles which, during the Saurian period, spread terror through the seas and estuaries of the time. The bones and exuviæ of these animals are now used as manure. They are ground and mixed with sulphuric acid, and sold under the name of "superphosphate of lime."

In this country the importation of bones for mechanical and chemical purposes, amounts to about 70,000 tons per annum. The mechanical purpose for which bones are used are such as the making of handles for knives, tooth, and nail-brushes, &c. The quantity imported represents a money value of 350,000*l.*

When we examine the chemical composition of bone, we find it to consist of organic matter 33 parts, of phosphate of lime 56 parts, of carbonate of lime 8 parts, and of fluoride of calcium and phosphate of magnesia 2 parts, making 100 parts. Now, I can easily show you the earthy matter, taking it generally, and the organic matter. I have here put a bone, which was of the form you see it here, in a little weak muriatic acid. That has dissolved out the earthy portion and left the organic matter of the cartilage, which you see is quite soft. Now, this cartilage is extensively used for purposes which I have not time to enter into, because that is not what I have to deal with. It is used extensively in making a glue or size used for stiffening calico prints, which is of a less stiff and firm character than the glue used for ordinary purposes. The bones are boiled, and this cartilage becomes converted into gelatine, or into the jelly with which you are familiar under the name of "calve's-foot jelly," in which the cartilage is changed into a gelatinous substance. This is extensively used, and it is a subject which one would like to dwell upon.

Bone Black.—If instead of taking out this gelatine by boiling it, you take the bones and calcine them with this cartilage in them, the bones are converted into a black substance which is called "bone-black." The fact is, the cartilage becomes carbonised, the volatile matters are driven off, and the earthy matters of the bone become mixed with charcoal, which remains behind. This charcoal is extensively used for the purpose of decolourisation. It is that which is employed for the purpose of making brown sugar white. If any coloured organic substance be passed through these calcined bones, and you allow it to go gradually you will find that it filters through with the colour, perhaps not wholly removed by the first operation, but it will be removed by the second. You see this liquid is now passing through almost wholly decolourised, because this charcoal has a strong affinity for the colouring matter and unites with it. Bone-black is extensively used for decolourising syrups and other things. When this bone-black is formed by the calcination of the bones, there is also a large quantity of oil which distils over, and is sold under the name of "Dippel's animal oil," being useful for various purposes.

PHOSPHORUS.—The earthy matter of bones consists of three equivalents of lime united with one equivalent of phosphoric acid. It is what chemists term "a tribasic phosphate of lime." Phosphoric acid, as you are no doubt aware, consists of one equivalent of phosphorus united with five equivalents of oxygen. In order to obtain the phosphorus, it is only necessary to take away those five equivalents of oxygen, which we can do by mixing the compound with charcoal after some preliminary operations, and heating them together. The charcoal takes away the oxygen and forms carbolic oxide with it, whilst the phosphorus distils over. In this way we get phosphorus in the condition in which you are very familiar with it. Here it is in the state in which we obtain it, by this distillation, after it has been again melted and filtered through chamois leather, and cast into quill tubes. You see it is a wax-like substance, which I must handle with care, because if I allow it to dry, the heat of my fingers would be sufficient to inflame it. Now, observe what this substance looks like. It is semi-transparent; it is soft; you can cut it like wax. It is exceedingly poisonous, and in the making of lucifer-matches is found to be a very insidious poison. Lucifer-match makers are apt at first to be subject to an affection which does not draw much attention. They complain frequently of toothache, but they do not know the insidious disease which is creeping upon them. I will not pain you by describing this disease in its progress, but will merely say that the workmen who make lucifer-matches from this phosphorus are subject to the most distressing of all diseases; the jawbone becomes destroyed, and frequently disappears or becomes useless, and some of them spend the greater part of their lives in the wards of hospitals.

It therefore became an important point for science to find some way by which this phosphorus should be deprived of its poisonous properties without losing those chemical characters which make it so useful in making matches for instantaneous light. Now, a gentleman who is at present in London, as one of the Jurors of the Great Exhibition, met this want of science in a very skilful way. Bodies are capable of assuming two conditions, and sometimes more, which the chemist calls "allotropic" conditions; that is to say, they are, in fact, old friends with new faces given to them by some artifice, but still the same body, and not having gained or lost anything. Now, here is our old friend phosphorus with certainly a new face. By taking common phosphorus and exposing it for some time to a temperature of 460 deg., this yellow waxy, transparent substance transforms into a dark brick-like substance. It is no longer so inflammable as to ignite spontaneously. I place it in water because it will ignite upon the application of a light, and it is best to keep it away from the possibility of those conditions under which it might be accidently ignited. It may be packed up in boxes without danger of spontaneous combustion; but what is more important, it has lost all its poisonous properties. The phosphorus, which

was poisonous before, is no longer poisonous in this allotropic condition, and it is still capable of being used for making lucifer-matches. In passing into that allotropic state it has lost its power of dissolving in bisulphide of carbon, and if any of the old phosphorus remains in it, it may be dissolved out by this bisulphide of carbon. I have here some of this ordinary substance which is dissolved in bisulphide of carbon, and if I pour it now over this paper you will see the properties which it possesses, in a very short time. It will ignite of itself as soon as it becomes sufficiently dry by the passing off of the bisulphide of carbon. When this evaporation takes place the phosphorus is left in such a fine state of division upon the paper that it bursts into flame. The allotropic phosphorus is altered very considerably in its chemical characters.

Lucifer Matches.—I cannot tell you who was the first inventor of a means of getting instantaneous light. Many admirers of Prometheus declare that it was Prometheus, but he does not do so himself. He says this:—

> "I am he who sought the source of fire,
> Enclosing it hid in my narthex staff;
> And it hath shown itself a friend to man,
> And teacher of all arts."

You recollect the circumstances under which Prometheus got the fire. Jupiter was so angry with Prometheus for having stuffed a bull's skin with bones, and passed it off as a real carcase for a votive offering, that he took away fire from the earth to punish Prometheus. We might suppose that the father of the gods removed the fire lest the ingenious Prometheus should have made phosphorus from the bones, and thus become independent of the gods. Whether man would thus have been independent of the gods for fire I do not know, but fire was taken from the earth. What Prometheus actually did was only to steal fire from the chariot of the sun, and keep it alive, until he reached the earth and gave it to man, by blowing with the pith of the giant Fennel, which he used as a staff. We are told by Pliny and Virgil that the tinder-box, similar to those used by us, was well known in their time. They describe the properties of the flint and steel, and Virgil says that dry leaves may be ignited by means of the flint and steel with the rapidity of speech. The savages of various countries found for themselves a means of getting a light which was far from instantaneous. I think it would require much more dexterity than we can employ, to demonstrate how a light may be got by rubbing together two pieces of wood; but we can get sufficient heat in that way to ignite some substances which are more combustible than the wood itself. By rubbing these two pieces of wood together, in a little time they become very hot. Now they are smoking violently. Observe that there is now heat enough to ignite a piece of phosphorus readily. In this case the friction

by a philosophical process, which I need not describe just now, is sufficient to produce a large quantity of heat, and savage tribes have been accustomed to use that friction to obtain a source of light. For a long time, as many of our older readers will recollect, our only means of obtaining an instantaneous light, even within my own recollection, was the tinder-box. The tinder-box with its trio, burnt-rag, flint, and steel, was familiar to many of us. These were used to obtain a flame, and then in addition to this trio there was the sulphur-match, which was ignited after the flame had been obtained by the sparks falling among the burnt-rag. If the rag were not damp, and everything was in perfect order, you could get a light in a short time ; but if the rag were at all damp, or the day was draughty, you might get a light in a quarter of an hour. There, now we have got a light, and by blowing it up I may succeed in getting the sulphur match alight. I recollect when I was a boy remaining for at least half an hour in a castle which I was to be shown over, whilst a light was got in this way.

Dobereiner's Lamp.—The first invention which led the attention of chemists to the importance of a means of obtaining an instantaneous light occurred in 1820, when Dobereiner produced a lamp of an elegant character. You will see it represented in this diagram. Here is a vessel in which hydrogen gas is collected. The hydrogen gas is formed by the action of sulphuric acid and water upon zinc. These acting upon the zinc produce hydrogen, and the hydrogen rises here, and as it is formed it expels the acid from the vessel, so that it no longer acts upon the zinc. I have in this way a reservoir of hydrogen ; and now if I take a piece of spongy platinum, which has the power of absorbing oxygen from the air and condensing it within its pores, and bring this platinum in contact with the hydrogen, you see that it gets red hot, and ignites the hydrogen. Thus, you see that this plan of applying hydrogen for the purpose of acting upon the oxygen condensed in spongy platinum is a method by which a light can be obtained. The spongy platinum absorbing oxygen, presented oxygen to the hydrogen, and caused the formation of water, and in the formation of water, so much heat was produced that the hydrogen became ignited, and a light was obtained. One disadvantage which prevented it being universally adopted was simply this : that the least speck or fouling of this spongy platinum puts the lamp out of order. For instance, this may have been in order five minutes ago, and it may be out of order now. Some dust or dirt may have got upon the spongy platinum. Still, the application was so elegant that it drew the attention of scientific men to the importance of getting an instantaneous light.

The next invention consisted in mixing phosphorus and sulphur in a bottle, and then taking them out upon a splint of wood, which was rubbed, and a light obtained in that way.

Then came the method of getting a light by means of chlorate of potash and sulphuric acid. Here I have some chlorate of potash mixed

with sugar, and I place a little of it on a plate. I will not put too much because of the fumes. I now dip this rod in sulphuric acid so as to get a little on the end of it, and with this I touch the mixture of chlorate of potash and sugar. The sulphuric acid liberates the chloric acid, which gives oxygen to the sugar; the sugar burns and an instantaneous light is obtained in this way. Captain Manby used this process for firing off his safety mortars, and thus drew considerable attention to this mode of obtaining a light. An application of this chlorate of potash and sulphuric acid to match-making was now made. There were two applications: one was older than the other. The method which was first introduced consisted of having a little bottle of asbestos. Here is one of the old kind, which many of us can recollect. This asbestos is moistened with oil of vitriol, and the chlorate of potash and sugar, instead of being separate, as I showed you there, are put upon the end of the match, and you dip it in the sulphuric acid, and the chlorate of potash and sugar mixture gets ignited, and the light is got in that way. Well, that was the first application of the old experiment of chlorate of potash and sugar. Then there was another. I am sorry to say that I have only one or two of these ancient matches left, and they will soon be gone altogether. The plan was to take the chlorate of potash and sugar, and wrap it in a piece of paper, and to have the sulphuric acid sealed up in a little glass globule inside the mixture. The mode of using it was, if you had a pair of pincers at hand, to break the globule with them, and so ignite the match; but if you had not a pair of pincers in readiness, you did it between your teeth; and if you were very clever, you might do it without getting the sulphuric acid into your mouth, or burning it with the explosion. This match had a great objection—that chlorate of potash and sugar always go off violently, and the sulphuric acid in the globule, although in small quantity, was spirted over the dress, and destroyed the dress whenever it came in contact with it.

The first friction-match was introduced in 1832. The mode in which these friction-matches are made, many of my hearers who lived in 1832 will recollect. I have a lively recollection of it. The mode was this —sulphide of antimony was mixed with chlorate of potash. Here the sulphide of antimony gave sulphur, just as the sugar gave, a combustible to the chloride of potash. This was put upon the end of a piece of wood; and the friction was produced by drawing this through a piece of sand-paper. I have there some antique matches of all kinds, which are now very valuable because they are very difficult to obtain. My experience as a boy with regard to these friction-matches was that with considerable adroitness you might get a light after pulling off the ends of half a box; and when it did come, it came with such violence and explosion that it projected a considerable quantity of the ignited matter over the hands and burnt

them. You might get a light for 6d. or 8d.; at least, that was my experience as a boy. My seniors may have been more successful.

In 1834 the phosphorus-match was invented. In this, after a time, sulphur became substituted for sulphide of antimony, and it was a great improvement upon the old congreve. At first the phosphorus match was violent in its action, and it projected its melted materials over the fingers unless you held it carefully, and the reason of that was that nothing but chlorate of potash was used as the oxidiser. The friction produced the heat necessary to ignite the phosphorus: the chlorate of potash gave it the oxygen, and it burnt violently. After a time manufacturers learnt that it was better not to take chlorate of potash by itself, but to mix it with some less energetic oxidising agent—as, for instance, with saltpetre or nitrate of potash, or with peroxide of lead, or with some agent less energetic than the chlorate of potash. In this way the phosphorus-match became much improved in character. The sulphur, which was used to carry out combustion, and to get up sufficient heat to make the wood ignite, was also gradually substituted in the better kinds of matches by melted stearine. The wooden match was dipped into melted stearine, and all possibility of fumes of sulphur was in this way obviated. The common phosphorus match became gradually improved, and its use has now increased to such an extent, that it may surprise you to know that there are some chemical works in this country where they make nine millions of matches daily. In France and England alone 300,000 pounds of phosphorus are annually made into matches, and as three pounds of phosphorus are sufficient to tip five or six millions of matches, you can conceive what a large industry this has become. But the larger the industry has become the greater has been the evil with regard to the workers. On account of the extreme cheapness of the phosphorus-matches there is a desire to make them of the cheapest materials, and as this waxy phosphorus is cheaper than the allotropic phosphorus, all the common matches are, of course, made with the ordinary phosphorus. I show you a better kind of matches, which I hope all my hearers will encourage, which are not made with the waxy phosphorus, but with the allotropic, or brown phosphorus. You may easily know them by their brown ends. The allotropic phosphorus fortunately answers equally well for the purpose, and is not at all poisonous to the match-makers who have to use it. There are two kinds of matches made with the allotropic phosphorus. One kind is made like the ordinary match, with the oxidising material and the allotropic phosphorus mixed together and put upon the end of the match. It, therefore, differs from the ordinary kind only in the fact of its being made with allotropic phosphorus. But there is another kind of match which has been manufactured, and is an exceedingly beautiful invention. Here the oxidising material alone is put upon the match, the phosphorus not being put upon the wood. It is not, therefore, a match of the ordinary kind. You could not get it to ignite in the usual

way. Here the oxidising material is put upon the piece of wood, and the allotropic phophorus is put upon the friction paper mixed with the emery. This piece of wood does not, therefore, become a match until I take off a certain quantity of that phosphorus along with my oxidising material, by rubbing it upon the paper upon which the emery and phosphorus are spread. The value of that device is great, because there can be no accidental firing, as in the ordinary matches. Trampling upon them, or leaving them too near the fire, cannot make them ignite, because the match is not a match until it is drawn over the sand paper and takes up phosphorus. Accidental ignition is thus prevented.

ON THE MILLETS AND OTHER SMALL-GRAINED GRASSES, USED FOR HUMAN FOOD IN VARIOUS COUNTRIES.

BY P. L. SIMMONDS.

What is Millet? Doubtless every reader will think he can very readily reply to this simple question. But we fancy that, like the definition of Corn, it will vary considerably with the locality and the experience of the person answering the inquiry. The "corn" of England is not the "corn" of the United States, for while we apply the term to wheat, the Americans restrict it to maize. In Scotland again the name corn is given to oats, and still further north, in Sweden, Iceland, &c., barley is the bread corn of the country. So with the term Millet, the word has a widely extended signification, and embraces the edible seed of grasses of various genera very dissimilar in habit and appearance.

What is generally known as Millet in popular parlance in England is the seed, chiefly yellow, of the *Panicum miliaceum* sold in seed-shops for feeding cage-birds. But the collective term takes in a much greater range of product. In many countries the millets form large and important staple food-crops, and in some years considerable quantities are even imported into the United Kingdom. Thus, the imports here of late years have been as follows:

	Millet.	Dari.
1853	158,159 cwts	cwts.
1854	16,470 „	—
1855	58,263 „	—
1856	41,284 „	7,542
1857	230,451 „	147,187
1858	58,866 „	171,277
1859	107,600 „	84,763
1860	53,624 „	960
1861	55,674 „	5,716

The consideration, therefore, of the millets is not without interest, both in a commercial and agricultural point of view; and since there is little collected accessible information on these plants, we propose to treat somewhat at length of their peculiarities and uses, and shall endeavour to reconcile some discrepancies, and correct popular errors which are very apt to lead those astray who have not looked very closely into the subject.

If we turn to an ordinary dictionary we shall merely find "Millet—the name of a plant." Whilst Webster quotes the 'Penny Cyclopædia.' "Millet, a plant, or the grain of a plant of the genus *Holcus*, or *Sorghum*, having a stalk resembling a jointed reed, and classed by botanists among the grasses. Various species are used as food for man and animals, but the Indian Millet is the most common. The species are mostly natives of warm climates."

Simmonds's more recent 'Dictionary of Trade Products,' tells us that "Millet is a common name for several species of small seed corn, which on the Mediterranean coasts are generally called Dhurra, in the West Indies guinea corn," &c.

But we want something more than this; and although we cannot branch out here into an abstract definition of what is millet and what is not, and where the line of demarcation of these small seeded grains should be drawn; we can at least look at the matter in a technological point of view, and show what are the millets, popularly so termed, cultivated in different countries, and what are their local and generic names for identification, and what their uses, modes of cultivation, &c.

Dr. Forbes Watson, in his treatise "On the Composition and Relative Value of the Food Grains of India," states that the millets in India occupy a position second to none in the country, and form the staple food of a larger number of the population than perhaps all the other cereals put together.

At the head of the list of these stands the millet called Bajra (*Penicillaria spicata*), and which itself, with the usual adjuncts of a little milk, &c., forms the chief article of diet of a very large number.

Compared with rice, it is considerably more nutritious, containing about $10\frac{1}{2}$ per cent. of gluten, and giving a proportion between the carbonaceous and nitrogenous compounds of from 7 to $7\frac{1}{2}$ per cent. of the former to one of the latter, whereas the kind of rice most rich in gluten contains only about $8\frac{1}{2}$ per cent. of that substance, and gives the proportion of a little more than 9 of the non-nitrogenous to the nitrogenous—thus involving the addition of a large quantity of some pulse or extra nitrogenous substance to increase the proportion between the flesh-forming and heat-and-fat-yielding constituents.

The great millet, Jowarree (*Sorghum vulgare*) stands next in order of importance, both on account of its intrinsic value as well as the numbers it chiefly supplies with food.

Natchenee or Ragee (*Eleusine Coracana*) stands at the bottom of the

list of grain plants, as far as nutritive power is concerned, and hence the necessity also for adding pulse, &c., in order to bring its important ingredients into due proportion. This grain in some districts is looked upon entirely as a famine food, and only had recourse to in seasons of drought, when other crops are very defective. In some places during ordinary seasons as much as from 130 to 140 lbs. are procurable for a couple of shillings. A third part of the inhabitants of the globe feed upon the various millets, especially those of Africa, the greater part of Turkey, Persia, and India. Millet forms the principal sustenance of the people of Bokhara. The grain there yields so abundant a harvest that there is a large quantity for export. The seeds of millet are excellent for food both to domestic animals and man. The grain mixed with that of wheat gives an excellent bread, though a little heavy; but generally it is boiled with milk, like maize flour; it swells considerably in water. Millet fattens poultry in a very short time. The stalks serve for heating ovens or for cooking food in countries where fuel is scarce. The panicles, after the separation of the grain, form excellent brooms. The sale of these brooms in Italy, in Spain, France, and North America, is so remunerative that they enter largely into the value of the profits of culture. An article on the growth of millet for the manufacture of brooms in the United States will be found at Vol. i., TECHNOLOGIST, page 239.

The seed is kept like wheat in granaries or sacks, but it loses its flavour with age, and with humidity gets mouldy, and is much subject to the attacks of weevil.

SORGHUMS.

In Paxton's 'Botanical Dictionary,' eleven species of Sorghum are enumerated—namely, *S. avenaceum* (*Holcus avenaceus*, Linn.), *bicolor*, *Caffrorum*, or *arduini*, *cernuum*, *elongatum*, *halepense*, *nigrum*, *rubens*, *saccharatum*, and *vulgare*.

The two genera *Andropogon* and *Sorghum* are closely allied. Some of the best authorities consider the difference so slight as to warrant their union into one. Steudel arranges Andropogon, Sorghum, and Trachypogon all under one head—Andropogon. Lindley italicises Sorghum in the last edition of his "Vegetable Kingdom," and places it beneath *Trachypogon*, evidently considering them equivalent. The differences between them are these:—

Andropogon.	*Sorghum.*
Inflorescence spicate.	Inflorescence paniculate.
Spikelets in pairs, only one being fertile.	Spikelets in twos or threes, central one only being fertile.
Glumes herbaceous or membranaceous.	Glumes hard, coriaceous or indurated.
Rachis hairy.	Rachis smooth.

SUGAR MILLET.—*Sorghum saccharatus*, Willd.; *Andropogon saccharatus*, Kunth and Roxb.; *Holcus saccharatus*, Linn.—Deodhan, Hind;

Shalu, Tel. Erect, panicles verticillate; culms erect, round-jointed; seeds black or deep purple.

Little seems to have been known in Europe of this species until 1851, when Mr. Montigny, French consul at Shanghai, sent this, among other seeds, to Paris, labelled "Sugar Cane of the North of China." Professor Arudin of Florence would seem, however, to have grown it in Tuscany in 1766, and published in 1786 an account of his experiments in making sugar from it.

The cultivation of this plant within the last ten years has been widely extended; more, however, as a forage plant than for its saccharine properties as a sugar producer. It is now grown in France, Algeria, Lombardy, Russia, the United States, India, and Australia.

An innumerable number of treatises on the culture and uses of this species have been published in the United States, and on the Continent. Mr. Leonard Wray first drew attention to it here in a pamphlet printed for private circulation in 1854, "On the Zulu Kaffir Imphee or Sweet Reed." In America Mr. H. S. Olcott has collected in a volume under the title of "Sorgho and Imphee, the Chinese and African sugar canes" (Moore, New York, 1857), a large amount of useful and practical information; and Mr. Hyde has published a "Manual of the Chinese Sugar Cane." We may also enumerate, for the reference of those who take an interest in the culture, the following treatises published in France:—"Monographe de la Canne à Sucre de la Chine, dite Sorgho à Sucre, par le Docteur Sicard" (Marseilles); "Recherches sur la Sorgho Sucre," par Louis Vilmorin; "De l'Introduction et de l'Acclimatation du Sorgho dans le Nord de France," par Dumont-Carment; "La Sorgho Sucre, sa Culture," &c, par Louis Hervé; "La Sorgho à Sucre," par Paul Madinier;" "Guide du Cultivateur du Sorgho à Sucre," par Madinier et Lacoste; "Guide du Distillateur du Sorgho à Sucre," par Bourdais These are for the most part published at the Central Library of Agriculture and Gardening in Paris.

Although the seed of this species has hitherto been taken little into account in an economic point of view, it appears that in France a hectolitre of 65 kilogrammes of the grain unhusked yielded by grinding 13½ kilogrammes of coarse, and the same quantity of fine bran, and 37 kilogrammes, flour or semola. This was of a violet colour, but when boiled with great care, the meal becomes perfectly white. But as this product would scarcely repay the trouble of grinding, it is chiefly for soups, puddings, and for feeding stock that it might be utilised. The yield of seed would seem to be about 60 bushels to the acre, of juice from the stalk 45 to 55 per cent. of a density varying from 1.050 to 1.075, and the proportion of sugar, crystallisable and uncrystallisable, from 10 to 16 per cent.

Mr. Wray states from his Natal experience that he is acquainted with fifteen varieties of this *Sorghum*, and certainly the panicles which he has shown us are very different in the colour and shape of the seeds, &c., to the ordinary *Sorghum Saccharatum*.

In Northern Africa, millet—but a much larger and more prolific grain, derived from a species of *Sorghum*—enters generally into cultivation under the name of Dourah or Dari. It is produced in considerable quantities in Upper Egypt, and being 40 or 50 per cent. lower in price than wheat, is more commonly the food of the fellah or peasant than any other grain. The late Professor Johnston states that by his analysis Dourah flour contains 11½ per cent. of gluten.

There seem to be three leading species, with short, close-set panicles, having either white, red, or olive-coloured seeds, probably *Sorghum vulgare*, *S. rubens* and *S. bicolor*.

While many of the Sorghums have rigid, compact heads, others have loose and spreading panicles, and the colour of the seed or grain appears to vary considerably, so that there is some difficulty, in the absence of precise information, in identifying them or naming them botanically, amid the scientific complexities of *Holcus*, *Sorghum* and *Andropogon*, to which they have severally been referred by various authors. Then they bear different local names in different countries :—The broom corn of the United States, the negro or Guinea corn of the West Indies, the Dourah of Northern Africa, the Kaffir corn of South-Eastern Africa, and the Jowarree or Cholum of India, being evidently the same plant and seed.

The Sorghums require a more tropical climate to bring their seed to perfection than the common millets of Europe, but yield a much greater quantity of seed per acre than other grains.

The different kinds of Sorghum are usually called joar in India, where they form principal objects of culture, and are of much more importance than would appear in Europe, as many of the inhabitants live as much upon these small or dry grains as upon rice. The joar is the durra of some Arab tribes, and the zurrut of others. It is extensivly cultivated throughout Asia, and appears to be the "tall corn" of the Chinese. It has been introduced into the South of Europe, where it is chiefly employed in feeding cattle and poultry ; but is also made into cakes. The flour is white, and a good deal resembles that of the Indian corn in nature. The species commonly sown in India are *S. vulgare* and *S. bicolor*. *Kala-joar (S. cernuum)* is a distinct species, which forms the principal food of the mountaineers of the Munnipore district. *S. saccharatum* is also cultivated in many parts during the rainy and cold seasons, on land which is too high for rice. The stalks and straw of all are much valued as fodder for cattle, being cut into small pieces commonly called *kurbee*,

Great Millet, or White Cholum.—(*Sorghum vulgare*, Pers. ; *S. commune*, Beauv. ; *Holcus Sorghum*, Linn. ; *H. durra*, Forsk ; *Andropogon Sorghum*, Brow. ; Jowar, Hind. ; Janoo, Tel. ; Cholum, Tam. ; Durra or Doora of N. Africa. Culms erect, panicles contracted, very dense. There is a red seeded variety, called Yerra Janoo, in Teloogoo, the panicle of which is rather loose. *S. vulgare* has long been cultivated in the southern parts of Europe, India, Egypt, and Barbary. The seeds of the Sorghum are large, compressed, nearly oval, variable in colour, white, yellow, reddish, or black. In parts of India the great millet is

cultivated for its grain, which is much used for food. The produce in good soil is upwards of a hundred fold. Cattle are very fond of the straw ; the latter is also a substitute for forage for horses, when grain is not obtainable. There are three varieties grown in Madras, known as Munja Cholum, Mootho Cholum, and Secapoo Cholum.

Sorghum vulgare is cultivated in the southern provinces of France, up to the environs of Macon, for feeding poultry, under the names of great millet, great panic sagina, &c. In Egypt the name of Dourah, or Dora, is specially applied to this millet. The *S. bicolor*, Willd., is also used for the same purposes.

By some, *Holcus compactus*, Linn. ; *H. cernuus*, Willd., is thought to be but a variety of *S. vulgare*. It is occasionally cultivated for food. It differs in the panicle being more dense, more shaggy, depressed, and twisted, when young. The seeds are very white.

In Algeria, in the Sahara, and the Tell, two species of Sorghum are cultivated.

1. A variety of the great sorgho (*Sorghum vulgare*,) of which the grain is red, and the panicles form excellent brooms. The stem attains a height of six or seven feet.

2. The Bechna of the Arabs, *S. cernuus*, or the Doura of the west, resembling *S. saccharatus*, which recent experiments have proved well suited for the manufacture of sugar. It is the righiffa of the Arabs.

3. The benitche of the Arabs (*Penicillaria spicata*), sometimes called candle millet, is also grown in Algeria.

It is worthy of remark that the natives of Upper Egypt call the Sorghums "Baalee," or Doora, whereas the Zulu-kafir's name for the same plant is "Ma-baalee," the Ma being merely a prefix which they give to a great number of other proper names. Of Sorghums there are in Egypt six kinds, viz. Doora Sayfee, or Baalee, D. Hamra, D. Kaydee, D. Byood, or Dimeeree ; D. Owaygeh, and D. Saffra.

Wilkinson says that the *Holcus saccharatus*, (Arabic name, Dokhn), is grown about Asouan, in Nubia, and the Oasis.

S. halepense, *Holcus halepensis*, Linn., *H. exiguus*, Forsk. In this species the panicle is loose, pyramidal, and ordinarily purple.

An amazingly prolific variety of millet was introduced into Jamaica a few years ago from Texas. The precise species has not been determined. It grows in a much cooler climate than the *Sorghum vulgare*, and it would be desirable to test it as a mountain corn. It is not the *Sorghum cernuum* of the mountaineers of Munnipore, in India, for although that is a straggling millet, it is heavy grained, whereas this grows thin and light. A mountain millet is a desirable acquisition for some of our colonies. The stalks and straw of all the Sorghums being much valued as a fodder for cattle, an upland species would materially assist the mountaineer in feeding close-penned stock. Everything that gives variety to the food of a people is an addition to their resources beyond the mere multiplication of victual. It augments their home economy,

and adds to their abundance the wholesomeness and usefulness of a mixed diet.

In the various districts of Bornou, a species of millet is produced, which is called by the inhabitants *gussub*, and upon which both men and animals are almost exclusively fed. By the poorer classes it is frequently eaten, simply parched, or even without any culinary preparation; other persons crush and then steep the seeds in water previous to eating them, and some few, who are the epicures of the land, clear the grain from the husk, pound it, and make it up into a light paste with melted fat; this favourite dish is called *kaddel.*

Panicums, or Loose-Headed Millets.

Common, or Small Millet (*Panicum miliaceum*, Willd.).—Waragoo, Tamil; Cheena, Hindustani; Worga, Teloogo; Iddal Jungo, Singhalese. The Panicums were probably so named scientifically from *panis*, bread, or *panicula*, a panicle. The panicle is loose, nodding; seed, when ripe, about one-eighth of an inch in length, oval, and slightly pointed at both ends, smooth, shining; height, about three and a-half feet.

In the book of the Prophet Ezekiel (iv. 9) is contained the only allusion to millet. By some writers, the millet is conjectured to be the parched corn which Boaz gave to Ruth, and which David carried to his brethren. The native country of the millet is supposed to be Tartary, where it is largely used for food. In the time of Columella, it was cultivated in Italy, who mentions it as growing abundantly in the Campania.

In America, the common millet is often known to yield twenty bushels per acre, after one quarter of a bushel sown; and the hay is so relished by cattle, and horses in particular, notwithstanding its seeming coarseness, that they prefer it to that of common Timothy grass. In Germany, and other southern countries of Europe, also in America, some parts of Asia, and in most countries lying under the warmer latitudes of the temperate zone, the millets form a very essential article in the domestic economy of the inhabitants; and when deprived of the husk, are used whole, as rice, or ground into meal, or flour, and made into bread, &c. In England, millet is chiefly used for feeding small birds.

This plant has been introduced into Algeria with success, from 3,000 to 3,500 kilogrammes of grain having been obtained per hectare.

The following varieties are arranged according to their time of ripening, the difference between the earliest and the latest being only about a week:—

1. Common Millet. Panicle rather fasciculated, and nodding a good deal to one side. Colour, light green; colour of the seed, yellow.

2. Grey-seeded Millet. Panicle more loose and spreading than that of the last variety; seed greyish coloured; panicle darker green than the last.

3. White-seeded Millet. Panicle light green; more contracted, or bundled, and nodding, than in any of the others; seeds white.

4. Black-seeded Millet. Panicle of a mixed, blackish-green colour, very loose ; seeds almost black.

The four varieties cultivated in Madras are called Varoogoo, Varoogoo Arisy, Samay, and Samay Arisy, in Tamil. Vellai Thanie is a species grown in Tinnevelly.

Millet Rice, *Panicum miliare*, Lam.; *P. colonum*, Linn.—Nella Shama, Telugu ; Shama, Tamul.

Culms erect, ramous, two to three feet high, smooth ; flowers paired on a common pedicel, with unequal partial pedicels. Corolla three-valved, seed ovate, smooth, fine streaked. Panicle oblong, beautifully bowing with the weight of the grain ; glumes of the calyces striated. This is cultivated under the name of millet rice in the peninsula of India.

There are several kinds of Panicum cultivated in India, among which the most celebrated are *P. miliaceum*, and *P. frumentaceum*, of which there are some varieties.

Panicum frumentaceum, Roxb.—Bonta-Shama, Telugu, called Shamoola in the Deccan. Culms erect, two to four feet high ; panicle erect, spikes secund, incurved, flowers three fold, unequally pedicelled ; leaves large, margins hispid. The seed is wholesome and nourishing. It yields about forty fold in a dry rich soil. Cattle are very fond of this, the *P. spicatum* and others.

Bhadlee (*P. pilosum*), also called Vursuom ; Pil arisy in Tamil.—This seed is used in the Madras Presidency in time of famine.

Setaria, or Close-seeded Millet,

From *seta* a bristle (in reference to the hairy involucre), is a genus separated by Beauvois from that of *Panicum*, on account of its panicles being contracted so as to resemble a spike ; its other characteristics are the same, except in having a bristle-like appendage proceeding from under the glumes, considerably longer than the spikelet, termed the involucrum.

1. Italian Millet (*Setaria Italica*, Beauv., *Panicum Italicum*, Linn., *Pennisetum Italicum*, R. Br.), Tenney, Tamul; Tenna, Malabar; Kangoo Kungnu, Beng. ; Kora, Hindustani ; Coraloo, Telugu ; Thadahaal, Singal ; Culms erect, three to five feet high ; round, smooth ; leaves sheathing ; spikes nodding ; seeds about half as long as those of the common millet, not so small, and of a lighter colour, slightly tinged with green.

This millet, called Raggy in Madras, is considered by the natives of India one of the most delicious of cultivated grains. The Brahmins, indeed all classes of natives, particularly esteem it, and use the seeds for cakes, and porridge, &c. It is good for pastry, scarcely inferior, says Ainslie, to wheat, and when boiled with milk, makes a pleasant light diet for invalids. It is cultivated in many parts of India, requiring a dry light soil. The seed time for the first crop is in June and July ; for the second, between September and February. The Italians make a sort

of coarse brown bread from the flour of the seeds. The numerous grains adhere but slightly to the husks, and are easily shaken out; the seeds are of various colours.

2. German Millet (*Setaria Germanica*). differs from the last in being much dwarfer; spike shorter, more compact, and upright; seeds about the same size, and of a dark greyish colour. There are two varieties—a red seeded, which seems to resemble the Italian millet; seed larger, smoother, and of a reddish colour; spike not so pendulous; height about four feet.

And a small white seeded variety, spike larger than any of the preceding; bristles much shorter; height about four feet.

This is the "moha" of the Germans, it is cultivated chiefly in Moravia, South Hungary, and Lombardy. The seed is made into bread, eaten instead of rice, boiled in soup and milk, and used for feeding all domestic animals.

Dr. F. Welwitsch sent specimens of two gigantic close-seeded millets (*Setaria*), to the Exhibition, from the Portuguese Colonies in Africa.

Paspalum,

From *paspalos*, one of the Greek names for millet.

Aullo (*Paspalum frumantaceum*), and Munyo and Kodro (*P. scrobiculatum*), supply in India a cheap grain, which is considered wholesome. The latter, under the name of Koodaka, is cultivated in the Gawel range north of Berar, and forms the staple food of the natives.

Fundungi—This is a small edible grain produced by *Paspalum exile*, which is much cultivated and esteemed in Sierra Leone and other parts of Western Africa by the natives, to whom it is known under the local name of Hungry rice. It produces a semi-transparent cordiform grain, about the size of a mignionette seed. The ear consists of two conjugate spikes, the grain being arranged on the outer edge of either spike and alternated; they are attached by a peduncle to the husk. It is sown in May and June, and ripens in September, and grows to the height of eighteen inches; its stems, which are very slender, are bent to the earth by the mere weight of the grain. The grain is trodden out with the feet, and is then parched or dried in the sun, to allow of the more easy removal of the chaff and the process of pounding, which is performed in wooden mortars. It is then winnowed with a kind of cane fanner, on a mat.

Choua, or Chooa.—The seeds of *Amaranthus frumentaceus*, Linn., *A. oleraceus*, and of *A. anardhana* are also gathered as corn crops in India. The former is extensively cultivated in the Coimbatore district, for the flour of its seeds, which is a great article of diet among the natives.

Teff (*Poa Abyssinica*) is another African grain used for food. Bread is made of it by allowing the dough to become sour, when generating carbonic acid gas, it serves instead of yeast to leaven it. It is then baked in circular cakes, which are white, spongy, and of a hot acrid taste, but easy of digestion. This bread, carefully toasted and left in

water for three or four days, furnishes the *bousa* or common beer of the country similar to the *quas* of Russia.

EGYPTIAN, OR SPIKED MILLET (*Penicillaria spicata*, Swz.; *Holcus spicatus*, Linn. ; *Panicum spicatum* Roxb.), Kumboo, Tam. ; Bajree, Hind. Terminal cylindric spike erect, as thick as a man's thumb, from 6 to 9 inches long ; seed obovate, peach-coloured, smooth, with hilum.

RAGGEE (*Eleusine Coracana*, Gaert. ; *Cynosurus coracanus*, Linn. ; Natchanee, Hindust ; Mootamy, Malab ; Kayvaroo, Tam.) Culms erect, 2 to 4 feet high, a little compressed, smooth ; spikes 4-6 digitate, incurved, secund 1 to 3 inches long ; seeds globular, brown, a little wrinkled, covered with a thin aril.

This is the most prolific of cultivated grasses, forming the chief diet of the poorer classes of some parts of India, as Mysore, N. Circars, slopes of the Ghauts, &c. On the Coromandal Coast it is known as the Natchanee grain, and is the Raggee of the Mahomedans. In Teloogoo the name of this grain is Ponassa. A fermented liquor is prepared from the seeds called Bojah in the Mahratta country.

Eleusine stricta, Roxb.—This species is cultivated in the Peninsula of India and Rajahmundry to a great extent. It differs from the preceding in having the spikes straight, being of a larger size and more productive. The seeds are also heavier, which cause the spikes to bend down horizontally.

All the millets prefer a light good soil, from which the water readily flows after the heavy rains. In a favourable season, the farmers reckon on an increase of about 120 fold. The variety known in Teloogoo as *Maddi ruba soloo* requires a richer soil than the others, and in good years, when the land fit for its cultivation can be procured, increases five hundred fold.

CANARY GRASS.—(*Phalaris canariensis*) generically named from *phalaros*, brilliant ; in consequence of the shining character of the seeds. Panicle contracted, so as to resemble an oval spike ; straw from one and a half to two feet high ; grain smooth and shining, of a whitish colour, difficult to thrash or separate from the glumes. Is cultivated to a considerable extent in some parts of England chiefly as food for birds. In the Canary Islands, it is ground into flour and made into a nutritious bread by the inhabitants. It also forms a considerable article of commerce in Italy, and some very fine samples appeared in the collection sent from that country to the Exhibition.

PERUVIAN RICE.—(*Chenopodium Quinoa*, Willd.) In Chili and some other parts of South America this plant ranks in utility next to the potato, maize, and wheat, the leaves being used as greens, and the seeds in soups, or eaten as rice. They also make an excellent beer. Mr. Lawson states that on account of its ascertained suitability for our climate, and its great productiveness, it would be well worthy of attention if the modes of preparing it for food were better understood. A meal is obtained from the seed having a tinge of yellow. It con-

tains scarcely any gluten, but like oatmeal, makes very good porridge and cakes. Dr. Voelcker, who analyzed it, states it to yield 3.66 per cent. of nitrogen, equal to 2.87 per cent. of protein compounds. In this respect the meal appears to be superior to rye, barley, rice, maize, or the potato.

Gingeley or Till Seed.—(*Sesamum indicum*, Linn. ; *S. trifoliatum*, Mill. ; *S. luteum*, Retz ; *S. laciniatum*, Willd.) Annual, 2 to 3 feet high, capsule, oblong, tetragonal, four-celled seeds numerous.

Extensively cultivated in India, the seed yielding one of the most valuable vegetable oils. The seeds are toasted and ground into meal, and so eaten by the Hindoos, and also made into a kind of bread and puddings, or used in soups, &c. It has a wide range, being grown in Central America under the name of Ajonjoli, and in the West Indies as oily grain ; also in Africa, Siam, China, and Cashmere. Children are very fond of the seeds, which have a nutty flavour. In Egypt they are eaten after being baked in an oven, and are also sprinkled over bread and pastry. The cake, after the oil is extracted, is also eaten kneaded with honey.

Polish Millet—Manna Kroup.—(*Glyceria fluitans*, R. Brown). Striped ; seeds small, yellowish-white ; paranchyme farinaceous, sweet, and mucilaginous. These succeed best in very wet districts. This grass produces such abundance of sweet seeds that they are exported from the Syrian coast and sold in Turkey, Hungary, and the South of Germany, under the name of sweet manna seeds for the table, where they are presented in the form of soup, puddings, and confections of various kinds.

In Russia and North America the seeds are also collected. Bryant, in his 'Description of California,' says he saw five old Indian women gathering grass seed for bread. This process is performed with two baskets, one shaped like a round shield, and the other having a basin and handle. With the shield the top of the grass is brushed, and the seed by the motion is thrown into the deep basket held in the other hand.

Here, then, we close our summary of what may be broadly termed the millets. Their uses, it will be seen, are more various and important than generally supposed, and their culture widely extended and daily increasing. Besides food for man and poultry, and fodder and fuel, sugar, vinegar, spirit, and beer, are also obtained from them ; and the panicles make excellent carpet and other sweeping brooms and brushes.

THE TRADE IN SKINS AND FURS.*

BY EDWARD B. ROBERTS.

Furs have for many years formed a leading branch of commerce in this country, England being possessed of so vast a territory in its Canadian, Hudson's Bay, and British Columbia colonies, and of Islands on the north-west coast of America, has long been the country to which exports have tended, as preliminary to their distribution to the various parts of the world in which furs are in request as articles of warm clothing, of official costume, or for ornamental attire.

The greater portion are annually imported by the Hudson's Bay Company, and become dispersed at their sales, which are held three times in each year: the first in January, which comprises beaver and musquash, from their Canadian, Labrador, and Hudson's Bay settlements.

The second in March, of bears, foxes, otters, wolves, fisher, marten, mink, and minor furs from the same districts; the third in September, the products of their trade from the north-west coast of America. An immense number of kind of the same kind are also imported by the American fur merchants, whose sales follow immediately upon those of the Hudson's Bay Company. The principal skin imported from the United States, both for number and value, is the raccoon, of which from 350,000 to 500,000 are annually received and again exported for use as a lining to the shube, or long travelling coat, and other equipments of northern countries. The most costly furs are not adequately prized in England, the choicest are therefore exported, a large portion being consigned to the merchants at the Leipsic Easter and autumn fairs, from whence they are transmitted to France, Russia, and China, where the climate and fashion not only demand their use, but higher prices are more readily obtained.

The value of the several skins greatly fluctuates, according to the caprices of fashion or the limited or abundant importations: the differences of quality also occasion extreme ranges of value—that of the raccoon, for instance, varying from 6d. for the most inferior, to 58s. for the choicest—it is, therefore, difficult to determine the value; but as the price realised more than a century since may be interesting, it is attached

In 1738, the average value of bear skins was 12s. 10¼d.; of beaver, 5s. 5¼d. per lb.; of fox skins, 10s. 2¾d. each; fisher skins, 8s.; lynx, 15s. 2d.; marten, 6s. 5¼d.; common otter, 7s. 7d.; wolf, 9s. 10¼d.; wolverine, 6s. 10d. The whole imports from the Hudson's Bay territories then were 266 bear skins, 69,911 beaver, 234 fox, 51 fisher, 1,011 lynx, 15,196 marten, 355 otter, 454 wolf, and 853 wolverine.

The French were the first fur-traders to America; and subsequently the Hudson's Bay Company, in the reign of Charles II., received a royal

* Altered and Enlarged from the Jury Reports.

charter, granting unto them the entire fur trade of British North America. The following statistics will show the magnitude of the fur trade now :

BADGER (*Meles Labradoria*).—Imports in 1851, 1,632 ; in 1860, 5,628.

BEAR (*Ursus arctos* et *Americanus*).—Imports in 1851, 10,342 ; in 1861, 8,715, nearly all from North America ; estimated import price, 21s. to 27s. 2d.

BEAVER (*Castor Fiber*).—Imports in 1851, 59,959 ; in 1861, 106,512, nearly all from North America ; estimated price, 7s. to 17s. 6d.

CAT (*Felis Catus*).—Imports in 1851, 13,451 ; 1860, 9,741.

CHINCHILLA (*Chinchilla lanigera*).—Imports in 1851, 79,446 ; 1861, 22,757 ; from South America.

DEER (*Cervus Tarandus, &c.*)—Imports in 1851, 79,380 ; in 1861, 66,586 undressed, and 18,375 dressed. Of these 29,551 came from North America, 7,667 from Central America, 14,920 from India and the East, and 4,872 from Central Africa. Price, 2s. 7d. to 8s.

DOG (*Canis*).—Imports, 3,142 in 1860.

ELK (*Cervus Alces*).—Imports, 2 in 1851, 363 in 1861.

ERMINE (*Mustela erminea*).—Imports in 1851, 221,853 ; in 1861, 307,282 ; principally received from Russia and through Hamburg ; value about 1s. to 1s. 6d. each.

FISHER (*Mustela Canadensis*).—Imports in 1851, 9,011 ; in 1861, 10,706.

FITCH (*Mustela putorius*).—Imports in 1851, 65,899 ; in 1861, 25,229. From Russia and Hamburg valued at 1s. to 5s. 7d. each.

FOX, Silver (*Canis argentatus*).—Imports in 1861, 1,028 ; average worth, 9*l.* 1s. 6d. each ; chiefly from North America.

FOX, other sorts (*Canis sp.*)—Imports in 1851, 62,320 ; 1861, 67,666 ; principally from North America ; valued at 5s. to 6*l.* In 1860, 4,765 foxtails were received.

GOAT (*Capra hircus*).—Imports in 1851, 675,988 ; 1861, 466,736 undressed ; 1,151,067 dressed. The former come chiefly from South Africa and the Continent ; the latter from India and Ceylon ; value from 1s. to 3s.

HARE (*Lepus timidus*).—Imports in 1851, 42,005 ; 1860, 136,684.

KANGAROO (*Macropus major* and *cæruleus*). — Imports in 1860, 1,199 skins from Australia.

KID (*Capra hircus*).—Imports in 1851, 81,188 ; in 1861, 9,912 undressed, 222,510 dressed—nearly all the imports from France ; value of the skins, 1s. to 1s. 9d. ; a few thousands from India worth only about 4d.

KOLINSKI (*Mustela siberica*).—Imports in 1851, 4,400 ; in 1861, 67,549.

LAMB (*Ovis aries*).—Imports in 1851, 1,521,138 ; in 1861, 1,086,197, of which 6,050 were dressed. Italy, Turkey, and Austria are the chief sources of supply.

LEOPARD (*Felis Leopardus*).—Imports in 1851, 75; in 1860, 186.

LION (*Felis Leo*).—Imports in 1851, 1; in 1860, 19.

LYNX (*Felis Canadensis*).—Imports in 1851, 15,546; in 1861, 8,415; chiefly imported from British North America, price, 7s. 9d. to 17s. 6d.

MARTEN (*Mustela Canadensis*).—Imports in 1851, 171,945; in 1861, 97,685; all from North America; worth 12s. to 3*l.* 3s. 6d. each.

MARMOT (*Arctomys empetra*).—3,639 were imported in 1860 from North America, some few are also received under the name of Weenusk.

MINK (*Mustela vison*).—Imports in 1851, 191,729; in 1860, 111,926.

MONKEY (*Colobus leucomerus* and *Cercopithecus Diana*). — Imports in 1860, 5,787.

MUSQUASH (*Fiber Zibeticus*).—Imports in 1851, 1,541,268; in 1861, 1,657,243; all from North America; valued at 7d. to 8½d.

NUTRIA (*Myopotamus Coypus*).—Imports in 1851, 9,332; in 1861, 506,089; chiefly from the River Plate republics; value, 5½d. to 3s.

OTTER, Common (*Lutra Canadensis*).—Imports in 1851, 12,147; in 1861 17,873 from North America; value, 9s. 7d. to 3*l.*

OTTER, Sea (*Enhydra marina*).—Imports in 1851, 98; 1861, 202; value 8*l.* 12s. to 25*l.* 15s. each.

PANTHER (*Felis concolor*).—Imports in 1851, 6; in 1860, 78.

RABBIT or CONEY (*Lepus cuniculus*).—Imports in 1851, 71,394; in 1861, 333,057; value 2½d. to 4½d.; chiefly from Hamburg and Belgium.

RACCOON (*Procyon lotor*).—Imports in 1851, 465,340; in 1861, 380,182; nearly all from North America; value, 2s. to 10s.

SABLE (*Mustela zibellina*).—Imports in 1861, 1,309; value, 3*l.* 3s. to 7*l.* 7s. 6d.; principally from Russia.

SEAL (*Phoca*).—Imports in 1851, 769,756; in 1861, 494,079; from the Polar Regions and South Seas; value, 3s. 9d. to 14s. 3d.

SHEEP (*Ovis aries*).—Imports in 1851, 392,293; in 1861, 2,554,894, of which a little over one million were dressed. The principal imports are from Africa, Australia, India, and South America; value, 9d. to 3s. 8d.

SKUNK (*Mephitis Americana*). — Imports in 1851, 1,454; in 1860, 138,376; all from North America.

SQUIRREL or CALABAR (*Sciurus vulgaris*).—Imports in 1851, 4,516,914; in 1861, 537,950.

SWANSKINS (*Cygnus ferus*).—Imports in 1851, 1,613; in 1860, 2,932

TIGER (*Felis Tigris*).—Imports in 1851, 14; in 1860, 380.

WEASEL (*Mustela vulgaris*).—Imports in 1851, 89; in 1860, 463.

WOLF (*Canis lupus*).—Imports in 1851, 2,391; in 1860, 6,186; in 1861, 3,669; from Hudson's Bay Territories.

WOLVERINE (*Gulo arcticus*).—Imports in 1851, 1,400; in 1861, 1,453.

In reviewing the fur trade in England from the year 1851 to the present date, there is little to remark denoting progress. In this country utility has perhaps been too closely regarded, and artistic feeling too little exercised upon the combinations that may be effected of form, colour, and texture with other materials.

Time has long proved the style of manufacture most useful in this climate for fur clothing, and in all the familiar varieties it would be difficult to surpass the excellence of materials and workmanship of the exhibitors rewarded. With each exhibitor there appears to have prevailed the same, and a natural desire, on such an occasion to produce the most costly goods—a circumstance in some degree regretted by the Jurors, inasmuch as the cheap and imitation furs have been lost sight of, and scarcely exemplified.

As there exists in England an extensive consumption of low-priced furs, it would have appeared desirable if some attention had been given to the inferior skins, to have demonstrated how far effective goods can be produced at moderate prices.

The furs which have been brought into notice since the above period are the beaver, the badger, the monkey, the musquash, and the skunk. Prior to the year 1851, the beaver, which had commanded very high prices, and had formed the staple article of the Hudson's Bay Company's trade, began annually to decline in value in consequence of the great perfection to which the silk hat had then been produced. The skins became almost unsaleable, and the price, which had reached in more favourable times 2*l.* 3s. 7d. per pound, had declined to 4s. per pound.

In the year 1851, the writer after some few experiments, introduced it as a fur, by removing the upper coarse hair and retaining the soft fur beneath, when, with the aid of an ingenious machine he had constructed or the purpose, he cut the fur to a fine, even surface.

When finished it was universally admired by the fur trade, immediately rose considerably in value, and has continued in demand, both for home and continental consumption.

The writer has since introduced the Badger for ladies' muffs—a genuine-looking fur at a very moderate price, which has led to the introduction of the Virginian opossum, a skin of less value, but interesting, as meeting the requirements of purchasers at a still lower price.

The long shaggy black skin of one species of monkey, the white thighed-Colobus, has been imported from the West coast of Africa : the skin at first was not welcomed, and met with a very dull sale. The low price encouraged speculators, and the skin was largely manufactured into muffs, which, from the low rate they were offered at, and the really good appearance they presented, did not fail to receive a favourable reception from the ladies.

A fashion arose, and from the original price of 1s. per skin, they advanced in the year 1860 to 12s. per skin. Imitation by another long-haired fur, and less care in manufacture, have occasioned the skins

again to recede, and will afford time to the monkeys, who must have been sorely hunted, to recruit their numbers. There are two other species of monkey, which might be introduced with advantage, they are the Diana monkey and the *Colobus Guereza.*

The fur seal has annually increased in demand for ladies' mantles and like all other goods of a costly nature, has called forth an imitation of less value. This has been effected by removing the upper hair from the skin of the musquash, leaving the finer portion, which having passed through the hands of the fur dyer, forms an excellent substitute at half the price.

The Skunk *(Mephitis Americana)* is a fur new to commerce: owing to the repugnant smell which the animal possesses, and which the fur, even when it has passed through the dressing process, retains, it has not been considered of great commercial value. Continued experiments have surmounted the difficulty; the two stripes of white coarse hair down the back are removed, and a skin of rich black fur is formed. It will no doubt take rivalry with superior furs for ladies wear.

The history of this skin is suggestive that there may be many other skins that could be rendered useful were apparent objections sought to be overcome. But a few years back the number that appeared in the London sales was trivial: in 1861, 110,000 were brought to public sale; and now that their preparation has been still further improved, this formerly neglected skin will probably bear a high value.

In 1851, there were seventeen English exhibitors of furs, nineteen colonial, and fifteen foreign; in the late Exhibition there were eighteen English, forty-one colonial, and eighty-six foreign. Of the English exhibitors, Messrs. Smith and Sons made the best and most prominent display; the skins had been carefully selected and well manufactured.

Messrs. Bevington and Morris showed some excellent samples of angora and sheepskin rugs; the grease appeared to have been thoroughly extracted, and the several colours were particularly bright and good.

Messrs. Tussaud Brothers exhibited specimens prepared under their patent for the removal of the hair or fur from skins, by which process the fur is preserved for warm clothing, and the skin or pelt left available for tanning. The skin is in the first instance steeped in lime-water to loosen the fur from the skin; the fur is then, by the aid of a solution, adhered together, and as soon as dry it is stripped from the pelt. When stripped, a coating of India-rubber is spread on the roots of the hair, which is finally protected with thin cambric, to form an artificial pelt. The process is very cleverly and ingeniously effected; and should the new material stand the wear and tear of fair usage it may prove of much utility.

From such of our Colonies as are of high temperature we cannot look for skins of fur-bearing animals, at the same time they have been larger contributors than on the former occasion in 1851.

Ceylon and India exhibited chetah and tiger skins, the demand for which is very limited being solely for ornamental purposes.

The Government of Newfoundland showed black bear skins, with a superior collection of silver and red fox and otter. The foxes were very fine, but the prices at which they were valued, too high.

New South Wales had but two exhibitors, who showed a few specimens of ornithorhynchus and native cat, of comparatively little value.

From Nova Scotia there was but one representative, a Mr. Coleman, who fully illustrated the furs of the colony. He sent some very fine silver, cross, and red foxes, superior mink and musquash, for which the province is noted ; these skins command higher prices at our London sales than those trapped in the interior of North America. There were also lynx, raccoon, and otter, with some few manufactured specimens, forming in the whole a very interesting collection.

From Queensland some opossum wrappers were shown as used by the natives. In the Tasmanian collection the commissioners for the colony and private exhibitors made an excellent display of indigenous skins; comprising the kangaroo, wallaby, wombat, opossum, native cat, native tiger, and ornithorhynchus. The native tiger skins are scarce ; they are applicable for hearth-rugs or mats. The ornithorhynchus are also very rare ; they make up prettily into muffs and cuffs. The skin of the kangaroo is more valuable for leather than for its fur ; but that of the brush kangaroo (*M. cæruleus*), which is less woolly, would be useful for carriage-wrappers. The opossum, wombat, and wallaby are admirably light, and the fur being very thick, renders them invaluable for native clothing and the use of colonists. These skins, although not high priced, do not possess sufficient beauty to enter into competition with our cheaper European furs. The chief application in this country is for carriage-wrappers. Opossum-skins can be purchased in the colony at 5s. per dozen.

From British Guiana there were sent many specimens of sloth, monkey, ant-eater, otter, and jaguar. These skins are instructive, as exemplifying the natural history of the colony, but, with the exception of the otter and the jaguar, are not of use to the furrier. The otter is very large, and an interesting species ; the outer hair is a light brown, very short, and much resembles a fur-seal ; its habits are those of the sea-otter, and it is said to be very scarce. The colony possesses other species of the monkey, but they were not exhibited.

The colony of Natal sent several varieties of deer and antelope skins, adapted for oil-dressed leather ; also lion and leopard skins. The latter command good prices for hearthrugs and military purposes. There were some carosses, of which that made from the springbok was the best ; the others not being well-selected specimens. A fine land otter was exhibited, much resembling that of this country. It is stated to be found in all the principal rivers, and, if existing in sufficient numbers, may be made a beneficial article of export.

From Prince Edward Island some nicely tanned sheepskin rugs ; also a few furs, in fox, mink, &c., were shown, scarcely worthy of notice. But the island possesses furs equal in quality to those of the neighbour-

ing provinces of Nova Scotia and New Brunswick, in bear, fox, otter, marten, mink, cat, and musquash.

In the foreign courts, Messrs. Hesnault and Brothers, of Belgium, showed a good assortment of rabbit skins in different stages of manufacture, natural, dyed, and pulled. As is well known, a large trade is carried on with our markets in the flesh of these animals, the skins having been previously retained by the skin-merchants, to be by them prepared, in imitation of superior furs, to meet the requirements of the less wealthy classes. The inferior skins have the fur cut off them, which is sold to the hat-maker, and applied for making felts. Considering that in the markets of Leadenhall and Newgate alone 870,000 rabbits are annually disposed of, the fur of which is of small value, this collection is suggestive that rabbit-breeding might become an important branch of British industry, if conducted in a more systematic manner.

From Costa Rica were sent skins of the puma, or lion of the New World, and the jaguar. The number of puma skins collected annually are few, and of little value. The jaguar is used for ornamental purposes, as hearthrugs, &c.

Denmark displayed some good blue foxes. These skins are not much esteemed by English ladies, but in Germany realize very high prices. Not many blue foxes are found in North America. Both the white and blue are very numerous in Greenland, the northern and unexplored part of which, subject to the permission of the Danish government, is open to our trade, and well worthy the attention of an enterprising adventurer. It is only needful to remark the high figures attached to the goods exhibited to ascertain the value in the Danish market.

The quilts shown from the dressed skin of the eider duck were neatly made ; they are exceedingly light and warm. The specimens of Esquimaux workmanship are admirably executed, and merited the rewards of the Jurors.

From France there were three exhibitors. In Mr. Hasse's case the goods presented were well assorted, from the finest Russian sables to the common cat and rabbit, meeting the requirements of the noble and the peasant. In the development of the rabbit-skin trade, Mr. Hasse has taken a commendable interest in bringing the skins to great perfection, having successfully laboured to spread a knowledge amongst the peasantry of the necessary demands of the furrier, which has resulted in more than trebling the value of the skin. Skins of large size, and of many colours and gradations, were exhibited, and also of the silver-gray rabbit, a variety which has a special value as an important article of trade with China and Russia. In the finer manufactured furs, Mr. Hasse showed marked taste and superior workmanship.

From Hungary, Messrs. Goldstein and Son presented some fine skins in baum and stone-marten, lamb and fitch. Of these skins large quantities are manufactured in England. The cost of the European marten is

under that of the American; the fur at the same time much resembles it, and when dyed by a clever workman, it requires a better judge than the ordinary purchaser to determine its quality. The fur is rather coarser, which renders it the more durable. The fitch, although fashionable many years since, is not now a favourite fur in England, but is much worn in France. The skins found in Scotland of this animal are considered finer than from any other country. The black lambskins shown, for which the country is celebrated, were particularly fine. There were also some fine samples of wild cat.

Norway sent a collection of skins, the products of the country, comprising foxes, wolverine, otter, and marten. The wolverine and marten were very fine samples; but in their manufactured goods the Norwegians seem to be far behind other countries.

From Prussia, an excellent assortment of squirrel backs and squirrel belly linings were shown by the Messrs. Keller of Weissenfels. Large quantities of these skins are imported into England, but to a far less extent than in 1851, when 4,500,000 were received. The fur of the squirrel is light, and not capable of imitation; and the goods, when manufactured, being suitable to the means of the middle classes, it will probably always continue in demand. The importation in 1860 was 164,976 skins, and in 1861 more than three times that number.

In the Greek court a few skins were shown in red fox, squirrel, lamb, and wild cat, not one of which is promising for the trade.

The fur trade of Russia from the vastness of its territories, and the exigencies of many portions of the country, is, as may be conjectured, one of great magnitude. With the view of forming an adequate idea of its extent, it may be desirable to introduce the latest official returns upon the subject—viz., value of furs imported into European Russia (exclusive of Finland) from various countries in the year 1859, 2,252,776 silver roubles.

Value of furs exported from European Russia (exclusive of Finland) to various countries in 1859:—

To Prussia	823,338	silver roubles.
„ Great Britain	114,734	„
„ Other countries . . .	42,947	„
	981,019	„
	= £155,328	

Value of furs imported into European Russia, exclusive of Finland, from various countries in Asia in 1859:—

From Persia	117,380	silver roubles.
„ Kirghise Steppes . .	347,176	„
„ Bokhara	162,113	„
„ Other countries . . .	85,943	„
	712,612	„
	= £112,830 4s. 8d.	

Value of furs exported from European Russia to various countries in Asia in 1859 :—

To China	1,081,337	silver roubles.
„ Other countries . . .	44,455	„
	1,125,792	„
	= £178,250 8s.	

The Russian-American Company of St. Petersburgh were exhibitors of sea-otter, cross, silver, and blue fox skins. The sea-otter skins were particularly choice ; but owing to the great demand which exists for home consumption, the prices there realised exclude them from an export trade. The blue-fox skins were also very good and cheap. The cross fox are large, although not of the first quality : the price is so low, that they demand attention. There were also specimens of fur-seal skins in the raw state from the same territory, the prices of which are reasonable. The moderate prices may arise from the judicious arrangements made by this Company, under which only the mature animals are slaughtered. At one period of the trade upon the coast 200,000 were annually obtained ; but, by the indiscriminate destruction of old and young, the race was nearly exterminated.

These animals appear on the coast in the month of May, and remain until October, when they disperse no one knows whither. Marked ones have returned to the same places for ten years ; and there is therefore no inducement to destroy the young, wherever wholesome restraint can be placed on the trade. Under the Russian regulations, animals of four years old are alone allowed to be killed, and the trade has revived.

The sea-otter, an animal of analogous habits, was formerly found in thousands on the Pacific coast, from California to the Russian settlements ; but, in the absence of proper restrictions, is progressing towards extinction on those parts of the coast under British rule.

The Agricultural Department showed a large assortment of black and gray lamb and sheep skins. These skins were beautifully tanned, to form the clothing for the peasant. The wool side had not received the same share of attention ; but if cleansed and bleached by one of our sheepskin dressers, the skins would present a far more valuable appearance.

The squirrel skins were good and the price remarkably low ; the ermine were also very cheap, and worthy of attention.

There were some young reindeer skins, and coats made of the same, the tanning of which was excellent. The Russians evidently excel in this branch of fur-dressing.

There were some mantles and neckerchiefs made from the swan's down, very tastefully bordered with the down of the eider duck, shown by A. Vinograd, of Nijni-Novgorod. The manufacture of one mantle is quite novel ; it is exceedingly light and warm.

From Sweden, Messrs. Forssell and Co. showed some well-manufactured furs, and very fine baum marten, the produce of the country.

From Turkey there were several exhibitors, who showed a variety of skins indigenous to the country, consisting of marten, red fox, lynx, wolf, jackall, cat, hare, and badger. The skins most worthy of notice were the marten and hare. The hare skins were very large, the fur of these being much valued for felting and hat-making.

Scientific Notes.

Fir-Wood Paper. — The Rosendahl Manufacturing Company of Gottenburg makes yearly about 1,000,000 lbs. of paper from fir-wood. The wood is ground at a mill at the Trollhattan waterfall, using about 180 horse-power, and occupying twelve persons daily. The Jury made honourable mention of this paper in 1862.

Aliantus Silk.—The new Chinese silk-moth *Saturnia*, or *Bombyx Cynthia*, has been introduced into Canada, where the *Aliantus glandulosa*, on which it feeds, is quite hardy. Professor Lawson states that the chief obstacle in manufacturing this silk—the difficulty of unwinding or cording the cocoons—will no doubt be overcome by the method of soaking them in caustic potash, which has been found to answer so well in the case of the much larger parchment-like cocoons of the Canadian *Cecropia*. The potash disintegrates the parchment-like membrane into its constituent thread, by dissolving the adhesive substance which glues them together.

PUBLICATIONS RECEIVED.

Tropical Fibres; their Production and Economic Extraction. By E. G. Squier. James Madden.—Revue du Monde Colonial, No. 3, for March. — Technologiste, Paris, March. — Pharmaceutical Journal. — Chemist and Druggist.—Journal of the Board of Arts and Manufactures, Upper Canada.

THE TECHNOLOGIST.

NOTES ON THE ECONOMIC APPLICATION OF BARKS.

BY JOHN R. JACKSON.

(Continued from page 372.)

Agati grandiflora, Desf.—A common East Indian tree, 20 to 30 feet high. The bark is very bitter and is used as a tonic ; an infusion is also employed in small-pox.

Piscidia Erythrina, Linn.—The Dogwood of Jamaica, a native of the West Indies, where it grows to about 30 feet high. The bark is very astringent ; a decoction of it is said to be efficacious in allaying or stopping the discharge of ulcers, and is more powerful when united with that of Mangrove bark. A tincture of the bark is strongly narcotic and diaphoretic. This bark is one of the common fish poisons of the country.

Hymenea Courbaril, Linn.—A lofty spreading tree, sometimes 100 feet high, native of the South American forests, but growing also in Jamaica. A decoction of the inner bark is considered an excellent vermifuge. Canoes are made of the thick bark.

Acacia ferruginea, D.C.—A tree 20 to 30 feet high, native of the mountainous parts of India, where a decoction of the bark, combined with ginger and other ingredients, is used as an astringent wash for the teeth. The natives distil an intoxicating liquor by steeping the bark in Jaggery. The same may be said of the barks of *A. leucophlœa*, Willd., and *A. myriophylla*, Grah., both natives of the East Indies. From the bark of *A. odoratissima*, Willd., also an East Indian tree, growing 30 or 40 feet high, a juice is obtained which "mixed with lime-juice and green curcuma, and boiled in cocoa-nut oil, is given in leprosy externally, as well as applied to inveterate ulcers."

Adansonia digitata, Linn.—The Baobab, a widely distributed tropical African tree, now introduced into the East and West Indies. It grows

to a moderate height, but of an enormous bulk, sometimes measuring 20 or 30 feet in diameter. The bark has been used with great success by Dr. Duchassaing in the miasmatic diseases of the West Indies, and he has published the result of his experience with it. In France it has also been successfully employed in intermittent fever. The bark is mucilaginous, and almost without smell or taste. It produces increased appetite and perspiration. The leaves also have similar properties. The natives use the bark for various purposes, as for making ropes, nets, &c.

Inga Unguis Cati, Willd.—A small tree or bush, growing about 10 feet high, common in various parts of tropical America. The bark is very astringent, and is reported to have diuretic properties; it is used as a lotion, and for fomentations for external application, as well as injection in cases of relaxation of the parts.

Schinus Molle, L.—A small and very graceful tree, about 20 feet high, native of Peru and Brazil. The bark abounds in a whitish resinous substance resembling mastic. The natives prepare a lotion which they apply to tumours and inflammations, by boiling the bark in water. The bark of another species of the same genus, *S Aroeira*, of L., is said to be used by the Indians in diseases of the eyes. They also employ it, when fresh, for rubbing upon new ropes to strengthen them.

Quercus pedunculata, Willd.—This is our well-known English oak, the bark of which is so much used for its astringency. The principal uses to which it is applied in medicine are in gargles, lotions, &c. It is also given in powder as a febrifuge, made into poultices it is applied to ulcers and external gangrene ; a decoction is given in chronic diarrhœa. This bark, so much used for tanning, will be noticed more fully under that head.

Quercus alba, L.—The white oak, and *Q, tinctoria*, the black oak of North America, are both large trees found growing in the American forests. The properties of the bark are the same as our *Quercus pedunculata*, that from the black oak being considered inferior for internal administration, having the power to irritate the bowels in a greater degree than that of *Quercus alba.*

Ficus Indica, L.—The Banyan tree of India, where it is common in all parts, growing to an enormous extent by throwing adventitious roots from its horizontal branches, downwards into the soil, thereby supporting the superincumbent weight, and at the same time adding extent to the circumference. The bark is considered by the Hindoos as a powerful tonic, and is used by them in diabetes.

Ficus racemosa, L.—Also an East Indian tree, produces a bark which is somewhat astringent, and is used in native practice in cancerous affections, being reduced to a fine powder and mixed with gingelley oil ; an infusion is given in diabetes.

Myrica cerifera, L.—A small tree or bush called Bayberry, sometimes growing 12 feet high, native of the woods of North America. The root bark is astringent, and very acrid. It produces a strong burning

sensation, followed by vomiting if taken in large doses. In powder it has the repute of acting as a stimulant. It is of a fibrous texture, with a whitish shining exterior, and a cinnamon brown coloured fracture.

Populous tremuloides, Michx.—A tree growing to 20 or 30 feet high, common in the swamps of North America, where it is known as the "American Aspen." The bark has tonic properties, and has been used successfully, and esteemed as a febrifuge in the United States. It is of a lightish brown colour, with silvery white patches.

Achras Sapota, L.—A tree sometimes growing 50 feet high, native of the West Indies and the neighbouring Continent of South America. The bark is said to be powerfully astringent, and to have been used successfully in place of cinchona.

Diospyros Melanoxylon, Roxb.—This is one of the trees supposed to furnish the ebony wood of Commerce. It is a native of Ceylon, Coromandel, and other parts of India, growing to a height of 20 or 30 feet. The bark is a valuable astringent, and, mixed with pepper, is given in dysentery, by the native Indian practitioners, who also reduce it to powder and apply it for the cure of ulcers. The bark is of a spongy nature, deeply furrowed, or cracked. In colour of a dull grey.

Ulmus fulva, Michx.—The slippery elm of North America is a common tree in the United States, growing to a height of 50 or 60 feet. The inner bark is employed in medicine, and is considered an excellent demulcent, the mucilage being highly nutritious; an instance is told of a soldier who supported life for ten days on this bark and sassafras. The Indians also employ it as an article of food in times of great scarcity. In North American practice, it has been recommended in diarrhœa and dysentery, and also in cutaneous eruptions. It occurs in long nearly flat pieces, of a fibrous nature, tawny externally, and somewhat reddish on the inner surface.

Ulmus Campestris, L.—The common field elm, found in all parts of England, but especially in the southern counties. The bark of this tree is used as a medicinal agent by our own practitioners. Its properties appear to have been known to the ancients. Dioscorides and Pliny both speak of the astringency of the elm. It contains a quantity of mucilage, and is therefore slightly demulcent, but its effect upon the system is that of a gentle astringent tonic. It is given in the form of a decoction, and has been used in cutaneous diseases, and also as a substitute for sarsaparilla. The inner bark is the part used. It occurs in Commerce in thin pieces, of a toughish texture, and a brownish yellow colour, and is without smell, but has an astringent bitter taste.

Ilex Aquifolium, L.—The Holly, a common bush or tree of our own country, but found also in many parts of Europe, Asia, and America. The bark has been reported to possess emollient, expectorant, and diuretic properties, and has been employed successfully in cases of epidemic intermittent fevers, when cinchona has been of no avail. It contains a large quantity of viscid matter, and when macerated in water

and fermented, forms bird-lime. It is of a dirty greyish brown colour, with a short brittle fracture and a slightly bitter taste.

Ipomœa Turpethum, R. Br.—A twining plant, native of the East Indies, New Holland, Otaheite, the Friendly Islands, &c. In India the natives use the fresh bark of the roots as a purgative by rubbing it up with milk, a piece about six inches long, and about as thick as the little finger is considered sufficient for one dose. It is also used in Ceylon for a like purpose in combination with tamarinds, ginger, and sugar. It is of an earthy brown colour, with a very white fracture, having little or no smell or taste.

Hymenodictyon excelsum, Wall.—A tree growing about 50 feet high, native of the East Indies, chiefly in the mountainous parts of the Circars, and in the adjoining valleys. The inner layers of the bark possess strong bitter and astringent properties resembling those of cinchona, but when fresh in a greater degree; these properties, however, are not so quickly extracted by chewing as they are from Peruvian bark, but the taste is much stronger and more durable. The bark is of a thick spongy consistence, much cracked on the outer surface, which is of a grey colour, the inner layers white, the middle portion between the outer and inner coats of a farinaceous consistence. This bark is used for tanning as well as in medicine.

Hollarhena febrifuga, Kl.—A small tree or shrub, native of Eastern tropical Africa. The bark of this tree is used by the Portuguese on the Zambesi as a substitute for cinchona, and is spoken of by Dr. Livingstone, who, in his travels, says he employed it himself in decoction, and found it very efficacious in fevers, &c. The plant is known in that country as "Kumbanzo" or "Quina" of the Portuguese.

Hollarhena antidysenterica, Wall.—A small tree, native of the East Indies. The bark, under the name of Conessi bark, has great reputation in India as a tonic and febrifuge, and has been successfully employed in dysentery.

Cosmibuena hexandra, Pohl.—A middling-sized tree, native of the mountain woods of Brazil, in the provinces of Rio Janeiro and Minas Geraes. The bark, like most other plants of this order, is very bitter, and is employed by the Brazilians as a febrifuge, and for other purposes to which cinchona is applied. The outer surface is of a bay colour, the inner of a deep red, or blood colour.

Bignonia antisyphilitica, Mart.—A moderate-sized tree, growing in the Province of Rio Negro, Brazil. The bark obtained from the young branches is used as a remedy in the worst cases of syphilitic swellings. It is employed in two forms, externally in powder, and internally in decoction.

Cordia myxa, L.—A small tree, growing to a height of 10 or 15 feet, native of many parts of India, Arabia, Persia, Egypt, &c. The bark has the reputation in Java of being a mild tonic, for which purpose it is generally used. It is of a grey colour, much cracked on the surface.

Terminalia tomentosa, W. et A.—An East Indian tree, growing about 40 feet high. The bark is astringent, and is used in India as a febrifuge, powdered and mixed with oil, it is said to have been successfully employed in Apthæ. It is of a reddish brown colour, the surface very deeply cracked, or furrowed.

Syzigium Jambolanum, D.C.—A tree of moderate size, native of the East Indiies, but now introduced into Jamaica and other West Indian islands. All parts of the plant are said to be astringent. A decoction of the bark is employed by the native Indian practitioners in fevers, bowel complaints, &c., and they also apply it externally in the cure of ulcers. It is rather a thick bark, the outer surface of a brown colour.

Calotropis gigantea, R. Br.—A large shrub, very common in all parts of India, growing on waste and uncultivated ground. From all parts of the plant a milky juice flows when wounded ; this is used in combination with the powdered bark of the roots in all cutaneous affections, and is considered very efficacious in the cure of leprosy. Its activity, no doubt, exists in a principle called "Mudarine," discovered by Dr. Duncan, of Edinburgh. The bark, as employed, is of a whitish colour, of a bitter, nauseous taste, devoid of any smell. The juice which exudes is in great repute in India, not only as a remedy in the above-named diseases, but also iu rheumatism, dropsy, intermittent fevers, &c. A strong fibre, known as Yercum or Mudar fibre, is procured from this plant.

Condaminea corymbosa, D.C.—A tree about 40 or 50 feet high, native of Peru and New Granada. The bark of this plant, like nearly all the Cinchonaceæ, has tonic and febrifugal properties. It is said the Peruvian bark gatherers adulterate the true cinchona barks with this, but it may be detected by its white inner surface, its less powerful bitter taste, and a viscidity, which the cinchonas have not.

Sambucus Nigra, L.—The Common Elder.—This plant is found growing in all parts of Europe, the Caucasus, and Siberia. It has a variety of uses, the bark and flowers being employed in medicine, and the berries in the manufacture of a well-known wine. The inner bark of the branches is the part employed ; it is of a greenish white colour, and has a slightly astringent and somewhat sweetish taste. Its properties are hydragogue, cathartic, and emetic ; and it has been used in dropsy, as well as an aperient in various chronic disorders.

Olea Europœa, L.—The Olive.—This is a common tree, all over the south of Europe, Barbary, the Levant, &c., usually growing to about 20 feet high. The bark is said to have been used as a substitute for cinchona. It is bitter and astringent. The exterior of a greyish brown colour, very much cracked. The fruits and the oil obtained from them are articles well known in commerce.

Cinnamomum culilawan, Bl.—A large tree, native of the Moluccas, Cochin China, &c. The bark is very aromatic, much resembling cloves ;

it has also an agreeable fragrant odour. Its medicinal properties resemble those of cinnamon, the principle being contained chiefly in a volatile oil which can be separated by distillation. The bark is not more than two lines thick, sometimes in flat pieces, but usually more or less quilled, it is of a somewhat corky consistence, of a dull cinnamon brown colour.

Hamamelis Virginica, L.—A shrub, growing to about 15 feet high, native of North America, east of the Rocky Mountains, growing chiefly upon hills or near streams. A decoction of the bark is employed as a wash in diseases of the eye, and in hæmorrhoidal affections, as also for poultices. Its properties are said to have been first noticed on account of the uses to which the natives applied it—viz., for outward applications to humours and other such diseases, and also as a sedative. Its taste is bitter astringent, with a slight sweetish pungency.

Euonymus atropurpureus, Jacq.—A shrub, growing about 10 or 12 feet high, native of North America, extending from New York to Carolina. Is is known as Spindle tree or burning bush, from the rich red colour of its fruits, which appear in autumn. The bark obtained a notice in America some years ago as a reputed remedy in dropsy ; it was also considered to have tonic, diuretic, cathartic, and antiperiodic properties, but its action seems to be doubtful, so that it is not an officinal medicine in that country at the present time.

Dirca palustris, L.—A small shrub, growing only 6 or 8 feet high, common in damp swampy places, all over the United States, where it is called leather wood. The bark is said to act as a slow vesicatory, and also to have cathartic properties ; a dose of 6 or 8 grains of the fresh bark will produce great heat in the stomach, followed by violent vomiting. It has a disagreeable smell and an acid taste, is very tough, somewhat fibrous, and difficult to reduce to powder.

Dictamnus fraxinella, Pers.—A small perennial plant, native of Southern Europe and West Asia. The bark of the root is bitter and aromatic, and has been considered a good anthelmintic, emenagogue, and stomachic tonic. Its use in medicine is now nearly obsolete.

Pinckneya pubens, Michx.—A small tree, or shrub, native of North America, and found in most low damp places, along the sea coast of South Carolina, Georgia, and Florida. The bark is bitter, and is employed as a febrifuge, and as a substitute for cinchona generally.

Samadera Indica, Gærtn.—A tree, growing to a height of 30 or 40 feet, native of the East Indies, where the bark is used by the natives as a febrifuge, under the name of Niepa bark. See an article on Samadera wood, TECHNOLOGIST, vol. II. p. 317.

Barringtonia racemosa, Roxb.—A tree, 30 or 40 feet high, native of the East Indies, the Moluccas, &c. The bark is said to possess properties analogous to those of cinchona, as a substitute for which it has been used.

Antirrhœa verticillata, D. C.—A tree attaining a height of about 20 feet, native of Bourbon and Mauritius, where it is known as "Bois de Losteau." The bark of the root is reputed to be a powerful astringent, and is used in Bourbon as a styptic.

Exostemma caribœum, Rom.—A shrub, about 10 feet high, growing in Mexico, San Domingo, and most of the West Indian Islands. The bark is reputed to be a good febrifuge, and also to be employed as an emetic. It has a very bitter taste and disagreeable smell. It would seem, according to Guibourt to contain some peculiar principle, as the fracture displays an abundance of small crystals. The barks of several other species of this genus have more or less febrifugal properties, amongst them may be mentioned *E. floribundum*, R. et S., a native also of the West Indian Islands., *E. Peruvianum*, H. et B. and *E. Souzanum*, Mart., both natives of South America.

Remija ferruginea, D. C.—A small shrub, growing only about 5 or 6 feet high, native of Brazil, where the bark is used as a substitute for cinchona, under the names of Quina de Remijo, or Quina de Serra.

Manettia cordifolia, Mart.—A twining plant, growing in hedges in the province of Minas Geraes, Brazil. The bark of the root is considered as an emetic, and is very efficacious in the cure of dropsy and dysentery, being applied in the form of a powder.

Alyxia steuata, R. et S.—A shrub, native of the Society and Friendly Islands. The bark is stimulant and tonic, and has been employed in Germany in nervous complaints and chronic diarrhœa. It is of a whitish colour, with a short brittle fracture, a very pleasant odour, and a sharp aromatic taste.

Nerium odoratum, Lam.—A shrub, 6 or 8 feet high ; native of India, China, and Japan. The native practitioners of India use the bark of the root, beaten into paste, for external application in ringworm. It is said that the root itself, taken inwardly, acts as a powerful poison. A decoction of the bark of *N. Oleander*, L., is much used by the poorer classes in the South of France, as a remedy in itch and many cutaneous diseases. The powdered bark and wood is employed as a poison for rats.

The foregoing list of barks having real or reputed medicinal properties is as perfect as I have been able to make it. As will be clearly seen, it applies only to those whose scientific names are known ; some few of these, indeed, have been omitted as unimportant, or on account of the fact of their reputed properties being very doubtful. But it will be as well to give the latter a passing mention before closing this section of my paper.

The bark of *Michelia champaca*, L., an Indian plant, is considered febrifugal in its native country. *Isertia coccinea*, Vahl., a native of Guiana, has also similar properties. *Mikania opifera*, Mart., a Brazilian plant, is said to be a powerful diuretic, and is used for poultices in venomous snake-bites. The bark and young shoots of *Canthium parviflorum*, Lam., a native of the East Indies, are considered efficacious in dysentery. The root bark of *Triosetum perfoliatum*, L., a native of

North America, is cathartic and emetic. Several species of *Bauhinia* furnish medicinal barks; that from *B. acuminata*, L., an Indian plant, is considered a remedy in cutaneous affections. The bark of *B. tomentosa*, L., is used as a plaister for outward application to wounds, &c., while a decoction of the root bark is employed as a vermifuge. The bark of *Pterocarpus flavus*, Lour., a native of China, is reputed to be resolvent and vulnerary. It is also employed for dyeing silks yellow; that from *Magnolia hypoleuca*, S. et. Z., is considered in the same country a good tonic. The bark of the mulberry, *Morus nigra*, L., is cathartic and anthelmintic. In Borneo, the bark of a species of *Wickstromia*, known as "Merik" bark, is chewed as a cure for toothache, and is said to possess the entire properties of Mezereon bark. Many barks are known only by the names in which they appear in commerce; but the properties and uses of these are so well understood as to require no notice here.

THE COMMERCE AND USES OF THE HAIR OF ANIMALS.

Hair, the covering of many animals, consists of slender flexible tubes, growing from bulbs in or under the skin, which resembles the fibres of horn, and possesses the properties of coagulated albumen. Hair is made up of three parts called the cuticle, the cortex, and the medullary substance. The cuticle is formed of plates placed like tiles, the one above the other. The cortex, a fibrous matter, arranged in long narrow plates, makes the chief part of hair. The minor portion, or medullary substance, consists of closely-arranged rows of glandular cells. Hair is very elastic, and can be stretched one-third in length, returning nearly to its former size. From its elasticity and durability, it forms the best stuffing for cushions and mattrasses, and hence is always used in the best description of upholstery.

Human Hair is remarkable for being the only recognised marketable article produced on the bodies of our race. It is chiefly imported from France, the north of Germany, and Italy: small quantities are occasionally received from Bohemia, Austria, and Belgium. Great Britain also furnishes a small quantity, and even India and China have at various times contributed to the supply; but the bulk of hair used in this country is the growth of France, Germany, and Italy. From France the finest and softest hairs are received; from Germany the light and flaxen colours; and from Italy the long dark hair. The hair from India and China is scarcely marketable, as the texture is too coarse for use in this country.

The only purposes for which human hair is used here are the various branches of tress and wig-making, and small ornaments.

The imports of human hair average about 15,000lb. weight in a year. Although this small amount of raw material supplies the whole consumption of England, it must not be inferred that it is an insignificant trade; on the contrary, it gives employment to many thousands of hands in its manufacture from the raw state into wigs, fronts, &c.

The price varies from 4s. to 30s. per pound for the average qualities, but as high as 80s. is frequently paid for parcels of choice goods even in the raw state.

Some curious information on "New Manufactures from Human Hair:" will be found in a paper by Mr. W. Danson. TECHNOLOGIST, vol. 2, p. 88.

France exports a large quantity principally to England. Twenty years ago the exports amounted to about 50,000lb. a year, of the value of one million francs, exclusive of the value of wigs and curls which were set down at another half a million francs. That which is esteemed the best is obtained from the country-women, who wear their hair uncovered, and never curled or much combed. The north of France furnishes the best, but when the crop of Brittany and Normandy is insufficient, the hair collectors invade the central departments, and return to Paris twice a year to effect their sales. The hair of the females in the North of France is finer and more supple, but that of the centre of the empire best retains curl.

Human hair is an article of commerce in many countries, young women selling their tresses for trinkets and dresses. A head of hair weighs from ½lb. to ¾lb. Its wholesale price is from 30s. to 60s. per lb. The light coloured and most valuable hair comes from Germany and the Scandinavian States. The darker shades are supplied by the female peasants of France, from whom the spring harvest of hair is stated to average 200,000lbs.

The average weight of a French head of hair is five ounces, Italian six ounces, German ten ounces; but the German hairs seldom come to market in their original condition, being mixed together to conceal the bad colours and inferior qualities. Commercially a head of hair is only the piece which forms the knot at the back of the head; that which grows on the front is seldom clipped, as it is always much shorter than the back hair, and to cut it would be a disfigurement.

The preparation of hair into a state suitable for the wig-maker is intricate, and in the hands of a few manufacturers. Some idea of the time and labour bestowed upon it may be gathered from the fact that the price of the raw material is increased from 300 to 500 per cent. even before it passes into the hands of the wig-maker.

So distinct has Nature made the various nations of the earth that the hair of the inhabitants of different countries can be easily distinguished by the manufacturer; even where the heads of hair are made to resemble each other externally, the workmen can, it is stated, by the odour, distinguish the products of each country.

In the 'Book of Costumes by a Lady of Rank.' we find the following :—"The peruke, or at all events false hair, was much used by the ancients. It is supposed that the perukes then worn were made of painted hair glued together. An account is given of that worn by the Emperor Commodus ; it is described as having been powdered with gold, and previously oiled and perfumed, to cause the gold to adhere to it. In the British Museum may be seen a peruke, found in the Temple of Isis, at Thebes, the curling and arranging of which would puzzle many a modern coiffeur. It is of a large size, and each ringlet is arranged with the greatest nicety; apparently the Theban perruquiers possessed a secret unknown to modern *artistes* in *wigology*—that of preserving the curl in the hair."

In Planché's work on British Costumes, it is stated that when Henry I. was in Normandy in 1104, a prelate named Serlo preached so eloquently against the fashion of wearing long hair that the whole congregation was cropped. This was followed by a royal edict prohibiting the wearing of long hair ; in the next reign, that of Stephen, the old fashion was revived ; until in 1139 it received a sudden check, and cropping was again the order of the day. But this reformation was of short duration,—scarcely had a year elapsed, before the people returned to their former follies, and such especially as would be thought courtiers permitted their hair to grow to such a length that they resembled women rather than men. Those to whom Nature had denied abundance of hair, supplied the deficiency by artificial means. Wigs, therefore, may date in England from the time of Stephen.

In Ellis's Letters, we read, among other items, of the wardrobe of Queen Elizabeth, the following :—"One cawle of hair set with pearls in number 43."

In the reign of James I., the king set the fashion of a "love-lock," which was a curl on the left side considerably longer than the rest. Nothing in the annals of hair, of wigs or of periwigs caused such a consternation among quiet, staid people as did this unfortunate "love-lock."

In the time of Charles I. and Oliver Cromwell, the Puritans wore their hair so short as to scarcely cover the ears, and thus marked their sense of the "loathsomeness of long hair." The Royalists pursuing the contra extreme, left their hair as long as nature would permit ; and those to whom flowing locks were denied, supplied their place by wearing a wig, a fashion which after the Restoration flourished greatly. In the reign of Charles II. the periwigs attained an enormous size, and the "Heartbreaker," a long lock of hair worn by the ladies, corresponding with the "love-lock" worn by the gentleman, was introduced.

From Samuel Pepys' Memoirs we make the following extracts :—"1663, Oct. 30. Bought two periwigs, one whereof cost 60s., the other 40s. 1663, Nov. 3. Home, and by-and-bye comes Chapman, the

periwig maker, and upon my liking it (the wig) without more ado I went up, and then he cut off my haire, which went a little to my heart at present to part with it ; but it being over, and my periwig on, I paid him 3*l.*, and away went he with my own haire to make up another of ; and by-and-by went abroad, after I had caused all my maids to look upon it, and then concluded it did become me." "1664-5, March 13. This day my wife began to wear light-coloured-locks, quite white almost. 1666, May 30. Being come now to an agreement with my barber to keep my periwig in good order at 20s. a year."

In the reign of James II. and William and Mary, periwigs became more monstrous ; the full-bottomed wig was worn by the learned profession and those who affected particular gravity. Farquhar, in his comedy of 'Love and a Bottle,' written in 1698, remarks that "a full wig" is imagined as infallible a token of wit as the laurel." Wigs of smaller dimensions called "nightcap-wigs," the "campaign major," "bags,' and the "riding wigs," were worn.

The most striking novelty of the time of George I. was the "Ramilies" tail, which was a tail plaited to the wig with an immense bow at the top and a smaller one at the bottom. The pigtail, that favourite ornament of sailors in later years, first appeared in the reign of George II., and it banished the Ramilies tail and tie. Marie Antoinette invented a coiffure in which were represented "hills, and enamelled meadows, silvery rills and foaming torrents, the well-trimmed garden and the English park." The servants of our nobility now seldom appear in wigs, unless on state occasions. In our time false hair has a very different office to perform, and by the skill of our artists in that commodity we are enabled to wear that article so as to deceive almost our very selves.*

Horsehair.—Though in nearly every country horsehair is collected, the chief sources of supply are Russia, South America, and Prussia. The importation into England amounts annually to about 1,450 tons, of the value of 152,000*l.* We get some good long tail hair from Russia—other qualities long, medium, and short from the River Plate.

The forensic, theatrical, and coachmen's wigs are made of horsehair, but these are fast getting into disuse ; the latter are sometimes made of goat's hair.

Horsehair is used on the helmets of the Horse Guards. It is made into ropes and wigs, even the learned lawyer is obliged to rob the poor Siberian horse for his wig. Horsehair shirts were formerly worn for the health of the soul, but gloves of the same material are now used for the health of the body. False tails of horsehair are made for the use of those horses which are deficient in that respect. Fishing lines are occasionally made of horsehair.

A queue, or tail of horsehair, suspended at the end of a pike, ter-

* Jury Reports, Exhibition, 1862.

minated by a gilded pennant, is the Turkish standard, or emblem of authority. Commanders are distinguished by the number of horse tails carried before them, or planted in front of their tents. Thus the Sultan has seven, the Grand Vizier five, and the Pasha three, two, or one. The usage of these tails is of Tartaric origin.

Hair thread and hair sacks are made in Romalia and Anatolia. For upholstery purposes, Ohio hogs' bristles are used for stuffing in the United States, and it is possible that this kind of hair sometimes gets mixed with the description designed for mattresses, &c. The process of manufacturing horsehair is as follows:—From the bales it is thrown into a 'picker' making 800 revolutions per minute, and then twisted into ropes by machinery, to make it curl. The next process is to boil it, that it may be thoroughly cleansed, for which purpose it is put into vats, heated with exhausted steam from the engine; this done, it is thoroughly dried in an oven. The ropes of hair are then ready to be picked into pieces for use.

The short hair is serviceable after curling, for stuffing chair seats, cushions, sofas, mattresses, &c. The long hair for weaving into seating and covering; and the middle lengths for brush-making in lieu of bristles. In Sicily cheap and rough ordinary paint-brushes of horsehair are sold as low as a farthing to a penny each, and rough-made clothes-brushes at 8d. Light horsehair can be dyed of various colours, but as there is only a limited supply of the pure white, some difficulty would arise in obtaining the raw material.

Hair-seating is wove by hand, every hair being introduced singly. It differs in this respect from most other woven fabrics, in which there is uniform and continuous supply of material, thereby permitting the application of steam power. In hair-seating, the weft being in detached pieces, it has been found that power-looms cannot be advantageously employed.

At the South Kensington Museum, in the Animal Collection, there are some interesting specimens of damask hair cloths made by Mr. E. Webb (Worcester), and Messrs. S. Laycock and Sons (Sheffield). Among these are fancy green striped hair seating, plain grey satin ditto, orange damask figured, scarlet damask, figured black diaper damask, plain black satin hair, &c. In some of these specimens a variety of damask patterns or designs are introduced by the application of the Jacquard loom, and also diversity of colours.

Among the various other purposes to which horsehair is applied are for making crinoline or ladies' petticoats, mixed with cotton; for bags for pressing apples, cloth for straining purposes by brewers, oil-refiners, &c., for rope, for socks or soles for lining boots and shoes, for brush-making, &c.

Formerly the warps of hair seating were made exclusively of linen yarn, but of late years, cotton has been extensively used on account of its softness, as it produces hair cloth of more pliable texture, and of smoother and more even surface.

Pig's Hairs or Bristles.—The stiff glossy hairs growing on the back of the hog or wild boar, which are in great request by shoemakers, saddlers, and brush-makers, are chiefly imported from Russia, Prussia, and Germany. The sources of supply will be seen from the following imports in 1861 :—

	lbs.
Russia	1,644,751
Prussia	21,906
Hanover	20,338
Hamburg	159,184
Holland	16,333
Belgium	84,038
France	37,797
United States	40,658
Other Countries	11,875
	2,036,880

The exports from Russia were formerly larger than they are now, but many substitutes have been brought into use for brush-making.

The imports from 1820 to 1833, ranged from 1,178,346 lbs., the lowest to 2,320,993 lbs. ; from 1835 to 1841, the imports were much about the usual average, namely, from 1,200,000 to 2,000,000 lbs.

The imports since have been as follows :—

Year.	lbs.	Year.	lbs.
1842	1,732,739	1852	1,953,488
1843	2,020,435	1853	3,237,059
1844	2,132,300	1854	1,807,765
1845	2,412,267	1855	179,260
1846	2,234,782	1856	2,876,838
1847	1,547,981	1857	2,644,802
1848	2,064,739	1858	2,055,596
1849	2,504,676	1859	2,595,926
1850	2,305,685	1860	2,534,217
1851	2,238,710	1861	2,036,880

The hair of pigs is used for stuffing chair seats and other upholstery purposes in America, either alone or mixed with horse hair. As the supply of bristles from wild hogs cannot continue on the same scale, our manufacturers have began to tax their ingenuity for other materials for brushes—various strong vegetable fibres have been brought into use, and the last invention is metallic dents or fine wire teeth for brushes.

A writer in 'Household Words' on this subject, observes :—"This brush question may be said, figuratively and literally, to bristle up before us in greater importance than most persons would imagine. What with the wax-ends for our Crispins, and the materials for our brush-makers, the demand for bristles is quite enormous. Only think of our importing more than two and a half million pounds of bristles every year

irrespective of those which grow on the backs of true-born British hogs! Why it is that a hog's bristle is more useful for such purposes than the hair of horse, ox, or sheep, a microscopic examination would possibly reveal; but of the fact itself there can be no doubt. Those countries which rear most hogs and make fewest brushes, can sell most bristles to their neighbours. Russia is such a country. Barren as the region is, it has immense forests of those trees in which, or rather under which, hogs delight to pick up a living. There are large establishments, too, in which oxen are slaughtered for the sake of their hides and tallow; and there are nice pickings in such places for the porcine tribe—the hog being a sort of optimist, finding good in everything. The good feeding not merely renders the hog fat, but the fatness renders his bristles susceptible of easy extraction. The bristle harvest is no small affair. Like the hair harvest in France, it is a grand time when the agents come round to collect the crop. What sort of prices the agents give, is a mystery we are unable to solve; but the bristles are conveyed by these agents to the great fairs held periodically in Russia; and at these fairs merchants from St. Petersburg and Odessa make their purchases. The cropping and transporting, and selling, are so managed that, if possible, the cargoes shall be shipped off for foreign export before the Baltic and the Black Sea become frozen over. The bristles, varying from three or four to nine or ten inches in length, vary much in quality; the white are better than the yellow and the yellow better than the black; the wiry are better than the limp; and the moderately long are better than the very long. The bristles are tied into bundles, and the bundles are packed into casks containing four or five hundred pounds weight each. Our brush-makers are sometimes indebted to Westphalia, whose hogs can afford bristles as well as hams; and sometimes to Australia, whose forests afford abundant hog meat; and sometimes to France and Belgium, which supply bristles in limited quantity and fine quality; but Russia is the great source of supply.

"Russian and Polish hogs are not more cleanly than other hogs. Their bristles are dirty and piggish, and require much cleansing. First of all, in preparing them for the market, they are assorted into colours and qualities—the blacks, the greys, the yellows, the whites, and the lilacs; and then they receive a thorough good dressing. The root-ends are carefully kept together; the long are separated from the short, and the bristles are combed and combed and combed, again with a kind of wool-comber's implement, until they become as sleek as may be."

Manufactures from Hair.—Brushes.—This branch of industry belongs more to the useful than to the ornamental, and is annually increasing in importance, as civilization advances and education induces that self-respect, one of the first objects of which is cleanliness.

From the peer to the peasant, there is seldom to be found any one who does not indulge in the luxury of the hair-brush; and although the fashion which the 1851 Exhibition thoroughly introduced among us,

threatens ere long to throw into disuse the once almost universal shaving-brush, the brush trade must always be one of magnitude, for no dwelling, however humble, is complete without the use of the paint-brush, or kept in order without the broom and the scrubbing-brush.

The brush trade of the United Kingdom finds employment for a large number of people: its various branches are distinct, the workmen of one branch being seldom employed upon any other. The brush-makers and bristle assorters number 2,300 men, of whom 1,500 belong to a trade union, while 800 are not members of this society. The painting-brush-makers number 80 men, of whom 72 belong to a trade union, and only 8 are not members of this society. About 400 hands are employed in making bass brooms for sweeping streets, areas, etc.

It would be difficult to ascertain correctly how many men and women are employed in the other branches of the trade, such as—

Fancy hair-brush making.
Bone and ivory brush making.
Artists' and grainers' brush making.

The amount of the home trade in brushes cannot be ascertained, but the returns issued by the Board of Trade show that the exports of brushware and brooms have been as follows:—

1853	43,635	1858	£39,408
1854	45,284	1859	42,570
1855	26,307	1860	41,898
1856	37,041	1861	37,986
1857	43,915		

And the imports of paint-brushes have been—

1855	£824	1859	£1,329
1856	968	1860	1,407
1857	1,548	1861	8,423
1858	1,153		

Whilst, however, the demand for brushes is increasing, the supply of bristles, which is the material chiefly used in their manufacture, is slowly but surely decreasing. Fifty years ago excellent bristles were collected in England and Ireland; but the present breed of pigs in the United Kingdom produces no bristles fit for brush-making.

Until the year 1816 hair brushes were made upon the same principle as clothes-brushes are now made—the surface of the bristle being flat or even; but in that year a simple invention was patented, the object of which was to insert the bristles of hair-brushes in an uneven or spiral form, in order that they might penetrate the hair. This patent was upset on the plea of insufficient description; the process is now almost universal, an even hair-brush, except for smoothing the hair, being seldom made.*

* Mr. Kent, Jury Reports, Class xxv. Sect. B.

Cow Hair is in this country chiefly used by plasterers for mixing with mortar to make it adhere to walls. It has lately been made into a kind of waterproof bituminous felt, to line damp walls, to place between partitions, to prevent draft or deaden sound, for roofing, for sheathing ship's bottoms, and for clothing boilers and pipes of steam engines.

In Sicily it is used for stuffing sofas and chair cushions, the price locally being about 4*l.* per cwt. Carpets of cow hair are common in some parts of Germany, selling at about 10 Prussian dollars each. Cow hair socks are made by the peasantry in the interior of Norway. Cow hair rope is used in paper manufactories, and occasionally for other purposes. The supply of cow hair is principally obtained at home, but about 20,000 cwt. is imported chiefly from Germany and France, worth about 5*l.* the cwt. This is probably cow-tail hair, which is used for stuffing furniture in the same way as short horsehair. Wet cow hair is sold at tanneries for about 2s. 6d. the bushel, and is afterwards dried and the lime beaten out. Cow hair is sold here in packs of 240 lbs.

Goat's Hair or Mohair, is the woolly hair or fleece of the Angora goat, (*Capra Angorensis*), a native of a small district of Asia Minor. The silky hair of this goat, which hangs in long curls, is invariably white, the average length of the staple being 5 to 6 inches. The fleece is called locally "Tiftik." When clipped annually in April or May they yield from 1½ to 4 lbs. of wool or hair according to age. The demand for this wool is only of recent origin. In 1848, mixtures of it, with alpaca, silk, cotton, and worsted, came into use for ladies dresses, and for a heavy material known by the name of flushing, for gentlemen's overcoats; in which article the goat's wool was thrown to the surface, so as to resemble, to some extent, the original fleece, except in colour. The principal consumption of mohair now, is for mixing with other animal fibres for ladies' dresses, light overcoats, coat-linings, lustres, tabinets and fringes, umbrellas, &c.; and also for spinning into yarn, which is exported to France and Belgium, chiefly for the manufacture of Utrecht velvet, for the coverings of furniture, linings of carriages, plush, &c.; and to some extent for a cheap imitation of black silk-lace, braid button coverings, and other articles.

Mohair is perfectly free from "underdown," unlike the Thibet or Cashmere fleece, which has a downy covering on the pelt, with long coarse hair, or kemps at the top, the separation of which is both tedious and expensive. In sorting mohair, about one-sixth part is taken out, which is too short in the staple and not applicable for combing purposes, and in the process of combing, about one-fifth part is made into "noils;" these, together, are bought by woollen manufacturers, for making into cloth of different kinds and other materials.

Late accounts state that the animals yielding the fleece have been so multiplied that the product has realised about 1,000,000 okes, nearly 3,000,000 lbs. But the price having greatly risen in England from its

still more extended use in new stuffs, for which it is found adapted; the cost at Angora has advanced 30 to 50 per cent. over that of previous years, being quoted at 28 to 40 piastres per oke, metallic money, about 2s. 3d. to 2s. 4½. per lb.

The common domestic goat of Thibet (*Capra changra*), is distinguished by the uniform abundance of its long flowing straight hair, which descends below the knees and hocks, and covers the whole animal pretty uniformally. This and the Kirghis breed are closely allied to the celebrated shawl goat, and their exquisite sub-fleece, or abundant outer coat, might be turned to good account, if not immediately, yet after crossing the breed with some nearer appropriate stock, such as the Angora or Whidah. The natives of Thibet manufacture ropes, caps, and coarse overalls out of the long hairs, and a fine woollen cloth out of the sub-fleece, mixed occasionally with the wool of the Silingia sheep.

Twenty years ago, the imports of goat's wool from Turkey were under 4,000 bales, of 2 cwt. each; now, the average is nearly four times that amount. In 1861, the imports were 3,334,748 lbs., worth about 2s. 8d. a lb., and of the gross value of 456,542*l.*

The Cashmere, or shawl goat, so highly prized for its fleece, is decended from the goat of Thibet, which pastures on the Himalayas. When picked, the wool is soft, rich, and lustrous; indeed, superior to any lambs' wool that possibly can be produced, and afterwards divisable into two or three qualities. The kemp is a coarse and harsh straight hair, and when the animal has not been shorn for some time the spiral points out-top the rest of the fleece. Goats producing the shawl wool are common in the countries west of the Caspian.

The first step in the process of converting the wool into a shawl, is to submit it to a delicate and tedious manipulation for the purpose of extracting the long hairs. The wool is next carefully washed in a mixture of rice-flour and water. It is then hand-spun by the women, and made into woollen thread. This thread is inspected by experienced persons, and divided into qualities of fine and coarse, to be used for shawls of superior or inferior qualities. The yarns intended for white shawls are sent to the bleacher, and, by a peculiar method, are rendered beautifully white. Those for coloured shawls are handed to the dyers. The Cashmerian dyers profess to use sixty-four different tints, and obtain some of these by extracting the colours from European woollens imported expressly for the purpose. After being dyed to the proper colour, the yarn is again carefully washed. It is next given out to the weavers, to be made into pieces of cloth for scarfs, handkerchiefs, and square shawls of all sizes. Next comes the preparation of the warp and woof for the border; the warp being of silk and the woof of wool. We have now got the cloth of the shawl, both middle and border. Next comes the important work of embroidering. Connected with this branch of the manufacture, there are persons to design patterns to particular shawls. When a shawl of ordinary size

and pattern is to be embroidered, three men are appointed to the work, and are engaged upon it for three months. But when a rich and rare pair of shawls is to be embroidered, the men will be eighteen months and even two years, in finishing the elaborate patterns which have to be produced upon the cloth. The embroidered borders of the finest shawls are made separately, and are afterwards so cleverly attached to the middle that the eye cannot detect the junction. This is the most curious and ingenious part of the fabrication. A lady's shawl of the finest and most costly description, is, in fact, nothing less than a piece of cunningly devised and delicately jointed patchwork, setting at defiance the most rigorous scrutiny to discover a seam. The labour required to produce a first-rate Cashmere shawl is immense, and this will account for the fact that a shawl will cost sometimes 600*l.* or 700*l.* before it passes the rocky portals of the valley of Cashmere. These shawls always form part of the presents made to persons who visit the courts of Indian princes.

Thirty ounces of wool, valued at 8s. or 9s., is all that is required in the manufacture of a shawl a yard and a half square. The immense cost of these shawls in the European market is, therefore, a subject of much wonder to those unacquainted with the history of their manufacture and transportation. A heavy duty is first paid upon the wool; then a further tax upon the yarn when it reaches the bazaar; and the manufactured shawl, when taken to the custom-house is further taxed according to the discretion or caprice of the collector. If intended for the European market, the shawls have to pass through the ordeal of still heavier exactions. They must be borne from Cashmere across the Indus to Peshawur, on the frontier of Afghanistan, a journey of twenty days, upon the back of a man, the road being often impassable by camels or mules, deep precipices are crossed upon suspension bridges of rope, and perpendicular rocks climbed by means of wooden ladders. At various stages of this journey taxes are exacted, amounting to 36s. or 42s. in the aggregate. From Peshawur to near the confines of Europe, tribute is paid at many custom-houses; but this forbearance of the marauders of Afghanistan and Persia, and of the Turkomanic hordes, must also be purchased at a high price. The precious burden is thus conveyed to Europe over the Caucasus, and through Russia, or as is now frequent, through the Turkish provinces to Constantinople.

The Rocky Mountain goat (*Ovis montana*), of North America, has a fleece almost as valuable as that of the Cashmere goat. It has a shaggy appearance, in consequence of the protrusion of the long hair beyond the wool, which is white and soft. It has been named by some authors the *Mazama Americana*. The pile is of two kinds, one long and coarse like that of lamb's wool, the other like the under coat of the poodle dog. It is thought that this goat might prove a valuable addition to the fleece-bearing animals now domesticated, for the pile would improve by the care and attention that could be bestowed upon

the animal. The fleece of this animal, exhibited by Mr. E. B. Roberts, may be seen in the Fur Court, South Kensington Museum.

The hair of the common goat, which is in colour mostly grey, brown, and black, is used for very low-priced carpetings, &c. Tents and baling cloths are made of it, in the East. Several hundred tons of goat's hair are now imported annually from Ireland to mix with low carpet yarns.

Camel's Hair.—The hair obtained from an ordinary camel weighs about 10 lbs., but its colour and abundance depend entirely upon the particular species of camel, and the climate which he inhabits. It is sometimes finer than silk, and is always longer than sheep's wool. The camel annually casts its hair in the spring. The hair of the Arabian camel is thin and whitish; that of the Bactrian camel thicker and darker coloured. The hair is principally imported into this country for the manufacture of fine brushes or pencils for drawing and painting. It is exported in considerable quantities from Smyrna, Constantinople, and Alexandria, and is largely used by the French in the manufacture of hats. It may be obtained in many parts of Africa and Asia. In the East it forms an important article of commerce, and is extensively used in the arts. When spun it serves for wrappers for merchandise, and the fabrication of the tents, shawls, and carpets of the Arabs. A coarse kind of clothing, almost impermeable to rain, is made for camel drivers and shepherds, and as a wrapper for merchandise long exposed to wet in heavy rains. In Persia more valuable manufactures are produced in cloths of different colours, and fine stockings, of which white are the highest prized. The Tartar women of the plains make a kind of warm, soft, and light narrow cloth from the hair of the Bactrian camel, preserving the natural colours. The hair for sale is divided into three qualities—black, red, and grey. The black is the dearest, the red the second quality, and the grey is only worth half the value of the red. The import of camel's hair into England, which, but a few years ago, only amounted to a few thousand pounds, has greatly increased of late, as much as 322,000 lbs. having been received in 1861.

Porcupine's Quills.—In certain parts of the bodies of some animals, hairs sometimes become remarkably developed and strangely modified, as in the case of the hedgehog or porcupine, where they assume, over the greater part, but not the whole of the body, the form of spines and quills. Those of the porcupine (*Hystrix cristata*) come into commerce, and are rather expensive. They are used for penholders, work-piercers, or eyeletteers by ladies, for tooth-picks, fish-floats, making fancy boxes, and other ornamental purposes.

The hair from the tail of the elephant is stiff and smooth, of glossy black colour, 14 to 15 inches long, the size of small iron wire, solid, of a horny nature, very tough, and will bear to be doubled and tied without breaking (though some are brittle), and therefore useful for making

braids to fishhooks ; neat ornaments for rings, brooches, &c., are made of them in parts of Africa and Asia.

Coney Wool, or the hair of the rabbit and hare, is shaved off by a mechanical process. The vast number of these prolific rodents in Spain and other countries, afford a large supply of this kind of hair, which is put to the same uses as down.

Badger hair is used for shaving-brushes, and for graining tools ; sable and hog's hair are also used for the latter purpose.

The highest quality of artists' brushes, which formerly were imported into England, are now manufactured by the artists' colourmen of London, and exported freely.

A rope-like girdle of opossum hair is worn by the aborigines of Western Australia, partly by way of ornament, passed many times round their waist. But it serves also for other useful purposes. In it are carried the kadjo or hammer, the dowak or throwing stick, and the kyli or boomerang. It is tightened or loosened like the belt of famine of the Africans, according to their supply of food, and it answers for string occasionally, or for rag in the case of a cut or wound ; and small articles, such as the teeth and barbs of spears, are frequently deposited in the folds of it.

The following is a summary of the value of the hair of different kinds imported into the United Kingdom in the year 1861 :—

Quantity.	Value. £
Cow hair, cwts., 21,639	103,229
Goats' hair, lbs., 3,334,748 . . .	456,542
Manufactures of ditto	347,217
Horse hair, cwts., 29,033 . . .	151,800
Camels' hair, lbs., 321,897 . . .	8,047
Manufactures of hair	16,724
Human hair, lbs., 15,672 . . .	6,268
Bristles or hogs' hair, lbs., 2,036,880 .	251,191
	£1,341,018

ON THE ODOROUS SUBSTANCES SENT BY THE FRENCH COLONIES TO THE INTERNATIONAL EXHIBITION OF 1862.

BY EUGENE RIMMEL.

The perfumery trade in France, has of late years considerably increased, and has become one of the most important branches of the industry known under the name of "articles de Paris." The exports of perfumery, which from 1827 to 1836 did not rise on the average to more than six million francs per annum, had in 1860, according to the official reports, attained the sum of thirty-one million francs, and if we add to this amount that of the interior consumption, we arrive at a very considerable total of production.

It becomes then interesting to learn the sources from which the substances are derived to sustain this industry. For a long time Provence furnished her *extraits de fleurs*, and essences of aromatic herbs, but perfumery also requires the aid of the odorous substances which are diffused in such wide profusion in tropical climates. All these products, with some exceptions, are found in the French possessions, and we will now offer a few words of notice upon the splendid collections forwarded to the late Exhibition by the Ministry of Marine, and the Ministry of Algeria.

Martinique and Guadaloupe produce a great variety of odorous substances. Cloves, nutmegs, and cinnamon are equal in quality to those of the East Indies, but the culture is extremely limited, and is not sufficiently large to make them an article of export. The *graine d'Ambrette*, or musk-seed (*Abelmoschus moschatus*), the tonquin bean (*Dipterix odorata*), and Vanillon or Vanilloes (*Vanilla Pompona*), of which Guadaloupe alone can furnish a thousand kilogrammes, are very nearly the only products which perfumery obtains from the French West India Islands.

We remarked the following specimens, however, which might advantageously be employed in this industry, if they could be procured in sufficient quantity, the *canang odorant* (*Uvarid Æthiopica*), which is known in Senegal under the name of boulon pepper, the seeds of the *bois d'Inde* (*Myricia pimentoides*), and the Jamaica pimento (*Pimenta vera*), both of which have a very agreeable aromatic odour, and lastly the Ben-oil seed (*Moringa pterygosperma*), which produces an extremely fine, clear, sweet, and fluid oil, qualities very valuable in perfumery.

This oil was formerly much sought after by perfumers, but it is now little used on account of its being so difficult to procure genuine. It appears, however, that this tree grows wild in the Antilles, and if the colonists would take the trouble of gathering the seeds and extracting the oil from them, it would be a sure investment. Bay rum is also a product of the Isles, and could be introduced into France with advantage. They make use of it largely in North

America as a toilet water for washing the head, but in Europe it is almost unknown.

Some use might also be made of the odorous flowers that these Colonies produce, such as Frangipane (*Plumesia vubra*), Cassie (*Acacia farnesiana*), and Henna (*Lawsonia inermis*), a dye-plant which is used by the women in the East to tint their finger-nails, the soles of their feet, and sometimes their hair. Guiana offers nearly the same products as Martinique and Guadaloupe. The Vanilla which is found wild in the woods, differs a little from the Vanillon. The pod is longer and more slender, but it has not the fine flavour of the Mexican. The "*bois de rose femelle*," (*Licaria odorata*), has a delicious odour which approaches to bergamot, but being extremely fugitive, it is necessary to pulverise the wood at the moment of distillation. The essence drawn from it, which has begun to be employed by the Parisian perfumers, would fetch a remunerative price if it were sufficiently known. The fat extracted from the oil nutmeg (*Virola sebifera*), would form a good base for toilet soaps, and the resin of *Icica heptaphylla* might be employed to make pastilles for burning.

Senegal did not send any odorous materials, although they ought not to be wanting; but we remarked a very varied collection of fatty substances which could be used in soap-making. Besides Palm oil, which is consumed in large quantities, one might also be found, the Dika, a solid oil, obtained from the seeds of the *Mangifera Gabonensis*, which appears very unctuous, and is offered at 150 francs the 100 kilos., free at Rouen, which is a very advantageous price for manufacturers. Henna, of which we have already spoken is also among the products from Senegal.

Réunion exhibited in the first place a magnificent collection of vanilla, contributed by thirteen exhibitors, of whom four received medals. This culture is of very recent date, for in 1849 it scarcely existed, whereas, in 1860, it produced more than 6,000 kilogrammes. We cannot congratulate the colonists too much on occupying themselves in propagating this excellent aromatic, which forms an agreeable condiment as well as a precious perfume. The vanillas exhibited were very fine; they had the length, the bulk and the penetrating odour of the best Mexican, and will, in course of time probably supplant the latter for French consumption. We also find that Réunion is overrun with aromatic plants and substances with which the perfumery trade has hitherto been supplied from the East Indies or the Eastern Archipelago.

Among these are the clove, cinnamon, nutmegs, citronella (*Andropogon citratum*), vetivert (*Anatherum muricatum*), coriander, fennel, fenugreek, and cardamoms, substances which are all employed in a natural state, or in the form of essences, in perfumery. A specimen of the leaves of the faham (*Angræcum fragrans*), struck us as possessing a very agreeable odour, which must be still better when fresh. From French India notwithstanding the narrow compass of its territory, were displayed a great

number of specimens of the riches of that country, amongst which we remarked the flowers of the cassie and lavender, vetivert, aniseed, cumin, nutmegs, ilipé oil, which could be employed in soap-making, and lastly, the ben-oil seeds, which we have already noticed from the Antilles.

In the extensive collection which Admiral Charner sent from Cochin China, were fine specimens of benzoin, and an aromatic bark (*Alyxia aromatica*), which could be employed in perfumery. New Caledonia offers a specimen of Erromanga sandal wood (*Santalum Austro-Caledonicum*), which is superior to that of other countries, owing to the strength and fineness of its odour. It is to be regretted that this tree is being ruthlessly destroyed in the colony, as the wood is of such great use in perfumery. We noticed some other interesting specimens, among which were *Ocotea*, a bark possessing an odour very nearly approaching to sassafras, and the leaves and essence of cajeput (*Melaleuca leucodendron* et *viridiflora*). It appears that the trees belonging to the family of *Melaleuca* are very abundant in New Caledonia. They are equally so in British Australia, which exhibited a very fine collection of essences extracted from the leaves of several *Melaleuca* and *Eucalypti*. Those essences, although a little coarse, would do to perfume common soaps, and might in the course of time prove a fresh resource for the colony, and a great saving to manufacturers; for they are yielded in such abundance, that they cost very little beyond the expense of distillation. The essential oil of *Eucalyptus amygdalina*, for example, exhibited from the English colony of Victoria, costs less than one shilling per lb. and its odour, which is a singular mixture of lemon and nutmeg, is so powerful that three ounces are sufficient to perfume eight pounds of soap. There is every reason to believe that the same kinds exist in New Caledonia, and in that case the extraction of the essence would become a profitable speculation for the colonists.

To return to the French colonies, St. Marie de Madagascar sent cloves, nutmegs, cinnamon, faham, citronelle and vetivert, and a very curious substance called Pulpe de Ravensara (*Agathophyllum aromaticum*). Tahiti exhibited a fine specimen of vanilla, the first that this colony has produced, and tamanu oil, from the fruit of *Calophyllum inophyllum*, which might be made use of in perfumery.

It remains now to speak of Algeria, which bids fair soon to rival Provence for the manufacture of the finer materials of perfumery. In fact, its magnificent climate admirably favours the culture of the principal flowers which are employed in this industry, such as the rose, jasmine, orange, cassie, tuberose, and jonquil. The violet alone does not find there that shade which it requires; but the geranium, lavender, thyme, rosemary, and other aromatic plants grow in wild luxuriance. The citron-tree and all its varieties, such as the bergamotte, bigaradier, &c., the fruits of which afford such precious essences for perfumery, are equally abundant. A dozen exhibitors sent specimens

of odorous substances ; but it is to be regretted that they were not more complete, for they did not comprise all the different kinds manufactured in Algeria. Amongst the new products we remarked a water distilled from verbena (*Aloysia citriodora*), wrongly named citronelle ; but we should have liked to see by the side of it the essence which was probably produced by the same operation.

THE TRADE IN NUTS.

BY P. L. SIMMONDS.

Of the commerce in fruit in this country, that in nuts of various kinds forms a very considerable share, furnishing a carrying trade of at least 10,000 tons. The average value of the foreign nuts sold annually amounts to upwards of 400,000*l*. There are are but five kinds specified in the official trade returns—almonds, chestnuts, cocoa-nuts, small nuts (hazel nuts), and walnuts. But there are various other kinds forming articles of commerce in a smaller degree, among which may be mentioned Brazil nuts, pistachio nuts, cashew nuts, sourai and sapucai nuts, hickory, and peccan nuts.

We present a summary of the imports of foreign nuts during the last nine years, compiled from the Board of Trade Returns, and shall proceed to furnish some few details respecting each.

	1853.	1854.	1855.	1856.	1857.
Almonds, sweet, cwt.	21,743	23,561	24,581	34,043	33,465
„ bitter, „	6,352	5,910	7,366	9,194	6,184
Chestnuts, bushels	35,300	31,809	64,756	67,270	77,197
Cocoa-nuts, No. .	1,388,774	1,730,963	2,217,350	1,879,388	2,129,993
Small nuts, bushels	148,680	243,458	256,396	254,415	200,900
Walnuts „	50,125	21,949	34,832	56,534	60,128

	1858.	1859.	1860.	1861.	Value in 1861.
					£
Almonds, sweet, cwt.	33,176	24,619	19,638	29,307	158,976
„ bitter, „	8,370	10,125	7,361	7,517	16,168
Chestnuts, bushels	35,300	57,048	25,218	53,711	26,792
Cocoa-nuts, No. .	2,508,869	2,484,423	2,479,251	2,804,657	17,114
Small nuts, bushels	177,859	222.218	198,562	218,548	156,721
Walnuts „ .	56,468	68,363	52,090	71,699	27,453
					£403,224

In 1850 the following quantities of foreign nuts were sold in the markets of London and Liverpool :—

	London Markets.	Liverpool Imports.
Cocoa-nuts . . . . . No.	1,250,000	325,000
Black Spanish, Barcelona, Black Sea Nuts, &c. . . . . bushels	72,500	66,000
Brazil nuts . . . . . ,,	11,700	27,000
Chestnuts . . . . . ,,	26,250	3,000
Walnuts . . . . . ,,	36,000	2,000
Other sorts . . . . . ,,	8,000	3,000

A comparison of prices with those of seven or eight years ago, will show that the variations are considerable in some kinds, especially in almonds, which, as respects the sweet almonds, have nearly doubled in price. The price of chestnuts has risen fully 50 per cent. Cocoa-nuts, although the imports are so much larger, keep up in price. Walnuts are about the same, but small nuts have advanced in price.

Average Prices of Nuts.

	1854.			1861.		
	£	s.	d.	£	s.	d.
Almonds, Jordan, per cwt. . .	6	10	0	7	6	10
,, Spanish do. . .	3	17	6	0	11	7
,, Morocco do. . .	2	10	0	4	4	6
,, Bitter do. . .	3	0	0	2	9	0
Chestnuts, per bushel . .	0	6	9	9s. 3d. to 10s.		
Cocoa-nuts, per 100 . . .	0	14	3	8s. 11d. to 12s 5d		
Small nuts, per bushel . . .	0	10	0	13s. to 14s. 6d.		
Walnuts, per bushel . . .	0	7	6	6s. 9d. to 8s. 8d.		

The duties have varied as follows :—On 9th July, 1842, a duty of 1*l.* 6s. 3d. per cwt. was fixed on Jordan Almonds, and 10s. 6d. per cwt. on other than Jordan. On the 4th June, 1853, the duty on all kinds of sweet almonds was reduced to 10s. per cwt. Bitter Almonds were made free of duty on the 19th March, 1845 ; and Sweet Almonds in March 1860. Chestnuts and cocoa-nuts have been free of duty since 1845. Small nuts and walnuts, on which a duty of 2s. 1d. per bushel was levied in May, 1840, were lowered to 1s. per bushel on the 4th June, 1853 ; and have been entered free of duty since the 7th March, 1860.

Almonds.—The almond gives rise in France, Spain, and Italy, to a large commerce. Although there are a great number of varieties arising from cultivation, all are derived from the *Amygdalus communis.* There are, however, two well defined kinds of fruit, the bitter and the sweet.

The sweet variety of the almond was well represented at the late Exhibition in the French Court, by M. de Bec, Director of the Agricultural School of Montaurone, Bouches de Rhone, whose description of the principal varieties was recently published in this Journal.* The production of almonds is for Provence a very fertile source of revenue, as the quality of the product is excellent and the frost does not kill the blossoms. The ordinary varieties produced there are the Crombecs and other semi-hard kinds called Aberanes, Matherones and Molières sold generally in the shell; the Princesses, consumed in France, Belgium Holland, Germany, and Russia; the variety called Ladies, sent exclusively to the United States, and where the import of almonds is from 3 to 5 million pounds a year; and the "flot" variety employed chiefly for confectionary and burnt almonds. This last kind is peculiar to Lower Provence, the best being grown about Aix. These are consumed entirely, in Paris, and double the quantity of these is sold over other sorts because they keep best.

The Jordan almonds which come from Malaga were formerly the highest priced of any, but those from France, from the care in cultivating good varieties, now fetch a better price. The imports of almonds into France in 1860 were 714,256 kilogrammes, and the exports 2,379,839 kilogrammes. In this country, although many kinds are now imported, we have chiefly clung to two varieties, known as Jordan and Valencia almonds. The Jordan almond is characterised by a longer, narrower, and more pointed kernel, about one inch long. The Valencia almond is somewhat shorter, and broad in proportion to its length. Nearly half the sweet almonds now imported, 11,000 cwt., come from Morocco, 11,000 cwt. more from Spain and Gibraltar, and about 2,000 cwt. each from Italy, Portugal, and France.

The bitter almonds, 7000 to 8000 cwts. in quantity, come almost exclusively from Morocco, chiefly from Mogadore. They are employed in the preparation of noyeau, macaroons and ratafia cakes. By the cook and confectioner they are used for flavouring, and are occasionally employed for medicines.

In France the fine almonds, as the Princesses, the Ladies, &c., are sold wholesale in the shell, and the hardshelled almonds also, the expense of breaking them being repaid by the value of the shells, which serve for fuel. Different varieties of almonds yield of course different proportions of kernel and shell. According to M. Arnaud, 16 decalitres of wild almonds in the shell yielded 16 kilogrammes of almonds; the same quantity of large green, 18 kilogrammes. Again 16 decalitres of "flots or trochets" gave 26 kilogrammes of almonds. The hectolitre of almonds in the shell weighs about 56 kilogrammes. The price varies, but the average a few years ago was for the Princesses 100 francs the

* See 'TECHNOLOGIST,' anti p. 223.

100 kilogrammes; for Les Dames 50 francs, for common almonds 25 francs, and for Wild, 18 francs.

Chestnuts.—Our foreign trade in chestnuts, the fruit of *Castanea vesca*, is not very large, scarcely ever exceeding 70,000 bushels. In 1861 it was 53,711 bushels, of which about 40,000 came from France, 10,000 from Spain and Portugal, and the rest from Italy. There is very little difference in the wholesale price, but the French chestnuts fetch about 8d. or 9d. the bushel more than those from other quarters.

The two most desirable varieties of this tree cultivated in France are La Chataigne verte du Limousin, which produces very large excellent nuts, of a rich creamy flavour and aromatic odour when roasted, that will keep a long time, and the tree of which preserves its leaves green much longer than any of the other sorts; and La Chataigne exaltade, the fruit of which is the best of all common chestnuts for the table; but, although the tree is low with spreading branches, it is such an abundant bearer that it soon exhausts itself. The best chestnuts are those which permit of being kept in a good state for several months. This is done by preserving them in layers of straw or in sand. In parts of France and Corsica the fruit is husked and dried, and then bears the name of Chataigne blanc. In France and Corsica they are made into flour for a porridge boiled with milk, or a kind of cake or pudding.

The large species of chestnuts grown in France and Italy are known by the name of Marrons. The best are those of Lyon and St. Tropez (a small town in the department of the Var.) Those of St. Tropez are divided into three sorts—common, good, and best, but these last do not include the marrons of first quality, of a very large size. They are gathered during the month of September. The usual modes of cooking chestnuts in France and Italy are boiling them in water with simply a little salt, or with leaves of celery, sage, or any other herbs which may impart to them an agreeable flavour; and roasting them in hot ashes or in a coffee roaster. They are also occasionally scorched before the fire, or on a shovel; but when thus prepared are not considered so good. In whatever way they are roasted, the French cooks previously slit the skin or shell of all except one; and when that cracks and flies off, it is an indication that the rest are done.

The principal countries in which the chestnut is employed as an important article of food are the south of France, Spain, and the north of Italy, where it serves in a great measure as a substitute both for potatoes and bread. In the island of Corsica, Tuscany, and several parts of Italy, there is a very large commerce in chestnuts. In these countries, especially in Corsica, as well as in Limousin and other places, chestnuts form the chief sustenance of the country people, as the grain harvests would be totally insufficient for their consumption. Bilbao, Bayonne, Libourne, Bourdeaux, Limousin, Berry, Perigord, the Rhenish Provinces, the Tyrol, Hungary, Moravia, &c., produce a smaller kind of chestnut. Chestnuts to the value of 834*l*, were shipped from Bilbao in 1860 to Holland and Bel-

gium. France exported in 1834 537,518 kilogrammes of chestnuts, of which 366,364 went to England, 21,339 to Belgium, and 46,437 to Algeria. But she imported in the same year 124,134 kilogrammes of chestnuts and chestnut flour, of which 86,665 kilogrammes came from Sardinia, and 35,183 from Germany. In 1860 the importation in France had risen to 2,293,003 kilogrammes, and the exports to 2,018,704 kilogrammes, of which 289,072 went to Algeria. These figures, combined with the amount of local consumption, which reaches to two million hectolitres, is an evidence of the importance of the trade in chestnuts to France.

Cocoa-nuts, which are now pretty generally termed coker-nuts in the trade, to distinguish them from the seeds of the *Theobroma cacao*, are becoming of increasing importance in commerce, and maintain high prices, in consequence of the value of the husk or coir as a fibrous material, and of the waste for garden purposes. They are even brought as dunnage in ships on the long sea voyage from Singapore, India, and Ceylon, where they are extensively grown. In Ceylon the cocoa-nut palm gives rise to a very considerable cultivation, and forms a most profitable investment from the value of the nuts for the oil and husk. They are brought chiefly to this country for sale to hucksters and retail dealers. Royle says that in Malabar 300 or 400 millions are produced annually. In Travancore there are from five and a half to six million trees, which produce on an average 80 to 100 nuts a year. Upwards of $2\frac{3}{4}$ million nuts are now imported here annually; the largest quantity are brought from Jamaica, British Guiana and Honduras, and some now come from the West Coast of Africa. Last year there was a considerable advance in the price paid for them. France imports about $1\frac{1}{4}$ million cocoa-nuts.

Hazel-nuts come into commerce under the general term of Small nuts; but included in these are sometimes Peccan and Hickory nuts from the United States. Of the imports of Hazel nuts in 1861, 177,142 bushels came from Spain, 30,315 from Italy, and 4,202 bushels from Turkey.

Hazel-nuts are the fruit of the wild bush of *Corylus Avellana*, unchanged and unimproved by cultivation. The fruit differs from that of the domesticated varieties only in being smaller, while the tree is more hardy. This plant, which is a native of all the cooler parts of Europe, Northern Asia, and North America, is the parent of the many varieties of nuts and filberts now cultivated for their fruit. The trade in hazel nuts is very stationary in this country, and the consumption does not vary greatly. In 1846, we imported, chiefly from Spain, 182,702 bushels; in 1847, 207,784 bushels; and in 1848, 150,022 bushels. In the last ten years the imports have ranged between 148,000 and 256,000 bushels per annum.

In trade, though both produced by the variety *barcelonensis*, the nuts are classed into two kinds: 1. The Spanish, which are the fresh

nuts coming from Gijon, that will not keep for any time, and are said to be coloured by the Jew dealers with the fumes of sulphur. They are sold at public sales in barrels of about three bushels each. The Barcelonas, which are kiln-dried and shipped from Tarragona ; the annual export from thence is said to be about 8000 tons. The trade in Hazel nuts in France is very inconsiderable, and only sufficient for local consumption.

The finest kinds called Avelines are brought to Paris from several quarters. The principal are those termed cadieres or corrupted into acadierses from the neighbourhood of Toulon. The nuts are of an irregular round and the shell hard. Other kinds come from Languedoc and Piedmont.

The nuts of the Constantinople variety (*Corylus Colurna*) are roundish and very hard ; 160,000 cwt. of these nuts are annually raised at Trebizond and Kuirasond. Large and very fine nuts of this species grown in the Crimea were shown in the Russian collection at the late Exhibition, priced at 69s. 3d. the cwt.

The Filbert is the fruit of the *tubulosa* variety of the *Corylus Avellana.* The term was originally applied to those kinds of nuts which have very long husks, but owing to the number of varieties that have of late years been obtained, this distinction, which was never scientific, appears to be nearly disregarded, and nuts and filberts are almost synonymous terms, excepting that the wild uncultivated fruits, and those varieties which most nearly approach it, are never called filberts. Filberts are mostly grown in Kent, where as much as 30 cwt. per acre has been raised on particular lands. In order to preserve filberts in a fresh and plump state, it is only necessary to prevent their parting with their moisture by evaporation. Burying them in heaps in the earth, putting them in earthen jars in a wine cellar, and covering them with dry sand, are all excellent plans. It is estimated that 1,000 tons of filberts are annually sold in this country.

The Cob-nut of Kent is a large, roundish prolific variety—*grandis*—of the ordinary Hazel-nut. The wild nuts of this country seldom reach to any size.

For walnuts we are chiefly indebted to France, whence we received 55,500 bushels in 1861, and from Holland 8,300 bushels of a rather better quality. France is an importer as well as an exporter of walnuts ; for in 1860 she received 2,153,289 kilogrammes, and sent away 1,471,000. The principal French varieties are those of Chatellerault, Ireguel, Aisne, Sarthe, Corréze, and Drome, districts long renowned for the excellence of their fruit. Those of the Dauphiny and Savain, however, represent a very considerable production.

Pistachio-nuts which had been heretofore only a secondary item in the exports from A'eppo, now find an extensive sale at 1,200 to 1,300 piastres the quintal. 1,250 cwt. were exported from thence in 1861 valued at 2,465*l.*—*Gardner's Chronicle.*

THE FURNITURE WOODS OF COMMERCE.

BY P. L. SIMMONDS.

The commerce in Foreign Woods carried on by this country is much larger than would be supposed by those who had not looked into the figures; and the vast quantities of timber, useful and ornamental, received, form a very interesting subject of inquiry. The timber of many countries is a most important item in its annual income, especially in Russia, Austria, Norway, Switzerland, Brazil, and also in British North America, India, Guiana, and some other of our possessions. The value of the woods of all kinds that we import is not less than twelve millions sterling, whilst about four millions more may be set down as the value of the home produce. These woods, as far as their economic uses are concerned, are divided into three classes:—

1st.—Woods of construction, useful for ship and house-building and other rough work.

2ndly.—Those suitable for cabinet and ornamental work, as tables, and other articles of furniture, pianofortes, &c.

3rdly.—Dye-woods, and many hard woods, used chiefly by the turner, carver, engraver, &c.

To the first class belong such woods as the fir, and indeed all the Coniferæ, if we except the evergreen cypress, whose beautiful colour and pleasing odour fit it in an especial manner to rank among the higher class of cabinet woods. To this division belong also the beech, ash, chestnut, poplar, and willow; while teak, oak, and plane-tree would seem to occupy a middle class, connecting this with the second, or more ornamental woods, among which are ranked mahogany, rosewood, walnut, maple, laburnum, mountain ash, box, &c.

It is to the Furniture Woods that we purpose confining our present observations, and chiefly to those received from foreign countries.

The importance of this survey will be better appreciated when it is stated that the annual value of the household furniture made in this country alone was, more than ten years ago, estimated at fifteen millions and has certainly largely increased since then, keeping pace with the wealth and numerous wants of the nation, and the progress of commerce. The computed value of the rough fancy hard woods imported in 1861 was 804,426*l.*, to which has to be added household furniture and cabinet ware, valued by the importers at 32,557*l.*; 769 pianofortes, of the declared value of 24,542*l.*, besides other items. This, then, forms the aggregate trade in which we are specially interested, quite exclusive of the large commercial trade in rough woods and furniture carried on by other European nations.

The foreign fancy and hard woods specifically enumerated in the official trade returns are very few, being only mahogany, rosewood,

maple, satin, walnut, ebony, and cedar, and a few such as box, barwood and camwood, brazilleto, &c., which are chiefly used for other purposes. There are, however, some very beautiful woods which, being scarce, are imported in but small quantities.

Oak, ash, elm, beech, birch, &c., are designated *hard woods;* whilst mahogany, rosewood, zebra, tulip, kingwood, satin, and other furniture woods, are usually sold under the denomination of *fancy woods.* From the most common description of pine to the finest variety of satin-wood or calamander, from mahogany to walnut, from wainscot to ebony—all are in some way or other made to do service in their respective places for the cabinet-maker.

The elements of beauty in wood may be considered as consisting in lustre, figure, and colour; in the degree of which there are, however, numerous modifications as well as limitations.

The medullary plates contribute essentially to the character of ornamental woods, not only from being the secondary cause of the lustre of most of those woods that are remarkable for this quality, but likewise by their own inherent properties. In nearly all the coloured woods the colour of the medullary plates is much deeper than that of the fibres, sometimes varying even in kind, so that when viewed in different lights they present different colours. The plane or sycamore is remarkable for the size and distinctness of its medullary plates, these being of a rich chestnut brown, with a considerable lustre, while the fibres are nearly white and almost dull.

There is another source of variety in wood, both in figure and colour, depending on the comparison and contrast of one annual layer with another. Much irregularity takes place in this respect. But this very irregularity is a source of beauty, and is capable of being indefinitely varied by making the section more or less oblique to the axis of the tree. An alternation of colour not unfrequently accompanies these concentric rings, but is not indicative of any change of structure; and when the colours are lively, well defined, and well contrasted, their effect is very agreeable: kingwood, tulip-wood, Amboyna-wood, yew, lignum vitæ, and partridge-wood, are, perhaps, some of the most remarkable.

This symmetrical distribution of colour passes by insensible degrees into the striped, the veined, and the mottled, of which walnut affords the best example among the more common woods; and spotted and veined ebony, rosewood, zebra wood, and Coromandel-wood, among the more valuable ones. The three latter are particularly beautiful, especially the Coromandel-wood, whether we regard the harmonious tone of its colours, passing from brownish white to rich chocolate, and nearly black, or the broad masses in which these are arranged, giving it more the appearance of brecciated marble than of wood.

One other variety in the figure of woods is the occurrence of eyes, zoned spots and small curls, of which the bird's-eye maple, Amboyna-

wood, and the root or burr of the yew and the commom maple are the most beautiful. The knobby tubercles that form on the root and trunk of the common elm, from repeatedly stripping off the side branches, afford a very beautiful wood called "curled elm."

We will pass on now to notice the principal woods, giving prominence to Mahogany as being that most largely used.

In 1820, when the duty on mahogany was 11*l.* 17s. 6d. the ton, the imports were 16,005 tons; in 1830, nearly the same, although the duty had been reduced in 1826 to 7*l.* the ton. In 1850 the imports were 33,650 tons; and in 1861, 53,108 tons, valued at 569,000*l.* Mahogany unquestionably occupies the highest rank in the scale of furniture woods; it has long continued in steadily increasing request for all kinds of cabinet work, ornaments in woods, and generally for all purposes to which timber is applied for interior decoration. A thousand pounds has frequently been given for a good log of mahogany—and few probably of the visitors at the International Exhibition gave a second glance at the huge squared log of mahogany, which was shown in the Haytian Court, worth many hundreds of pounds, or reflected upon what might be its ultimate destination when sawn or cut into veneers. The principal sources of supply for this wood are Belize, British Honduras, which furnishes one half, St. Domingo, Cuba, and Mexico.

Spanish mahogany imported from Cuba, Hayti, and other West India islands, is in smaller logs than the Honduras, seldom exceeding sixteen to twenty-four inches square, and from six to twelve feet long. The colour is paler, the lustre less, in consequence of the medullary plates being smaller and irregularly distributed; the grain is also finer than the Honduras, and the texture harder.

Many of the more expensive woods are cut into thin strips, termed veneers, which are glued on to pine surfaces, or other common woods, and by this process nine-tenths of the wood are saved. By the use of beautifully adapted circular saws, worked by machinery, veneers are often cut of the thickness of one-fortieth of an inch, a little thicker than the sheet of paper on which this is printed. By the largest saws, logs of mahogany, three feet square, can be cut up into unbroken sheets of veneer at the rate of about ten or twelve to the inch, and so beautifully smooth as to require scarcely any dressing. The longitudinal edges of the veneers are protected by a calico band glued on, to prevent them from splitting when removed. Walnut is cut, not in longitudinal sections like other veneers, but in thin spiral sheets from the circumference of the tree. This makes the thinnest veneer of the whole, but it is frequently defective.

Rosewood, obtained from Brazil, and walnut, from Belgium and Italy, are probably, next to mahogany, the most important furniture woods.

There is still great confusion as to the trees which furnish the South American rosewood. From the Portuguese name of Jacaranda, the scientific name of *Jacaranda Brasiliana* has been applied to it. There

is, however, little doubt that several species of *Triptolomea* yield rosewood in the province of Bahia.

The demand for rosewood has lately fallen off; for whilst in 1854, 5,670 tons, of the value of 82,211*l.*, were imported, on the average of the three years ending 1861, the imports were only 2,000 tons.

Rosewood exhibits large elongated zones of black irregular lines on a reddish brown ground, of various tints and high lustre. The grain varies—being frequently very coarse, but in selected specimens is sufficiently fine for the best description of furniture. The dark colour in general is too predominant; but when this is not the case, and the lighter ground is disposed in larger masses than usual, the wood is considered very beautiful.

Some of the specimens of Maple wood from North America are very ornamental, especially those of the red-flowering maple (*Acer rubrum*), and the sugar maple (*A. saccharinum*).

It sometimes happens that in very old trees of the former species, the grain, instead of following a perpendicular direction, is undulated; and this variety bears the name of "curled maple." This singular arrangement, for which no cause has ever been assigned, is never witnessed in young trees, nor in the branches of such as exhibit it in the trunk. It is also less conspicuous at the centre than near the circumference. Trees offering this disposition are rare, and do not exist in the proportion of one to a hundred. The serpentine direction of the fibre which renders them difficult to split and to work, produces, in the hands of a skilful mechanic, the most beautiful effects of light and shade. These effects are rendered more striking if, after smoothing the surface of the wood with a double-ironed plane, it is rubbed with a little sulphuric acid, and then with linseed oil. On examining it attentively, the varying shades are found to be owing entirely to the inflection of the rays of light, and this is more sensibly perceived in viewing it in different directions by candle light.

Before mahogany came into such general use, the wood of the red-flowering maple was largely employed in America for furniture; bedsteads are still made of it, which in richness and lustre excel the finest mahogany. Veneers of it are much used to inlay other woods in articles of cabinet work and for the finishing of ship's cabins. The red-flowering maple, never produces the variety known as "bird's-eye maple," that being confined exclusively to the sugar, or the rock maple. The sugar maple exhibits two accidental forms in the arrangements of the fibre, of which cabinet-makers take advantage for making beautiful articles of furniture. The first consists of undulations like those of the red-flowering maple and is likewise known as "curled maple;" the second, which takes place only in old trees which are still sound, appears to arise from an inflection of the fibre from the circumference towards the centre, producing spots of half a line in diameter, sometimes con-

tiguous, and sometimes several lines apart. The more numerous the spots, the more beautiful and the more esteemed is the wood. This variety is called "bird's eye maple."

Maple is now imported in considerable quantities from New Brunswick and fetches a high price; 413 tons, valued at 2,752*l.* were received in 1861. The ancients held the maple in great esteem, and tables inlaid with curious portions of it, or formed entirely of its finely variegated wood, in some instances realized their weight in gold.

The principal portion of the Satin-wood that comes into commerce is brought from the West Indies, and is produced by *Maba Guineensis* an ebenaceous tree in the Bahamas, Hayti, &c.

It is of a beautiful deep yellow colour, mixed more or less with orange and brown, and hence called, locally, "yellow wood;" it is remarkably close-grained, heavy, and durable. It is sometimes confounded with East Indian satin-wood, the produce of *Chloroxylon Swietenia*, a cedrelaceous tree. The latter possesses the richest colour, whilst the West Indian satin wood has a higher and more variable lustre. In some instances the Indian wood is beautifully patterned or flowered, and is much used for picture-frames, rivalling bird's-eye maple. Indeed, Satin-wood fetches a much higher price than maple. The Chinese are very partial to this wood, and receive quantities of it from Siam. We obtain some from Ceylon and Madras.

Our supplies of the dark blackwood, known as Ebony, to the extent of 1,500 tons, are imported chiefly from the west coast of Africa, Madagascar, India, and Ceylon. It is the duramen or heart-wood of several species of *Diospyros*, and is much used for inlaying work by cabinet-makers.

Previous to the introduction of mahogany, rosewood, and other exotic woods, that of the walnut was held in higher estimation than that of any other European tree, and supplied their places in the manufacture of the most valuable and costly pieces of furniture, examples of which are still to be seen in the houses of ancient date, whose beauty in grain, polish, and pattern, would bear comparison with any of the choicest woods of the present day. Indeed, of late years we have been returning to this taste; for while foreigners prefer mahogony for cabinet we have taken again to walnut for suites of furniture. The imports of walnut-wood have recently averaged 3,200 tons, or double the quantity of rosewood imported.

The name of Cedar is given to several woods, but properly belongs to the almost incorruptible wood obtained from two species of *Cedrus*,—*C. Deodrar* and *C. Libani.* This is the cedar spoken of in Scripture: "The cedar of the house within was carved with knops and open flowers: all was cedar; there was no stone seen."—(1 Kings, vi. 18.)

The wood of the common *Cedrelas* is far less valuable. The cedar chiefly imported is *Cedrela odorata*, in logs free from knots and straight-

grained, from Cuba, Mexico, and Central America, in quantities varying from 3,000 to 5,000 tons yearly. Thirty years ago the consumption was less than half that quantity. The red or pencil cedar of Virginia (*Juniperus Virginiana*) is also imported, being serviceable for internal joiners' work. The rare beauty of the sideboard top of the Australian cedar root in the New South Wales court of the late Exhibition attracted much attention.

Oak still retains its time-honoured place in Gothic furniture and libraries. Wainscot oak is imported in logs from the Baltic, for cutting into planks or slabs for furniture, or for pannelling rooms.

Having noticed the principal woods imported in quantity, we may now incidentally glance briefly at a few others deserving of mention. And here it may be remarked that nearly all the ornamental woods used are derived from tropical countries, although occasionally specimens of woods grown in temperate regions are characterized by considerable beauty. Thus the curled ash of Canada, from the beauty of the figure, if better known, would be much appreciated by our timber merchants, the pattern resembling the renowned Hungarian ash, a wood which was in great favour here at one time, and realized a high price, but could not be obtained in large planks.

The Laburnum has a wood of a darkly variegated colour, rendered more beautiful by a lustre of metallic green, and when knotted is equal to mahogany. The medullary plates, which are large and very distinct, are white, and the fibres of a dark brown, a circumstance that gives quite an extraordinary appearance—a peculiarity not to be observed in any other wood.

To the fine woods of our colonies, but scant justice has yet been done in the way of publicity, either in the Jury Reports or through any other medium. Such a magnificent collection of woods of all kinds, many of them new and rare, from different countries, was never before brought together, and it is very doubtful if it ever may be again.

Many of these woods are as yet comparatively unknown; the difficulties in the want of labour, proper roads, and available means of transport, have hitherto prevented the various treasures of the colonial forests from becoming readily accessible to the requirements of our artizans.

Numerous illustrations were afforded of the suitability of many of these woods for furniture, for smaller articles of turnery and ornamental workmanship, and for parti-coloured work in marquetry, wood mosiac or Tunbridge ware, and Sorrento inlaying. Innumerable specimens of cabinet-work, of the highest excellence, were seen to great advantage and obtained universal commendation from competent judges.

Many of these elegant pieces of ornamental work displayed the peculiar beauty and figure, the closeness of grain, and, in some cases, revealed the fragrant odours of the smaller woods and showed how well

they are deserving of more extensive notice than they have hitherto received. Many of the woods exhibit a peculiar beauty of structure; some are highly fragrant, and retain their agreeable odour for a considerable period of time, which renders them additionally pleasant and acceptable in the form of ornamental articles to the boudoir and drawing-room.

Some of the rarest and and most esteemed ornamental woods are South American, and come chiefly from Brazil; among these are tulip-wood, zebra-wood, the produce of *Omphalobium Lamberti*, king-wood, canary-wood, partridge and pheasant-wood, and purple-wood.

Coromandel or Calamander wood is the produce of an ebenaceous tree of Ceylon, and considered, from its peculiar marking, one of the handsomest of the brown woods. It is getting scarce. King-wood and zebra-wood are rich yellowish-brown, striped; sometimes full of zoned eyes.

A valuable, heavy furniture wood of British India is the blackwood, locally called rosewood, obtained from the *Dalbergia latifolia*, a leguminous tree. It can be procured in any quantity, and of immense size, but in large pannels is liable to split. Jackwood (*Artocarpus integrifola*) furnishes a yellowish wood, which deepens into brown. When made into tables and well kept, it attains a polish little inferior to mahogany. The Chittagong wood (*Chickrassia tabularis*) is more used in Madras for the making of furniture than any other wood. It is light, cheap, and durable.

Lingoa wood, the Amboyna wood of commerce, was imported into this country in considerable quantities from the Moluccas during the time those islands were British possessions. It is stated to be abundant at Ceram, New Guinea, and throughout the Molucca seas. The wood can be obtained in any quantity if the precaution be taken of ordering it during the previous season. Circular slabs of Amboyna wood are occasionally met with as large as nine feet in diameter; but the usual size is from four to six feet. These slabs are obtained by taking advantage of the spurs which project from the base of the trunk, as the tree itself has not sufficient diameter to furnish such wide slabs. The kayubuka of commerce, so much esteemed as a fancy wood, is obtained from the gnarled excrescences which are found on these trees (*Pterospermum Indicum.*)

In the beauty of its duramen the blackwood of Australia (*Acacia Melanoxylon*), also known as lightwood, possesses many resemblances to the best walnut, and is considered even superior to that wood, being harder and more durable. It is a favourite wood with the cabinet makers of Victoria for furniture of every description, and receives a very high and beautiful polish.

There is one other very ornamental wood which has lately been largely used in cabinet work by the French,—the cypress of Algeria

(*Thuja articulata*). The wood is dark nut-brown, close-grained, and very fragrant. It is believed to be the *algum* or *almuz* of Scripture, one of the most costly materials furnished by Hiram, King of Tyre, to Solomon, for the building of the Temple, and for the house on Mount Lebanon. Planks of this wood formed the precious citrine tables of the Roman banqueting halls.

It requires a large capital to keep up a good stock of seasoned wood, so as even to support a moderately large manufactory ; but as there are no duties on wood, it pays the dealer well to lay in a stock of furniture wood for seasoning, because the unexampled prosperity of our colonies insures for a long series of years a market for the furniture of Europe. Nothing but the taste and make of the mother country will suit her colonists, and skilled labour is too high in the colonies for much attention to be given yet to furniture and cabinet-making. The value of the furniture, cabinet, and upholstery wares annually exported from the United Kingdom averages from 250,000*l.* to 350,000*l.*

There was a time, we are told by a leading Liverpool timber firm, when a portion of the capital of that county (Lancashire) employed its population in the manufacture, and its merchants in the exportation of furniture. The foundations of the fortunes of the more prosperous cabinet-makers and shipowners were so laid. Circumstances, however, interrupted this state of things, through the imposition of war duties of 12*l.* 10s. per ton on Spanish mahogany, and 45*l.* per ton on rosewood ; and Lancashire ceased to employ its people in the manufacture beyond the home trade, and its merchants ceased to load the 'tween decks of their ships with furniture to the colonies. — *Popular Science Review.*

NOTES ON MYRABOLANS.

BY M. C. COOKE.

The fruits of several species of *Terminalia* have been of late included under the general name of "Myrabolans," which, in truth, belongs only to the ripe fruits of *Terminalia chebula.* India is the chief source of these different fruits, where they are extensively employed by the natives in dyeing and in medicine. I was for some time, and until recently, under the impression that more than two species were to be met with in English commerce, but am now convinced that all I have hitherto met with may be referred to one of two species, viz.: *Terminalia chebula* and *T. belerica.* The *Mungachi* of the Canarese, (*T. augustifolia*) is still a stranger in our markets. Under the name of *Kiritoochie* (a corruption of *Huritochee*), the unripe fruits of *Terminalia chebula* have been referred to *T. angustifolia*, for which I know of no vernacular synonym in India resembling *Kiritoochie.*

In the *Mekhzen-ul-Adviyeh*, of Muhammed Hosen Shirazi, under the head of *Ahlile*, the following kinds of *Halileh* or chebulic myrabolan are enumerated :—

1. *Halileh zira.*—Gathered when the fruit is just set. Being dried, it is about the size of the *Zira* (cumin seed).

2. *Halileh-jawi.*—Gathered when the fruit is more advanced. When dried, it is of the size of a barley-corn (*jaw*).

3. *Halileh-zengi*, *Hindi*, or *Aswed.*—This kind is gathered when the fruit is still more advanced. Being dried, it is the size of a raisin, and is black, whence its name *Aswed* black, or *Zengi* negro.

4. *Halileh chini.*—Which is gathered when the nut has acquired some degree of hardness. The dried fruit is of a greenish colour.

5. *Halileh-asfer.*—Gathered when approaching to maturity. The fruit, when dry, is of a reddish yellow, whence its name (*Asfer* yellow).

6. *Halileh-cabuli.*—When the fruit has come to full maturity.

All these six kinds are the produce of the same tree (*Terminalia chebula*).

I have never met with any myrabolan so rudimentary and minute as the first variety named by Shirazi. The smallest kind which seems to be now known and employed in Hindustan corresponds more nearly with the second variety above-named, and is represented by a small black immature myrabolan, of the size of a barley-corn, which is used in Hindustani medicine, and is the *Halileh-jawi* of the Persian writers. It is not an article of European commerce, but may be examined by the student amongst the Pharmaceutical substances in the India Museum, Whitehall.

The *Zengi-har*, or black myrabolan (the *Halileh zengi* of the Persians) is the form which has been confounded with the fruit of *Terminalia*

augustifolia. It is the *Kooroo-villa cadookai* of the Tamuls, and the *Huritukee* of Bengal. This variety contains scarcely the rudiments of a nut, and is of the size and shape of a small black raisin, which, in appearance it somewhat resembles.

Dr. Fleming ('Asiatic Researches,' vol. xi.), says: "The *Zengi-har* is as far as I can learn, more frequently used in medicine by the Hindus than any of the other myrabolans, being generally employed by them as a purgative. It operates briskly, but without occasioning heat or irritation. Persons liable to a redundancy of bile, habitual costiveness, or any other complaint which requires the frequent use of gentle laxatives, will find this one of the most convenient which they can use." This form of myrabolan has several times appeared in the London market.

The *Halileh-chini* is doubtless the same as the *Munjulde* of Assam, noticed in vol. i., pp. 136 of this journal. The fruit is much more mature than in the *Zengi-har*, the nut being formed within it, but it is still of a greenish black when dried, with the epicarp shrivelled upon it or contracted into ridges. I have not, however, met with it commercially, and unless the *Munjulde* can be referred to this variety, I must consider myself still a stranger to the *Halileh-chini.* The kind known as *Munjulde* in Assam is about the length of a Tonquin bean, but thicker, angular, and with a shrivelled pericarp.

Of the ordinary myrabolans of commerce, two varieties at least will have been noticed. In one of these the surface of the pericarp is smooth and shining, and of a light yellowish brown or tawny colour, in the other, the surface of the pericarp is much shrivelled in drying, and the colour is seldom so bright or yellow, possessing generally a greenish tint. These differences are due to the degree of perfection at which the fruit had arrived when gathered, and between these varieties almost every gradation in regularity of surface may be encountered.

I have not the least doubt that some of the greenish yellow, and reddish yellow, small sized myrabolans often met with constitute the variety named *Halileh-asfer* in the *Mekhzen-ul-adviyeh* already quoted.

The mature myrabolan is too well known to need description. It is the *Helileh-kabulee* of the Arabs, and D'Herbelot is of opinion that this name is derived from "Cabul," the article having been first brought to Arabia from the country so named. At the present time mature Cabul myrabolans sell for a rupee each in Bombay under the name of *Surwarree hirda.* This induces the fraudulent admixture therewith of the fruits of *Balanites Ægyptaica* which generally accompany the Cabul myrabolans to Bombay.

The astringent pericarp of this fruit in combination with sulphate of iron makes a very good ink, and the kernels yield upon expression a small quantity of oil. The leaves of the tree are subject to the attacks of a gall insect. The galls produced are flat hollow cases of a horny

texture, and from half-an-inch to an inch and a half in diameter in one direction, and about one-fourth of that diameter in the other direction, with these galls and alum a durable yellow is dyed in India.

Mature myrabolans are called *Haritika* in Sanscrit, whilst in Hindustani they are known as *Hur*, *Harhara*, *Hulda*, and *Hura*. In many districts they have also their local names, as *Huritukee* in Bengal, *Heerda* or *Huldah* in the Deccan, *Arulay* in Mysore, *Kodorka* amongst the Malays, *Kadukai* of the Tamuls, *Karakaia* and *Seingi-tige* of the Telugos, *Araloo* in Ceylon, *Kayoo-bin* in Pegu, and *Ahlile* or *Halileh* in Arabia and Persia.

Myrabolans, the produce of another species of *Terminalia* (*T. bellerica*) have during the past few years found their way into the English market under different names, but generally as "Bedda-nuts." Their obovate form will at once distinguish them from the true myrabolan. Like the varieties already named, these are also an Indian product, and are much employed by the natives on account of their astringency both in manufactures and medicine. The kernels yield a larger quantity of oil than those of the Chebulic myrabolan which is employed for strengthening the hair.

Reference to the 'TECHNOLOGIST,' vol. ii., pp. 233, will furnish the relative values of the Chebulic myrabolan, mature and immature, and the Belleric myrabolan, as tanning substances, viz. :—

Chebulic Myrobalan (mature)	18·230
„ „ (immature) under the name of Kiritochee	35·280
Belleric Myrobalan	9·086

Other notes by the Editor on "The Myrobalans of Commerce" will be found in the same volume, p. 184, from which it would appear that he has met with the fruits of *T. augustifolia* in commerce; but I think that, on renewed examination, he will confess himself to have been misled by the different appearances of the fruits of *T. chebula*, when collected and dried at earlier stages of growth.

INDIAN CIVETS.

FROM NOTES AND OBSERVATIONS BY DR. MCCLELLAND AND B. H. HODGSON, ESQ.

"The zoologist has no greater difficulty to encounter in the mere descriptive part of his duty than in drawing just conclusions as to the specific value of characters in animals nearly allied to each other, and there is nothing of more importance to know, than the amount of variation nature is capable of assuming in a single form, and the circumstances to which such variations are due.

"We should not generally lay any great stress on slight shades of difference in colour, but there are some groups in which the distribution of particular spots and markings on the external covering is of much more importance than in others. In the *Feræ*, or Cats, for instance, as well as in their corresponding types throughout the animal kingdom, we often observe each species distinguished not merely by the number, size, and colour of spots, but by the particular forms these assume on various parts of the body. It is curious also to observe this law of *isographism*, if we may use such an expression, the more constant in those species whose form and habits approach nearest to each other, and which it would consequently be most difficult to distinguish but for the constancy of some peculiar marks. Until the time of Buffon, the difference between the Civet and the Zibeth was unobserved, both being of nearly the same form and colour, but the number of dark marks on the tail being different in the two, might have earlier led to a comparison of the number and form of the vertebral bones of which the organ is constructed, when a difference we may presume would have been detected that could only be accounted for by the ordinary laws of variation in animals of distinct species. Strange to say, however, that long after the difference between the animals in question had been first suggested, naturalists preferred dealing in opinions to searching for facts; and so slow is the discovery of truth, that it required some thirty years to reconcile naturalists to what they had been unaccustomed to suppose in this instance.

"The Civet (*Viverra civetta*) is most abundant in the hottest parts of Africa and in Abyssinia, where the animal is reared and an extensive trade carried on in *civet*, a peculiar odoriferous substance like musk, once very fashionable in medicine, and also as a perfume.

"The Zibeth (*Viverra zibetta*) has been found in the Philippine Islands, from whence the animal figured and described by M. F. Cuvier seems to have been brought; but it is said also to belong to India, but on what authority I have not the means of ascertaining.

"Colonel Sykes found *Viverra rasse*, Horsf. in the woods of the table lands east of the western ghauts,* and *V. indica*, a very nearly allied species to the latter, in the forests of the western ghauts. More

* Proc. Zool. Soc. 14th Feb., 1832.

recently Mr. Hodgson of Nipal mentions both these species as inhabitants of the Tarai.† The species figured in Hardwicke's Illustrations as *Viverra bengalensis*, Gray, seems to be *V. vindica*, Geof. It appears probable therefore that naturalists have fallen into a mistake in supposing *V. zibetta* to be an inhabitant of India, i. e., Hindustan, and we shall probably be able to account for the manner in which the error, if it be one, has arisen.

"In a collection of about 200 animals of different kinds recently formed by the plant collectors employed by our friend Mr. Griffith in the Kasyah mountains, is an animal which corresponds partly with *V. zibetta*, Gm. in the distribution of colour and size, but it has a shorter tail with only six complete broad black rings, and a broad black band passing below under the throat in addition to two black stripes on either side of the neck. As this animal corresponds nearly with the colour of the Zibeth, and is of the same size and form, we may presume that it has been supposed to be the same species. Without attempting to describe this animal fully, we beg to offer a few more remarks regarding its peculiarities.

"Throat white, with black band passing from the ear backwards under the neck, a second interrupted black band on the side of the neck, and a third passing along either side of the nape and descending in front of the shoulder with a black streak along the spine, forming a short mane. There are six broad black rings encircling the tail. Head grey, with a dark spot on the base of the outer side of the external ear, general colour grey, darker above than below. The sides are streaked transversely, the streaks longitudinal on the hind quarters and shoulders, becoming closer and darker on the limbs, which are nearly black. The length of the tail is thirteen inches, length from the tail to the snout two feet nine inches. Height about thirteen and a half inches.

"The tail of this animal is about the same length as that of *V. civetta*, but the black rings which surround it are broader, and this last peculiarity also removes it still farther from *V. zibetta*; in which the rings on the tail are more numerous and incomplete. It also differs from *V. civetta*, in having a white throat, and from *V. zibetta*, in the neck being crossed below by a black band. Should it prove a new species, as we have no doubt it will, we trust that its name may be connected with that of the distinguished botanist to whose liberality we are indebted for the first knowledge of its existence; and who, while employed himself in one extremity of India, can find means for supporting, and time for organising establishments for collecting natural productions in another.

"The different animals of the Civet kind are in India called *Catàs*; there is one in Bengal, probably *V. indica*, Geof., which is very common, and has been know even to enter houses in Calcutta at night in search

† Ib. Proc. 26th Aug. 1834.

of poultry. A few months ago an instance of the kind occurred in a house surrounded by a high wall, and in which there were several dogs. The Catàs on finding itself pursued, entered a large pond, and appeared to rely with much confidence on its dexterity in the water for its safety.

J. M. McCLELLAND."

In the above notice of a Civet from the Cossia Hills, Dr. McClelland supposes it to be distinct from Civetta and Zibetha of authors. "The subject is involved in double perplexity from the variations to which these animals are liable, and from the inadequacy of all recorded descriptions of the Civet and Zibet. The greater and the lesser species of these animals are common in the Tarai and Hills of Nepal, and they are recorded by me in my Catalogue of Mammals as *Viverra orientalis*, new forsan *Civetta* vel *Zibetha*, and as *Viverricula* (nobis) *Indica* and *V. Rasse.*

"The first of these three is probably identical with Dr. McClelland's animal, but from my experience during the past 12 years, I own myself as much inclined to doubt the specific distinctness of the *Viverra et Zibetha* of authors as to allege positively the independence of this third species on both the former. The specific character which I gave to my *V. orientalis* in May 1838, when I forwarded drawings and skins to England, is as follows :—Iron grey Civet, with body marked or unmarked, with lateral and anteal surfaces of the neck conspicuously quadricinctate, with black and white, the black prevailing, and black tail furnished with six narrow perfect white rings. Snout to rump 32-3 inches; tail 19; mean height 14 to 15. It seems to me, however, that the specific characters of Civetta and of Zibetha must be amended before one set can be assigned to *V. orientalis* (Potius *melanurus*) at once precise and accurate.

"Without further preface I will proceed now to a full description of a fine male specimen of our animal which I obtained in our valley in March, 1836, thereafter noticing contradistinctively a specimen from Dorjiling, in which the Civet-like markings of the body, so faint in the former as most striking.

"The general colour of our animal, which is an old male, 'is iron grey, more or less fulvescent and sordid. Below the belly and inside of the limbs close to it are hoary white. Limbs nearly to the body brown, black, or deep sooty; whole inferior surface of the head and throat with the margins of the gape and bridge of the nose, the same: mystaceal region and tip of chin hoary like the belly; ears outside black for the most part, but becoming dusky and even grey towards tips; lining of the ears hoary grey; head above and laterally void of marks, and coloured like the body, but paler; no mark under the eye; sides and front of the neck occupied by four conspicuous alternating black and white bands, which proceeding from behind the ears first run longitudinally towards

the shoulders, and then suddenly turn down to gird the front of the neck, which they entirely embrace, and which from the superior breadth of the inner dark zone is rather black than white. Within (that is nearer to the head) this large dark zone is a semblance of a third dark one, which however rather resembles horns put off towards the ears from the dark inferior surface of the head than a separate pectoral zone. Outside the external dark zone there are traces of a pale edging or band; and if we include this faint line (clear enough on the abdominal aspect) as well as reckon separately the last named, also counting the dark line of the head below, we have a succession of eight pale and dark spaces. But the more prominent are only four, whereof the outer dark one is somewhat broken on the shoulder, it descends nearly at right angles, whilst the inner one is quite entire, more accurately curved, and so broad below or on the abdominal aspect of the neck that that aspect must be called black rather than white. Above, or dorsally, the neck has no mark, at least none distinct, though the vague tracing of the dorsal mane which only becomes distinct at the withers, may here be seen. This mane is by no means strong or conspicuous, and it ceases wholly at the base of the tail after somewhat breaking the first pale caudal ring. It is accompanied by a white edging on either side, and these colours thus pass into that member, or the tail, which somewhat exceeds half the length of the animal, and is gradually attenuated from a thick base.

"Whatever other changes our larger *Viverra* are liable to, the caudal rings hold an unvarying character, and in this species they are uniformly six in number, pale upon a black ground, with a gradually increasing interval towards the tip, and, though wider below than above, yet upon the whole far smaller than their dark interstices. One and a half to two inches of the dark ground colour occupy the tip of the tail before the nearest pale ring is reached. It has already been noticed that the dorsal mane breaks the first ring towards the base of the tail. The body of the animal is almost wholly immaculate, and even on the shoulders, and tibiæ the wavy bands we expect to meet can hardly be traced. In other mature specimens these lines may be seen here and there only, not on the flanks or body of the animal where the iron grey has a bluish cast, sometimes overlaid with dull fawn, especially on the buttocks. In our present subject little or none of the latter hue can be traced.

"In all our specimens the fur consists of wool and hair constituting a thick warm covering, but liable to vary with the seasons and health of the animals. The wool is copious and wavily curled: the hair straight, and a third longer, moderately adpressed, and neither harsh nor soft. In the present animal the hair is $\frac{1}{2}$ to $\frac{3}{4}$ inch long: the wool one inch. On the tail the wool and hair are both present, nor is either longer than on the body: the face and limbs are dressed in fine close glossy hair only: the colour of the wool (in all specimens) purpurescent, dusky: two-thirds of hair and more, towards the base, the same: the terminal

third $\frac{1}{4}$ white, or fulvescent-white, and $\frac{1}{2}$ (the outer) black. Some hairs wholly dark, and hence results the iron grey hue of the animal, the generally sordid tinge of the white even on the belly, being caused by the interior dusky colour of the wool and hair throughout. The Dorjiling specimen is of the same size as the above, and also a male.

"The general resemblance of the two in the essential marks, proportions, &c. is perfect including the scantiness of the mane; nor will the nicest scrutiny serve to detect any differences, save that the fur is rather shorter and more adpressed in this one, and that the third dark pectoral zone is distinct from the dusky throat, instead of merely forming horns to it, whence, reckoning the pale edging between the last two, and that without or beyond all the dark marks, we have here the complete series of eight pectoral zones, though a fastidious objector might reject some of them as vague. They may be counted however, and therefore are noted, lest their omission should hereafter mislead. The line of these zones is in general black and white respectively; but the latter colour is more or less sordid; and the dark inferior surface of the head (here included) is decidedly not black but dusky, or sooty brown, like the limbs. All these things are however so in the first specimen also, from which this therefore is only differenced by the clear and striking Civet-like marks occupying the body of the present subject. These marks are oblique on the shoulders and hams, and have there usually a straight lined character, whereas on the body they are vertical and wavy, presenting the exact appearance of a succession of waves, advancing from the rear to the front, and often passing, as real waves will do, nearly into open circles or eyes, especially towards the dorsal ridge and mane. This may possibly be a distinct species or variety. I have noted it as the latter, with the trivial name of *Undulatus.* In this marking it is nearly allied to *Civetta.*

"My other specimens are mostly of the unmarked kind, and juniors: the rusty hue is clear on the hams, and sometimes passes on to the tail near them. The tibiæ are barred, and the shoulders or brachia likewise, but the flanks and body are immaculate: six narrow perfect white rings on a black tail, and four principal, or six to eight principal and inferior, alternate black and white pectoral zones, of which the former constitutes the ground hue, distinguish all alike.

"In May (27th) 1836, I procured four young ones of one of these species or varieties, but of which I know not, for the mother escaped. The young were about a span or six inches long, and could not have been born a week, yet their eyes were open, and all their organization (save the teeth) perfect; they had the pectoral and caudal marks, especially the latter palpably developed, but the dorsal dark line could hardly be distinguished owing to the generally darker hue of the little creatures, none of which lived beyond September. They were found on the bare ground, under thick copse wood, and their mother with them. On the 26th July they were two spans, or twelve inches, long, or

double the size when first taken, and then they had four molars above and as many below. A survivor to 15th September was then 14½ inches long, and had cut all the molars. On 20th June the incisors appeared. But I must hasten to return to my first subject, and subjoin such a detail of its dimensions as *with* the colours, may serve to fix the species in the judgment of the skilful. Dimensions of *Viverra orientalis*, potius *Melanurus*, mature male.

	ft.	in.
Snout to base or tail	2	8
Tail only	1	5½
Tail and terminal hair	1	6¼
Head, length of a long curve	0	6¾
Ditto, ditto, straight	0	6¼
Greatest breadth	0	3
Ditto, depth	0	2⅞
Width between the ears across parietals, straight	0	2½
Ditto, between inner canthi of the eyes	0	1¼
Length of ears from crown of head	0	2
Ditto, ditto, from the lobe	0	2
Elbow to top of corpus	0	5⅛
Corpus (inclusive) to tip long finger	0	3½
Knee (true) to os calcis	0	7
Os calcis to end of longest toe	0	5¼
Mean height of the animal	1	3
Girth behind the shoulder	1	5
Weight (fat)	18 lbs.	

"I shall close this description, in order to render it complete with a notice of the structure of the animal: head conico-depressed, with ears and eyes remote; its vertical line very slightly curved from snout to occiput, and the bridge of the nose straight; muzzle or nude extremity of the nose clearly defined, rounded, slightly grooved in front, not so above nor mobile, nor much exceeding the teeth; the nares canine, being opened chiefly to the front with a narrower curved fissure to the sides; eyes midway between the snout and anteal base of the ears, somewhat oblique; rather prominent, largish, dark, with variable pupil, the third lid capable of being brought entirely over the eye; lips adpressed, and furnished with long firm mustachios; lesser tufts above each eye, two behind the gape on the cheeks on either side, and one under the chin, nine in all; ears moderate, ovoid, longer than wide, placed rather high up, and yet remotely from each other; the helix anteally having but a moderate attachment to the sides of the head,* fissure on posteal edge of helix small and simple; tragus small, but palpable; antitragus less so, one small salient process on the superior

* In *Viverrula* the helix is carried forward toward the eye so that the ears are brought near to each other.

margin of the couch, helix freely exserted from the scull, and capable consequently of free lateral motion ; softly furred behind and on the margin before or within ; the couch and auditory passage hid by longer soft hairs springing from the anteal and attached portion of the helix ; neck and body moderately elongated and full, especially towards the buttocks ; tail rather more than half the length of the animal, furred like the body, thick, and gradually tapering from the base ; limbs short, fine, strictly digitigrade, five-toed before and behind, the two centrals longest and equal ; the two laterals shorter and equal ; the fifth or thumb very small, but not elevated, being placed close to the edge of the main rest or pad of the foot, and touching the ground with its own little pad ; toes short, and connected by a furred membrane to posteal edge of terminal pads, which are soft and nude : main pad trigonocordate, full soft, nude, and extending forwards to ends of first phalanges of the digits ; a small metacarpal tuberosity behind the limb ; but no metatarsal one ; nails or talons subfeline and partially retractile, but except in youth blunt and worn by constant attrition with the earth, to which these animals are exclusively confined, and are thus distinguished by habits, as well as structure, from the small vermiformed and scansorial species (*Indica et Rasse* of authors) equally common throughout India, which I have separated under the subgeneric term of *Viverrula.*

"The greater species are as frequent in the mountains as in the plains ; the lesser vermiformed species are found only in the latter, and in every part of them. In both the peculiar odoriferous apparatus is fully and equally developed, and each has besides a fœtid anal apparatus analagous to that of *Mydaus ursitaxus*, &c. consisting of two solid glandular bodies placed centrally on either side the anus, just within its external margin, and opening on either side by a palpable pore whence pressure sends forth a marrowlike offensive secretion ; essentially similar glands and pores are found in the *Maries flavigula* and others of the fœtid genera of this family ; but it has not been noticed that they exist in the true Civets, in addition to their peculiar organs, which last as to position are pubic or preputial, as in the *Paradoxuri*, and also in *Moschus*, or the *Musk Deer*, a very noticeable circumstance !

"The peculiar glands of the Civets when dissected from the skin, are found to be not rounded bodies but flat ones, each (in *Orientalis vel melanurus*) $2\frac{1}{2}$ inches long by $1\frac{1}{2}$ broad, a congeries of glands like a cauliflower exactly. Cuvier asserts that the Genets, to which our lesser Indian Civets are so much allied in size and form, have this peculiar odorous apparatus only in any evanescent or rather incipient state ; and as I cannot doubt his assertion (the type of *Genetta* being common in France) it follows that our lesser species are not, as alleged, Genets, for they have this apparatus as complete as the large or true Civets. I have therefore separated the smaller Civets, and constituted them a new group, which is equally distant from *Viverra* on one side and *Genetta* on the other.

"The *Viverrula* are not one-third of the size of the *Viverra;* they have the true vermiform structure; the thumbs are more remote than in *Viverra;* and the animals are enabled, and wont with their more acute and more feline talons, to climb with facility, a faculty wholly denied to the *Viverra.* Lastly, whereas the latter are more common in the mountains than in the plains, the former are exclusively confined to the plains, where they appear to be spread universally from Cape Comorin to the base of the Himalaya. How many distinct species India possesses of the small, as well as of the large Civets, may perhaps be disputed, but *Bengalensis, Indica, et Rasse,* certainly appear to be distinct, whilst, if *Civetta et Zibetha* be justly sundered, our present subject, or *Melanurus,* may prove to be independent of either. The young I procured are believed, with some reason, to have belonged to this species, which therefore would appear to produce four perfect young ones at a birth, at the beginning of summer (the teats are six and ventral); and as these helpless little creatures were found on the bare ground, the species would seem seldom or never voluntarily to seek the shelter of holes or burrows, though I have known it do so for safety when pursued.

"These animals, in the mountains, dwell in forests or detached wood and copses, whence they wander freely into the more open country by day (occasionally at least) as well as by night; for I have seen one killed at noon three miles from cover, in the midst of the fields of this valley. They are solitary and single wanderers, even the pair being seldom together, and they feed promiscuously upon small mammals, birds, eggs, snakes, frogs, insects, besides some fruits and roots. In the Taroi the larger Viverræ are found in uncultivated copses, and they are said further to protect themselves by burrowing; at least they are frequently taken in holes, whether made by themselves or obtained by ejection of other animals. The Mushars, a low caste of woodmen, eat their flesh. The Tarai name of the animals is Bhraun, the hill name Nit Biraloo. The lesser species are called in the Tarai Sáyer and Bugmyúl, indiscriminately, but not Katás, that name being given to a distinct animal. The Tarai specimens of the Bhraun agree sufficiently with those obtained in the mountains, but I have only procured skins from the former tract; nor is there any essential difference of habits or manners in the high-land and low-land animals, though subterranean dwellings are seldom used, if at all, by the mountaineers."

THE TECHNOLOGIST.

THE MANUFACTURE OF COMPOSITE CANDLES AT CLICHY.

BY J. TURGAN, OF THE 'MONITEUR UNIVERSAL.'

The manufacture of stearine* is essentially French—from the first works of MM. Chevreul and Gay-Lussac in 1824, and the industrial realisation of MM. de Milly and Motard in 1835, down to the recent idea of decorating the wax candle, and making it an ornament which completes the luxury of candelabra. The numerous inconveniences of the candle, its nauseous odour, its insufficient consistency, its smoky wick requiring snuffers, added to the high price of wax, stimulated the inventors in their researches. As in a great number of industrial operations, the spirit of fraud guided the wax-chandlers. They commenced by making tallow candles coated with a layer of wax; but the fraud was discovered quickly enough by the fœtid emanations arising therefrom. They mixed with the wax different kinds of flour—beans and horse-chestnuts. They also tried to fabricate tallow candles which appeared to be wax; but this did not give very satisfactory results. The wick was always smoking, the snuffers necessary, and the candle disguised under divers names, continued to soil the hands, and to stain the clothes and furniture. It was reserved for MM. Chevreul and Gay-Lussac to discover, in 1825, the principles by the aid of which MM. de Milly and Motard, assisted by the researches of M. Cambacéres, should, in 1835, lay the foundation of an entire industry, one of the most flourishing of the present day—the fabrication of the stearine wax

* Stearine (from *stear*, suet) that part of oils and fats which is solid at common temperatures. The nature of these substances was first made known by Chevreul, in 1823, who showed that they were compounds of peculiar acids, with a base termed glycerine; of these compounds the chief are stearine, margarine, and oleine (from *elaion*, oil).

candles. The trials of experience had been fruitless; it was the methodical researches of chemistry which triumphed with *éclat*. They had a portion of tallow analysed, which they found composed of three acids—stearic, margaric, and oleic, with a base termed glycerine, the first acid fusible at 60°, the second at 47°, and the third liquid at 0. They analysed the three acids, and they discovered that they were formed of carbon and hydrogen, together with a certain quantity of oxygen, which was the most favourable composition to produce by combustion a brilliant light. In fact, they contained hydrogen, the most inflammable of gases; oxygen, without which all combustion is impossible; and, finally, carbon, the disengagement of which puts in suspension in the flame of the hydrogen little corpuscles which, passing to a reddish-white, give brilliancy to the flame. Of the three acids, two were, by their physical properties, that is to say, by their consistence and whiteness, in the best condition possible for making the wax candles. The third, on the contrary, by its extreme fluidity, was an obstacle that it was necessary to surmount. Its reddish colour, the volatile matters that it contained, the smoke that is disengaged by an excess of carbon, rendered it unadapted for luxurious lighting. These principles once laid down, we perceive the means they used to obtain, in their purity, the stearic and margaric acids; they mixed the melted tallow with a base of soda or potash, and they thus got rid of the glycerine, which could be of no use. By adding a certain quantity of sulphuric acid, which has an extreme affinity for bases, they formed a sulphate of soda, and the three fat acids were set at liberty in a state of paste; the solid crystals of the stearic and margaric acids containing in their network the fluid oleic acid. An energetic pressure disengaged it mechanically, and the two acids remained pure in a state of white matter like alabaster, solid enough, and fusible at about 55°. Towards 1835, the application commenced on a great scale at the *Usine de l'Etoile*, extended into Germany, where the Austrians distinguished themselves notably in the manufacture, which established its lf in England, where the powerful firm of Price and Co. produce immense quantities of fat acids, and now all nations make large quantities of the stearine wax candle, more or less handsome, particularly since the economical method of distillation has allowed a decrease in the price by making use of matters of less value, such as palm oil and all kinds of inferior fats.

The manufactory at Clichy, the description of which will give us an opportunity of furnishing a detailed account of the making of candles, is the last established. The company has studied rather to introduce processes for the purpose of bringing the manufacture to perfection, than the erection of one of those immense buildings that swallow up the bulk of the capital, leaving little or no residue for the carrying on of the business. The tallow factory, however, is necessarily a vast edifice, and its chimney is one of the highest. The only object of the company has been the manufacture of irreproachable products, and to raise the

character of its manufacturing mark. Let us see what series of operations resulted from this. The first is the melting of tallow. No industrial manipulation is more infectious or more nauseous—none more repulsive for the neighbours. The factories where it is carried on are built as far as possible from the centre of habitation. The authority for establishing them is a sort of privilege. The use of the tallow candle, which scarcely extended to the south, where oil was abundant and very cheap, was extended, and became perfected in the north of Europe—in particular, in France. The butchers themselves melted their fat and made candles of it. Towards 1016, a corporation of chandlers was established by Philip I., re-arranged towards 1470, and kept its privileges to the end of the last century. Moreover, without being as much shackled and as well regulated as formerly, it is, however, practised under a very active superintendence of the police prefecture and of the supervision of the butchers of Paris. The tallow arrives at the manufactory *en branche*, that is to say, as it comes from the offal-houses and butcheries. The sooner it is brought the better, especially in summer; in fact, the fat-matter is enveloped in fibrous cells, eminently liable to putrefaction, which decomposes rapidly at their contact. In order to disengage these fat-matters from the membranes which envelop them, two means are employed: the most ancient consists in melting the tallow in copper pans, then to extract, by strong pressure, all the liquid part, and having for remainder *des cretons* (the residue of tallow) in little loaves. The procedure employed at Clichy consists in reducing the fusion of the tallow into a liquid with an addition of sulphuric acid, which destroys completely all the membranes, and brings with it a certain quantity of glycerine, when they pour the mixture into large vats, capable of containing four or five thousand kilogrammes; they barrel up the tallow, after having previously added a little water and sulphuric acid; they then introduce a current of vapour at 133° by means of a serpentine pipe, perforated with little holes; ebullition commences, the cells open, and the membranes are destroyed. At the end of four hours, it is poured into crystallising copper vessels and left to cool; they then rack and leave it to settle in forms of wood named *jalots*. The tallow then takes the form of cone-shaped loaves. By this process they withdraw about 88 to 100 per cent. of useful matter, already white, purified from all organic bodies not belonging to it, leaving a little glycerine, which it is necessary to get rid of altogether. This object is attained by saponification, that is to say, by the combination of the fat acids of the tallow with a basis. The tallow coming out of the melting-house in a state of stearine, the margarate and oleate of glycerine are collected in gigantic vats, capable of containing 10,000 kilogrammes of matter, and are put in fusion by means of an injection of vapour, admitted by a serpentine pipe at the bottom of the vat. They add lime, dissolved in water, which soon seizes on the acids, forms stearate, margarate, and oleate of lime. All the glycerine is racked and poured into the Seine, for they have not yet

learned how to utilise it economically. The soap obtained by this operation is of a greyish white, and of great hardness. In order to separate the fat acids from it, they pound it, and throw it into great vats, lined with lead, where is already to be found the quantity of sulphuric acid necessary to neutralise the lime ; a pipe heats this mixture by an injection of vapour, and soon a sulphate of lime is formed, drawn by its weight to the bottom of the vat, whilst the stearic, margaric, and oleic acids remain on the surface, presenting the appearance of a pretty thick liquid, of a reddish colour, and of a disagreeable smell. A series of canals, of a calculated inclination, conduct into little flat reservoirs, made of iron plates and disposed on props, one beyond the other. The liquid fills the superior reservoir, that which flows over falls into the immediately inferior scale, then into the third, and so on in continuation. In cooling, the matter coagulates, and, drawn from the mould, forms a large square of four centimètres in thickness, by fifty-eight in length and thirty-five in breadth. From these squares it is now necessary to withdraw the oleic acid that they contain. Chemistry is not competent to perform this task ; mechanism can succeed, thanks to the hydraulic press. But it is not one simple pressure which can obtain this result ; two, three, and even four, are necessary. The first is a cold pressure. The tablets, placed horizontally, enveloped in coarse woollen stuff, horse hair, or even ordinary hair, called *malfils*, and separated by plates of iron, are piled up under an ordinary hydraulic press, and compressed as much as possible. A great part of the oleic acid contained between the crystals of the two other acids passes off in a reddish-brown liquid, and descends to the cellars, where we shall find it by-and-by. The cakes, now flattened, still contain a large quantity of the proscribed liquid, as one can judge by the large red spots which mottle them. They then submit them to a final pressure, which should entirely purify them. This pressure, which is accompanied by heat, is effected by means of ingenious machinery, brought to perfection by M. Galabrun. The tablets are placed vertically between horse-hair *étreindelle* covered with a printer's blanket, separated from each other by one of plated iron, composed of two plates supported by props, leaving between them sufficient space for an injection of vapour, which maintains them at about 80°. The hydraulic pressure is made horizontally, and, thanks to the clever invention of M. Galabrun, the vapour continues to penetrate between the plates by pipes made of caoutchouc.

The oleic acid squeezed out runs into the inferior part of the preparation, and goes to find that which has deposited itself there in escaping from the cold presses. There they make it pass through felt filters, in which it still leaves a good part of the stearic and margaric acids, which again undergo pressure. The oleic acid, disembarrassed of the useful matters which it contained, is casked, given up to commerce, or employed in the manufacture of soft soap ; for the Clichy manufactory, like almost all others, possesses an important soap-making department.

The tablets of stearic and margaric acids, freed by the hot pressure of the greater part of the oleic acid, are afterwards employed in making candles. The first kinds for commerce are made thus :—At Clichy the loaves undergo a second hot pressure, and they then obtain the stearic acid almost pure, of a beautiful white, translucent colour, and deprived of odour, of a pretty good resistance to fusion, presenting, in fact, all the qualities which in commerce have given it the name of *extra-double*. In coming out of the presses, the stearic acid is purified by several washings in water, at first acidulated, to purge from all foreign matter, and particularly from the oxide of iron by oxalic acid, to take away every trace of lime, then clarified *à l'albumine*. Thus purified, it crystallises with an excessive rapidity, which would present a great difficulty in the making of the candle if it were not remedied. Formerly, they added in the coppers a small quantity of arsenic acid, which prevented, it is true, the crystallisation, but was entirely injurious to the consumer. In a great many stearine manufactories they employ the old candle-moulds, slightly warmed, before pouring in the liquid stearic acid. At Clichy they make use of apparatus by means of which they can easily make 40,000 candles per day. This apparatus has the advantage of being heated and cooled at will, of being worked by women and children, and owes its rapidity of execution to the clever mechanism which supplies it with a series of wicks without end. In coming out of the mould, the candles are exposed to the air on frames of lattice-work ; there they undergo the discolouring influence of light, and become of an absolute whiteness. After forty-eight or sixty hours of exposure, according to the season, they bring them to the cutting machines. An endless chain, composed of parallel staffs, receives each candle at the moment in which, escaping from the notches of the cylinder, it is cut by a circular saw, warmed by friction against two corks, which press it lightly. During their passage on the endless chain, a brush, animated by a to-and-fro movement, washes and rubs the candles, on which fall some drops of water charged with carbonate of soda ; from thence they pass over the polisher, a machine in which the brushes are replaced by plugs of flannel, which gently polish the cylindrical surface, and give it an agreeable brightness. The candles are then finished ; but their fate varies according to their degree of perfection. Those which contain any defect whatever are broken and again melted down; those which satisfy in every way the experienced eye of the persons charged with the examination of them, are recognised by the house and judged worthy of bearing its mark. By means of a little apparatus in silver, maintained at a heat of about 212° F., they impress the word "Clichy," and the candle goes to the packing-room with its fellows, or, if it present an unusual degree of perfection, it is judged worthy of being decorated. The idea of decorating the candle by ornamenting it with paintings, escutcheons, and figures, is an elegant and graceful invention, that the proprietor of the manufactory, M. Casinberche, has developed with the

same certainty of purpose which distinguishes all his enterprises. Nothing in the world is more unseemly than to see in rich candelabra with costly carvings, or even in small delicate porcelain candlesticks finely painted, thick ugly candles, very unjustly called wax candles, yellowish and dropping grease, with a shrivelled-up wick, emitting with an unpleasant smoke an insipid and repulsive odour.

Exaggerating the contrary idea, the manufactory of Clichy has had the foolish prodigality to paint on the candles some *chefs d'œuvre,* signed by the best names of the manufactory of Sèvres; the ever-to-be-regretted Mme. Laurent, and other artists of talent, have executed charming subjects on stearine. But we must not forget that ornamental painting has its laws. Execute on the candle ornaments of every kind—flowers, birds, chimeras, but do not trace portraits thereon. Nothing can be more tasteful—nothing more simple and more natural than to have on the candle of which you make use your armorial bearings, if you have inherited them from your ancestors—your figure when you can draw one, or, at least, choose it well. This kind of ornamenting is still expensive, but researches actively and cleverly conducted will soon lead to a reduction in the cost, which will generalise the custom in every house priding itself on elegance.

TROPICAL FIBRES.

BY E. G. SQUIER.

No person from northern latitudes can long reside in tropical countries, particularly in tropical America, without being struck with the number and variety of endogenous plants, such as the agaves, pineapples, plantains, and palms, which form a characteristic, and to northern eyes, a novel feature in every landscape. If of an observant and inquiring turn of mind, the traveller will soon be brought to reflect on the economic value of these plants, and their thousand useful applications in supplying human wants. He will discover that they not only furnish staple articles of food, oil, and refreshing as well as intoxicating drinks, but also that they are the productive sources of valuable fibres, of every degree of fineness and strength, and fit for the most delicate tissues as well as for the strongest cables. He will find that the hammock in which he reclines is netted from a material almost as fine and soft as silk, and will probably be surprised to learn that it is supplied from the leaves of the wild pineapple, which he sees everywhere forming the hedges of enclosures, and scattered thickly through the forests. He will find the native boats rigged with cordage of superior description, and will be told that it has been procured from the agaves or "henne-

quins," of which he will observe a small, perennial patch, with their green, fleshy leaves, growing by the side of almost every hut. Or, if in Mexico, he will receive his passport on paper of surprising toughness and durability, made from the leaves of the "maguey"—the juice of which, supplying there the place of beer, cider, and more potent whiskey, is sold in the shops, under the name of "pulque." Or if, in the East Indies, he desires to send home some souvenir of his travels, he will select from the stock of an itinerant pedlar, a handkerchief of gossamer-like texture, almost as fine and as delicate as that which the spider weaves, made from the fibres of the pineapple plant, the fruit of which he ate for his dessert. If in Manila, he will find ships of all nations filling up their cargoes with bales of excellent fibres, which he will mistake for hemp or flax, but which he will ascertain, on inquiry, are extracted from the stalks of the plantain—the forests of which, with their broad leaves, shadow over every path and by-road of the island.

And if our traveller be well-informed as to the wants of manufactures and the arts, he will wonder how it is that the acknowledged and increasing deficiency in the world's supply of fibrous materials, has not been filled from the numerous and prolific sources which he sees everywhere around him. He will, perhaps, be induced to inquire why it is that the millions of plantain trees which are cut down throughout tropical America, after having yielded their fruit, are suffered to rot on the ground, instead of being utilised for the excellent fibres with which they are lined. He will ask why the countless agaves, which sometimes surround him like forests, and the myriads of wild-pine plants which throng the woods, and invade every abandoned field, are allowed to send out their fibre-stuffed leaves to flourish and decay, while the world clamors for an increased supply of fibrous materials?

The supply of vegetable fibres from all sources does not meet the present and increasing demands of manufacture, and many of the most important articles of common use, such as paper and fabrics, are steadily advancing in price, from an absolute and growing deficiency of fibrous materials.

Where is this deficiency to be supplied, is a question which is now frequently and earnestly repeated with every succeeding year, and to which no satisfactory answer has yet been obtained. It is true that naturalists without exception, have always pointed to the tropics within which are numerous and exhaustless varieties of endogenous plants producing foliaceous fibres, capable not only of supplying all existing or possible deficiencies, but capable also, of furnishing beautiful, as well as cheap materials, for new and useful manufactures. It is also true, that the production of fibres from tropical plants, has of late years rapidly increased, but not in a ratio equal to the demand for them, owing to the want of simple, cheap, and efficient machinery for extracting the fibres.

All vegetable fibres used for textile purposes, resolve themselves into three great classes, viz., Foliaceous fibres, Cortical fibres, and Capsular fibres.

1. *Foliaceous fibres.*—These are obtained from *Endogenous* or *Monocotyledonous* plants, or inside-growers, which are best known to us in their herbaceous forms, such as the grasses, including the cereals, sugar-cane, and common cane, as also the lily, the cat-briar, and all plants in which the leaves have parallel veins. Under and near the tropics, the *endogens* are represented by the yuccas, the agaves, the plantain, and the great family of palms. These plants do not form a regular bark, show no signs of annual growth, and do not increase by continual additions to the outside of the stem, as is the case with the trees common to our climate. Their fibres are imbedded in the cellular tissues and pulpy matter of their stems and leaves, and may in most, if not all cases, be extracted by a purely mechanical process. The fibres known as Manila hemp, Sisal hemp, silk-grass, etc., are obtained from plants of this class. It is only in tropical and sub-tropical regions that endogenous plants attain any great development, take aborescent forms, or yield fibres suitable for textile purposes. To an inhabitant of the northern temperate zone, an endogenous plant of which the green leaves yield valuable fibres, is a curiosity only to be seen in conservatories or botanical gardens.

2. *Cortical fibres.*—These are obtained from what are botanically known as *Exogenous* or *Dicotyledonous* plants, or outside-growers, and are contained in their bark or bast. They are often of great length, but little hardened, and with the exception of cotton, are the most valuable produced in temperate climates. Some of the plants of this class attain great size. A familiar example is the linden (bass or bastwood) of Europe and America, and the wild-fig or banyan tree of the tropics. A greater number, however, are herbaceous, such as most of the *Mallows*, in which is embraced the cotton plant), a large part of the *Urtica* or nettle family (embracing the familiar hemp), the *Linacea* or flax family, and some varieties of the *Leguminosæ* or pea and bean tribe, such as the *Crotalaria juncea*, which supplies the *Sunn* or Bengal hemp. The stems of these plants consist of a woody core, surrounded by a sheath of fibrous texture, and the two are connected by a peculiar vegetable glue, which unites them in a solid stem. In the preparation of flax, hemp, China-grass, etc., the object is to remove this matter, and thus separate the useless stem from the valuable external sheath of fibres.

3. *Capsular fibres.*—These, as the name indicates, are obtained from pods or capsules. Cotton, a familiar type of this class, is found in the capsules of the *Gossypium*, enveloping the seeds, and in nearly all cases closely adhering to them.

OUR OIL FLASKS.*

Oils? Of course every one knows what oil is. Florence oil—for salads—comes from Florence in those thin flasks always on one side, with a wicker covering that never stands straight, stoppered with cotton wool, or the blunt end of the little straw tassel, when people are untidy and put things to wrong uses;—comes out of the olive berry, those mouldy-looking green things, all salt and oil, which one eats after dinner and thinks very nasty, but daren't say so, and doesn't know what to do with the stones, when one is young and shy and not up to all the niceness of table-manners. Surely there is nothing so very particular about oil that one need make an article out of it! And yet it has some curious facts and circumstances connected with it in its various appearances; quite curious enough for a ten minutes' rapid reading among the graver tasks of the day.

There are two kinds of oils, the fixed or fatty, and the volatile or essential. The first are bland and mild to the taste, and, whether of animal or vegetable origin, are all composed of oxygen, hydrogen, and carbon, but with a large proportion of carbon, which makes them good for food and light. They are the chemists' "oils," "tallows," and "butters." The second are hot and pungent, chiefly used in perfumery and as stimulants in medicine, and of a very varied chemical composition—some containing only carbon and hydrogen, as the oil of turpentine; others adding oxygen, as the oil of cloves; and others containing sulphur, as the oil of garlic. But our present flasks are all filled with the fixed or fatty oils: the volatile or essential must wait their turn.

By the discoveries of Chevreul, "the father of the fatty acids," as he is called, the fixed oils are known now to have three invariable constituents, oleine, margarine, and stearine—all compounds of glycerine with fatty acid—and it is according to the greater or less proportion of one or the other that fat is more or less fusible or solid. Thus, oleine is liquid at any ordinary temperature, but margarine is solid up to 116 deg. Fahrenheit, and stearine up to 130 deg. Fahrenheit. An experiment on these two substances may be made by those fond of chemistry and not afraid of evil smells or dirty fingers. Melt some solid mutton fat in a glass flask, and shake it with several times its weight of ether. When cool the stearine falls in beautiful soft crystals, leaving the margarine and oleine in solution. Press out the soft mass of stearine in a cloth, and evaporate the liquid remaining; you will then get margarine and oleine together, if you press them out through folds of blotting-paper. The residue, dissolved afresh in ether, gives pure margarine;

* There are a great many palpable errors in this article, both in botanical classification and in commercial and chemical details; the writer having evidently aimed more at popular information than technological description, but we republish it for what it is worth, although some parts will cause our readers to smile.—Editor, TECHNOLOGIST.

very like stearine, only melting at a lower point. Oleine is difficult to get pure. The best way is to freeze olive oil, when the margarine crystallises and sinks, and the oleine is left floating at the top, and can be skimmed off. The importance of all these discoveries, and which of the animal fats and vegetable oils have more or less of these compounds, can hardly be over-estimated, when we see their practical results in the beautiful candles which are sold now at half the original cost, and more than twice the light-giving power, of the ancient wax and muttons; and in the pure and bright burning oils—so pure and colourless that they reveal the secret of straw-coloured gloves, and do not let them pass for white.

There is scarcely a portion of the animal body that has not fat mixed with it, either in separate masses, or indistinguishably; as in the bones and fibrous parts of the body to be got at by only certain processes; but not many plants yield oil. The richest are the cruciferous tribe, including the seeds of radish, mustard, rocket, Camelina (gold of pleasure) garden cress, and rape, in the three varieties of *Brassica napus et campestris*, the common rape; *Brassica præcox*, summer rape; and *Brassica campestris oleifera*, or colza. But these are not all good for food or light; some of them being of the kind called "drying oils," as we shall see presently. The quantity of oils to be got from plants and seeds varies, not only in different species of the same thing, but according to climate and culture; still, for broad measurement, it may be said that nuts yield half their weight of oil; *Brassica oleracea campestris*, one-third; the variety called colza, in France, two-fifths; hempseed, one-fourth; and linseed from one-fourth to one-fifth. The grasses and pea tribe (*Gramineæ et Leguminosæ*) rarely give a trace of oil; only one of the former—the roots of the cyperus grass, which is not a true grass by the way—and two of the latter; both foreign. One is called the oil of Ben, from the seeds of a plant (*Moringa aptera*) growing wild in Arabia and Syria but cultivated in the West Indies, and chiefly used in perfumery, "to dissolve out the odoriferous principle of the flowers," being absolutely pure, mild to the taste, inodorous, becoming slowly rancid, and free from all acid; the other is ground-nut oil, from the *Arachis hypogæa*, a native of America. The properties of ground-nut oil were tested by a kind of accident in Europe. A large cargo of nuts had arrived at Bremen, and found no purchasers in their natural state, as good for luncheon or dessert; so the importers expressed the oil, and then found market enough. Where the ground-nut grows, that is, in tropical climates, the inhabitants eat the seeds raw, which then have a slight resemblance to haricot beans, or make them into a kind of paste like chocolate. They are very pleasant when properly roasted, which is rather hard to get done down stairs; and have the further quality of being wholesome and nutritious. The potato tribe, *Solanaceæ*, gives us henbane-seed oil, tobacco-seed oil, and oil of deadly nightshade; while the *Rosaceæ*, which term includes the peach, cherry, plum, almond, and the

seeds of the apple, are among the most valuable of all. But the king of the oil-yielding trees is the Olive; that dusky-looking, shadeless, narrow-leaved, humbug of a tree, which disappoints every one so bitterly at first sight, and for which Europe is indebted to the Greeks of past times, who introduced it from Syria, where the Hebrews had long known its virtues.

The salad oil of commerce and our summer dinners, is said to be got from Nice and Genoa; we call it Florence oil, in a grand kind of generalising way; but excepting the coarse shipments from Gallipoli, good chiefly for machinery, we get but comparatively little Italian oil at all, and very seldom good olive oil unadulterated, even from Aix and Montpellier, whence our chief supplies come. Poppy oil, ground-nut oil, and oil of sesamum, adulterate our table oil; colza oil adulterates the second running of olive oil, for the manufacturers; and colza oil itself is adulterated with various cheaper oils, but principally with whale oil. All of which may be discovered by various chemical tests, by which the oil changes colour according to the kinds employed; but by ways and appearances too long to give here.

The olive harvest at Aix is an important circumstance in the local life; on the good or ill-results of which depends the well-being or misery of many hundreds of people. When gathered, the fruit is heaped up in barns and cellars for a few days, to allow just the beginning of fermentation to set in; only the beginning; for, if suffered to ferment throughout the mass as it lies there, the whole yield would be ruined, and rendered useless save for the coarsest purposes of manufacture. When the exact moment has arrived between the loosening and fermentation, the olives are put into bulrush bags, called cabas, and crushed very gently under a screw. The pale, greenish-yellow, limpid, sweet, inodorous liquid that runs from this first gentle squeeze, is called Virgin Oil, and is the oil used in the watch trade, being a kind of idealisation of oil, not clogging the finest wheels; but happy the gourmand who can go shares with the watchmakers, and command fresh virgin oil for his kitchen! Nothing in the world is such a delicious cooking medium; and the cordon bleu who can get this, dispenses with all forms of lard or butter, until the pale, greenish yellow turns to a more decided gold, deepening and deepening till it gets the awful hue and flavour known as rancid. When the virgin oil has run out, the half crushed olives are taken out of the bags, to be put in again with boiling water, and again pressed, a little harder under the screw this time. The oil and water run out together; and, when cold, the oil floats on the top, and is skimmed off with flat ladles: "lever l'huile" the technical term. This is Ordinary Oil, and very good for the table, too, when perfectly fresh, but inclined to become rancid sooner than the virgin. After the skimming there is still some oil left in the water, which is led away into a large cistern or reservoir, called l'enfer, where it remains for many days, the oil gradually collecting on the top. Then the water is drawn off

from below, leaving the oil, which is known as l'huile d'enfer, or Lamp Oil. Another yield called l'huile fermenté, is oil got from olives in a state of fermentation; but this is rarely employed, and the oil is never met with in trade. Only the virgin oil and the ordinary oil are sent abroad; l'huile d'enfer and the horrible fermented stuff are mercifully kept at home.

Though Spain has such magnificent fruit—the Spanish olives are much larger than the French—she makes but inferior oil, owing to the rudeness and poverty of her machinery, whereby the olives ferment before they can be crushed, and thus the oil is never quite sweet or pure, and soon turns violently rancid, which is the reason why that terrible smell and taste of bad oil, mingled with the smell and taste of garlic, destroys every meal cooked in Spain; while in Italy you have oil cookery without any of these disagreeable results. Italian oil is certainly first-rate, though the machinery employed is not much superior to the Spanish. As for the Gallipoli oil, the manufacture of that is of the rudest and simplest description. The Neapolitan women and children pick up the ripe fruit as it falls from the tree, fling the olives into a mill and crush them up body and bones, skin and kernel together; whence streams forth an oil, according to the law of olive nature. They ladle this oil into skins—sheep, goat, kid, bullock, anything handy—and send it to the seaport of Gallipoli, to be clarified in the huge cisterns cut in the rock on which the town is built; and to be finally shipped off to England and elsewhere, under the name of Gallipoli oil; but by no means to be attempted for food, for frying fish, or for summer salads.

Almond oil is got by squeezing bitter almonds, which are cheaper than, and as good as, the sweet, between cold metal plates. This is the first quality; the second is got by pressing them again between heated metal plates, the heat acting as a further power of expression; and the result of both processes is a sweet-tasted and inodorous oil. When an almond scented oil is needed, then the almonds are first blanched in hot water, and carefully dried again previous to being pressed; by which process the oil retains the odorous particles, and is the "oil of bitter almonds" we all know of. If we want the essential oil of almonds, which is quite another thing, the marc or bitter-almond cake left by the first process—the almonds with all the bland oil expressed—is distilled with water, and the essential oil passes up with the steam and condenses in the worm. Cocoa-nut oil is obtained by heat, pressure, and water, all together. It soon turns rancid, and is principally used here for candles and soap; but employ what perfumes we will in the latter, the horrible smell of the cocoa-nut oil survives and overpowers everything, and when the rose and the almond and the lavender and the patchouli have all vanished from our hands, cocoa-nut oil remains. The Indians and Cinghalese use this oil largely as a pomade, but we cannot do so, unless we become indifferent to evil smells as a national characteristic.

Palm oil is that gold-coloured "butter" which one puts into home-made pomades, more as a colouring agent than anything else, seeing that it soon turns rancid, and so spoils the whole making. It is said that palm oil, when fresh, has the odour of violets, but I suppose I have never met with it perfectly fresh, as this is a fact quite undiscovered by me. It is principally used in making candles, when it is bleached, unless people chance to prefer them of a muddy yellow instead of white ; and that sickening-looking stuff which the railway porters dab into the wheel-boxes to keep them from taking fire, is palm oil and tallow, mixed with a little soda lye.

We all know something about colza oil ; those of us at least who use moderator lamps ; but we do not all get it quite pure as it comes from the seeds of that special *Brassica* devoted to its expression. Colza oil was put on its trial in 1845, when Faraday reported on its excellences and blemishes, on behalf of the Trinity House, interested in getting the best light at the least cost, and, until then, burning sperm in all its lighthouses. This report was decidedly favourable to colza : the light being full one and a half as compared with sperm oil, and the cost three and sixpence a gallon as against six-and-fourpence for the sperm. The price has risen since then, unfortunately, being now, for the ill-luck of the consumers, four and ninepence or five shillings the gallon, and decidedly not better than in the early days ; indeed, not so good, because now adulterated, which it was not then. Not only for light, but also for food and manure, is the colza plant valuable to the world. Cattle fatten on it, and ground fattens on it ; and the Abbé de Commerel, the introducer to the French Agricultural Society in 1789 of this chou à faucher—"mowing cabbage," as he calls it—was a greater benefactor to mankind than he dreamed of. Colza cabbage may be said to have been one of the agents of civilisation.

Then there is laurel oil, or "the oil of bays," got from the berries of the bay tree (*Laurus nobilis*) principally from Italy and the south of Europe generally ; the greater part being shipped from Trieste ; and which our doctors and veterinary surgeons use as a stimulating liniment for sprains and bruises, and in paralysis. Is it one of the ingredients of the famous nine oils ? Also the native oil of laurel or laurel turpentine, imported from Demerara, and got by making incisions in the bark of a large forest tree called by the Spaniards Azeyte de sassafras, and growing in the forests between Orinoco and Parime. These incisions yield a pale yellow oil, smelling something between turpentine and oil of lemons, and easily dissolving caoutchouc. The *Vateria Indica* a Malabar tree, gives "piney tallow oil," if the fruit is boiled in water and the fat skimmed from the top. It is white and smells pleasantly, makes good soap and candles out in its native place, but is little known and less used here. Then our spindle tree gives us an oil as well as butchers' skewers ; an oil yellow and thick, bitter and acrid to the taste, and in odour like colza ; and the beech-tree has nuts good for feeding pigs,

but better for the 12 per cent. of oil to be expressed from them—a clear oil, thick, inodorous, and pale-yellow in colour, used in France for both light and cooking, and in Silesia, by the peasants in the place of butter. And there is the oil of mustard-seed, good for soups and cooking; and tel oil, or the oil of the *Sesamum Orientale*, called "oily grain" in South Carolina, and used for soups and puddings like rice, the oil coming in for salads, and, indeed, being often mixed with olive oil: the oil of Ben, already spoken of; rapeseed oil—the ordinary English rape, which is the best—used for lighting, for the manufacture of soft soaps, in the preparation of leather, and for oiling machinery; plum-kernel oil, tasting like the oil of sweet almonds, transparent, and of a brown-yellow, soon turning rancid, but much liked in Wurtemburg for lighting purposes; and the "butter of cacao," from the nuts of the *Theobroma cacao*, when crushed in hot water, and had to the extent of 50 per cent. It is yellow, but can be melted white in hot water; smells and tastes like the cacao nut; is of the consistency of suet, and keeps long fresh without turning rancid. And, lastly, there is the "butter of nutmegs," prepared by beating the nutmegs to a paste, steaming them, and then pressing them between heated plates. This butter is imported in oblong cakes, covered with leaves and looking like common bricks, of an orange colour, firm consistency, aromatic and fragrant in odour, like the nutmegs themselves—when not wooden. A spurious article is sometimes made of animal fat boiled with powdered nutmegs and flavoured with sassafras; but it can be easily distinguished by the wary. All these are the non-drying oils, good for food and light, the oils which, as they grow old, get thicker, less combustible, offensive to the taste and rancid, irritating the throat in consequence of the acid that is developed in them. But that acid can be removed by boiling rancid oil in water, with a little magnesia, for a quarter of an hour, or until it no longer reddens the litmus paper.

Now we come to the drying oils, those which go chiefly to make painters' varnishes, which dry up into a transparent, yellowish, flexible substance, with a skin formed over the surface of the oil, by which all alteration of its condition is stopped. When boiled with litharge, or oxide of lead, they become even more drying, as every painter, fond of experiments, knows; and if one-eighth of resin is added to the process it greatly improves the look of the painting when dry. First, there is linseed oil, which makes printers' ink when it has been burned and mixed with one-sixth of its weight of lamp-black, which is a final dressing to thin-gummed silks, which varnishes leather and oilcloth, and which, when thoroughly expressed from the seeds, leaves "oil cake" for cattle-feeding and the destruction of pleasant milk and butter. Then there is walnut oil, an even more rapidly drying oil than linseed, used chiefly for paints and varnishes, and, because it gets white by age, for white paints; and hazel-nut oil; and poppy oil from the seeds,

which have none of the narcotic properties of the capsules whence we get the laudanum, the seeds being sold for birds, under the name of maw-seed, and quite harmless. The oil is like olive oil in look and taste, and is used to adulterate it; when treated with litharge or sub-acetate of lead, it is used for paints—without such treatment, for lighting. Hempseed feeds birds, and gives a capital oil for varnishes; also sometimes used for lighting, but not often or satisfactorily, for it makes a thick edge and clogs the wick; it does better in the soft soap and paint manufactories. Sunflower oil makes soap; it is sometimes used for food, and sometimes for lighting, but chiefly for soap. Grape-seeds have an oil which must not be confounded with the fusil oil obtained in the rectification of spirits, whether from grapes or corn, for the one is bland and insipid, inodorous, and sometimes, in the south, used for food, and the other is simply disgusting, but largely used for confectionary. And there is the oil of belladonna, which is used in Wurtemburg for lighting and cooking, limpid, golden-yellow, insipid, and inodorous, with all the poisonous principles left in the residual cake, which cannot, therefore, be used for cattle-feeding, as other more harmless residual cakes, and the expression of which stupifies the workmen employed. And there is tobacco-seed oil, limpid, green-yellow, and inodorous, and with no more of the narcotic principles of the plant than poppy-seed oil. And, lastly, there is castor-oil, and there is croton oil; the one got by expression from the seeds of the *Ricinus communis*, or Palma Christi, the other by expression and distillation by alcohol, from the seeds of the *Croton Tiglium.* These are the principal vegetable oils, of the fixed or fatty kind.

The only animal oils, properly so-called, are lard-oil, tallow-oil, and neat's-foot oil: and these are obtained from the fats of the various beasts indicated—from hog's lard, from sheep's tallow, and from cow-heel; but the fats, or stearine, or adipose tissue, or by what name soever it is considered well to call them, come quite under another heading, and do not rightfully run into our oil-flasks. Lard oil is used for greasing woollens; tallow oil makes the best kind of soap; and neat's foot oil oils church clocks admirably, because it does not solidify at even a comparatively low temperature, neither does it soon turn rancid.

The animal oils are few, and the fish oils are not many; but of enormous value. First, there is train oil, which comes from the whale, the porpoise, the pilchard, the seal, and others; an oil of a brownish colour, disagreeable to the smell, used for lighting, for making soft soap, and in the preparation of leather; also, says historical ill-nature, much valued as a winter dram by Russian soldiers, to whom a pound of tallow candles is as welcome as a box of bonbons to a Spanish belle. The peculiar, and most peculiarly disagreeable odour of train oil, is due to the decomposition, during the homeward passage, of the animal

matter attached to the blubber, by which is developed a certain fat composed of glycerine and phocenic acid. Porpoise oil is very like whale oil. Cod-liver oil is got from the livers of the common cod, the dorse, the coal-fish, the burbot, the ling, and the torsk. In Australia, the liver of the dugong is used instead of the cod; but no dugong liver oil has found its way over here. Fish oil of various kinds is largely used for soap-making; and the famous Naples soap is made from fish oil and potash, giving a marvellous lather for strong beards; but before any soap can be made, the glycerine of the oil must first be got rid of, when the fatty acid is mixed with alkali and soap is formed. In the case of glycerine soap, the glycerine is put back again, when it combines in a different manner. Diachylon plaster, an insoluble soap, is only lead and oil; and ammonia and oil is a "volatile liniment, forming a milky emulsion, and used as a rubefacient in medicine." Are there many who recognise in these majestic words our old greasy friend, the hartshorn and oil bottle?

Then there are essential or volatile oils, found in various parts of plants; in the flowers of some—as the orange-flower (neroli), the dried clove-bud (essential oil of cloves), the elder-flower, lavender-spikes, rose-leaves (attar or otto of roses), jessamine, mignionette, camomile, and, indeed, in all sweet and strong-smelling flowers; in the fruit of others—as the oil of bergamot from the ripe fruit of the *Citrus bergamia*, the oil of nutmegs (not the butter), extracted from the inner lining of the nutmeg, from juniper-berries, orange rinds, and lemon rinds; in the bark of others—as oil of cinnamon from the bark of the cinnamon tree of Ceylon (*Laurus cinnamomum*), oil of turpentine, distilled from the "oleo resin" of pine trees, and when rectified and re-distilled sold as the camphine which smokes so abominably when not sufficiently supplied with air, and which smokes more abominably still when left exposed to the air, by which it becomes resinified again, and unfit for burning; in the leaves—from orange-leaves, from the dry leaves of the *Melaleuca cajeputi*, known as cajeput oil from the Moluccas, oil of savine, from the leaves of the *Juniperus sabinus*, and others; in the seeds of many, and in the roots of a few. But the essential oils have a less varied usefulness than the fatty; and if a law was passed prohibiting the use of perfumes, there would then be very few distilled at all. But all are not distilled; for the essential oil of certain flowers, in which resides the perfume, or what chemists call the "odoriferous principle," is so delicate and evanescent that the only way to get at it is by imprisoning it in a neutral medium, as in the process called enfleurage. Scented buds and petals are gently laid in perfectly inodorous grease, which thus becomes impregnated with the perfume.

Oil has a peculiar facility for developing heat. If hemp, or wool, or paper, sawdust, rags, soot, shavings—what not of refuse—be smeared with oil, and left to the free action of the sun and air, they will soon

get hot, begin to smoke, and finally burst into flame; which accounts for many of the apparently mysterious fires of mills and manufactories. And if linseed oil and ground manganese are "triturated" together the soft lump so formed will speedily become firm, and take fire of is own accord. Oils are purified by sulphuric acid, by steam and hot air passing through them, and by tannic acid. Mineral oils, so-called, are not oils at all, according to the proper definition of oils; they are fluid hydro-carbons, with the addition in the Burmese naphtha, of a considerable quantity of paraffine.—'All the Year Round.'

THE TOBACCO PIPE MANUFACTURE, PIPE CLAYS, AND MEERSCHAUM.

BY JOHN GEORGE REYNOLDS.

The manufacture of the tobacco pipe is an item of labour which has required for this purpose nearly 40,000 tons of clay per annum, of which quantity about 12,000 tons are consumed in the United Kingdom, supplied principally from the Clay works of Messrs. Whiteway and Co., Kingsteignton, Newton Abbot, Devonshire, who have also supplied the French manufacturers for the last six years.

Those who do not indulge in the use of tobacco may despise an article which ministers in no way to their pleasure, but on the other hand excites their disgust. A feeling kindred to this might have possessed the mind of the Greek Sage, who, when passing through a fair at Athens, and on seeing stalls filled with a variety of wares, exclaimed, with a derisive smile:—"How many things are here that I do not want." Many may smile at, but we think they cannot but admire, the amount of science and skill which has been brought to bear upon a want so general, and in the gratification of a pleasure which none but the smoker can appreciate. There are those who decry the use of tobacco, and who denounce it in the strongest terms. Medical and other men have written against it; but they have never advanced anything specific upon the subject. They argue, that as nicotine the active principle of tobacco is injurious in its isolated form, the use of it must be pernicious. The experience of mankind does not confirm their opinion although we cannot but admit, that the excessive use or abuse of tobacco, as of everything else is injurious.

We shall proceed to illustrate the nature of clay, and its adaptation to the tobacco-pipe, and then go step by step through the several processes, from the native material to its completion.

Granite is the primary constituent of pipe clay, deriving its name from the Latin word "Granum" (grain). Granite is a mixture of quartz, felspar, and mica; the pavement of London Bridge, hewn from the Haytor

Rock in Devonshire, is a beautiful specimen of granite. It is chemically divided into alumina, silicic acid, and mica ; the disintegration of these three compounds forming an earthy mass, which is commonly called clay.

The clays principally used for pipe-making and other purposes, appear to take their origin from the above named granite hills of Haytor, on the borders of Dartmoor, and from thence deposited in a large sheet or mass at their base. Owing to floods and other causes, the purer portions of the disintegrated felspar of the granite has been propelled onwards towards the sea, and deposited in fine channel-like and continuous beds, by the flood-charged streams. This may account for the different qualities of the clays, as each ribbony deposit is varied from the others in its adaptation to manufacturing purposes. For instance—one, a dark body, burns similarly to China clay from Cornwall ; another is a white body, and is more plastic, and is used for long tobacco pipes, it would not vitrify sufficiently for pottery purposes These clays are unique in themselves for the particular manufacture for which they are suitable, and no deposits have yet been found of identically the same nature.

The Granite Hills at Haytor, from whence these deposits are presumed to arise, are in Ilsington parish, about twelve miles in a direct line from Teignmouth, passing through the neighbouring parishes of Bovey Tracey, Hennock, and Teigngraie, until they reach the parish of Kingsteignton, where the deposits appear to be the purest and most continuous, and whence clays have been procured for manufacturing purposes, for a period of at least a century. Messrs. Whiteway have the largest portion of these deposits, either as owners themselves, or renters of the clay property of other landowners ; and they are the present representatives of a firm which has been in existence for more than half a century.

As it may not be uninteresting to some readers, we shall briefly explain the nature of the three chemical divisions of this important article of manufacture, and would observe that aluminum forms a portion of the crust of our earth, since its oxygen compound, which is termed alumina, constitutes (next to silicic acid and lime) the mass of the greatest number of minerals.

Crystalized alumina is found under the same circumstances as crystalized carbon : thus the sapphire, consisting of pure alumina, and distinguished by its hardness, lustre, and the variety of its colours, is numbered among the precious stones, and is considered next in value to the diamond.

The aluminous portion of clay is an important material in the process of dyeing, and it is this that fixes the beautiful colours in our prints, muslins, and other fabrics. Alumina having an affinity for vegetable matter, forces a portion of the colour into the fibre, thus making it secure and permanent.

This clay purified, absorbs moisture with extraordinary power. Hence its use for removing grease spots from cloth and silk. As an experiment take purified pipe-clay in powder, moisten with water, powder sufficient to cover the grease spot the thickness of a shilling. then break the head from off a long pipe, placing the thick end in the fire until it is red hot, and placing the cool end in the mouth, blow hot air on the moist clay, by which means the grease is softened, and the water evaporated from the clay. The active evaporation brings into play the powerful absorbing property of the clay, for while the water passes off in steam, the grease takes its place. Remove the clay when cold, and cleanse the material with a sponge.

A remarkable and curious fact, illustrating the power of alumina, or of aluminous clays (5,000 tons of which are used annually in Newcastle-on-Tyne in making alum.), in the preservation of colour, may be here related. In the year 1854, bunches of nuts were discovered imbedded in the clay underneath the gravel at the Kingsteignton Pits, twenty feet beneath the surface, in all their natural colours.

Corundrum and emery are alumina, without the use of which substance grinding and polishing metals would be a diffiult process.

Silicic acid is another principal constituent of most minerals and next to oxygen, may be said to form the greatest portion of the earth's crust. It is found in a variety of forms. Rock crystal, found in the caverns of St. Gothard in beautiful hexagonal prisms, terminating in pyramids with six faces, is pure silicic acid. In the soluble form it is found in almost all springs, whence it enters into the organism of plants, being as essential to the vegetable world as salt is to the animal creation. It is not acid to the taste, and is endowed with very feeble affinity ; hence it is sometimes called silica.

Mica is the least important of the three chemicals enumerated as composing granite, and it cannot be described by formula. Alumina and silicic acid are the principal constituents. It is found in various rocks largely distributed ; for instance, in granite, gniess, and mica slates, in which it is observable as lustrous laminæ. It is found in Siberia in large plates, which are used instead of glass for windows.

Having endeavoured to describe the nature of pipe clay, we shall now proceed to point out the various processes which the pipe undergoes prior to its completion ; and here there is much to interest and much to admire. The pipe is an ingenious contrivance. The bowl is a kind of furnace in which tobacco is burnt ; the chimney to this furnace is a long or short perforated stem, and the draught is caused by the smoker drawing air through the bowl ; this supplies the ignited tobacco with fresh oxygen, and the products of combustion consisting chiefly of nitrogen, carbonic acid, and oil of tobacco in a volatile form, pass up the stem into the mouth of the smoker, the length of the stem cooling the smoke, and owing to the porous nature of the clay, absorbing

the oil; while the ashes, consisting of salts of potash, lime, and carbon, remain in the bowl.

The colouring of the pipe is not so much attributable to the deposits of oil in the bowl, as to the smoke itself. To illustrate this, procure two pipe bowls—one large, the other small; in the small bowl place the tobacco, and fix it in the larger; then ignite the tobacco, and you will find that although nothing but smoke comes in contact with the outside bowl, it will colour much sooner than that which contains the tobacco.

The clay is extracted from the pit in square blocks which weigh about thirty-two pounds. These are dried, and if dirty are scraped clean with a knife; they are then broken into small pieces, about the size of a hen's egg. These pieces are soaked in a slight excess of water, in tubs, iron tanks, or any suitable receptacle, for forty-eight hours. They are then taken out, and mixed with the cuttings or parings, for the purpose of preventing any waste, and also with the view of absorbing any extra moisture, and giving the clay its required firmness and plasticity. They are now beat with an iron bar, ground in a clay mill, or passed between rollers, according to the circumstances or notions of the maker. The clay is again worked into square blocks from 56 to 90lbs. weight; this weight is generally computed by the number of grosses each block will make, as the 4-gross or 6-gross block. Workmen accustomed to make the same sized pipes for several months, can judge the number of pipes each lump will make to a dozen or two. The clay is now placed on the bench, one corner of the ball resting upon the end of a board, called a rolling board, to the right of the operator, who grasps with his right hand sufficient clay for two pipes; this he divides with his left hand, and this is done so equally by the sense of touch, that out of a gross of these divided pieces, which are called nips (from being nipped in two by the fingers), you would scarcely find one that would vary more than a quarter of an ounce in weight. The nip is now placed under the palms of both hands on the board, and is elongated from the point, or what is to be the mouth-piece of the pipe, graduating in thickness to the bowl, about one-third of the nip being left on the thick end of what is called a roll. These rolls are laid in bunches of from 12 to 16, and are dried until they are fit for moulding. To test this they must stand on their heads or bowls without bending, then they are considered sufficiently dry.

Moulding gives the pipe any required shape, by the assistance of a screw-press and lever. In commencing this process the bunch of rolls is carefully divided, and laid loosely upon the bench, the point or narrow end of the roll near the left hand of the moulder. This point is taken between the fore-finger and thumb of the left hand, the wire to drill the pipe is in the right hand, and is drawn across oiled wool to prevent the clay from sticking to the wire. But the greasing of the wire is not sufficient of itself to the true boring of the pipe. The wire must

be scraped with a knife, and in the scraping the knife is made to vibrate by being held near the thin end of the blade, and the wire drawn sharply under it indents the wire uniformly, slightly narrowing it near the end which first enters the clay. This being done, the wire is cut off to the required length by being rolled backwards and forwards under the edge of a blunt knife. This process of cutting forms a projection on the point of the wire; should this projection or head be too small, it is enlarged in a similar manner to the formation of the head of a small nail. This head is called a button, and is somewhat larger than the thickest part of the wire. The notching of the wire is to form receptacles to carry the oil and the air up the stem; the button is to enlarge the bore, so as to allow the wire to pass freely up the stem, sufficiently oiling it so as to allow its withdrawal after the clay has received a heavy pressure. It requires more skill than is seen at first sight, to make a wire which can be thus withdrawn from the pipe in its soft state, after being pressed, so as to prevent the pipe being elongated beyond the length given to it by the mould, for in case the pipe were stretched, its tension would be destroyed, and if it did not break at the time, would be so weakened that it would be almost valueless. The roll with the wire in it is now laid in one-half of the mould, which has been well oiled; the second half is then placed upon it and fixed by means of pins which correspond in both halves, and is put into an iron press, the superfluous clay being pressed out between the joints. To form the bowl, a piece of iron of the required shape is suspended to a lever over an aperture in the head of the mould, the lever is then pulled downwards, and the piece of iron, called a stopper, is forced into the lump of clay left by the roller for this purpose. In thus hollowing out the bowl, the waste clay forms a ring around the stopper, and enters a space left for its reception; this waste in England is usually cut off by the moulder, but in France by the trimmer. In the writer's improved method, the machine cuts off its own waste. The mould is now opened, the pipe lifted out, the wire withdrawn and placed on a board to dry.

We are thus brought to notice the next process, which is trimming. When the pipe is sufficiently dry, the finisher or trimmer passes up another wire through the stem into the bowl, to remove any particles of clay, and to ensure a free current. While the pipe is thus stayed or strengthened, the trimmer removes the surplus clay or seam left by the mould with a grooved knife (this groove fitting the stem, as also another groove fitting the head of the pipe). The pipe is now laid on a smooth block of any hard suitable wood, when a steel burnisher is passed up and down the stem, the trimmer balancing the burnisher in order to keep a uniform pressure, at the same time turning the pipe, by which means it obtains an even polish. This method of polishing the pipe adds materially to its solidity and durability; hence, one reason why our pipes are stronger than those of other makers, especially of the Continental manufacturers, who give a polish to their pipes with a small

piece of agate, unsupported by the trimmer's block. The point of the pipe is now cut, and the top of the bowl smoothed down with the palm of the hand or a damp sponge. It is then taken off the wire, and is laid flat upon a board, if intended to be straight ; if bent with the usual curve, the pipe is laid on a dryer, the bars which support it being hollow in the centre. The pipes when of a greyish white, are removed and packed into a kiln, or into seggars (which is an improved method), the old and primitive plan being to pack them directly into a large crucible, standing upon five legs, made of fire brick or clay, mixed with crushed pipes. The crucible is built by piling small rolls of clay one on another, wetting each roll slightly so as to assist adhesion while worked together with the hand.

This kiln, or large crucible, is built inside a circular furnace about twelve inches larger than the kiln, leaving a space of about six inches between the furnace and the kiln. When the kiln is filled with pipes, the space that admits the man to stack the pipes within, is bricked up with pieces of burnt clay of the uniform thickness of the kiln, and the top or dome is covered with clay spread on paper, to keep out the flame and sulphur, which would otherwise discolour the pipes while burning. The kiln being ready, the fire beneath the centre is lighted, and is kept increasing in heat for from 7 to 16 hours, the time required depending upon the size of the kiln, some of which hold 30 gross, and some about 100 gross.

The improved, or seggar kiln, is simply a large furnace in which the seggars containing the pipes are piled, and which hold about 2 gross each, so that these kilns are made to contain from 200 to 1,200 gross. They have from three to six fire-places, the crucible kiln having but one. They are a decided improvement upon the old system, and add materially to the quality and shape of the pipes.

In the year 1653, King Charles the Second granted a charter "for the good of his subjects, tobacco pipe makers, as they had been trained up and long exercised in that art, and intending to restrain and suppress the growing numbers of loose and idle persons intruders in that trade, and to appropriate the same to such only as theretofore had been, and thereafter should be, orderly and honestly educated, and brought up as its apprentices according to law. For the effecting thereof, his princely wisdom thought fit to create and constitute sundry persons in the said Letters Patent named, into a Corporation, or body politique, and corporate in deed and name, by the name of the Masters, Wardens, and Assistants, and Fellowship of the Company of Tobacco Pipe Makers, in our cities of London and Westminster, and our Kingdom of England, and Dominion of Wales ; some of which Pipe Makers had, by their industry and expense, found out a new way of burning the said Tobacco Pipes with sea coals, or pit coals, which were formerly burnt with wood, to the consumption and decay thereof. And whereas our said subjects, the tobacco-pipe makers, have for them and their successors, entered

into a covenant with us, our heirs and successors, that for ever hereafter they will burn their tobacco pipes with sea coals or pit coals, without the use of any wood towards the same. Know ye, therefore, that we especially minding the due and orderly making of the said manufacture, and the encouragement and improvement of the same within this our kingdom, by forbidding the importation of all foreign tobacco pipes ; and being desirous also to provide for the preservation of wood, which of late years has been much consumed, and whereof there is now grown a great decay and scarcity in most parts and places of this our Kingdom of England and Dominion of Wales ; and being graciously inclined to the humble desires of our said subjects in the premises, and for divers other good causes and considerations, as hereunto moving our special grace, certain knowledge, and mere motion, have willed, ordained, constituted, granted, and declared, that our said subjects, the tobacco-pipe makers, within our said cities of London and Westminster, and our Kingdom of England, and Dominion of Wales, and every of their apprentices whatsoever, when they shall have served as apprentices in and unto the said art, mystery, and trade, by the space of seven years at the least, and all others that shall be admitted or made free of the said society in such manner as in these presents is declared and specified, shall be from henceforth for ever hereafter one fellowship and one body, corporate and politique, in deed and in name, by the name of the Master, Wardens, and Assistants, and Fellowship of the Company of Tobacco Pipe Makers, of our said cities of London and Westminster, and our Kingdom of England and Dominion of Wales."

The Charter proceeds to provide for the offices, and constitutes " our well-beloved subject," William Brown, to be the first Master of the said society of tobacco-pipe makers.

Four Wardens and fourteen Assistants are afterwards provided for in a similar manner, and a fine, or mulct of a sum of money, not exceeding ten pounds is imposed upon persons elected to fill the offices, " refusing to undergo or accept the same." A clerk is then appointed who is to continue in the said office during the will and pleasure of the Master, Wardens, and Assistants, during the time being.

It is further ordered and commanded, that " all and singular, justices, mayors, sheriffs, bailiffs, constables, and other officers, that they and every of them be helping, aiding, and assisting to the said Master, Wardens, Assistants, and Society, and to their successors, for and in the execution as well of these our Letters Patent, as all and singular grants, orders, etc., hereafter by these presents allowed and approved of according to the statutes of this realm ; and to the end, that the said Society of tobacco-pipe makers, may the better live and be maintained by the said art and mystery ; we do, therefore, for us, our heirs and successors, will, ordain, prohibit, and forbid, all and every person and persons whatsoever, of what estates, condition or quality soever, that they or any

of them shall not, or do not, at any time hereafter import, convey, or bring, or cause to be imported, conveyed or brought, into this our realm of England and Dominion of Wales, from any part beyond the sea, any kind or sort of tobacco pipes whatsoever to be here uttered, sold or put to sale upon pain of being punished according to the utmost severity of our laws." It was further enacted "that they nor any of them do from henceforth for ever hereafter directly or indirectly export, transport, carry, or convey out of our said Kingdom of England or Dominion of Wales, any tobacco-pipe clay into any other foreign parts under the penalty of three shillings for every pound of tobacco-pipe clay which shall be exported or transported, mentioned in a certain Act of Parliament began at Westminster the eighth day of May, in the thirteenth year of our reign, and there now held and continued."

It is not difficult to trace the motive which must have induced Charles to grant this Charter; for it is easily seen that the consumption of tobacco, from its introduction into England by Sir Walter Raleigh during a period of about 68 years, had become so great that it led the king to fear that his forests would be destroyed in supplying the timber necessary to burn the pipes made.

It is also a curious fact, that at the present day coals are prohibited in the burning of pipe kilns in populous towns, and of necessity a great quantity of coke is consumed.

This charter, from which we have extracted so freely, is kept up to a certain extent to the present time, for it is well known that within the last ten years pipe-makers have been imprisoned for disobeying its laws. The Company now hold their Court at the Guildhall, and is composed of a Master, Wardens, and a Committee, who are called "Legs of the Table," corresponding, we suppose, with the "Assistants" of the Charter.

Several Bye Laws were passed in the reign of George the Third, for the better regulation of the trade, and all persons exercising the same (pursuant to the Charter granted to the Company) and were approved, allowed, confirmed, and signed by the Right Hon. the Lord High Chancellor of Great Britain, and the Right Hon. the Lord Chief Justices of His Majesty's Courts of King's Bench and Common Pleas, April 9th, 1821. In the reign of Queen Anne, a duty was levied upon the pipe, but we may well suppose it was a tax as obnoxious to our countrymen who lived in that reign, as the latest item of American taxation will be to our Yankee cousins, namely, a duty upon Crinoline.

Smokers are not aware to what a wretched state the makers of the common clay pipe have been reduced by the Innkeepers of England and the Tobacconists of Scotland, owing to the introduction of the system of giving pipes away.

It may be readily imagined that persons buying articles to give away, will, in almost every instance, select the poorest quality at the lowest price possible. This state of things has not only materially injured the pipe-maker, but as well the smoker. I would show this from

the fact, that the proportion of best pipe-clay sold by the merchants, Messrs. Whiteway and Co., is only one third, while the second quality has increased considerably, and the consumption of the third quality is more than doubled. Taking into consideration the fact of third-class clays worked by ill-paid artisans and comparing them to the good old pipes in use twenty years age, the question is answered: Why smokers of the present day prefer an old pipe. While we need look back only a dozen years and find that thousands of smokers would not use a pipe a second evening, any more than a gentleman of the present day can with any pleasure smoke the second half of a cigar, left on the past evening, the following morning. Why this change? Because third-class clays emit an unpleasant odour when heated, termed the "clay odour," and because pipes made from these clays are only about half burnt and are thus not fully purified from their earthy taste and smell.

The untradesmanlike practice of giving away pipes to promote the sale of beer and tobacco, has done much to destroy this branch of industry, pipe-making, while at the same time it cannot have improved the quality of the article sold, or the morality of the retailer of beer or tobacco, the quality of which must be reduced in proportion to the value of the pipes given away. It can be easily proved that hundreds of Licensed Victuallers in this great Metropolis give pipes away, to the amount of from 5s. to 25s. per week; and does any one suppose that this loss is not counterbalanced in some other way?

It was the occupation of the landlady or barmaid, during the leisure hours of the day, to make preparation for the public. These ladies thought it would be less trouble to sell packets of tobacco rather than continue the old custom of filling each pipe and charging ½d., ¾d., and 1d., for pipe and tobacco, according to the size of the bowl and length of the stem. The idea was carried into practice and the tobacconists were appealed to, and they very naturally offered to supply 64 to 70 penny packages to the pound. This offer was accepted, and the package was introduced and was immediately baptized by hundreds of smokers and had as many sponsors who stood to the appropriateness of the name given. By some it was called a "Soft-roed herring," supposing it was anything of a respectable size. When small it was termed a "roeless herring" when smaller still "a dead nail;" when damp and the tobacco bad "a choker;" and in truth it was enough to choke any smoker often-times. However, the name which was ultimately given to it was a "screw." It is not for me to say who might have been the fanciful baptizer of this lilliputian parcel; but it may possibly be traced to the horse-jobber, who, after his days' work was done, sat down to his beer and asking for a pipe and tobacco was handed one of these pennyworths, when he was forcibly reminded of a transaction of the day and involuntarily pronounced the word "screw." Be this as it may, the screw was sold for a penny; but it often occurred that the halfpenny pipe filled with tobacco under the old system, contained as much tobacco as the screw. This

of course induced many to bring their tobacco with them, and then they borrowed a pipe. Borrowing led to stealing, and in some cases one halfpenny was charged for the pipe, which on its being returned was refunded.

The introduction of the screw gave rise to several curious laws which were local only, and which varied according to the temper and disposition of the several Bonifaces, and were peculiar to smoking rooms only. One of these is as follows, and was placed over the mantle-piece :—

> Those who bring Tobacco here,
> Must pay for Pipes as well as beer."

Some wag, however, soon caused the obliteration of these lines, by adding the following—

> "To buy Tobacco here from you,
> Convinces us that you're the screw."

This state of things continued for some time, until the respectable tobacconist sold a better article in pennyworths to the publican, but the principles of the trade have from that time to this been questioned ; the "pennyworth of tobacco" is looked at to this day with suspicion, and the publican is oftimes "roasted" respecting its size.

Then began the ruin of the pipe-maker's trade, for the answers to the complaning customer was—"Well, you get a pipe and paper of tobacco for a penny," and from this time the landlord's cry was "Make us cheap pipes, do not study their quality."

Importers of fancy goods, seeing that they could be made for publicans to give away, thought that they would sell pipes, and consequently sought out the little makers who manufactured their goods in garrets and cellars and bought all they could make. These poverty stricken pipe-makers were the discharged employées from respectable manufacturers who refused to use a third-class clay, to make an article which would ultimately destroy their credit as good manufacturers. Some of these buyers succeeded in getting a monopoly of the trade by representing themselves as makers, and sold the very worst description of pipe at the highest prices. By this means the English pipe got into bad repute, and the French manufacturers poured their goods into this market for ten years and have made large sums of money. Knowing this, and as an English manufacturer suffering a loss in consequence, I became determined to uphold the merits of English goods ; and owing to my having adopted a method of purifying my own clays in my factories at Bristol and in London, I was soon able to convince the public of the superiority of the English pipe, and thus restored much of the trade to its legitimate channel, reducing the importations from France about 20 per cent.

As this paper may not be considered complete without allusion being made to the manufacture of meerschaum into tobacco pipes, I will endeavour briefly to describe the properties of this substance which has been much misunderstood.

Meerschaum is a hydrated silicate of magnesia, $MG.O.SI.O_3.HO$.

It is found in Greece, Spain and Moravia, but the finest quality is produced in Turkey in Asia. Its French name is Ecume de Mer, hence the reason why it is almost generally supposed to be solidified froth of the sea.

Meerschaum is found in blocks of various sizes and shapes, and consequently, is not cast as Plaster of Paris, or moulded as clay. The natural blocks are cut into shape first by a saw, and then with a knife and chisel. The stem and upper part of the bowl are turned in a lathe After the turning of the pipe, it is cleaned and boiled in white wax, which imparts to it its required beautiful polish.

The meerschaum mines in Turkey are the exclusive property of the Sultan, who exacts a very high price for it. It is packed in cases, and the prices fixed upon it according to size of the blocks, the larger ones being ten times the value of the smaller pieces. This is one reason why a large meerschaum pipe is so expensive. Another reason which may be assigned is, that some of the blocks are faulty. These faults or blemishes are not discovered until the pipe has received its coating of wax, and, consequently, to a great extent the labour is lost, and the manufacturer is obliged to put an extra price upon the perfect pipe.

The agents of the Sultan of Turkey do not allow the purchaser to select his own meerschaum. The price is affixed on each case, which must be paid before it can be opened or examined, and should the case turn out faulty, the buyer has no redress.

It may not be out of place to add that the writer was the first Englishman who ever imported or manufactured meerschaum into the United Kingdom.

THE WINES SHOWN AT THE INTERNATIONAL EXHIBITION OF 1862.

BY J. B. KEENE.

We have been favoured with a copy of the report made by Mr. Keene to the Commissioners of Customs, of the results obtained by him in testing samples of the various wines exhibited last year, from which we make the following extracts :—

Those exhibitors to whom I had an opportunity of mentioning the subject entered willingly into the plan, and, from the wines which were deposited in the west cellar of the Queen's Warehouse, I was from time to time freely supplied with samples for testing. Of the wines which were exhibited in the International Exhibition Building I obtained 18 representative samples, of Australian vintages only. This result was doubtless the consequence of being unable personally to look after the

matter in that quarter, though I had numerous promises, which I fear, however, will remain unfulfilled. This I much regret, as not only the Spanish and Portuguese wines, but also the Russian, Greek, and other kinds hitherto comparatively unknown in this country, as well as the growths of our colonial vineyards, were solely represented there; examples of which would have added greatly to the interest and value of these tables.

The list is nevertheless a large one, comprising in all 569 samples, which are thus divided :—

France	331
Italy	112
The Zollverein	67
Austrian Empire	41
Australia	18

The first portion of the tables contains the information relative to the individual samples, namely, colour and strength, and, when it could be obtained, the date of vintage. The wines are classed, first under the National, and secondly under the Provincial head, while in some instances a more specific reference to the locality of the vineyard is given.

The whole is afterwards massed in a general abstract. In this the red and white wines of each province are separately arranged, to show the number of samples tried and the average strength obtained. The highest and lowest degree of actual strength is also given, and the number of samples in each instance, the strengths of which exceed or fall short of the average. This serves to give a truer value to the average itself, by indicating whether the bulk is tolerably uniform, or whether the average is raised or lowered by the extreme strength or weakness of a minority of the samples.

A desire was expressed by several persons interested, to have some guide by which to compare the French and English degrees of strength. Through the kindness of Mr. Selby, I obtained a French hydrometer, and, after a series of careful experiments with it and one of Sykes's, in mixtures of alcohol and water of various gravities, I calculated the table which I have placed at the end of these papers, and in which the value of degrees "overproof" and "underproof," and the relative percentages of proof spirit, are referable to the equivalent in the French reckoning.

As the means at my command were wanting in that extreme nicety requisite to obtain a perfectly exact result, it is possible that a slight error may exist. The maximum difference at the highest point could, however, be only 1·5 per cent. of proof spirit; that being the difference between 75·5 overproof, which is the strength of anhydrous alcohol, according to recent experiments of Mr. Phillips, and 74·0 overproof, which would appear to be the French estimate, according to the instrument I used. But it is probable that the estimate of Gay Lussac was

nearer the latter than the former strength, which would therefore reduce the supposed error, and what remained, divided through the table, would be inappreciable in practice at those parts most commonly required.

On inspection of the series of tests, some great extremes of strength are observable ; for instance, one sample from the Roman States is 52·7 per cent., one from Sicily 46·5, and one from Piedmont 43·1 ; Algeria also sends one 45·2. Each of these so-called wines partook more of the character of a liqueur, being sweet and highly fortified. Others of a less but still high degree of strength were professedly imitations of fortified wines, such as port, sherry, madeira, &c. Piedmont, on the other hand, furnished a sparkling red wine of a poor, low class, which only gave a strength of 7·7 per cent. ; and Hungary also, in one of her choicest sorts, sends the lowest of the whole, one sample being only 7·2 per cent. This latter is called "Menes Essenz," and is a red wine of the district of Arad ; it is produced from selected grapes, the juice of which has been extracted by the mere weight of their mass, without added pressure. A consequence of this mode of treatment is, that more of the sugar and less of the ferment and acids of the grape are in the must, and the spirit produced is necessarily small in quantity. In testing this sample, when somewhat less than two-thirds of its bulk had been distilled over, the residuum had become so thick as to endanger the retort, and when cold it formed a hard dark amorphous mass, of an intense brown colour, proving the very large preponderance of sugar.

It may not be uninteresting to observe, that on taking the average strength of the weakest wines of each country (omitting the two exceptional samples just mentioned) it exceeds in each instance the limit which in the first differential wine tariff was fixed as the strength of Class A, viz. 18·0 ; thus :—

In Italy the average lowest strength is .	19·5
In the Zollverein	19·7
In the Austrian Empire . . .	18·4
In France	19·0
In Australia	21·3

From this it is probable, that when the foreigner considered 18 degrees as a sufficient limit, it was with reference to the French computation, which by the table would equal 31·3 per cent. of proof spirit.

Three of the samples tested were altogether exceptional. The first two were samples called "Wine of Water," from Bavaria; one of these was said to be "produced at twopence the bottle ;" the other "at threepence." The former was a light agreeable drink, with 19·6 per cent. of spirit ; the latter was sweeter, and of better body, and had 29·9 per cent. The third exceptional sample was a mead or metheglin, a honey wine, called "Alt Deutscher Meth." This, according to our customs' tariff, is free of duty, yet it contained no less than 29·2 per cent. of proof spirit, at which strength wine would be liable to 2s. 6d. per gallon duty.

Some few samples are remarkable from their great age. Thus "Vin d'Alicant," of St. Gilles, Département du Gard, is of the vintage of 1801, and yielded 33·3 per cent. of spirit. A red wine from Luz in the same Department, dated 1811, is 23·9 per cent., and a wine called La Marigny, of Neunier, Department Indre et Loire, also of 1811, is 18·9 per cent. A sample from Chateau la Serre, of Libourne in the Gironde, is of the vintage of 1783, and strength 19·6. But these are but young in comparison with one from the Département du Tarn, which has reached the venerable age of 111 years, and maintained a strength of 18·9 per cent. This last, though still sound and healthy, possessed little or no character, and from the complete exhaustion of the sugar, and the greater prominence thus acquired by the tannic acid, it had a positively bitter taste.

The wines of Australia, of which 18 samples have been tested, are interesting as being comparatively unknown in this country, and as the representatives of a culture and manufacture yet in its infancy, but of high importance for many considerations. None of them are of high character, but those from Sydney in particular possess some sound and excellent qualities that promise well under improved culture and more careful manipulation. All have a high natural degree of spirit.

The wines from Victoria, though much the same in strength as those from New South Wales, are decidedly their inferiors in quality. The body is weak, and the flavour poor and uninviting.*

The names by which several of them are designated may perhaps indicate the kind of grape used in their manufacture; but, if so, the alteration of climate, season, or some other circumstance, must have completely changed their character, as not a vestige of resemblance remains. The Frontignac here is a red sour wine, instead of being white and luscious. The perfume, however, which attached to the distillate, gave indication of its origin in the muscat grape. The Hermitage and Burgundies are of a sickly pale red colour, and thin body. Indeed all the red wines bear a great family likeness to each other, and, as well as the white wines, are destitute of any great individuality.

The Tokay has no point of similarity to its celebrated namesake, and, except a higher degree of strength, is in other respects like the rest of the white wines; and the white Victoria was still in a state of fermentation.

* It appears that these wines, being in the first instance very new, were for three months exhibited in a hot glass building in Melbourne, had afterwards a voyage of four months to England, and were then shown in the International Exhibition building for six months in an upright position. It is, therefore, evident, that their flavour and character were not likely to be in good condition; that they were sound and alcoholic appears extraordinary under the circumstances.

General Abstract of the Average Strength of the Wines of Various Countries.

Country of Produce.	Proof Sp. per cent.			No. of Samples Tested.			Average Strength by the French Hydrometer of Gay Lussac.
	Greatest Strength.	Least Strength.	Average.	Above Average.	Below Average.	Total.	
Italy, viz.—							
Piedmont (Red) . .	27.9	7·7	20·9	20	10	30	12.1
Do. (White) . .	43·1	13·1	24·9	15	14	29	14·4
Lombardy (Red) . .	20·8	18·9	19·9	2	1	3	11·5
Do. (White) . .	—	—	22·0	—	—	1	12·7
Naples (Red) . .	28·6	15·4	23·7	7	6	13	13·6
Do. (White) . .	40·3	12·0	25·4	6	7	13	14·6
Roman States (Red) .	17·1	16·5	16·8	1	1	2	9·7
Do. (White) . .	52·7	18·9	29·8	2	4	6	17·2
Tuscany (Red) . .	22·0	16·5	20·4	4	1	5	11·8
Do. (White) . .	32·0	28·6	29·7	1	2	3	17·1
Sicily (Red) . .	30·6	26·5	28·5	1	1	2	16·4
Do. (White) . .	46·5	26·5	31·7	1	4	5	18·2
The Zollverein, viz.—							
Baden (Red) . .	22·0	18·3	19·9	3	3	6	11·5
Do. (White) . .	21·4	17·7	19·3	8	7	15	11·1
Würtemburg (Red) .	18·3	17·1	17·6	3	3	6	10·1
Do. (White) . .	25·2	15·4	18·1	9	13	22	10·4
Rhenish, Prussia (Red)	—	—	20·8	—	—	1	12·0
Do. (White) . .	22·7	18·3	20·1	6	6	12	11·6
Do. (Meth.) . .	—	—	29·2	—	—	1	16·8
Bavaria (White) .	22·7	21·4	22·1	1	1	2	12·8
Do. (Wine of Water, do.)	29·9	19.6	24·8	1	1	2	14·3
Austrian Empire, viz.—							
Austria Proper (Red) .	27·9	18·9	21·8	2	3	5	12·6
Do. (White) . .	28·6	12·0	21·0	3	1	4	12·1
Moravia (White) .	19·6	16·5	17·7	1	2	3	10·2
Styria (White) . .	—	—	19·6	—	—	1	11·3
Transylvania (White)	—	—	27·2	—	—	1	15·6
Hungary (Red) . .	27·9	7·2	20·5	5	6	11	11·8
Do. (White) . .	25·9	16·0	21·3	9	7	16	12·3
Australia, viz.—							
New South Wales (Red)	—	—	25·9	—	—	2	14·9
Do. (White) . .	24·6	18·9	22·7	3	1	4	13·0
Victoria (Red) . .	28.6	20·2	23·3	4	3	7	13·4
Do. (White) . .	27·9	20·2	25·6	2	3	5	14·7
France, viz.—							
Algérie (Red) . .	27.2	17·1	22·1	6	5	11	12·7
Do. (White) . .	45.2	19·6	26·8	5	10	15	15·4
Départ. de l'Aude (Red)	—	—	25·9	—	—	1	14·9
Do. Var (Red) .	23·9	19·6	22·1	4	4	8	12·7
Do. do. (White) .	23·9	18·9	21·6	2	1	3	12·4
Do. Gard (Red) .	33·3	19·6	26·8	2	3	5	15.4
Do. do. (White) .	29·9	24·6	27·9	2	2	4	16·0

Country of Produce.	Proof Sp. per cent.			No. of Samples tested.			Average Strength by the French Hydrometer of Gay Lussac.
	Greatest Strength.	Least Strength.	Average.	Above Average.	Below Average.	Total.	
France—*continued*; viz.—							
Depart. Loire Inférieure (White) .	19·6	18·9	19·2	1	1	2	11·0
Do. Allier (Red) .	19·6	18·9	19·2	1	1	2	11·0
Do. do. (White) .	—	—	18·9	—	—	1	10·9
Do. du Bas Rhin (do.)	19·6	16·5	17·9	2	2	4	10·3
Do. Haut Rhin (do.)	21·4	18·9	19·8	1	4	5	11·4
Do. Tarn et Garonne (Red) .	25·2	17·1	20·8	4	5	11	12·0
Do. do. (White) .	—	—	26·5	—	—	1	15·2
Do. Loiret (Red) .	19·6	15·4	17·7	4	6	11	10·2
Do. Vienne (Red) .	—	—	20·2	—	—	1	11·6
Do. Indre et Loire (do.)	23·3	17·1	19·7	6	6	12	11·4
Do. do. (White) .	22·7	18·3	20·5	1	1	2	11·8
Do. Dordogne (Red)	23·3	17·1	20·3	6	4	10	11·7
Do. do. (White) .	27·2	14·8	22·6	7	4	11	13·0
Do. Indre (Red) .	20·2	16·5	18·0	3	3	6	14·4
Do. Tarn (Red) .	26·5	18·9	23·7	1	2	3	13·6
Do. do. (White) .	—	—	17·1	—	—	1	9·8
Do. Moselle (Red) .	—	—	18·9	—	—	1	10·9
Do. Haute Garonne (do.)	—	—	22·0	—	—	1	12·6
Do. Lot (Red) .	23·9	17·7	20·8	1	1	2	12·0
Do. Sarthe (White)	—	—	17·1	—	—	1	9·8
Do. Isère (Red) .	—	—	17·1	—	—	1	9·8
Do. do. (White) .	—	—	21·4	—	—	1	12·4
Do. Maine et Loire (Red)	—	—	18·9	—	—	1	10·9
Do. do. (White) .	22·7	16·0	18·2	1	2	3	10·5
Do. Corse (Red) .	27·9	20·8	24·9	1	2	3	14·4
Do. do. (White) .	—	—	32·6	—	—	1	18·8
Do. Puy de Dome (Red)	25·9	19·6	22·7	1	1	2	13·1
Do. Charente Inférieure (Red)	—	—	19·6	—	—	2	11·3
Do. Vaucluse (Red)	27·9	24·6	26·4	2	2	4	15·2
Do. Ardèche (Red)	—	—	18·9	—	—	1	10·9
Do. do. (White) .	—	—	27·2	—	—	1	16·4
Do. Drôme (Red) .	25·9	12·0	21·6	4	2	6	12·5
Do. do. (White) .	25·9	14·2	21·1	2	1	3	12·2
Do. Hérault (Red)	34·0	17·7	23·6	2	3	5	13·6
Do. do. (White) .	35·4	20·8	25.6	2	3	5	14·8
Do. Beaujolais (Red)	23·3	18·3	21·0	5	7	12	12·1
Do. Cher (Red) .	20·8	17·1	19·3	2	2	4	11·1
Do. Loire et Cher (Red)	21·4	14·8	17·6	3	4	7	10·1
Do. do. (White) .	24·6	15·4	20·1	3	2	5	11·6
Do. Jura (White) .	27·9	22·7	25·3	1	1	2	14·6
Do. Deux Sévres (do.)	—	—	21·4	—	—	1	12·4
Do. Correze (Red)	—	—	17·7	—	—	1	10·2
Do. Gironde (Red)	23·3	14·8	19·5	31	14	45	11·2
Do. do. (White) .	27·2	17·1	22·8	5	6	11	13·1
Do. Saone et Loire (Red)	22·7	17·7	20·7	17	9	26	11·9
Do. do. (White) .	23·9	18·9	21·9	7	5	12	12·6
Do. Yonne (Red) .	22·0	14·8	18·7	14	13	27	10·8
Do. do. (White) .	22·0	18·3	20.5	3	1	4	11·8

TABLE SHOWING THE COMPARATIVE VALUE OF THE ENGLISH AND FRENCH DEGREES OF ALCOHOLIC STRENGTH OBTAINED BY AN EXPERIMENTAL COMPARISON OF THE HYDROMETERS OF GAY LUSSAC AND SYKES.

English.			English.			English.			English.		
Over Proof.	Proof Spirit per Cent.	French.	Over Proof.	Proof Spirit per Cent.	French.	Under Proof.	Proof Spirit per Cent.	French.	Under Proof.	Proof Spirit per Cent.	French.
74·0	174·0	100	30·5	130·5	75	13·0	87·0	50	56·5	43·5	25
72·3	172·3	99	28·8	128·8	74	14·7	85·3	49	58·2	41·8	24
70·5	170·5	98	27·0	127·0	73	16·5	83·5	48	60·0	40·0	23
68·8	168·8	97	25·3	125·3	72	18·2	81·8	47	61·7	38·3	22
67·0	167·0	96	23·5	123·5	71	20·0	80·0	46	63·5	36·5	21
65·3	165·3	95	21·8	121·8	70	21·7	78·3	45	65·2	34·8	20
63·6	163·6	94	20·1	120·1	69	23·4	76·6	44	66·9	33·1	19
61·8	161·8	93	18·3	118·3	68	25·2	74·8	43	68·7	31·3	18
60·1	160·1	92	16·6	116·6	67	26·9	73·1	42	70·4	29·6	17
58·3	158·3	91	14·8	114·8	66	28·7	71·3	41	72·2	27·8	16
56·6	156·6	90	13·1	113·1	65	30·4	69·6	40	73·9	26·1	15
54·9	154·9	89	11·4	111·4	64	32·1	67·9	39	75·6	24·4	14
53·1	153·1	88	9·6	109·6	63	33·9	66·1	38	77·4	22·6	13
51·4	151·4	87	7·9	107·9	62	35·6	64·4	37	79·1	20·9	12
49·6	149·6	86	6·1	106·1	61	37·4	62·6	36	80·9	19·1	11
47·9	147·9	85	4·4	104·4	60	39·1	60·9	35	82·6	17·4	10
46·2	146·2	84	2·7	102·7	59	40·8	59·2	34	84·3	15·7	9
44·4	144·4	83	0·9	100·9	58	42·6	57·4	33	86·1	13·9	8
42·7	142·7	82	0·8	99·2	57	44·3	55·7	32	87·8	12·2	7
40·9	140·9	81	2·6	97·4	56	46·1	53·9	31	89·6	10·4	6
39·2	139·2	80	4·3	95·7	55	47·8	52·2	30	91·3	8·7	5
37·5	137·5	79	6·0	94·0	54	49·5	50·5	29	93·0	7·0	4
35·7	135·7	78	7·8	92·2	53	51·3	48·7	28	94·8	5·2	3
34·0	134·0	77	9.5	90·5	52	53·0	47·0	27	96·5	3·5	2
32·2	132·2	76	11·3	88·7	51	54·8	45·2	26	98·3	1·7	1

PAPER MAKING.—ULMATE OF AMMONIA.

Nearly a year ago we described in considerable detail a large paper mill, at that time just completed on Dartford Creek. This mill was built complete by Messrs. Easton, Amos, and Sons, for the Hon. William Napier, and at a cost, apart from the site, of about 35,000*l.* A company has now been formed to purchase this mill, and another establishment at Grays, Essex, the former to be enlarged and both to be worked upon a capital of 135,000*l.*, with an additional 15,000*l.* subject to call. The concern at Grays, which is set down at 39,000*l.* in the prospectus (a sum we apprehend, by no means under-stated), is known as the "Ulmate of

Ammonia Company's" works, and already forms an indispensable adjunct to a thriving paper mill. What is "ulmate of ammonia?" Dr. Playfair describes it as the powder of woollen fibre, separated from muslin-de-laines by the action of high-pressure steam. Mixed cotton and wool fabrics are, unless specially treated, worthless as rags to the paper-maker. There have been practised two modes of separating the cotton and the wool, either at the expense of one or the other. Thus, if it were desired to obtain the wool, the rags of the mixed stuff were steeped in acids which decomposed the cellulose of the cotton, changing it into sugar, which was dissolved and lost in the process. To save the cotton, on the other hand, the rags were steeped in a strong alkali, which, acting upon the wool, formed a soapy compound in which the cotton remained intact. Now Mr. Ward, while separating the cotton fibre in a condition serviceable to the paper-maker, has contrived to retain the wool in a condition fit for something—manure, at least. He subjects muslin-de-laine, or the rags of mixed cotton and wool stuffs, to the action of steam of 50 lb. pressure or so, the effect of which is to convert the wool into a brittle, bituminous, or resinous matter, which separates readily, as a powder from the cotton.

The importance of this process will justify us in quoting at some length from Mr. Ward's specifications.

His improvements, patented in 1857, were intended to remedy the defects of the 'wet process' of separation, and to accomplish more economically and completely the separation of the azotised from the unazotised ingredients of the mixed materials.

In carrying this invention into effect Mr. Ward employs a closed boiler or digester, of any convenient form and size, preferring a cylindrical form with hemispherical ends, set with its long axis vertical, and having sufficient capacity to hold a ton of mixed rags. This digester has the usual fittings. There must also be provided, either in the structure of a digester itself or as part of the apparatus used therewith, suitable appliances to protect the materials under treatment from the injurious action of condensation water in excess. These appliances may vary, but the form preferred consists in an inner case or cradle, rather less in height and diameter than the cylindrical portion of the digester, into which it may be let down, and from which it may be lifted out by means of a crane.

The sides of this case or cradle should be perforated with numerous holes to admit steam, but its lid and its lower part should be unperforated: the object of the case or cradle being to hold the materials under treatment and to protect them from the contact of any condensation water that may be formed in the interior of the digester and run down its sides, or accumulate at the bottom, or drip from the lid.

To obviate, as much as possible, loss of heat by radiation, which involves formation of condensation water (and, consequently waste of fuel), the digester should be carefully clothed with non-conducting material.

The mixed rags or other such materials containing azotised matter mixed with vegetable fibre after being well beaten (preferably in a paper maker's rag-beating machine) to separate inert dust and grit, are put into the cradle or cradles and lifted into the digester, the lid of which is then screwed down steam-tight. Steam from a generator is then turned on through a tube and stop-cock in the usual way, at a temperature and for a time which may vary within wide limits. Mr. Ward has obtained good results, for example, with steam at from three to seven atmospheres pressure, kept up for from two to four hours' time, the time being lengthened when the temperature and pressure are diminished and *vice versâ;* but he recommends as a good working average steam at about five atmospheres pressure, continued for about three hours' time. The effect of these arrangements has been found to be, on the one hand, effectually to defend the materials from the contact or drip of any excess of condensation water that may form as aforesaid, and on the other hand to admit to the materials a sufficiency of steam to hydrate their azotised ingredients and to produce the above-described peculiar transformation thereof.

Any condensation water that may accumulate in the digester should be discharged from time to time by the stop-cock below, and as soon as the digesting process is finished steam should be suffered to blow off a little while through the steam cock above. The materials may thus be obtained dry from the digester, or if taken out while still damp they may be dried by exposure to a current of hot air in a drying chamber.

The mechanical means available for separating the manure product from the fibrous product are, it will be readily understood, numerous and susceptible of many modifications. Mr. Ward has obtained excellent results by passing the dry product of digestion between fluted wooden cylinders, such as are used in scutching flax, and afterwards through an ordinary paper-makers' rag-beating machine. Care must of course be taken to enclose dust-tight the space which receives the valuable azotised powder beaten out, so that none of it may be blown away and lost, and the machinery should be worked by steam or other power at sufficient speed and force thoroughly to separate the azotised dust from the fibrous vegetable matter without injuring the staple of the latter or wastefully wearing it away.

In dealing with greasy refuse, such as the oily waste of the wool manufacture called shoddy, the patentee proceeds in the same manner, merely omitting the final cylindering, beating and shifting process, as being in this case unnecessary, and instead thereof, subjecting the material to a preliminary process of pressure to extract the oil, such pressure being (preferably) applied by means of a hydraulic press, aided in some cases by moisture and heat to facilitate the running out of the oil. The cake left in the press is digested with the appliances and precautions above set forth, and makes a superior manure, more portable, and

richer in azote than when encumbered with oil, which has no fertilising properties; on the other hand, the oil extracted will be found applicable to a variety of useful purposes, especially when purified by any of the ordinary means.

Under a subsequent patent, Mr. Ward combined the wet and dry modes of separation.

This mixed method, partly wet, partly dry, was devised to remedy an inconvenience met with in working out the dry process. This inconvenience arises from the tendency of wool and other animal matters to become partially converted, under the influence of high-pressure steam, into a glutinous adhesive substance, which impregnates the more friable portion of the reduced animal matter, gluing its molecules to each other and to the vegetable fibres of the mixed material, so as to render the subsequent mechanical separation of the products, and the cleansing and bleaching of the vegetable fibre, more difficult. To remedy this Mr. Ward takes advantage of the remarkable solubility of the glutinous adhesive portion of the converted animal matter to remove this portion in solution, leaving only the less soluble residuum of the animal matter to be separated as a dry powder from the vegetable fibre, by beating, sifting, or other mechanical means. By thus separately withdrawing in solution the glutinous sticky product, instead of allowing it, as heretofore, to dry along with the remainder of the mixed material, the subsequent mechanical separation of the friable from the fibrous parts of the mixed mass is greatly facilitated, seeing that the molecules of the animal powder are no longer glued, as before, to each other and to the vegetable fibre; again, the cleansing and bleaching of the fibre is also made much easier, because it is no longer imbued and partially encrusted with animal matter. This mixed process can be performed in several ways, and the object being to dissolve part only of the animal ingredients of mixed materials, the choice of a partial solvent is the first consideration. The substances preferred for this purpose, on account of their cheapness and efficacy, are (1) water, and (2) a caustic earthy base, preferably lime.

If the mixed materials be slightly moistened with water before being subjected to the process of digestion in an atmosphere of steam, and if, after such moistening and digestion they be subjected to pressure to remove from them the dark-coloured solution of animal matter which will flow away, and if, finally, the pressed residuum be then subjected to the remainder of the process, the mixed mode of separation, partly wet, partly dry, will be effected, and the above described benefits of this mode will, to a considerable extent, be obtained. The addition of lime as well as water will, however, be to increase the advantage and diminish the cost of the new or mixed mode of treatment. The lime rapidly attacks the animal matter, combining in particular with the sulphur to form a soluble hydrosulphate of lime (probably a bi-hydrosulphate). The animal matter thus more energetically attacked, yields, and becomes

disintegrated under the influence of steam of lower pressure and temperature, or of steam of equal pressure and temperature, applied during a shorter time than when no lime is used. The quantity of lime which may be employed in applying this mode to the average mixed rags of commerce may, it is found advantageously, amount to $3\frac{3}{4}$ per cent. of their weight, or thereabouts ; and this lime, made into a milk with three or four times their weight of water will turn a suitable menstruum for the purpose. Two hours' digestion of the rags in this liquor in an antoclave boiler, supplied with steam at a pressure corresponding to 276 deg. on Fah. scale will be found in ordinary cases to accomplish a sufficient disintegration of the animal matter, such as wool, leather, silk, and the like. After digestion the liquor containing in solution the gluey product above referred to may be removed, either by ordinary drainage and ablution, or by the action of a centrifugal hydro-extractor or by subjecting the mass to powerful pressure. The partially dried mass thus obtained may next be opened and loosened and have its desiccation completed in any way. When dried the material may be subjected to any suitable mechanical process of beating, shaking, sifting, and the like. The animal part will be found to possess that greater degree of friability and that more easy and complete separability from the intermixed vegetable fibre, which it is the special object of the present invention to secure. The vegetable fibre also, freed as it thus may be from gluey impregnation and thoroughly disencumbered of adherent animal matter, will be found to bleach more easily and to attain a brighter whiteness with less consumption of bleaching liquor, and consequently less impairment of tenacity than when treated by former modes. In some cases, however, high-pressure digesters are dispensed with, and the process is conducted at ordinary atmospheric pressure and at (or even in some cases below) the ordinary boiling point of water ; making up, in such cases, either by length of the time of treatment, or by increase of the dose of caustic earthy solvent, or in both ways, for the diminished chemical activity resulting from the lowered temperature. In some cases indeed, when time is no object, the process may be conducted at the ordinary temperature of the atmosphere, the maceration being continued with occasional agitation until the animal matter is found to be sufficiently disintegrated, and a due proportion of the glutinous animal matter dissolved. The temperature, however, preferred, when operating on average commercial mixed rags, is the ordinary boiling point of water, or 212 deg. Fah. ; and in thus operating it is best to add to the rags about 5 per cent. of their weight of quicklime, and three or four times their weight of water, the lime and the water being mixed so as to make a milk of lime, and the boiling being continued for about three hours, after which the squeezing, drying, and beating processes may be applied, as above described.

Silk, which resists much more than leather and wool disintegration by hot steam, only yields readily under the combined attack of hot

steam or water and the caustic earthy base, so that the new process is peculiarly advantageous in its application to mixed materials rich in silk rags or waste. The above-mentioned proportions of solvent ingredients, temperature, pressure, and time, are indicated as the result of experiments made with the express purpose of ascertaining the minimum of solvent power to be employed when it is desired to remove as little as may be of the animal part of the mixed material in watery solution, and to leave as much as possible for removal on the dry way, which latter is by far the cheaper and more convenient way of removing it. It will be understood, therefore, that the above-mentioned proportions may be varied to any required extent accordingly as the operator's object may be to remove a greater or less proportion of the animal matter in solution. Indeed it is found easy, by a slight increase of the lime, and of the temperature or time of the steaming, to reduce the whole of the animal matter in the mixed mass treated to a gelatinous fluid condition so that it can be washed or strained away from the vegetable fibre which still remains unaltered.

The powder, for which the name of "ulmate of ammonia" has been invented, is said to contain 12 (the Dartford Paper Mill prospectus says 15,) per cent. of soluble nitrogen, and to be equal therefore, or nearly so, as a fertiliser, to Peruvian guano. It is stated that the works at Grays are now turning out 25 tons of separated cotton fibre, and about the same quantity of "ulmate" weekly. We are not aware how nearly the price at which this "ulmate" is sold approaches that of guano, but the estimate of yearly profits from its sale, and from the manufacture of from 32 to 36 tons of paper weekly, is from 20,000*l.* to 25,000*l.* Allowing one-half of this, or say 12,500*l.*, to accrue from the paper-mill, this would be equal to nearly 1d. per lb. upon the estimated annual production, an assumed profit which would appear to be reasonable enough. It is hardly likely, however, that the profits upon the "ulmate" works can be anything like 10,000*l.* or 12,000*l.* a year; while it is not unlikely that the profit of paper-making now amounts to considerably more than 1d. per lb.

The American paper trade has for some time been an object of interest to English makers. The present American tariff upon paper is from 20 to 35 per cent. *ad valorem*, under which such paper as is employed for the American journals can even now be laid down in New York, with all charges paid, at less than 7½d. per lb. We observe, by a paragraph in the "New York Times," that 5,000 reams, or say 90 tons, of paper for that journal had just been imported from Belgium, and that more was to follow.—*The Engineer.*

A FEW REMARKS ON BLEACHING POWDER.

BY MURRAY THOMSON, M.D., F.R.S.E.

This substance is so largely used in paper making, that it may form a subject of considerable interest to many. We have in the following paper treated the subject in such a way, that it will be simple and instructive to those who may be ignorant of chemistry.

This widely used substance, as many of our readers may know, was first prepared by Mr. John Tennant, the founder of the St. Rollox Works, Glasgow. And though it has now been in use for upwards of sixty years, it is still as highly esteemed as ever as a bleaching agent. At one time a difference of opinion existed as to what its active constituent was ; but now most chemists believe its bleaching power to be due to hypochlorous acid, a compound of chlorine and oxygen. It may be regarded as a mixture of hypochlorite of lime, hydrate of lime, and chloride of calcium, but it is only the first-named substance which is available for bleaching. Another circumstance, not to be lost sight of in this view of the composition of bleaching powder, is that hypochlorous acid is destructive of colour, not only on account of the chlorine it contains, but also on account of its oxygen. Indeed it is estimated that this acid has a bleaching power twice as great as the elementary gas chlorine itself. To understand this, our readers should remember that before chlorine and its compounds were employed to effect bleaching, the oxygen of the air, in one or other of its forms, aided by the sunlight and moisture, were the agents used to destroy colour. Keeping this in mind, it is now not difficult to see how a compound like hypochlorous acid should be more energetic as a bleacher, than either of its constituents separately. The method of the action of hypochlorous acid may be perhaps best understood, by saying that its elements, the chlorine and the oxygen, are apt to separate from each other. The tie that keeps them together as a compound is a feeble one, and once unloosed, they are not only free to combine with other substances, but in a state of greater inclination to do so. They are in what the technical language of the chemist calls the *nascent* state. And when in this condition, they are presented to compounds that they can combine with, such as colouring matter, they readily unite, and a new, but now colourless substance, is the result.

But although it be true that bleaching powder owes its efficacy to both chlorine and oxygen, it is not necessary in estimating its value, to take into account anything more than the amount of chlorine present ; because the more of it the sample contains, the more oxygen will it also contain, and its bleaching power will be the greater ; and if these follow by equal steps, it is sufficient to know the amount of either element ; and as it is the easiest to ascertain the amount of chlorine, it is always chosen as the element to operate on.

Moreover, as the processes used in estimating the strength of bleaching powder bring the functions of the chlorine into play, much in the same way as these are exercised in the act of bleaching, it is clear that we have in these processes a complete index to the purity on the one hand, or sophistication on the other, of any sample of bleaching powder.

The processes which have been recommended from time to time for estimating the strength of chloride of lime, are nearly equal in point of accuracy, but they are not all equally easy of performance. The method which we would recommend the paper-maker to adopt is one which, with a little care and nicety in its execution, may be employed by almost any one, however little he may have been engaged in chemical pursuits.

The only instruments that need be provided are a small common balance which will turn with half a grain. The small beams and scales used by the apothecaries will answer quite well. The other instrument is a glass tube closed at one end and open at the other, this open end having a small spout. It may be about eight inches long, and nearly one inch in diameter, and should hold when filled to near its top, a little over two fluid ounces. There should be a mark about an inch from the top, and the space between this mark and the bottom should be divided into 100 equal divisions. Such graduated tubes may be bought from almost any optician or philosophical instrument-maker, at a small cost.

The chemicals which are needed are very few, some tolerably clean crystals of green vitriol (sulphate of iron), some solution of red prussiate of potash (ferridcyanide of potassium), and some weak sulphuric acid.

Provided with these, we may now proceed to test the strength of any sample of bleaching powder in the following way :—78 grains of the green vitriol crystals are weighed out and dissolved in water, to which a drop or two of the weak sulphuric acid is subsequently added. While this solution is making in a tumbler or cup, 50 grains of the sample of bleaching powder are weighed out, and then thoroughly stirred up and mixed with water (this is best done with a small mortar and pestle), and then transferred to the graduated tube, and the mortar or other vessel in which the mixture has been made, is now washed, and the washings also added to the graduated tube until it is filled up to O or zero. A few drops of the solution of the red prussiate of potash are now sprinkled on a common white plate. If the crystals of sulphate of iron are now dissolved, then the mouth of the graduated tube should be closed with the palm of the hand, and its contents thoroughly shaken together, a creamy fluid being thus formed. This mixed-up fluid should now be transferred little by little to the vessel with the sulphate of iron solution. 30 or 40 measures may be added at once, but after this the additions should be smaller.

The effect of adding the chloride of lime solution to that of the iron salt, is to throw down a red powder (sesqui-oxide of iron). If, after the first addition of chloride of lime solution be made to the iron, one drop of the mixed solutions be now withdrawn on the end of a glass rod and brought in contact with the drops of the red prussiate on the white plate, there will immediately be formed a dark blue precipitate (Prussian blue). This indicates that the iron solution has not had enough of the chloride. A further small addition of the solution of bleaching powder is now made. Another drop of the mixture is withdrawn and laid on the prussiate solution as before—if there is still a dark blue precipitate produced, a further addition of the chloride of lime is needed. During the process this solution should be shaken up. The estimation of the chlorine is known to be complete when a drop of the mixed solutions no longer gives a dark blue precipitate with the prussiate drops on the white plate, but gives, instead, a green colour with little or no precipitate. When, after cautious additions of the chloride solution, this point is reached, the number of measures which it has taken to effect the change are now read off from the graduated tube. A very simple calculation now follows, which is based on the fact that the portion of the 50 grains of the sample now used in oxidising the solution of iron (for it is a process of oxidation), contains exactly 10 grains of chlorine available for bleaching purposes. The first step in the calculation is to divide the number of measures now used by 2. The reason of this step is obvious; because, as the 50 grains of the sample were diffused through 100 measures, each measure corresponds to half a grain of the sample. The quotient of dividing by 2 will, therefore, give the number of grains of the sample, containing 10 grains of chlorine. This number is now made the first term in a simple proportion; 10 the second, and 100 the third; and the result of this calculation is the percentage of chlorine in the sample. If the steps in this simple calculation be reflected on as they are worked out, it will be seen that the several steps might be combined into this one formula.—Divide 2,000 by the number of measures of chloride solution used.—An example will now make it all clear. If, in any sample, it takes 70 measures to oxidise thoroughly the iron solution, the half of 70 is 35, and as 35 is to 10, so is 100; the answer is, 28·57 per cent. A result which would be more easily deduced by dividing 2,000 by 70; when, as before, 28·57 would be shown to be the percentage amount of available chlorine in the sample supposed.

Though a description of this really excellent and trustworthy process cannot be well condensed into fewer words, yet it must not be thought tedious in its execution; because four or five times trial of it, by way of practice, is enough to render one sufficiently expert to overtake the testing of half-a-dozen samples in an hour or two; and, we may add, that the information gained by the process must be coupled with the satisfaction of having performed it all oneself.—*Paper Trade Review.*

LEATHER CLOTH.

The recent continuous increase in the price of leather has naturally directed the attention of practical chemists to the best methods of perfecting the imitations which, under the name of leather cloth, are now so largely used as substitutes for leather itself. The improvement in this branch of manufacture has been so steadily progressive that the original standard taken for imitation—The American leather cloth—has been long since surpassed, and it is, perhaps not too much to say that the art of making artificial leather has now attained a perfection which promises to make the imitation a better, and, though cheaper, a more valuable article than that which it imitates. Among the many new processes and inventions shown in the late Exhibition there was no lack of English representatives of this rising branch of manufacture striving to displace the American fabrics. Nearly all these however, were too much like the Transatlantic article to be perfectly successful. With its merits they produced its grave defects—the liability of the varnish to crack, the colours to fade, and the material itself to wear out fast as compared with real leather. One series of specimens, however in this class attracted a great deal of attention, though they failed to attract a medal. These specimens were shown by Mr. Szerelmey, a gentleman well known for his most curious chemical discoveries in hardening stone, wood, and paper, and up to the present time the most successful of all the many competitors for preserving the Houses of Parliament from further decay by indurating the surface of the stone with a fluid silica, which, it is asserted renders the stone beneath perfectly indestructible. The leather cloth of Mr. Szeremley has since then grown in reputation till it now promises to become a most important manufacturing discovery, since while the cloth thus prepared possesses all the best attributes of leather in great strength and durability, it has other and special advantages of its own which even the advocates of the famous virtues of leather have never claimed for it—namely, complete impermeability to water, a flexibility and softness equal to a woollen fabric, and a cheapness which makes its cost scarcely one-third that of real leather. Thus, a good calf-skin costs from 10s. to 14s., and yields leather for three or three and a half pairs of boots, whereas six square feet of the calf-skin leather cloth yields materials for five or six pair of boots, and costs only about 4s. 6d. Such an important difference and saving as this ought to satisfy any inventor; but even more than this is claimed for the "pannonia" in its capability of being produced in any quantity at a few days' notice and in sizes only limited by the size to which the fabric can be woven on which the composition is laid. The nucleus of a factory has been established at Clapham, where the leather is now made, and where a company is about to construct large works and carry on the manufacture on a most extensive scale. The fabric used in manufacture is entirely

according to the kind of imitation leather wished to be turned out. Thus "moll" a very thick soft kind of cotton fabric made at Manchester is preferred for calf-skin; fine calico or linen for waterproof material for macintoshes, siphonias, &c., as perfectly waterproof as india rubber itself; the alpaca, silk, cloth or common cotton for boots and shoes, bookbinding, harness, carriage furniture, and all the thousand purposes to which real leather is applied. What the composition of the pigment is which in a few hours changes common cotton into a substance like enamelled leather, and only to be distinguished from the real article by its non-liability to crack and its greatly additional strength, is of course a strict trade secret. The mode of manufacture, however, is simple. The fabric to be converted into leather, silk, alpaca, or what ever it may be, of any length or width, is merely wound on rollers beneath a broad knife-blade, which by its weight presses in and equally distributes the pigment previously placed upon it. A hundred yards may thus be done in a single minute, and in the most simple application the whole manufacture begins and ends, except that three coats of the pigment are necessary to perfect the leather, and an interval of twenty-four hours must elapse between the application of each. During this period the sheets are carried to a drying-house heated to a temperature of 94 degrees, and where they are hung like oil-cloth, according to the order in which they arrive, the last comers displacing those which have completed their time and are ready for their second coat. Thus the manufacture never stops, and three days suffice to complete "hides" of any length or breadth to which fabrics can be woven. For imitations of morocco or other grained leathers the long sheets are simply passed, when finished, through iron rollers, which indent them in any pattern required. For enamelled leather the enamel is applied after the third coat, by hand labour, which though slower of course, than that of machinery, is nevertheless rapid enough to cover the sheet in a very short time. The enamel, when dry is infinitely superior to any description of patent leather. It is perhaps, scarcely necessary to state that the pigment which transforms the cotton into leather is capable of being tinted to any shade that may be wanted of red, green, brown, black, blue, yellow, &c., and that whatever are the ingredients of the composition no admixture of india rubber or gutta percha forms part of it, inasmuch as the leather cloth when complete, even when left folded and exposed to a considerable heat is entirely free from the tendency to stickiness, which has been the great objection to all waterproof materials, —'*The Ironmonger.*'

GAS WORKS IN GERMANY.

There are in Germany 266 gas works, of which 66 are worked by townships or individuals, and 200 belong to various companies.

The combustible employed is chiefly coal, the largest quantity being supplied from England. Out of 7½ million quintals 3,350,000 are obtained from the English collieries. Berlin, which produces annually 800 million cubic feet of gas uses about half of this quantity of coal. Hamburg takes more than 500,000 quintals, and the rest is used in the gas works of Altona, Lubeck, Rostock, Stralsund, Stettin, Dantzic, Konigsberg, &c. The excellent quality of the English coal for gas-making causes the preference to be given to it over indigenous coal, but if the cost of transport of the latter can be cheapened it is thought that it will ere long come into use in Hamburg, Berlin, and other towns.

The following are the per centage proportions in which the various coal is used in Germany :—

English coal	46.00
Westphalia	18.00
Moravia	11.50
Zwickan	7.50
Saarbuck	7.00
Silesia	5.00
Dresden	2.25
Bohemia	2.00
Northern Bavaria	0.75
	100.

Besides the gas-works which consume coal Germany possesses twenty in which wood alone is employed for distillation ; and there are two small works in Holstein which consume peat or turf at certain times, and at others coal.

The retorts used are generally of clay, except in those works where gas is made from wood. The total number of retorts employed is estimated at 7,337, made for the most part in the immediate locality of the works ; their form and size differs considerably.

Assuming that the mean consumption of gas in the 24 hours is 25 millions of cubic feet, and supposing that each retort furnishes daily 4,500 cubic feet, it follows that these 7,337 retorts must be continually or three-fourths of the time in work.

The use of extractors is much less general than would be supposed. There are only ninety, or less than a third of the whole of the gas-works in Germany which employ about 107 extractors. The small works do not employ them at all.

The meters in general use are water-meters of native manufacture, and may number about 139,000, the mean number of lights of each is about eight.—*Journal de l'Eclairage au Gaz.*

RIMMEL'S TABLE FOUNTAIN.

Fountains constitute one of the chief enjoyments of the Orientals, who remain for hours in dreamy contemplation before their tiny streams. Although we do not profess for them the same partiality, which would be incompatible with our busy life, we consider them as pleasing ornaments for our gardens and conservatories, and numerous have been the attempts to introduce them into our drawing-rooms. These attempts, however, have hitherto signally failed; for, strange as it may seem, no system of self-acting fountain has yet been found to answer the desired

purpose. Weights, springs, and other contrivances have been tried, but they all get out of order in a very short time. Springs turn rusty, valves become loose, and the useless toy is soon ignominiously banished to the lumber-room.

Mr. Rimmel, of the Strand, the indefatigable caterer of novelties for the fashionable public, has just brought out a table fountain which appears likely to escape the dire fate of its predecessors. It contains no machinery whatever, and acts merely by the pressure of atmospheric air. It consists of a basin and side reservoir, which latter when filled forces the liquid up the jet. It plays for about an hour, and when it has run out it can be made to play again by reversing it and re-filling the side reservoir. The very simplicity of this system, which nothing can disturb, insures its success.

The fountain represented in our sketch is one which Mr. Rimmel was commanded by the Lord Chamberlain to supply for the Princess of Wales' bridal boudoir at Windsor Castle. It consisted of a chaste statue in Parian supporting a cut glass basin and was ornamented with silk, lace and flowers, to match the gorgeous apartment in which it shed a delicious perfume. After making such a brilliant *entrée* into the aristocratic world there is no doubt that Rimmel's Fountains will soon be thought an indispensable requisite in all drawing-rooms, and will be called in request to increase the attraction of our fashionable *fêtes* and balls.

ON THE CULTURE OF THE GROUND-NUT IN GAMBIA, WESTERN AFRICA.

BY HIS EXCELLENCY GOVERNOR D'ARCY.

The ground-nut, our staple product, is principally cultivated down the borders of the river, and in British Combo by the Serrawoolies. They are a nomadic tribe of Mahommedan farmers of the Senegambia; they leave their wives and children far up the country, and wander to the seaboard in search of fallow ground, to be left again as soon as the crops have worn out the soil. The native has unfortunately introduced, of late years, the pernicious system of beating, or threshing, instead of picking by hand, whereby the nuts are mixed with leaves, stalks, stones, and other extraneous substances, causing large deductions in the French market, and depreciating their value in the United States as an article of food, or, better to be described, a favourite dessert for the tables of the rich in the latter country. The resident native, the Jolloffe, or the liberated African, surrounded by his Lares et Penates, in the shape of women, children, and domestic servants, or slaves, takes his time to pick the nuts, so saving the grass for the Bathurst market, where it meets with ready sale as fodder for horses; whereas the Serrawoolie, who is anxious for quick returns, has not the time, and certainly not the energy, to pick two acres of ground-nuts between December and May, and which he can easily dress, work, and sow in June and November, thereby losing the fodder, but bringing a larger quantity of nuts to the market. I have endeavoured most earnestly to counteract this baneful mode of harvesting, not only in British Combo, but in the other parts of the country; for if it continues, it will lower the reputation hitherto enjoyed by the Gambia over the nuts exported from the neighbouring rivers of the Casamance, Jeba, the Rio Grande, and Sierra Leone.

I take every occasion to urge upon the natives most seriously the necessity of not solely relying on the ground-nut; it is a very precarious staple for a community only to depend on. I dread some day a famine, not to the extent of the suffering in Ireland from the potato disease, for sufficient corn is certainly grown to keep life from season to season, but, I fear they will lose all their comforts, such as warm clothes, tobacco, rum, &c., from their inability to purchase dry goods, owing to the nut becoming a drug in the market, from more causes than one; a French revolution for instance, as in 1848, left the exportation of the nut only to the States and Great Britain, leaving thousands of tons on hand, not to speak of the loss the colony will suffer from the absence of the tonnage dues. We shall then only have to fall back on our old articles of hides, wax, and ivory, which is a failing trade.

The reflection is very serious to one who studies the interests of the Gambia colony, in particular, and difficult to remedy, unless Providence in its mercy supplies some hitherto unknown or unappreciated article of

commerce to supply the place of this little oleaginous nut, which has, for the last twelve years, brought all the blessings of comfort, healthful occupation, industrious habits, and civilization, in the place of wars, famine and the slave trade of the interior.

Indigo might, in the opinion of some old residents, take a lead in exports, but I fear not to any extent. The natives understand its cultivation, growing sufficient to dye their "pangs," or country cloths, but not an ounce is yet exported.

The following is a correct return of the quantity and value of the ground-nuts exported from the Gambia for the last 24 years.

EXPORTS OF GROUND-NUTS FROM 1837 TO 1860.

	Quantity. tons.	Value. £
1837	671	8,053
1838	680½	8,264
1839	882	11,228
1840	1,211½	15,209
1841	2,334	26 932
1842	2,334	29,489
1843	2,680	32,899
1844	3,426	44,672
1845	4,027	51,270
1846	5,997	73,867
1847	8,237	98,395
1848	8,636	102,767
1849	4,339½	51,923
1850	6,009	72,237
1851	11,094¼	133,133
1852	9,295	153,098
1853	11,226	135,404
1854	9,162	109,846
1855	12,485	149,714
1856	10,874½	130,496
1857	13,554	162,650
1858	15,729	188,747
1859	8,539	68,745
1860	9,951½	94,008

The average annual export in the ten years from 1850 to 1860 was 11,196½ tons.

PUBLICATIONS RECEIVED.—Pharmaceutical Journal for May. Chemist and Druggist, No. 45. Revue du Monde Colonial, Nos. 4, 5, and 6. Technologiste for April and May. Holmes' Magnite Electric Light as applicable to Lighthouses. Transactions of the Royal Institution, and of the Institution of Civil Engineers. Journal of the Board of Arts and Manufactures, Upper Canada, for March and April. The Stationer. The Paper Trade Review.

THE TECHNOLOGIST.

NOTES ON THE ECONOMIC APPLICATION OF BARKS.

BY JOHN R. JACKSON.

Tanning Barks.

The tanning of the hides of animals is an art of very great antiquity. Pliny speaks of leather as the invention of Tychius of Bœotia; one of the oldest substances in use for the purpose of tanning, is undoubtedly oak-bark, and for a considerable time it was considered the only article suited for such purposes. Although tanning can be traced back to so remote an age, the ancient tanners seem to have known little or nothing of the chemical action of the properties of the bark upon the hide; but, of late, keeping pace with the advancement of all other branches of knowledge, changes have taken place in this work; new barks and other substances which have been found to contain the required principle have been tried, and consequently we have many other materials in the market, and new ones being frequently added. The demand for oak-bark became so great that in the year 1765 the Society of Arts were led to offer a prize for a substitute for use in tanning, and the application of oak-sawdust, which, however, had been previously used successfully in Germany, was the result; other substances followed, such as oak-leaves, &c., yet the bark of the oak maintained and still holds its superiority over them all, and is always used for the best kinds of leather. The present consumption of oak-bark for tanning purposes is enormous; besides the home supplies, which amount to between 200,000 and 300,000 tons yearly, we annually import about 4,000 tons from the Continent. Some interesting information on Tanning Substances will be found at p. 289, vol. 1, Technologist.

Quercus suber, L.—The cork-tree, a native of the South of Europe

and North of Africa. The inner bark is that used in the production of leather, the corky portion being devoid of tanning. The largest amount of cork-bark and the best quality is imported from Sardinia; it contains a large quantity of tannin, but is seldom used alone, being usually mixed with valonea, &c. The greatest use to which the bark of this tree is applied is for stoppers for bottles, and other similar applications which are so well known, and for which no substitute is equal. The trees are usually allowed about sixteen years growth before the bark is sufficiently thick for cutting. This is done by making longitudinal and transverse incisions so as to allow the cork to be taken off in flakes. These pieces are afterwards placed in water with heavy weights upon them to flatten them, after which they are scorched or blackened at a fire, chiefly for the purpose of giving a closer texture. They are then packed in bales ready for the market. About 2,500 tons of the bark are annually imported into this country.

Abies canadensis, L. The Hemlock Spruce.—This is another well-known material for tanning. The tree is a native of the colder parts of North America, growing to a height of about eighty feet. The bark is much used in the States, but an objection to its use in this country is on account of the red colour it imparts to leather.

Alnus glutinosa, Willd.—A tree twenty or thirty feet high, native of Europe and Western Asia. The bark has astringent properties, and is used, as well as the leaves for tanning purposes. It is also employed for dyeing black. The young shoots afford a dye of a cinnamon or brownish yellow, while from the catkins a green colour is procured.

Byrsonima spicata, Dec.—A small tree or shrub, native of St. Domingo, Dominica, Brazil, &c., produces a bark which is used in those countries for tanning. It is about a quarter of an inch thick, of a cinnamon brown colour, covered with a whitish cuticle.

Elæodendron croceum, Dec.—A tree about thirty or forty feet high, native of the neighbourhood of the Cape of Good Hope. It produces a thick fibrous bark of an earthy brown colour, and is much used in the colony for tanning and dyeing, though it appears to contain very little astringency. The tree is known as the saffron tree, probably from the bark being covered with a resinous coating of a yellowish colour.

Spondias lutea, L.—The Hog-plum of the West Indies, where it is a native, as well as of South America. It is a tree growing to a height of about fifty feet, of very rapid growth, and is frequently planted for hedges. The bark is about half an inch in thickness, of a very compact, close texture, and a deep mahogany colour, the outer surface very much cracked or furrowed. It is astringent, and has been successfully used for tanning in British Guiana and the West Indian Islands.

Mora excelsa, Bth.—A gigantic tree, growing to a height of from 120 to 150 feet, native of the forests of British Guiana. The bark is considered a good tanning agent, for which purpose it is much employed. It is about a quarter of an inch thick, very even and uniform through-

out, of a dull brown colour, with occasional patches of a whitish epidermis.

Rhizophora mangle, L. The Mangrove.—A tree forty or fifty feet high. The seeds of this plant, which grows in the tidal estuaries of rivers in Guiana, Brazil, and the West Indies, would inevitably be carried away by the receding tide were they like those of most plants, but while they are yet in the fruit, the rootlet grows until it is from one to two feet in length, and nearly twice the thickness of a common lead pencil; it then drops from the tree into the mud, where it establishes itself as an independent plant. The bark of this tree is much prized in Brazil as a tanning material, and small quantities have been imported into this country for the same purpose. It is reputed to contain a large quantity of tannin, and to be superior to many barks for that purpose, but its deep red colour is, perhaps, an objection to its being brought into greater use. It is about a quarter of an inch thick, of a dull, reddish brown colour, somewhat fibrous, and covered on the outer surface with a cork-like cuticle. Other allied species of this genus produce barks having similar properties.

Coccoloba uvifera, L. Sea-side Grape.—This is a large tree, native of the West Indies and South America. Nearly all parts of the tree have astringent properties, particularly the fleshy calyx, which partly covers the edible berries. These have a pleasant acid flavour. The bark is used for tanning in the West Indies. It is about a quarter of an inch thick, of a dusky brown colour externally, the inside of a lightish red, it breaks with a short brittle fracture.

Acacia Arabica, L.—A tree growing thirty or forty feet high, a native of the East Indies, Egypt, Senegal, &c., produces a bark known as Babool bark, much prized in the East Indies for tanning leather, and also for dyeing various shades of brown. The bark itself is of a deep red brown colour, much resembling in appearance that imported as "Mimosa bark." A decoction is employed as a substitute for soap.

Acacia melanoxylon, R. Br.—Known in Tasmania as Blackwood. A common Australian tree, growing thirty or forty feet high, also furnishes a bark used by the natives for tanning. *Acacia mollissima*, Willd., the Black Wattle, and *A. decurrens*, Willd., the Green Wattle, of New South Wales, both large trees, produce, with several other species of Acacia, barks more or less esteemed in the Australian colonies for tanning and dyeing purposes. The numerous species of *Acacia* growing in this part of the world are very imperfectly known, and consequently the native or commercial name of their products difficult of identification; thus, a large quantity of bark is imported into this country from Tasmania and Australia for tanning purposes under the name of "Mimosa bark," but the scientific name of the plant or plants producing it cannot be determined.

Weinmannia racemosa, Forst.—A moderately sized tree, native of New Zealand, where the bark is much prized for tanning,

It is very thick, heavy and ligneous, of a dull deep brown colour, the outer surface covered with patches of a thickish white cuticle.

Avicennia nitida, Jacq.—A native of British Guiana, where it is known as "Courida," produces a bark valued amongst the natives for its use in tanning. It is thin and somewhat brittle, the outer surface of a dusky grey colour, the inner having the appearance of being partly charred or scorched by heat.

Cassia auriculata, L.—A shrub common on waste land in various parts of the East Indies, where the bark is in great repute, both for tanning and also for dyeing leather of a buff colour. It is known by the name of "Turwur."

Betula alba, L.—The common birch, a native of the colder parts of Europe. The bark of this tree is much used in Scotland for tanning the lighter kinds of leather, and an oil is extracted from it which is used for dressing the well known Russian leather; the peculiar smell of this leather is said to be caused entirely by the use of this oil. The bark is also used in Lapland for tanning purposes, and in Scotland a wine is made from the sap of the tree.

Castanea vesca, Gaertn. The Spanish Chestnut.—This well known tree is now widely distributed over all parts of Europe and North America. It is supposed to have been originally a native of Asia Minor. The chestnut tree grows to a large size and a great age. In Piedmont the bark is used for tanning, and is said to impart a very dark colour to the skins tanned with it.

Larix Europoa, Dec.—The common larch is a native probably of Asia, and was introduced at the commencement of the 17th century, but it was not till about the middle of the 18th century that it was cultivated as a forest tree. It flourishes well in this country, but is more abundantly grown in Scotland than any other part. Its bark is much used among the Scotch, chiefly for tanning the leathers used in bookbinding. It is likewise used as a tanning substance in England as well as in America.

Bucida Buceras, L.—A tree growing twenty or thirty feet high, native of Jamaica and other West Indian Islands. The bark is said to be highly prized for its astringent properties in tanning. It is called in Antigua, "French oak;" in Jamaica, "Black olive."

Conocarpus racemosa, L.—A shrub or small tree growing in marshes on the sea-coast of the West Indian Islands and the neighbouring continent of South America. The bark is very largely used in Rio Janeiro for tanning purposes. The plant is one of the many known among the natives as mangroves.

Dyeing Barks.

Berberis vulgaris, L.—A shrub or small tree sometimes found growing to a height of eighteen to twenty feet. It is a native of Europe and Western Asia, and formerly grew in abundance in hedges in this country, but a groundless belief prevailed that corn growing in the

vicinity of these bushes always proved abortive, which caused the owners of the ground to destroy them in large quantities. The bark of the root, and also the inner bark of the stem yields a yellow dye, which is used for colouring linen, cotton, &c. In Poland, it is used for dyeing leather of a bright yellow colour.

Ventilago maderaspatana, Gaertn.—From the bark of the root of this plant, a native of the forests and uncultivated places in the North of Bengal, an orange-coloured dye is procured by the natives; it is usually employed with some other ingredients by which its colour is changed, as with galls it produces a good black. It is a favourite colouring agent, and is in common use amongst them.

Pterocarpus flavus, Lour.—A tree about forty feet high, a native of China, produces a thin but ligneous bark, of a bright yellow fracture. It is much used by the dyers in Canton. The colour is extracted by simply macerating in cold water, and is used without the aid of a mordaunt. The wood is called yellow sanders wood.

Morinda citrifolia, L.—A small tree, native of various parts of the East Indies, where the bark of the roots is more or less employed for the purpose of extracting a red dye. The red turbans and handkerchiefs so much in use in the Madras Presidency, owe their colour chiefly to this bark. From the bark of the roots of *M. tinctoria*, Roxb., and other allied species, red dyes are likewise procured. The number of plants whose barks afford dyes are small compared with the other uses to which this part of the plant is applied. Vegetable colouring agents are, perhaps more prevalent in the wood than in any other part, and a long list might be made of our dye woods, which form an extensive article of commerce. But the colouring matter is not confined alone to bark or wood; from the flowers of some, from the leaves of others, and from the fruits of others, again, different coloured dyes are obtained. In various parts of India the bark of many plants is used by the natives as local colouring agents, either alone or combined with other substances. Thus in Nepal, the bark of *Photinia dubia*, Lindl., is used for dyeing scarlet; that from *Datisca cannabina*, L., furnishes a yellow dye; from *Myrica sapida*, Wall., the same colour is obtained at Rohilkund. *Bruguieria gymnorhiza*, Lam., produces a black dye.—Quercitron; the bark of *Quercus tinctoria*, Willd., furnishes a yellow colour, in great repute among dyers; from that of the American Hickory (*Carya alba*, Nutt.), a colour is obtained much resembling that from Quercitron, but it is more difficult of extraction, on account of the hardness of its bark, and it cannot be obtained in such large quantities. The barks of *Wendlandia tinctoria*, Dec., *Cathartocarpus fistula*, Pers., several species of *Symplocos*, and many others are used as dye stuffs in India.

ON THE DESTRUCTION OF NOXIOUS INSECTS BY MEANS OF THE PYRETHRUM.

BY C. WILLEMOT.

Of all substances hitherto proposed for the destruction of noxious insects, powders have been found the only ones that can be used to advantage on account of their simple and easy method of application. All such powders, too, which have been employed, so far as known, are derived from the vegetable creation. It would occupy too great a space to enumerate here all the plants used in the form of powder for this purpose; it will suffice to mention some which have been more particularly under observation. Among these are the straight-leaved pepperwort (*Lepidium ruderale*, Linn., and *Thlaspi ruderale*, Desfon), found growing in uncultivated places and among rubbish around Paris. This is used in Southern Dalmatia in the form of powder almost exclusively for the destruction of fleas. In some parts of Southern Russia, especially in the Crimea, a plant very common in France, *Aristolochia Clematitis*, Linn. (common birthwort) is used exclusively to destroy bugs. Sawdust of aromatic wood, particularly American cedar (*Cedrela odorata*, Linn.), is largely sold for the destruction of insects, and, according to some authorities, most of the powders sold in Paris for that purpose are composed of that substance. But after using and experimenting with them we have been fully convinced that the object cannot thus be perfectly attained. Their action is feeble, or they merely stupefy, for a time, the insect, which soon recovers its strength and sensibility to do injury.

The greater number of the plants which furnish the most satisfactory means for the destruction of insects are of the genus *Pyrethrum*. Many observers, considering the botanic resemblance (as well as similar properties of this genus) with kindred ones as certain chamomiles, the *Anthemis Cotula* for instance, have pretended that such indigenous plants (chamomiles) may specifically furnish a powder for destroying insects equal in every respect to the *Pyrethrum*. But accurate and detailed experiments by ourselves and other competent observers refute such assertion. All the efficacy of the *Anthemis Cotula* consists in rendering the insects insensible for a time instead of destroying them. The inhabitants of the regions of Europe and Asia, near the Caucasian mountains, seem to have been the first to discover the properties of the *Pyrethrum*, and try on a large scale the powders obtained from these plants. The species employed differ according to the different localities.

It is easy to comprehend that the inhabitants of the Caucasus choose for their use that kind which is most abundant in their own country. Thus in Armenia they prefer the red Pyrethrum (*P. Roseum*, Biebers), commonly called Lowizachek, or flea plant.

The Persian powder which appears most extensively used is

almost wholly composed of this flesh-coloured Pyrethrum. (*P. carneum*, Biebers.) Dr. Ch. Koch in his 'Travels in the East' gives very curious details respecting this precious species in the Caucasian regions. In the 'Journal de la Sociéte Imperiale et Centrale d'Horticulture de la Seine,' vol. iii. 1857, p. 756, may also be found an analysis of a note by Mr. Neumann, of Breslau, on the 'Culture and Preparation of the Powder of the *Pyrethrum carneum*.

We may here remark, in passing, that in countries where the most frequent use has been made of these powders of *Pyrethrum*, they have only been applied to the destruction of those insects which are troublesome in dwellings. Our object has been to select from the different plants the one which presents the greatest range of efficacy; and we have been more exacting in this than heretofore has been the case in seeking a plant of incontestable efficacy for the destruction of insects, and which can be so applied, not only to vermin in the house, but also to those insects which every year commit such great ravages upon the cereals, fruit-trees, leguminous and ornamental plants, &c. A plant was desirable which can easily be acclimatized in France, the properties of which, in its wild state in its native regions, are neither destroyed nor weakened by cultivation, and which can be raised with but slight attention to its culture. We want, finally, a productive plant, to the end that the powder it furnishes may be sold at a very low price. Such a plant we are now fortunate enough to introduce for the public use. Its efficacy has been fully proved by a great number of persons, as will be seen hereafter; its acclimatization is very satisfactorily evinced; its culture is most simple; its properties are wholly retained; the production is very abundant; now nothing remains but its extensive propagation which, however, is not without many difficulties. We will not disguise the fact that the great success so far attained by no means makes us suppose the task accomplished, but it, nevertheless encourages us to continue our efforts with new perseverance. It was about 1850 when the first powder of Pyrethrum was introduced into France for the destruction of insects in houses. The powder came exclusively from provinces of the Caucasus, of Persia, and Dalmatia. Our researches have proved to us that that from the Caucasus is the best. For a number of years the inhabitants of those countries have successfully used the powder of the Pyrethrum to protect themselves against the ravages of numerous insects.

For a long period, a preparation was used throughout the Russian Caucasus for the destruction of injurious insects, and was regarded as a secret by the rest of the world, until its properties became known to Mr. Jumtikoff, an American merchant, while travelling through that country some forty years ago. He communicated his discovery to his son, who manufactured the article in 1828. This powder, or the plant from which it was obtained, was soon after introduced into Alexandropol, and subsequently the powder got into use in Germany and France, where its popularity is

rapidly increasing. At present there are more than 20 villages in the district of Alexandropol engaged in cultivating the plant and collecting its flowers. The plants from which this powder is produced, consist of small perennial shrubs, from twelve to fifteen inches in height, bearing flowers an inch and a half in diameter, and resembling those of the ox-eye daisy, (*Chrysanthemum leucanthemum.*)

They grow on the mountains of the Caucasus at an elevation of 5,650 feet above the level of the sea, in a temperature of 68° Fahr. They are of easy cultivation in gardens, and since their hardiness has become known, they have been introduced into Germany, Holland, and France, for the purposes of ornament, when they begin to flower in June. They will flourish in any ordinary garden soil, and may be propagated by layers as well as by seed.

The parts of the plants from which the powder is made are the dried flower-heads, gathered when ripe, on fine days ; and usually dried by exposure to the sun ; but they have been found to be more serviceable when dried in the shade, during which operation they are occasionally turned. In the process of dessication they lose about 90 per cent. When perfectly dried, they are first comminated with the hand, and then reduced to powder in a small mill.

A quantity of these plants grown upon eighteen square rods is estimated to furnish one hundred pounds of powder, which is best preserved in sealed vessels of glass. The application is made either as a powder or as an infusion, though in the latter form it is more beneficial, especially when intended for the destruction of insects on plants. The powder may be employed directly to the insects themselves, or in the places which they frequent. They are attracted by its smell, become stupified and immediately die. This substance may be employed without injury to the larger animals, or to man. It is intimated that the amount of this powder consumed annually in Russia alone is about 500 tons.

The inhabitants of the Caucasus and adjoining countries who used these powders had only a very limited knowledge of their plants, and did not suspect that one among them, the *Pyrethrum Willemoti*, Duchartre, would be called upon to render the most effective service to agriculture and horticulture, achieving the preservation of food, wool, furs, and the comfort of man and the domestic animals, &c.

These powders had been introduced into France for several years before a choice had been made among them, and the special importance of this particular species recognised. The high price and the numerous adulterations they have undergone, diverted the public from this acquisition, and from a public appreciation of its efficacy. Submitted to a close analysis, these powders as sold have been found to be mixed with dangerous substances, which in due regard to public safety require to be vigorously excluded from sale. In them sumac powder is a common ingredient from its close resemblance to the Pyrethrum powder,

and also jalap, cockle, of Levant, nux vomica, and even arsenic, enter into the composition of the powders we have examined.

It was not till 1856 and after many efforts that we could procure some good seeds of the Pyrethrum of Caucasus. We were then able to extend our researches as to the culture of the plant. We had to proceed cautiously in determining the soil best adapted to it, to find out the best exposure and to discover the care necessary to be bestowed on it. The first sown on September 15, 1856, produced only a few shoots. A great point was, to ascertain whether the plant was an annual or perennial. In order to determine this, several of the procured plants passed through the winter of 1856-57, and sustained from 8 to 12 degrees of cold without appearing to suffer.

The seeds gathered from this first culture were sown in February, 1858. In May, we communicated our experiments and the success that had crowned them to Messrs. Decaisne, Neumann, and Pepin. These gentlemen then examined the plant botanically, and their opinions are as follows :—

Botanical characters.—The genus *Pyrethrum* * has been established by Gaertner, according to Haller. Linnaeus classes it under the genus *Chrysanthemum*, but it differs from the latter by the strap-shaped flowers or semi florets situated on the circumference and terminating by three teeth, and because its fruits or akenes are crowned by a projecting membrane frequently toothed.

It must be admitted that these characteristics are not always very distinctly marked in some of the numerous species composing the Pyrethrum; and that the other characteristics of these plants resemble in every respect those of the Chrysanthemum. However this may be, present authors unanimously adopt the genus Pyrethrum. It belongs to the great family of the composite plants in the tribe of Seneciones, and the subdivision of Anthemideæ.

After the introduction into France, in October, 1857, of the first shoots of the species dwelt upon in this paper, there was a long period of indecision as to the true name which was to be given to it. On its presentation to the Imperial and Central Society of Horticulture, it was regarded as *Pyrethrum roseum*, Biebers; (*Chrysanthemum roseum*, Adam ;) but at that time the characters of the plant not being perfectly ascertained, this decision could only be the result of a supposition. Later when we presented some flowering specimens of the plant to the Museum, M. Decaisne believing that he was examining a plant well-known to the botanical explorers of the Caucasus, and described in botanical works in that region, at first sight took it for *Pyrethrum pedunculare.*

Shortly afterwards, having inspected the herbariums of the Museum,

* The name is a Greek word, signifying "fire," because the first plant of this name had a root which, when chewed, leaves a very burning taste in the mouth. It is a species of chamomile (*Anthemis pyrethrum*), used in medicine.

the celebrated professor recognised only one species to which it could be compared. Unfortunately the dried specimen which he was examining being imperfect, his researches were necessarily limited, and M. Decaisne regarded the plant as belonging to the species named by Fisher and Meyer *Pyrethrum elongatum*, (*Tanacetum elongatum*, Schultz, Bip.), which he with much kindness communicated to us.

Thus the Pyrethrum of Caucasus was propagated under this name to the time when M. Duchartre having made it a special object of study declared (Session of Hort. Soc., Nov. 24, 1859), that this species had not before been described, and that it differed by very marked characteristics from *P. elongatum.* The conclusions and scientific reasons which induced M. Duchartre to establish a new species for this plant are given in the 5th vol. of the 'Journal de la Societie Imperiale et Centrale d'Horticulture."

Pyrethrum Willemoti is a perennial herbaceous plant, which in its cultivated state reaches to the height of about 0·50 to 0·60 metres. All its green portions are covered with soft, cottony hair, giving it a whitish appearance. It forms rounded tufts, in the middle of which shoot up numerous little heads of flowers with long peduncles. The stalk is erect, nearly frutescent, rounded below, striped or furrowed, a little cottony towards the top. The lower leaves are large, and measure often nearly eight inches in length, by a breadth of about two inches. Borne by a long channelled petiole, slightly clasping at their base, they are divided into seven to nine segments or pinnatifid. These segments are alternate, deep, narrowed at their base, expanded at the top in unequal lobes terminated by pointed teeth. In proportion as they rise on the stalk, the leaves become smaller and less divided. Some of them towards the top may even be found linear and almost entire. The leaves finally vary in this form during the course of vegetation. They have a very bitter taste.

The peduncles are furrowed or channelled, and have hardly any but small linear leaves, and near the head (capatulum) very small green scales. The little heads formed by the re-union of the flowers on a common receptacle terminate each in a peduncle. The flowers of the disk are yellow and those of the circumference or rays white. The involucre or common calyx is composed of scales, brownish towards the middle and covered with a cottony and whitish down. They are imbricated, linear, the exterior ones are longer and terminate in a point, the interior ones on the contrary are truncate, curved and terminating in irregular teeth. The receptacle is nearly hemespherical, convex, without the spangles, which are found in many other plants of the composite family.

The flowers of the circumference, which are also called strap-shaped flowers or florets, have a corolla with a short tube and a tongue-shaped limb presenting two furrows above and terminated by these rounded teeth. Each little head is composed of from twelve to fifteen of these

flowers. The plants of the disk (those which are yellow and situated in the centre) have a corolla, hollowed, regular, divided at the top in five large teeth, and presenting on the external surface small grains. In cutting the corolla, we may see the several organs; the five stamens have their anthers united in a tube, each terminating by an appendix which results in the prolongation of the connexion in the form of an oval tongue. The threads are slender and abruptly inflated near the antheris. The style presents at its basis an inflation in the form of a bulb, crosses the tube of the stamens, and terminates in two developed branches with stigmas. The flowers on the circumference are female, that is, they inclose only the pistil, the stamens being represented by five little distinct thread-like bodies inflated with a rounded head at the extremity. The ovary of the flowers of the disk, as well as of those of the circumference, is inferior, that is other parts of the flower are inserted at the top, slightly arched and marked with five longitudinal angles, alternating with the teeth of the corolla. The ovary, the form of which is thus somewhat prismatic and surmounted by a border forming a cup irregularly toothed, and constituting what is termed an egret, because in many compound flowers that part forms a silky assemblage.

The external side of the ovary is flat in the flowers of the circumference, whilst in those of the disk it forms a projecting corner. Thus the portion of the sections of the ovary, situated at the bottom are also connected with the exterior of the flowers. The hollow of the ovary is filled almost entirely by an erect ovula inflated at the top and turned back or reflexed. The fruits or akenes which succeed the ovaries, are a little more arched than the last, presenting between their five sides small resinous grains. Their egret, as we have termed it in speaking of the ovary, is composed of a sort of cup, which does not reach scarcely the sixth or seventh part of the length of the fruit or akene.

Culture and Gathering.—The Pyrethrum, though a native of Mount Caucasus, where it grows abundantly and at a slight elevation above the level of the sea, under a latitude warmer than that of Paris, succeeds very well on good soil in France. It is very hardy and can sustain without hazard, the severe winter there. A few years' experience has taught the writer that it is little sensible to cold, and that it needs no shelter during the winter. It has been asserted that the kindred species which also grow in the Caucasus have rather suffered than benefited by the shelter given to them. The soil best adapted to the culture of the plant is a pure earth somewhat silicious and dry. Moisture and the presence of dung is injurious, the plant being extremely sensitive to a mass of water, and would in such case immediately perish. A southern aspect is the most favourable. The best time for putting the seed in the ground is from March to April. It can be done even in the month of February if the weather will permit it. After the soil has been prepared and the seeds are sown, they are covered by a stratum of

soil mixed with some vegetable mould, and the roller is slightly applied to it. Every five or six days the watering is to be renewed in order to facilitate the germination.

At the end of about 30 or 40 days the young plants make their appearance and as soon as they have gained strength enough they are transplanted. Three months after, they are transplanted again at wider distances according to their strength, each time being of course watered, but only moderately.

The blossoming commences in the second year towards the end of May and continues to the end of September. Within that period the heads from which the powder is made must be gathered. The most favourable time for gathering seems to be when the heads are about to open—that is, when the flowerets of the circumference are yet standing erect. In this state the fecundation takes place, and the essential oil contained in the heads has reached its highest state of development. The stalks and leaves through having the properties in a less degree, may be used also for making powder, but they must be mixed with the flowers in the proportion of a third of their weight. The powder thus obtained will perfectly answer the destruction of insects. Towards the end of September, at which time the blossoming has ceased, the stalks are cut at about 4 inches from the ground. As the flowers are cut they are dried in a granary or shed, great care, however, being taken not to expose them to moisture or to the rays of the sun. When completely dried the flowers are to be hermetically closed up in sacks, so as to prevent too early pulverization. In pulverizing them it is better not to take a larger quantity than the wants of the moment may require. The volatilization, which is of course more rapid in the powdered form than in flowers, will thus be avoided. It has been suggested that the drying of the flowers for making the powder might be effected on sheet-iron plates, like tea leaves are dried in China, but this operation is most injurious to the plant, dissipating the essential oil.

Pulverization.—Among the numerous methods which we have tried in order to simplify the pulverization of the dried flowers, that which appears the best is to pound the flowers in a mortar. The mortar should be covered with a piece of leather, through which the pestle moves, adjusting it in such a way as to prevent any contact from without, as is usually done in pulverizing drugs in a laboratory. The quantity to be pulverized should not exceed a pound at a time thus avoiding too high a degree of heat which would be injurious to the quality of the powder. The pulverization being deemed sufficient, the substance is sifted through a silk sieve, and the residue, with a new addition of flowers, is put into the mortar and pulverized again.

This method of preparation is so simple as to be within the reach of all; the pulverization by steam is more rapid and effectual, but necessarily more expensive. The best receptacles for holding the powder seem to be bottles, these, if well corked, will keep out moisture

which is so injurious to the properties of the powder. If the powder is not to be kept long, small boxes will do as well as bottles.

Insects Destroyed by the Powder.—The principal insects to which the powder is destructive may be ranged under four classes—first, insects injurious to agriculture and horticulture; second, insects obnoxious to man and his habitation; third, insects destructive to certain substances, as wool, furs, feathers; and fourth, insects injurious to museums of animal and vegetable products, and collections of natural history. We do not pretend to enumerate all the insects to which the powder is destructive, it will suffice to mention a few instances which will sufficiently show what applications may be made of it. Our domestic animals, dogs, cats, fowls, pigeons, &c., are subject to annoyance from insects which cannot withstand the effects of this powder. Of the numerous insects injurious to agriculture and horticulture we may mention the following which have been destroyed by it: the weevil, bark beetle, wheat-fly, maggots, cocci, aphides, earwigs, spiders, ants, &c. It is evident that not only the perfectly developed insects are destroyed, but also the larvæ, which in some cases, do greater injury than the insects themselves. Large depôts where military stores or navy supplies are kept, and especially extensive bakeries, may use the powder with great advantage for the destruction of weevils, midges, crickets, cockroaches, &c., the great plague of those establishments. The powder is equally efficacious in destroying insects which are a constant source of annoyance to the inhabitants of cities and the country. Gnats and musquitoes are banished; bugs, fleas, and flies disappear from houses under its influence. As to manufactured articles, the powder is applied effectually to the following:—

1. Furs.—These require great care for their preservation. Numerous insects live upon them. Their propagation is rapid. The only remedy against their ravages hitherto has been pepper or camphor, but by using the powder of Pyrethrum the insects and their larvæ will be most effectually destroyed.

2. Feathers.—The same result will be arrived at by using this powder for the preservation of the costly products of feather dealers. Most woollen products have also a number of insect enemies, especially in their undeveloped state, as larvæ. The powder of Pyrethrum, if applied in proper time, will effectually preserve all woollen articles. Natural history, too, has its share of the advantages afforded by this powder in the preservation of collections of mammalia, birds, fishes, reptiles, insects, and anatomical preparations.

Herbariums are very frequently devastated by insects gradually piercing the paper as well as the dried plants, reducing the latter almost to powder, more especially if they have not been poisoned by chloride of mercury dissolved in alcohol—a substance both expensive and dangerous. By applying a pinch of the powder between the leaves of his herbarium, the botanist will soon get rid of the enemies of his

collection. Finally, a most important advantage of this powder is that it is innocuous to man, and can be absorbed by the human subject without the slightest danger to his health. Some physicians of celebrity even assert that the powder can be advantageously sprinkled upon sores or open wounds that diffuse an unpleasant odour.

Mode of Applying the Powder.—In using the powder it must be applied carefully and in sufficient quantity, otherwise the result will be unsatisfactory, especially if used against some of the hardy or very resisting species of insects. Occasionally the powder, by being exposed to the air or moisture, will have lost its destructive properties, so as to render the result doubtful and wholly inefficient; at others the result has been unsatisfactory because the most favourable moment for the operation has been overlooked. A rainy or wet day, for instance, always lessens the destructive efficacy, because the powder, containing a very volatile essential oil, renders the conservation of this principle extremely difficult.

Of all the methods for applying the powder to plants attacked by insects, including the vine, the bellows will best accomplish the object. As there is only a small quantity of powder thrown at once, the loss will be very small, whilst in any other way a good deal of it will fall upon the ground. The powder should be directly applied to the parts operated on, and with care and precaution it may be made to penetrate into the most inaccessible parts of a plant. If, for instance, a plant has been attacked by plant lice, which are often hidden or masked by thick foliage, it will become necessary to turn aside this foliage, so as to have the insects exposed and the powder directly brought into contact with them.

In all cases these operations should take place on a warm day, the morning being always preferable. A slight moisture arising from the morning dew will make the powder more easily adhere to the spots where it is applied, and maintain its properties long enough to cause the death of the insects. The insufflation should be renewed several times, according to the nature and number of insects to be destroyed. The first operation generally stupifies them, while at the second or third application they lose their strength, fall to the ground and die sooner or later.

In order to prevent the ravages of the wheat midge, the powder is mixed with the grain to be sown, in the proportion of about two ounces to two or three bushels, which will save a year's crop.

For insects in dwellings the insufflation may be performed by bellows of a smaller size than those used in agriculture and horticulture. Proper care should be taken to make the powder penetrate to the recesses where the insects lodge. Household furniture ought to be scrupulously searched, and bedsteads and sofas sprinkled in the evening. By continuing this for several days, the premises will be thoroughly rid of insects.

For the preservation of furs, woollen garments or patterns, it is necessary, at the approach of spring, to sprinkle the articles abundantly with the powder, the object in contemplation being not the destruction of the insects, but the preventing their reappearance.

THE STRAWBERRY, ITS SPECIES, NATIVE LOCALITIES AND THEIR NORMAL SEXUAL CHARACTER.

BY WM. R. PRINCE.

The publication in your periodical of an article written by Leonard Wray,* who had recently visited this country, in which he explains "The scientific culture of the strawberry in America," has evidently awakened public attention in England to this highly interesting subject. As very erroneous views have existed both there and here, I presume a short paper on it will be acceptable to the public.

EUROPE presents us with three species of strawberries which, in their normal state, all produce fruit of small size. Two of these species have hermaphrodite flowers, and the third (*Fragaria elatior*) comprises male, female, and hermaphrodite flowers.

These European species are :—

F. vesca—The Wood and Alpine strawberry.

F. Collina—Green Pineapple strawberry.

F. elatior—Hautbois strawberry.

F. monophylla, of Linnæus, does not exist as a species, it being a variety of *F. vesca*. *F. sterilis*, of Linnæus, has proved to be *Comarum fragaroides*. Both Linnæus and Miller supposed, and so stated, that the *F. elatior* (Hautbois) was obtained from America ; an error that can scarcely be accounted for.

ASIA presents us with one hermaphrodite species, *F. indica*, producing yellow blossoms, and whose fruit is not edible.

SOUTH AMERICA presents us with two species, both of which have large foliage and flowers, and fruit of remarkable size, and which comprise in their normal state, both staminate and hermaphrodite varieties. These are :—

F. grandiflora—Pine strawberry.

F. Chilensis—Chili strawberry.

The *F. Bonariensis* of Loudon, is only a synonym of *F. grandiflora*.

NORTH AMERICA presents us with six species, very distinct in character from all the European and South American species, and producing fruit varying from a medium to a large size. These species each present, in their normal state, plants of two characters : 1st, hermaphrodite, or bi-sexual ; and 2nd, pistillate, or female. Of the hermaphrodite section there are two divisions : the one combining the stamens and pistils in each flower ; and the other producing some peduncles of entirely bi-sexual, and others of entirely pistillate flowers. These American species are :—

F. Virginiana vel Canadensis—Scarlet strawberry.

F. Hudsonica—Hudson's Bay strawberry.

* "TECHNOLOGIST," vol. i., p. 44.

F. Iowensis—Iowa strawberry.

F. Illinoiensis—Illinois strawberry.

F. lucida—California strawberry.

F. sericea, Douglas, *F. Chilensis*, of Torrey and Grey—Oregon strawberry.

The *F. Caroliniensis* of Loudon, and *F. Caroliniana* of Duchesne and Poiteau, has no distinct existence, but is merely a synonym of *F. grandiflora.*

The European species being hermaphrodite, and but one of the North American species being known to Europeans in the time of Linnæus, he supposed that all the species of the genus *Fragaria* were of the same character, and consequently placed them under the class and order *Icosandria polygynia*, comprising the stamens and pistils in the same flower. The two South American species which comprise staminate and hermaphrodite varieties, and whose large fruit caused them to be preferred in Europe, are the only species from which the numerous seedling varieties they now possess have been originated; and as but one sexual variety of the *Chilensis* was carried to Europe, there have been only a few hybrids grown therefrom. All the others are seedlings of the *F. grandiflora*, and they are very numerous throughout Europe.

These seminal varieties have retained their normal parental character, as this species does not admix even with its own congener of South America (*F. Chilensis*) as but one sex of this species has been obtained.

This primal character of the Pine family, comprising staminates and hermaphrodites has always been sustained, but the adoption in Europe of an unnatural system based on the extermination of all the staminates (males) has resulted in filling the gardens of Europe exclusively with varieties of the hermaphrodite character; and, as preference has been thus given to these large white-fleshed varieties over the scarlet-fleshed varieties of the *F. Virginiana*, it has caused an almost total exclusion from their gardens of all the North American species and varieties. The prejudice thus generated has prevented the introduction into Europe of the productive American pistillate, or female varieties, as well as of our hermaphrodites, comprising the numerous large hybridized varieties which constitute such remarkable improvements over the few North American kinds they already possess, both in the size and flowers of their fruit, in the far greater hardihood of the plants suitable to the most northern climates, and especially in their great productiveness, the latter quality arising from their sexual physical capacities, and from the "scientific culture of the strawberry," in the combination of the sexes.

Europe, at the present time, possesses no female varieties except the pistillate Hautbois, which she exterminates, and the few pistillate varieties of *Virginiana*, mostly obtained from America two hundred years ago, and two only of our estimable pistillate varieties, which have

been recently introduced there; this deficiency having resulted from her fatuity in ignoring the rapid progress made in the strawberry culture in America during the last fifty years.

Black Strawberries.—The varieties which are so called and classed as a distinct species or family in the London Society's Transactions, are not actually so, but are merely very dark-coloured varieties of the *F. Virginiana*, or hybrids. No such distinctive division is made by the French and Belgians. The Downton is a seedling of *F. Virginiana*, and others may be hybrids, such as Black Prince, Hovey, &c.

In Johnson's Dictionary of Gardening this section is distinguished as "*F. vesca nigella*;" but as *F. vesca* is European, and all the black strawberries are from American species, the author could not have been very conversant with the subject.

Mr. T. A. Knight, when president of the London Horticultural Society raised a large number of seedling strawberries, from which he selected about twenty varieties, which were described in the Society's Transactions, but these were grown from seeds injudiciously selected without any proper regard to sexual hybridization, and it would seem that he was then, as Dr. Lindley has been since, ignorant that such sexual distinctions existed, although he had seven pistillate varieties in the garden over which he presided. The varieties produced by him have, in consequence of their inferiority, been long since abandoned. Mr. Knight considered the *F. grandiflora* or Pine, the *Chilensis* or Chili, and the *Virginiana* or Scarlet, to be only varieties of one species, as all these (he says) may be made TO BREED TOGETHER INDISCRIMINATELY. This is a radical error. The first two species will blend with each other, although they are very distinct, but these two differ so entirely from the *Virginiana* that they never commingle therewith.

It is plainly apparent that in Europe this subject of sexuality has been almost entirely overlooked by the mass, and that investigation has been neglected by the professedly scientific, and discouraged by the prolonged assumptions of Dr. Lindley and others, that the "science" of the otherwise "cute" Americans was mere "theory and assertion," which simply required a little English "practice and common sense" to regulate it. Thus they have, during the whole period of forty-four years since the establishment of the London Horticultural Society's garden, remained in the ignorance of "intellectual exclusiveness," from which Mr. Wray's account of what he saw in America has at last awakened them.

Undoubtedly the publication by Mr. Wray of the "Scientific culture of the strawberry," resulting from his recent visit to our American gardens, will effect quite a change in the European method of culture, so that it will henceforth be based on those scientific principles long practised in this country, and which were announced by my father, William Prince, and myself, in various horticultural periodicals, and published in our "Treatise on Horticulture" in 1828, and which have

been assumed by Mr. Longworth and others throughout our country, until they have become the recognized basis of all American strawberry plantations.

So indispensable is the sexual combination to the production of abundant crops in all the American varieties, and in the Pine and Hautbois varieties cultivated in Europe, that it may well be doubted whether any person in England has yet realized what constitutes a full crop of strawberries. Attention to sexual distinctions being indispensable in a scientific view, it is equally demanded in every country and climate where strawberries are grown that possess these characteristic distinctions.

There should be no confused application of the sexual terms STAMINATE and HERMAPHRODITE, as the plants of these sexual divisions are entirely distinct; and while there are some species or families that combine both of these traits, there are others that possess but one, to the entire exclusion of the other; and a lack of discrimination will consequently produce confusion. Nor should the term "sterile" be ever used in reference to staminates or pistillates, it being inapplicable to either.

It may here be cited as a singular fact, that of the eleven edible species of the strawberry, there is but one which is positively known to combine all the three variations of staminate, hermaphrodite, and pistillate; although European writers, and some of our own, have run into the idea that the seeds of any one species would produce plants of all the three sexual divisions, and some have even declared that there was such confusion and vacillation in the sexuality, not only of seedlings, but of the actually existing varieties, that no reliance could be based on these distinctions as a reliable test for distinguishing species and varieties. Such views, however, are adverse to the facts. No such variations of character ever occur, but Nature sustains these normal distinctions as permanent and eternal, the vacillations finding existence only in the brains of such theorists.

Although it is a truism that the differences between the humid and cool climate of England and our dry and hot atmosphere cause the best educated English gardeners who migrate here to commit great absurdities, yet these climatic variations have no more connexion with the sexuality of strawberries, nor with the results of that sexuality in the productiveness of the crop, than they would have on two crops grown side by side—the one on dry soil, and the other subjected to irrigation. SEXUALITY IS NATURE'S OWN FACT; the success and extent of the crop are the result of art and culture. The incontrovertible truth thus stands forth that the exercise of science in regard to the existing sexuality is not necessarily variable by climate but is quite as important in one country as in another.

The chimerical idea of a transmutation of sexes by any variations of climate or circumstances is antagonistic to that order of Nature

which can never be varied or contravened any more in the humblest plant than in the largest animal, or in the movements of the spheres.

> "From Nature's chain whatever link you strike,
> Tenth or ten-thousandth, breaks the chain alike."

As climate—cold or hot, dry or humid—can in no wise affect the sexuality of any plant more than of any animal, the assertion made by a quandam observer, which has been made in print, that the Alpine varieties of strawberries, which have perfect flowers (hermaphrodite) in the regions of perpetual snow, when removed to the climates of lower parallels produce pistillates and staminates as seedlings HAS NO FOUNDATION IN TRUTH. As the plants growing in the alpine regions are all of the *Fragaria vesca* and *F. collina* species, I now put the question to every cultivator whether he has ever seen one single variation, as alleged, in all the seedlings that have ever been produced from those two species. No such variation has ever occurred, and the assertion is in direct contradiction to Dr. Lindley, who says he has never seen any other than hermaphrodite plants, except of the hautbois (*F. elatior.*) It is also controverted by the fact that it is universally recommended that the wood and alpine varieties be propagated from seeds, their sexual organs being always perfect; and this course is specially urged by Keen, in the London Horticultural Transactions, and in the "Bon Jardinier," they having been grown in France for centuries without the least variation.

All the esteemed European seedling varieties now cultivated in England, France, and Belgium are hermaphrodites, and Mr. Wray states that "these are so imperfectly developed in their organs they seldom produce other than a very scanty cross of inferior and imperfect berries." That the object of the high-priced grower is attained if he only has a few large-sized berries on each plant; but that if these plants were placed in an open field, deprived of hand-glasses, artificial impregnation, and unremitting watchfulness, they would be dead failures, and for a general crop quite unsuitable.

It is admitted on all hands that the principal strawberries in England are treated as tender exotics, and Mr. Wray asks, "Why is it so pampered, swathed, and swaddled, and its hardy character so completely ignored?" In England the fine varieties of strawberries are so expensively grown that they only reach the tables of the wealthy classes, whereas in America they are chiefly grown for the million. Mr. Wray also remarks that "so hardy a plant should certainly appertain more to open field culture than to the elaborate and expensive culture of the garden." The reason, he says, is "because science has not been applied to its culture," and hence "the supply is totally inadequate to the demand."

There are points of consideration other than the sexual question which European writers and cultivators have hitherto lost sight of, and

that even Mr. Wray does not seem to realize, which hold a most important bearing on the success of the strawberry in open field culture in England; but as these appertain more particularly to that special point, I propose to consider them in a future paper specially devoted to strawberry culture.

Here strawberries are grown, without any special care, in vast fields of ten to fifty acres, without any covering or protection. The idea of treating our estimable varieties as tender exotics, when their parentage is traceable to Labrador and to the Arctic regions on the Atlantic, and to Oregon and Vancouver's Island, and beyond Lake Attabasca, on the western side of the continent, is an absurdity which no American has been guilty of. Mr. Wray speaks of 5,000 quarts being grown to an acre in Cincinnati; but on many plantations, there and elsewhere, 200 bushels (6,400 quarts) are not considered an extraordinary crop, and in frequent instances it is claimed that the crop amounts to 250 bushels, or 8,000 quarts, per acre. It is shown by our present statistics that one strawberry-grower sent to market 6,000 quarts a day, his crop for the year amounting to 6,200 dollars. In statistics published in the "New York Times" the following statement is made: "The strawberry trade of New York is the largest of any one point in the world. It is estimated that 50,000 bushels are sold annually in New York, while about 12,000 bushels are sold in Philadelphia, 12,000 in Cincinnati, and 10,000 in Boston. During one week last season 400,000 baskets were received daily in New York. From one port in New Jersey, twenty-five miles distant from the city, there were received by steamboat, in a single day, 200,000 baskets. The largest receipt of strawberries in a single day, by railroad, was a load of 892 bushels, or 142,000 baskets, brought in by an evening train on the Erie railroad. New York city received last year, from all sources, not less than 8,000,000 baskets of strawberries; the value of these, at the wholesale price of 2½ cents the basket, was 200,000 dollars, for which the consumers probably paid double that sum. About 1,500 acres of choice land in the vicinity of New York are required to supply this market with strawberries. Some farmers cultivate 30 to 50 acres."

How great, then, the loss to Europe that they have failed to introduce our robust and productive American varieties! Not content, however, with ignoring our productive pistillate varieties, the European culturists have, with a singular lack of judgment, cast aside also the advantages which nature had presented to them, and adopted the custom of annihilating the indispensable staminate plants of the hautbois and pine families.

The large "white-fleshed varieties," as the pine family is termed in Europe, and which are there held in most esteem, have all been originated from seeds of the *F. grandiflora*, which comprises both male and hermaphrodite varieties, and it has there been particularly insisted that the hermaphrodites of this family possess both the male and female

organs in perfection. It is true that the organs are always present, but the male organs of these hermaphrodites are deficient in pollen, whereby a combination with the staminate is rendered indispensable to a perfect crop. The assumption of the fatal error as to the perfection of the hermaphrodites culminated in the adoption everywhere in Europe of a system based on the destruction of all the male seedlings, and a practice thus fallacious—an utter perversion of nature—has been universally urged in England and elsewhere throughout Europe, and has resulted in the extermination of the male plants. It seems never to have occurred to their superficial minds that nature, always equally economical and provident, and ever compensatory, had not furnished these staminate or male varieties without a purpose, and that they were, therefore, essentially necessary to the ample results which nature had designed as to the crop.

> "Go, wiser thou! and in thy scale of sense
> Weigh thy opinions against Providence;
> Call imperfection what thou fanciest such,
> Say here he gives too little, there too much."

Although the hermaphrodite varieties combine the two sexual organs, yet normally but one of them is perfect and preponderates, and the other is defective; consequently, the combination of the male is required in the one case and of the female in the other to perfect a full crop. It would therefore seem that nature, in the vegetable as in the animal kingdom, is ever exercising her influence on the compensating principle, and that the means imparted are always in exact ratio to the result to be attained. And it must here be borne in mind that these sexual conditions are all normal or primeval, and consequently are permanent.

From the time of Linnæus and Jussieu to the present day we do not witness any sexual change whatever, and a standard that has remained unchanged from their day down to the present time, with no prospect of any future variation, may well be considered as permanently established.

When in any of the *Fragaria* species the male organs of the hermaphrodite are imperfect, nature, ever provident, furnishes the male or staminate plant to supply the deficiency. And when in any species the female organs in the hermaphrodite are defective, nature presents us with the pistillate or female variety. But when any species like the *F. vesca* and *F. collina*, and also the *Indica*, are perfect in both organs throughout all their varieties, nature, never wasting her resources, gives us none other than hermaphrodites.

These exterminated males are as necessary to make up the imperfection of the MALE organs in the European and South American hermaphrodites as the female or pistillate varieties of North America are essential to compensate for the deficiency in the FEMALE develop-

ment of our hermaphrodites. It is this perversion of nature, by the destruction of the male plants which she had furnished, that has rendered it necessary in the humid climate of England to have recourse to artificial culture by hand ; and this attempt to improve on nature, while in reality waging a most unnatural war against her, has been the long continued cause of the miserable crops produced in England, where the flowers of many varieties are reduced by hand to four on each plant, and the plants have also to be specially nursed to insure the development of even this small product. The wanton destruction of the male plants, so necessary to efficient impregnation, is precisely similar to a man's cutting off both his natural arms in order that he might find use for artificial ones. The annihilation of the males of their own native hautbois is not only strenuously urged in Europe, but it is declared by their most intelligent (!) cultivators that it is to the existence of these "sterile" (males are not sterile) plants that the discredit and abandonment of its general culture is to be attributed, in consequence, as they say, of some people believing (as the Americans do) that it is necessary to combine the two sexual varieties to insure a good crop ; and that by adopting this course the "sterile plants" (males) overrun the females, and thus the beds become nearly barren. I would suggest the adoption of our American practice of planting the sexes in distinct beds. I desire also to impress on European cultivators that it is the same unnatural destruction of the males that has reduced the crops of the hautbois, which were formerly abundant in a state of nature: and I urge the adoption of American science (as to sexuality) in their treatment, by which they can restore its former fertility. Thus by reversing their practice they will revolutionize the results.

The additional normal fact that the four great families—the *F. elatior* (hautbois) and *F. vesca* (wood), the *F. grandiflora* (pine), and *F. Virginiana* (scarlet)—NEVER BLEND WITH EACH OTHER BY ANY SEXUAL UNION WHATEVER, AND CANNOT CONSEQUENTLY BE FERTILIZED EXCEPT BY THEIR OWN STAMINATES, RENDERS THE PRESERVATION OF BOTH SEXES INDISPENSABLE, WHERE THEY NORMALLY EXIST ON DISTINCT PLANTS.

As a proof of this fundamental fact there has not, during the two hundred and fifty years which have elapsed since the first interchange of European and American strawberries, been produced a single hybrid between the species of the two hemispheres, or between the three species which are natives of Europe, or between the species which are natives of South with those of North America. The six North American species blend sexually with each other, and the two South American varieties blend sexually with each other, but these two sections can never be sexually blended, nor can any American species ever be blended with those of Europe.

THIS NORMAL FACT OF SEXUAL AVERSION, WHICH FORMS THE SCIENTIFIC BASIS OF ALL STRAWBERRY CULTURE, appears not to be

understood, but to be entirely unknown to Europeans, as even the French as well as the English publications recommend that the male hautbois be planted near the Chili and pine varieties, in order to render them fruitful.

The neglect of scientific sexual culture has been more unfortunate in regard to the *F. Chilensis*, the largest strawberry of the earth, than to any other. It appears that when this, which in its native country produces fruit as large as a medium sized hen's egg, was brought to Europe in 1712, only the hermaphrodite variety was introduced, and that its potent staminate, so indispensable to develop this large fruit, was left behind. The neglect of scientific scrutiny, and the apathy which has consequently existed in Europe as to the present vital question, has caused their cultivators to ignore the great advantage attainable by the importation of the other sexual variety; and as the staminates of other species have proved incongenial, the seminal production of this noblest of all strawberries, by improved seminal varieties, has had necessarily to be abandoned, and not one representative of this magnificent species now exists in the London Horticultural Garden, and with the exception of three or four HYBRIDIZED seedlings in France, the *F. Chilensis* is only known throughout Europe as a botanical curiosity, not one genuine seedling having ever been produced for want of the other sex. Such is the unfortunate result for which the horticultural savans of Europe are responsible, by their having left the question recently propounded by Mr. Wray to be answered at this late day in the negative: "Is science brought to bear on the art of strawberry culture in England?" Fortunately, we have, by several importations, established a basis for a great extension of the varieties of this interesting family, and can boast of the production of many fine seedlings. Mr. Wray, despite the adoption of the enlightened views lately presented by him, falls into some errors as to culture, which I shall correct in my next article; but there is one which I cannot leave unnoticed at this time. Mr. Keen has been referred to as having made some discovery as to sexuality in 1809. He did so and, as he states in the Horticultural Transactions, his discovery was as to the hautbois strawberry only. Mr. Wray, however, applies this discovery as to his "Keen's Seedling," which was not produced until 1821, to which, of course, it can have no application, and which, with his "Imperial," the only other variety he ever produced, are both of the *F. grandiflora* family, of which no pistillate or female variety has ever yet been produced in Europe, nor yet has one ever been enumerated in the London Horticultural Society's catalogues to the present hour. Mr. W. fell into this error, probably, by following Mr. Longworth, who makes the same transposition of facts and dates. The "pistillate Keen's Seedling" that found its way to Mr. Longworth is a misnomer. It is a native seedling of Indiana, of the wild prairie species, termed *F. Illinoiensis*. I obtained it in 1847 from Mr. Longworth, who supposed it had been imported from England; and I also obtained from him the

"Necked Pine," which proved to be another pistillate of the same Illinois species, although bearing a foreign title. Prof. Huntsman (our closest observer of the strawberry) and myself tested both, and we had many a laugh about the supposed voyage across the Atlantic. Mr. Hooper, also, author of the "Western Fruit Book," who resides within a mile of Cincinnati, states that the "pistillate Keen" came from Indiana. Many of us were then cultivating the true Keen's Seedling and Imperial, which my father had received from the London Horticultural Society, and which were the same as have been cultivated here and in Europe down to the present period. Neither will produce a full crop unless attended by a pine staminate. At the present time, it is the MALE ORGANS of all the European hermaphrodite pine varieties, and not the FEMALE ORGANS, as Mr. Wray, in common with others, supposed, that demand an application of a corrective by staminates.

Flushing, Long Island, N.Y.

[Mr. Prince then furnishes a detailed description of the several species and cultivated varieties, European and American, extending over about 10 pages, which is too specially horticultural to be given in detail in our pages.—EDITOR.]

THE GUARANA OF BRAZIL.

In a paper read by Mr. T. C. Archer before the Botanical Society of Edinburgh in April last, that gentleman furnished the following particulars respecting *Paullinia Sorbilis*, Mart, and its products.

There is no more remarkable plant in the order Sapindaceæ, if regarded from an economic point of view, than *Paullinia sorbilis*, although as a plant it is not well known to the botanical world. From its large seeds is manufactured the substance called Guaraná, which is extensively used in Brazil, Guatemala, Costa Rica, and other parts of South America, as a nervous stimulant and restorative. The seeds, deprived of their coverings, are pounded into a paste, which, hardened in the sun, constitutes Guaraná. It is used both as a remedy for various diseases, and also as a material for making a most refreshing beverage; and it adds another of those incidents so puzzling in human history, of the discovery of these qualities in plants least likely to be suspected; such, for instance, as that of the leaves of tea, the seeds of coffee and cacay, the leaves and twigs of the various American Ilexes and other plants should have this wonderful restorative effect on the nervous system, and that this should not be a mere vague notion, such as attaches to thousands of other plants, but that it should really depend upon the presence of a chemical principle the same in all, and the operation of which

can be satisfactorily explained. The presence of an alkaloid which he called Guaranine was discovered some years ago in Guaraná by Dr. Theodore von Martius, of Erlangen, but its identity with Theine was soon established, and subsequent analyses, especially one by Dr. Stenhouse in 1856, proved that not only was the active principle of Guaraná identical with Theine, but that as far as is known, no other substance yields it so abundantly, the amount being 5.07 per cent. as against good black tea, which yields 2.13 per cent., and coffee from 0.8 to 1.00. The mode of using the Guaraná is curious and interesting. It is carried in the pocket of almost every traveller, and with it the bony palate of the large fish (*Sudas gigas*), locally called "pirarucu," the rough surfaces of which form a rasp upon which the Guaraná is grated, and a few grains of the powder so formed are added to water and drank as a substitute for tea. The effect is very agreeable, but as there is a large portion of tannic acid also present, it is not a good thing for weak digestions. Its remarkable restorative power has given it a further great reputation as an aphrodisiac.

Another species of this genus, *Paullinia cupana*, also enters into the composition of a favourite national diet-drink. Its seeds are mingled with cassava and water, and allowed to pass into a state of fermentation bordering on the putrefactive, in which state it is the favourite drink of the Orinoco Indians.

We append to the above details the following further information.—EDITOR.

The tree is abundant in the new province of Amazonas, where the seeds are collected, reduced, and prepared in mass, and sold to the Bolivians, who use it largely. It is also sent to the provinces in the South. There is exported annually from the city of Santarem, about 500 arrobas, or 16,000lbs., valued at 8d. or 9d. per pound.

Specimens of the Guaraná were exhibited in the Brazilian Court, made by the Indians of the River Amazonas, who not only prepare it for their own use, but for conveyence to Pará, Matto Grosso, and Goyaz, where it finds a ready market. It is made from the seeds of a low wide-spreading tree, which grows abundantly along the banks of the Upper Tapajós, Rio Negro, and other tributaries of the Amazonas, as well as in Guiana and Venezuela. The fruit is scarcely as large as a walnut, and contains five or six seeds ; these are first roasted, then mixed with a little water, moulded into a cylindrical form, the size and shape of a large sausage, and dried in an oven, in which state it is known as an article of commerce. It is grated into a powder by means of a rasp, (the bone before alluded to,) which was shown in the Exhibition. Two spoon-fuls of this powder are mixed in a tumbler of water ; this is considered to be a very refreshing drink, and regarded as a stimulant to the nerves, and like strong tea or coffee, is said to take away the disposition to sleep, It is exported also from the Rio Negro, where it has been purchased for 1d. per lb. ; in 1851, 3,500lbs. of Guaraná was exported from Pará,

which was there valued at 13d. per lb. In the Exhibition six different preparations made in Vienna from Guaraná were exhibited in the Austrian Court. Guaraná has been analysed by Dr. Stenhouse, who ascertained that it contained a quantity of a principle first called Guaranine, but which has been found to be identical with Theine, the principle to which both tea and coffee owe their invigorating qualities. The same principle, in the amount of $1\frac{1}{4}$ per cent., also exists in the Yerba Maté, the celebrated Paraguay Tea, which consists of the dried leaves of some species of *Ilex*.

The powdered seeds of the *Paullinia* are said to have been employed with much success by French medical men in cases of headache. They furnish by analysis a small quantity of resinous matter, starch, tannin, and a particular alkaloid guaranine.

HINTS ON PAPER MATERIALS.

In searching for fibre suited for the manufacture of paper, the following hints may be found useful to residents in tropical and other regions.

Any fibre capable of cohesion when precipitated on a draining surface from mechanical suspension in water, after having been reduced to a pure state of capillary subdivision by mechanical action, is fit for the manufacture of paper.

For all practical purposes it may be accepted as a rule, that for the manufacture of white paper all fibre requires bleaching.

Raw fibre may be divided into four classes :—

1. That which is easily reduced and easily bleached.
2. That which is easily reduced, but difficult to bleach.
3. That which is difficult to reduce, but easily bleached.
4. That wherein perfect bleaching involves the integrity of the fibre.

The most profitable shape in which to send fibre to the English market is that of half-stuff (or pulp). Well-prepared bleached half-stuff would fetch 25*l.* per ton in the market.

The best machine for reducing fibre to half-stuff is the ordinary rag-engine, costing about 150*l.*, carrying about 2 cwt. of stuff, and requiring a maximum of 7-horse power for driving. The half-stuff would require to be pressed, dried, and packed in bales. For experimental purposes in reducing the fibre, anything smaller than the ordinary sized rag-engine is useless, as the weight of the triturating roll—about 15 cwt.—cannot be dispensed with, so that laboratory experiments are necessarily confined to rough separation and bleaching. Moreover, laboratory experiments, unless conducted with the utmost care and skill, furnish no

reliable data for commercial operations. As a preliminary, the character of the fibre ought to be determined in the laboratory.

1st. In relation to its structure, having in view ease in fibrous separation. 2nd. In relation to its chemical constitution, having in view ease in bleaching.

Bleached half-stuff would realise a larger profit than unbleached, always supposing that the process of bleaching, owing to the accident of geographical position or otherwise, did not entail expense extra to that properly belonging to the operation under the most favourable circumstances.

Fibre could be sent into the market as half-stuff unbleached whenever its characteristics were reliably established.

B. L.

UNINFLAMMABLE STUFFS.

On this important subject the French Academy of Sciences has received a report from MM. Payen, Velpean, and Rayer, in which M. H. Chevalier's paper sent in to the Academy on the 25th of January last, is discussed. From this report it appears that only three salts have hitherto been found that may be successfully applied to the purpose in question, viz., that of preventing ladies' dresses from catching fire. There are many other salts that would do the same, but not without spoiling the dye, or the gloss, or the texture of the stuff, &c. Of the three in question, the sulphate and phosphate of ammonia have the inconvenience of being decomposed by the heat of a smoothing-iron ; but they are applicable in those manufactures where stuffs are stiffened by the action of hot air or cylinders heated by steam. They exercise no action upon either the thread or the colour of the stuff. The phosphate of ammonia may be mixed with half its weight of hydro-chlorate of ammonia. To obtain an efficacious solution, 20 per cent. of this mixture must be dissolved in water. A solution of 7 per cent. of sulphate of ammonia produces the same effect, and is therefore the most economical salt that the trade can employ. But in those cases in which the smoothing-iron cannot be dispensed with, as in linen, for instance, a solution of 20 per cent. of tungstate of soda should be preferred. To obtain the desired effect all these solutions must be applied to the stuffs after they have been stiffened and dried, because starch is always used in a weaker solution than that required for these salts. Acid tungstates destroy the thread of cotton stuffs, like borax, alum, and other substances previously recommended. The tungstate of soda is prepared in Cornwall, where the tin mines yield a large quantity of wolfram. It costs from 12*l.* to 18*l.* per ton. The sulphate of ammonia costs about 14*l.* per ton, and has hitherto been used for manure.

M. Sauvageon, a French investigator, has discovered that cotton cloth which has been exposed for a certain time to the vapour of burning sulphur, assumes such an amount of incombustibility, that although it will char and become brittle when held over the flame of a spirit lamp, it cannot be made to take fire, while under like conditions similar cloth, but unprepared in this way, is flamed immediately. If the alleged facts be borne out in practice, the problem is solved, for the simplest domestic means may be devised for subjecting, after being washed, all white clothing to the vapour of sulphur, which will tend to make it still whiter. Moreover, it may not prove necessary to repeat the exposure so often.

ON THE MANUFACTURE OF NICKEL.

BY LEWIS THOMPSON, M.R.C.S.

Commercial Nickel is a very impure article, and bears no more relation to pure nickel than brass or bell-metal does to copper. The following table will show its average composition, as it is found in the market.

	English.		German.		French.
Nickel . .	86·0	84·5	75·7	80·9	77·5
Cobalt . . .	6·5	8·2	2·2	5·2	3·7
Copper . . .	—	0·6	12·5	7·7	10·2
Iron . . .	1·4	1·1	0·4	1·2	1·1
Arsenic . .	1·3	0·4	2·6	3·8	2·8
Zinc . . .	2·0	0·7	4·1	0·5	1·4
Manganese . .	0·2	0·8	—	—	0·6
Sulphur . .	1·7	2·2	2·3	0·2	1·1
Carbon . . .	0·5	0·9	0·2	0·1	0·7
Silica and Alumina	0·4	0·6	—	0·4	0·9

There is every reason to suppose that our accounts of metallic nickel relate to an alloy of that metal with cobalt, in greater or smaller proportion; that in fact absolutely pure nickel has not hitherto been obtained. Pure nickel, is however, much more easily made than pure cobalt, for its affinity for oxygen is much less. Taking advantage of this point, I made up a quantity of pure oxide of nickel into a paste by means of a little water, and forced this paste through a perforated earthenware plate, so as to form it into a granulated mass; when this mass had been thoroughly dried, I introduced it into a porcelain tube,

and after heating it red-hot, I passed a current of pure hydrogen gas over it, and continued this until it had become cold. The grey metallic shape thus produced was fused with a little borax in a crucible, lined with pure alumina, and yielded a beautiful white silvery looking button of the weight of 620 grains; its specific gravity was 8·575, and it was almost as soft as copper. Its malleability seemed very great indeed, for a piece of it was rolled out nearly to the thinness of tinfoil; it showed, however, a disposition to tarnish after a few days' exposure to the air, and became then of a pale yellow colour, a kind of green sickness tinge. Its magnetic properties were less dreaded than those of either cobalt or iron; and judging by the globular form and other evidences of perfect fusion in the button, I believe that nickel is much more fusible than the two metals just mentioned. When portions of it were melted with copper and zinc in the quantities usually adopted to form albata, it produced a compound vastly superior in appearance to any of the miserable makeshifts that now disgrace our markets. Indeed, I am quite convinced that it would well repay any respectable person to commence the manufacture of pure nickel; and it would not surprise me, if a compound of aluminium and nickel could be found which, for beauty of appearance, might equal silver and surpass it in durability and freedom from sulphurous deterioration. Whilst alluding to the advantages of an improvement in the manufacture of nickel, it may not be amiss for me to notice two points of some importance in the way of improvement. At present this extraction of nickel from the ore is made to depend very much upon the affinity of arsenic for that metal, so as to form with it an arseniuret of easy fusibility, and sufficient specific gravity to separate freely from the melted slag or gangrene; and for this purpose large quantities of arsenic are employed by the workmen, not only to the detriment of their own health, but to the injury of their neighbours. This pernicious practice is quite unnecessary, as I have myself proved by experiments upon a large scale; for example, after roasting six hundred weight of the common ore of nickel, which is an arsenio-sulphuret, I mixed it with half its weight of chalk, and threw the mixture into a cupulo furnace in full blast; the result was that the lime of the chalk formed with the quartz and oxide of iron in the ore a perfect flux, whilst the oxide of nickel, being reduced to the metallic state, fell in that condition into the well of the cupulo, from whence it was run out in a melted form and readily separated from the slag. There was no apparent appreciable loss of nickel in this operation, and the rough metal was found to contain 88 per cent. of pure nickel, the rest being cobalt and iron, with a little sulphur, but no arsenic could be detected in it; moreover, this rough metal might, from the cheapness of the process, have been profitably sold at 3s. per lb., and was decidedly more pure than the ordinary commercial nickel.

The other point to which I have alluded is applicable to the wet mode of separating nickel, and depends upon a fact hitherto, I believe,

unnoticed by chemists. If we have in solution a mixture of the sulphates of nickel, cobalt, zinc, manganese, iron, and copper, we have only to add to this solution in a warm state as much sulphate of ammonia as it will dissolve, and then set it aside to cool. Almost every particle of the nickel and cobalt will separate as a green crystallized powder and leave the other metals in solution. The explanation is very simple. The sulphates of nickel and cobalt form triple salts or alums with the sulphate of ammonia, and these salts are absolutely insoluble in a cold saturated solution of sulphate of ammonia, particularly when the solution is slightly acidulous.

I shall conclude these remarks upon nickel by stating that this metal appears to possess the property of "welding" like iron. At my request, a workman heated two small bars of nickel which had been previously powdered over with borax. The bars were heated in a forge, and the two hot ends "jumped" together,—that is to say, the white hot ends were forcibly driven one against the other by gentle blows with a hammer applied to the other ends, the symmetry of the bar being preserved by blows applied laterally. Although the point of junction was afterwards subjected to much twisting, straining, and so forth, with a view to test its cohesive power, yet it showed no signs of weakness even after much cold hammering.—'Newton's London Journal.'

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