THE

TECHNOLOGIST.

A MONTHLY RECORD OF

Science Applied to Art, Manufacture, and Culture.

EDITED BY

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THE TECHNOLOGIST.

THE GENUS ARAUCARIA.

BY JOHN R. JACKSON,

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In the year 1774, the good ship 'Resolution,' commanded by the great circumnavigator Captain Cook, was calmly sailing along through the glorious southern seas, when the cry of "Land a-head" echoed through the vessel. All eyes were directed towards the point indicated. The faint outline of an unknown shore was visible. Gradually they neared the coast. The pleasure of those upon the deck was equalled by their surprise as by degrees the scene became more visible. They saw what appeared to them to be tall pillars, or spires, or the masts of a thousand ships, towering high over all else around them. On they sped without being able to determine what this unusual and unexpected sight could mean, till upon nearing Cape Coronation a few days after, the same objects presented themselves to view. What could they be? Could they be nearing a land where civilization held sway? or could these be magnificent columns of basaltic formation? This latter was the general opinion of the naturalists on board. Speculation was rife, expectation was on tip-toe. The enlightened commander maintained from the first that they were trees. The telescope was kept pointed towards them, and at last it became evident that these strange pillars were, in fact, trees, but trees of a new and wonderful species. A landing was proposed, all hands being determined not to leave the place till they were satisfied as to what kind of trees they were. Captain Cook with the botanists on board now first set foot upon the island. The hearts of the enthusiastic company bounded within them at the sight, as they for the first time made the acquaintance of a goodly number of *Araucaria columnaris*. Nor was this discovery interesting alone to the botanists, here were trees the trunks of which on this little isle were from sixty to seventy feet high admirably adapted for ships' spars. Captain Cook says:—"If I except New Zealand, I at this time knew of no island in the South Pacific Ocean where a ship could supply herself with a mast or a yard, were she ever so much distressed for want of one. My carpenter, who was a mast-maker as well as shipwright, was of opinion that these trees would make exceedingly good masts. The wood is white, close grained, tough and light. Turpentine had exuded from most of the trunks, and the sun had inspissated it into a resin which was found sticking to them and lying about the roots. These trees shoot out their branches like all other pines, with this difference, that the branches of these are much smaller and shorter, so that the knots become nothing when the tree is wrought for use. I took notice that the largest of them had the smallest and shortest branches, and were crowned, as it were, at the top by a spreading branch like a bush. This was what led some on board into the extravagant notion of their being basalts, indeed, no one could think of finding such trees here." This island was afterwards named by Captain Cook the Isle of Pines. We do not know whether at the time we write the particular tree that first attracted Captain Cook's attention ninety years since is still standing, but in 1850 it was reported to be "in a flourishing condition," and was said to exactly resemble "a well-proportioned factory chimney of great height." From the peculiarity of the foliage and general habit of the Araucarias, and more especially of *A. columnaris*, it is certainly a matter of no wonder that all on board the 'Resolution' were surprised and astonished upon first beholding so novel and beautiful a scene. There is, perhaps, no one family of plants more interesting than that to which the Araucarias belong (the *Coniferæ*), and it is certain of all the timber-trees none have produced so much interest among botanists as the Araucarias. And there are many reasons for this, for if we except the Mammoth trees of California, the Araucarias take a position among the largest and most majestic forest trees.

To Captain Cook and his fellow-travellers, then, are we indebted for the first accurate general account of *A. columnaris*, though it had been previously mentioned by several authors, but under other names.

The Araucarias, which take their rank as the noblest of all that noble family of trees, the Conifers, are now confined to the Southern hemisphere ; but there is evidence that would lead us to suppose that at one time they held a footing even in our own island. Geologists, and notably poor Hugh Miller, speak with confidence of having found fossil Araucaria stems. The microscopic structure of the wood corresponds very closely with that of the recent Araucarias. The remains of one found in the lias of Dorsetshire have been figured and described under the name of *A. primæva*. There are some seven or eight species of the genus now known to botanists, and these are natives of Brazil, Chili, New Caledonia, Norfolk Island, Australia, &c. Some of them have been only recently introduced to our gardens, others have been cultivated for many years. A few particulars concerning them may not be without interest to the readers of this magazine. The name of the genus is derived from that of a tribe of natives called Araucarians (the word signifying freedom), who inhabit the district of South America where *A. imbricata* abounds.

If *A. columnaris* holds good as a species, decidedly the most similar to it is *A. excelsa;* indeed, the difference seems to be so slight that many authors have united them under one specific name (*A. excelsa*). In general habit and appearance they so much resemble each other that to a casual observer not the slightest difference could be detected, without it is in the manner of branching, *A. excelsa* throwing out its branches nearly horizontally and in regular whorls, while those of *A. columnaris* are slightly inclined upwards, but this may not be the case in old plants. Loudon considers them synonymous and says, "The *A. excelsa* is a native of New Caledonia, or Queen Charlotte's Island, and of a small neighbouring island, which is a mere sandbank only three-quarters of a mile in circuit." After being discovered by Captain Cook, as mentioned above, on the Isle of Pines it was brought home by Brown and Flinders, who found it growing abundantly on the east coast of New Holland, and the tree was introduced into this country about 1793. Of all the Araucarias the *A. excelsa* is the most beautiful and graceful in habit. Its naked tapering trunk, with uniform branches clothed with rich green foliage, makes it a very handsome object, The leaves are not more than three-quarters of an inch long, awl-shaped, and curved upwards. The plant is not hardy, but grows well in a greenhouse, where it is fully protected from the frost. There are several fine specimens of this beautiful tree in the temperate house of the Royal Gardens, Kew, some of them over twenty feet high. These trees would have been much taller, but want of accommodation made it necessary to cut them down repeatedly. The wood of *Araucaria excelsa* is white, as indeed are most of the coniferous woods ; the upper part of the trunk is knotty, while the lower part is invariably unsound in old trees. It is however, much used by the natives in house-building and similar work. It forms a large tree, averaging from 180 to 230 feet high. In the Sydney Botanic Garden there are some remarkably fine specimens of the Norfolk Island pine ; in beauty and symmetry they are said to have no equal ; their perpendicular trunks, the regularity of their branching, and being covered with the most beautiful dense foliage, giving them a drooping feathery appearance. Their age is computed to be about fifty or sixty years. The largest of these trees has attained a height of seventy-six feet, and a circumference near the base of twelve feet, This tree has occasionally borne fruit, the first time in 1839. Dr. Bennett, in his 'Gatherings of a Naturalist in Australia,' tells us that the first instance of perfect seeds having been produced in that colony was in 1857, when the trees at Ash Island, Hunter's River, bore female cones. The seeds, upon ripening. scattered themselves, taking root and producing young plants, spontaneously, thus naturalizing the plant as it were.

A. excelsa is of all the species the most majestic, and the places of its growth perhaps the most picturesque. It loves the mountain side, the overhanging precipice, the storm-torn rocks; among these it firmly anchors itself with its twisting roots. These roots descend many feet into the ground and penetrate into every lateral crevice. They form wood of some thicknesss and of great density, of a deep red colour, from which the inhabitants make small articles of utility or ornament, such as candlesticks and the like. From the tremendous storms with which Norfolk Island is occasionally visited, the Araucarias suffer considerably, but chiefly in their uppermost branches; in the valleys where they are most sheltered, therefore, the best formed and most symmetrical trees are to be found. They do not grow in very dense forests, other and smaller trees coming in and filling up the spaces between them, thus tending to give the forests a very ornamental appearance. The wood is free from any resin, but a sort of white milky juice exudes from the bark; this has been tried for various purposes as a substitute for pitch, but found to be useless. A former governor (Governor King) of Norfolk Island was so partial to this tree that he adopted it as his family crest. Another species of this group, and nearly allied to *A. excelsa*, is *A. Cunninghami*. This, which is called the Moreton Bay pine, was named by Aiton in honour of the indefatigable botanist and explorer Allan Cunningham. It is found on the shores of Moreton Bay, in lat. 14° to 29° south, and on the alluvial banks of the Brisbane River, lat. 27° to 30° south. It grows, however, in the greatest profusion in the brush forests, on the Richmond River. The trees seem to thrive best near the coast, attaining in such a situation their greatest height, often from 100 to 130 feet, but gradually diminishing in height the farther the trees are inland. It would appear from this that the sea air has a great effect upon it. Other large trees of different genera are found growing amongst the Araucarias in dense woods. The Moreton Bay pine was discovered in 1770, by Sir Joseph Banks and Dr. Solander, and the first living plant did not arrive at Kew till 1824.

From the time of the discovery of *A. columnaris* in 1774 up to 1824, the two trees were considered to be the same species, but in the latter year Mr. Allan Cunningham revisited Moreton Bay in company with Mr. Oxley, and after a careful examination, came to the conclusion that *A. Cunninghami* "was a very distinct species, not simply in its habit of growth, which is very remarkable, but in the character of its leaves." The branches are much more drooping than those of *A. excelsa*, and very lax as compared with that species. On the young twigs the leaves are very minute, gradually developing themselves till they attain maturity, when they become slightly imbricated. The branches are given off in whorls of six or eight, in the young plants slightly bent upwards, but in those of greater age bending down in a very graceful manner. It forms a very straight trunk, frequently rising to a height of eighty feet before any branches are given off. The diameter of the trunk averages from four to five feet, the cones are ovate, from three to four inches long, and nearly as broad. The scales are very closely set together, wedge-shaped, of a leathery texture, each ending in a sharp recurved spine, about a third the length of the scale. The seeds are small and flattened, in the form resembling the scale itself. The whole cone is of a deep rich brown colour. Allan Cunningham says that this plant bears young cones in the month of September. It has never fruited in this country. The wood in appearance and colour much resembles some of the lighter kinds of deal. It is of a very uniform grain, and works well. Some specimens are very beautiful, on account of small knots interspersed throughout, giving it somewhat the appearance of bird's-eye maple, though being of a lighter colour it has a more delicate appearance. It is chiefly used in the colony for house carpentry and many kinds of furniture. For the masts of vessels it is peculiarly adapted when green, as spars can be obtained in any quantity, from eighty to a hundred feet in length ; but it is said in drying, these masts cannot be depended on, as there is little lateral cohesion between the fibres, and being entirely devoid of resin, there is nothing to strengthen them. The timber procured from the inland or mountain brushes is considered superior to that grown near the coast ; from some trees as much as ten thousand feet of saleable timber can be obtained. From Sydney and other parts, large quantities are imported, giving employment to a large number of sawyers, who receive pay at the rate of 2*l* 10s. per thousand feet. In Queensland, also, the timber is an article of great commercial importance. Though there is no actual resin deposited in these trees, there is an abundance of a clear, white, transparent substance, which exudes from the trunks and adheres to them, hanging in the form of icicles. Some fine specimens of the wood of this tree were exhibited in the International Exhibition of 1862, in both the Sydney and Queensland collections. These are now to be seen amongst the magnificent collection of colonial and foreign woods in the Royal Gardens, Kew.

The *Araucaria imbricata*, Pav., or Chili pine, is, perhaps, the best known of all the species, having of late years been so largely planted in this country. It was known to the Spanish settlers nearly a century back. In 1780, Don Francisco Dendariarena was commissioned by those settlers to examine the Araucarias, and report upon their suitability as timber for ship-building. The result was that the wood of *A. imbricata* was considered good, and at once applied to the repairing of the vessels of the squadron then lying in the port of Talcahuano. In a work published by the Abbe Molina, two years later (1782), the tree is described as *Pinus Araucaria*. In the same year the botanist Pavon was sent by the Spanish Government in search of this tree ; having secured the flowers and fruit (the most necessary parts for determination), he had no hesitation in making it a distinct species of Araucaria (*A. imbricata*). The plant had, however, been gathered by Pavon in a previous expedition to Chili, and transmitted by him to France, where falling into the hands of Lamarck and Jussieu, the former authority named it *Dombeya Chilensis*, but through inaccuracies in the description of its botanical characters, this name fell to the ground, and Pavon's subsequent name was generally used. The tree was not known in Europe in a living state till Archibald Menzies, accompanying Captain Vancouver secured some fresh seeds.

Having been invited to dine at the house of one of the officials, at Valparaiso, he begged a few of the seeds of this tree, which formed part of the dessert. These were planted, and carefully attended to by him on board ship; these young plants were brought home, and were presented by Menzies to Sir J. Banks, who reared one in the garden adjoining his house at Spring Grove, and the remainder were presented to the Royal Gardens, Kew. One of these trees is now among the finest in Europe, and stands our winter climate well. Previous to 1806 it was kept in a greenhouse, but after being planted out it was carefully covered, to protect it from the frost. This precaution has now been discontinued for many years, and found to be quite unnecessary, as the abundance of these trees in almost every well-kept garden testify. Plants can now be obtained for a few shillings which about twenty years since could only be had for as many pounds. The best description of the Chilian Araucaria forests is from Pœppig's travels in the Peruvian Andes. He says: "The Araucaria—a tree that affords the Indians of the Pantagonian Andes a great part of their food—will not grow on the lowlands, and it also preserves an accurately defined boundary with respect to its northern limits. When transplanted into many parts of the province of Concepcion, it exhibits a sickly, deteriorated appearance, and vegetates so reluctantly that from many fresh seeds which were sown in Talcahuano, only two sprung up, which shortly afterwards died. An Alpine atmosphere and a severer climate than can be expected in the lower tracts of the country, and above all a stony soil, seem to be indispensable for its growth. In the immediate neighbourhood of Antuco not a single tree of Araucaria can be seen, and it requires a fatiguing excursion to gratify the naturalist's desire to behold a wood of these truly regal trees." The writer then goes on to say: "Towards the evening we had ascended the moderately high ridges that form the background of the valley," which runs between Antuco and the fort of Trun Leuvu, "and the dense crown that was seen above these, from afar, had indicated our near approach to the desired aim, and added new vigour to our exertions. When we arrived at the first Araucarias, the sun had just set, still some time remained for their examination. What first struck our attention were the thick roots of these trees, which lie spread over the stony and nearly naked soil, like gigantic serpents, two or three feet in thickness; they are clothed with a rough bark, similar to that which invests the lofty pillar-like trunks, of from fifty to one hundred feet in height. The crown of foliage occupies only about the upper quarters of the stem, and resemble a large depressed cone. The lower branches, eight or twelve in number, form a circle round the trunk ; they diminish till they are are but four or six in a ring, and are of most regular formation, all spreading out horizontally, and bending upwards only at their tips ; they are thickly invested with leaves, that cover them like scales, and are sharp-pointed, above an inch broad, and of such a hard and woody texture that it requires a sharp knife to sever them from the parent branch. The general aspect of the Araucaria is most striking and peculiar, though it undeniably bears a distant family likeness to the pines of our country ; its fruits placed at the end of the boughs are of a regularly globular form, as large as a man's head, and consist of beautifully imbricated scales that cover the seeds, which are the most important part of this truly noble tree. The Araucaria is the palm of those Indians who inhabit the Chilian Andes, from lat. 37° to 48°, yielding to these nomade nations a vegetable sustenance that is found in the greater plenty the more they recede from the whites, and the more difficult they find it to obtain corn by commerce.

" Such is the extent of the Araucaria forests and the amazing quantity of nutritious seeds that each full-grown tree produces, that the Indians are ever secure from want, and even the discord that prevails frequently among the different hordes does not prevent the quiet collection of this kind of harvest. A single fruit (*cabeza* 'a head') contains between 200 and 300 kernels, and there are frequently twenty or thirty fruits on one stem ; and as even a hearty eater among the Indians, except he should be wholly deprived of every other kind of sustenance, cannot consume more than 200 nuts in a day, it is easily seen that eighteen Araucarias will maintain a single person for a whole year. The kernel, which is the shape of an almond, but double the size, is surrounded with a coriaceous membrane that is easily removed. Though relishing when prepared, it is not easily digestible, and, containing but a small quantity of oil, it is apt to cause disorders in the stomach with those who are not accustomed to this diet. When the scarcely matured seeds are dried in the sun, a sugary substance exudes, which appears to reside chiefly in the embryo. The Indians eat them either fresh, boiled, or roasted and the latter mode of cooking gives them a flavour something like a chestnut. For winter's use they are dried, after being boiled, and the women prepare a kind of flour and pastry from them.

" The collecting these fruits would be attended with great labour if it were always necessary to climb the gigantic trunks ; but as soon as the kernels are ripe, towards the end of March, the cones drop off of themselves, and shedding their contents on the ground, scatter liberally a boon which nothing but the little parrot and a species of cherry-finch divide with the Indians. In the vast forests, of a day's journey in extent, that are formed by these trees in the districts of Pehuenches and Huilliches, the fruits lie in such plenty on the ground, that but a very small part of them can be consumed. In former time a great quantity came to Concepcion and Valdivia by trading with the Indians, and thence they found their way to Valparaiso and Lima ; but now they are seldom seen anywhere near the coast, or they are too old to be palatable. The reason why all the seeds of Araucaria that hitherto were sent to Europe did not vegetate, is because the collectors did not procure them from the Indian country, but bought them in the market at Valparaiso, where they are offered for sale boiled and dried. My excursion to Quillay-Leuvu obtained for me fresh seeds of the Araucaria, which reached Germany in October, 1829, being seven months after they were ripe, and being sowed immediately, the period was just that of the Chilian spring. Of some hundreds, about thirty came up ; but ignorance of the true climate, which led to the error of placing the young plants in a hothouse, killed the greater part during the first year. To my great satisfaction, however, about six individual plants have been preserved in different places, and they are, to the best of my belief, the only ones in Europe. The wood of the Araucaria is red where it has been affected by the forest fires, but otherwise it is white, and towards the centre of the stem, bright yellow. It yields to none in hardness and solidity, and might prove valuable for many uses if the places of the growth of the tree were less inaccessible. For ship-building it would be useful, but is much too heavy for masts. If a branch be scratched, or the scales of an unripe fruit be broken, a thick, milky juice immediately exudes, that soon changes to a yellowish resin, of which the smell is agreeable, and which is considered by the Chilians as possessing such medicinal virtues that it cures most violent rheumatic headaches when applied to the spot where the pain is felt.

"The Araucaria forests of Antuco is the most northerly that is known in Chili, so that the boundary of this king of all the extra-tropical American trees may be estimated at 36° south lat. The extreme southern limit is not so clearly ascertained, which is not surprising when we consider how little comparatively is known of Western Patagonia ; it seems probable, however, that it does not stretch far beyond lat. 46°. Between Antuco and Valdivia this tree only grows among the Andes, and, as the Indians assert, solely on their western declivities, and nowhere lower than from 1,500 to 2,000 feet below the snow line, up to which they frequently reach. Further to the south the Araucaria appears at a lower elevation, and in the country of the Cuncos, and about Osorno, is said to occur on mountains of a very moderate altitude near the sea. The Corcovado, a mountain that rises opposite Chilöe, is said to be studded from its foot to the snow line with large groups of these beautiful trees. Of all other vegetation the Araucaria forests are as bare as the pine woods, offering but few plants which can interest the botanist. Steep, rocky ridges, where there is no water, are its favourite habitat."

The Chilians eat the seeds either raw, roasted, or boiled, and consider them very nutritious; they also procure a spirit from them by distillation. The timber is easily worked, and takes a high polish. Pavon mentions a peculiar fact connected with the height of these trees. He asserts that the female is by far the largest, frequently 150 feet, while the male seldom exceeds forty or fifty feet. The inner bark of the trunk is peculiar from its light, porous nature; it is very thick. The outer bark is also of a great thickness, and of a similar corky consistence.

The Bunya-Bunya, *Araucaria Bidwilli*, Hook., is a noble tree, inhabiting the scrubs between the Brisbane and Burnett Rivers, between the 26 and 28 parallels of latitude, and longitude 152° to 153°·30 east. On the east coast of Australia the trees grow in dense forests over a tract of country ranging about thirty miles long by twelve broad, where they form one of the principal features in the surrounding vegetation, being strikingly contrasted by their rigid growth and bright green colour. The tree is a magnificent one, growing from 100 to 200 feet high, with a stout trunk, scarcely tapering, and covered with a thick, smooth bark, often unbranched for half the height, with a conical, loose head, overtopping all the other trees of the forest. The branches are arranged in whorls, sometimes giving off near the summit as many as sixteen in a whorl; these branches average twelve feet in length, and about one and a-half inches in diameter. The young branches are arranged horizontally on the stem, but the older ones have a drooping habit. The branchlets are disposed in pairs, opposite, about eighteen inches long, very slender, sparsely covered with the thin, long leaves; in the younger and terminal branches the leaves are more crowded. The cones are very large, quite the size of a man's head, and sometimes nearly as broad as long, the top often slightly depressed. The scales are large and thick, with an acute ridge running across them, terminating in a sharp-pointed, recurved spine. The seeds, seated between these scales, are also very large, frequently from one to two inches long, and sometimes even longer, and quite three-quarters of an inch wide, broad at one end and tapering at the other. The cones are produced on the uppermost branches of the tree, and one cone frequently contains as many as 150 seeds which are freely scattered on the ground as the cone ripens. The trees bear fruit plentifully once in three years, usually between the months of January and March. At these seasons the aborigines assemble from far and near to collect the seeds, which are a favourite food with them. They roast them in the shell, crack them between two stones, and eat them while hot. In flavour they somewhat resemble roasted chestnuts. So well does this food agree with them that they are said "to grow sleek and fat" upon it. That part of the district where these trees most abound is called the Bunya-Bunya country.

The Brazilian Araucaria, *Araucaria Brasiliensis*, Rich., is found growing at a great elevation, chiefly in the province of Minos Gerœs, and to the north of Rio, at an altitude of 1,000 feet above the sea-level. They are exposed to some of the most violent storms, accompanied by the fiercest of lightning, from the effects of which the trees suffer considerably—their beauty and symmetry being greatly lessened by the stripping off of their lower branches, or the shivering of the younger and more tender parts. The height of the tree itself adds greatly to the chances of injury, as it attains from 70 to 100 feet, having a very straight trunk, which is covered for the most part with a smooth bark, except near the summit, where the remains of old leaves still persist, as on the trunk of *A. imbricata.* In its habit it is more loose and spreading than that species, but more nearly resembles it than any of the other species. From the date of its introduction in 1819 to 1822, *A. Brasiliensis* and *A. imbricata* were considered as one species. In the latter year, however, M. Richard, who had paid some attention to the two plants, published a description of this species, separating it from *A. imbricata,* and giving the plant its existing name of *A. Brasiliensis.* He states in that account that the chief botanical difference is, that in this species the seed is entirely devoid of the winged appendage, which is a distinctive mark of *A. imbricata.* The disposition of the branches also was made a character for distinction, as well as the greater softness and whiteness of the wood. The branches are arranged in whorls round the stem, but much more numerous than the other South American species. The form of the leaves is linear-lanceolate, very sharp at the apex, from one to two inches long, not so thickly disposed upon the stem as in *A. imbricata.*

The cones are more close and compact than those of that species; they are of a dingy, yellow colour, about six inches long. The scales are of a soft, corky nature, thick, and wedged-shaped, very closely packed together, each having a long, recurved spine. In general appearance, this tree is much more spreading and loose than *A. imbricata,* and it makes a more rapid growth. It is not hardy enough to bear the frosts of our winters, but thrives well in a greenhouse. The nuts, or seeds, are commonly sold in the markets of Rio Janeiro, as an article of food. The resinous matter which exudes from the trunk, mixed with wax, is much used by the natives in the manufacture of candles. Two species similar to this have been described: the first by M. Savin, under the name of *A. Ridolfiana*—this has been proved by Professor Parlatore to be nothing more than a form of *A. Brasiliensis.* The second by Professor Parlatore, who has given it the name of *A. Saviana,* and considers it a very distinct species. This plant is growing in the Botanic Gardens of Pisa, where it was planted in the open air in 1846, and is now a flourishing tree. It may also be seen growing in the Botanic Gardens of Florence, and in both gardens it has borne cones. These, in their young state, strongly resembles *A. Brasiliensis,* with the exception that the spines of the scales are much longer, very uniformly recurved, and curling so far back as to completely cover the junction of the two scales. So dense are the spines on these young cones that the scales are completely hidden by them, and the cone much more resembles a fine head of fuller's teazel than the fruit of a coniferous tree. In the mature cone the scales are much more fully developed, and the spines have the appearance of small recurved hooks.

The newest of all the Araucarias, and perhaps one of the most remarkable, whether as to its place of growth or its habit, is the *A. Rulei*, Muell. This was first known in England in 1861 or 1862, when small specimens of the foliage were received by Sir W. J. Hooker, at Kew. The native habitat of this species is very limited ; the whole of the trees as yet discovered occupying a radius of only half a mile, and this on the summit of an extinct volcano, where the changes of season produce the greatest extremes of drought and heat, or rain and cold winds, and where no other vegetation exists for hundreds of feet below. It grows on a parallel lat. with *A. Bidwilli*, but situate at double the elevation of the habitat of that tree. It was discovered and introduced from Port Molle, by Mr. W. Duncan, collector to John Rule, Esq., of Victoria, in honour of whom Dr. Mueller has given it its specific name. It is a tree rising some 50 or 60 feet high, branching in like manner to *A. imbricata*, but the branches more thickly arranged round the stem, and these of a more rigid and tabular form, forking in all directions, at equidistances, in a most symmetrical manner. The leaves are very closely imbricated, of a dark, shining, green colour. Its nearest affinity is with *A. imbricata*, which it resembles in a remarkable degree in many points, but in others it is wholly distinct. Its beauty is said far to surpass the last-named species, or even of any other species known. The cones are nearly spherical, the scales about an inch broad, terminating with a long, projecting narrow point, or scale, about an inch long. Of the economic uses of this species nothing is yet known, though it is probable the seeds are eaten like some of the other species. Mr. W. Bull, the well-known nurseryman, of the King's road, Chelsea, introduced this rare plant into this country.

The following, from an account of two Araucarias, one of which is *A. Rulei*, is given by Dr. Mueller, in his report on Lieut. Fitzalan's expedition :—" *A. Cunninghami*, found on Cumberland Islands, occurs southward to the vicinity of the Hastings River. The branches, with immature fruit, gathered during the Burdekin expedition, accord fully with others from Moreton Bay, Rockhampton, and the Hastings River. It remains as yet unascertained whether more than one Araucaria belongs to the East Australian flora. Mr. Fitzalan offers on this pine the following notes : Very abundant from Percy's Island upwards. On Percy's Island it differs but little from the Moreton Bay pine, except in the invariable regularity of its branches—these being in regular tiers, opposite. The Moreton Bay pine is seldom so. As we go further north, this regularity increases, and the foliage becomes more glaucous, until, at Port Molle and on Whitsunday Island, the tree assumes the habit of the New Caledonian species, the tree being conical, the tiers of branches perfectly regular, and having a slight droop at their tips. cut a spar of it on Magnetical Island, to make a top-mast, and the wood was hard and close-grained, paler than that of the Moreton Bay pine, and would not swim. It produces a white resin abundantly."— 'The Intellectual Observer.'

SUBSTITUTES FOR GUTTA-PERCHA.

THE forests of British Guiana yield caoutchouc and a variety of gums of allied nature. Sir W. H. Holmes, of Georgetown, when commissioner in London at the Exhibition of 1862, drew prominent attention to a new insulating material possessing properties intermediate between those of caoutchouc and gutta-percha.

"It is the dried juice of the bullet tree (*Sapota Mulleri*), and is called Balata. It appears likely to be more valuable than india-rubber or gutta-percha by themselves, as it possesses much of the elasticity of the one and the ductility of the other, without the intractibility of india-rubber, or the brittleness and friability of gutta-percha, whilst it requires a much higher temperature to melt or soften it. . . . There appears to be every probability that balata will become an important article of commerce, supplying the great want of the day—a good insulating medium for telegraphic purposes. Professor Wheatstone is now investigating its electrical and insulating properties. Another substitute for gutta-percha, the juice of the *Alstonia scholaris*, a tree belonging to the natural order Apocynea, has been forwarded from Ceylon by Mr. Ondaatjie; it is stated to possess the same properties, and to be as workable as gutta-percha. It readily softens when plunged in boiling water, is soluble in turpentine and chloroform, receives and retains impressions permanently, and is adapted for seals to documents. These specimens are sent in response to premiums offered by the Society of Arts for the discovery of a subsitute for gutta-percha."

Although several of this class of gums differ but slightly in chemical composition, it is well known that they are possessed of very different properties. For example, gutta-percha becomes plastic when immersed in hot water, a property not possessed by caoutchouc. Again, while the latter can be extended with facility in all directions, the former admits of extension only in the direction of the fibre or grain. Caoutchouc seems impermeable to water, even under great pressure and elevated temperature, while gutta percha is of a somewhat porous nature and not so well adapted to the purpose of insulation in the construction of submarine telegraphs. This fact appears to have been established by the Messrs. Silver, of Silvertown works.

While it is desirable that a more extensive knowledge should be obtained of the various gums yielded by the forest trees and plants of our colonies, attention should be strongly directed to the importance of extending and improving the preparation of caoutchouc in Demerara and Africa, as being likely to be attended with benefit in a commercial point of view. The numerous samples brought from the Upper Essequibo and Western Africa, although of fair value, indicate that the process of preparation admits of great improvement.

ANIMAL SUBSTANCES USED FOR WRITING ON.

Various forms of parchment and vellum, prepared from the skins of the sheep, goat, calf, and other animals, were not only much used in the times of the Romans, but continue to be used for legal and other documents desired to be preserved in our own day. Parchment and vellum seem to have superseded papyrus about the seventh century. A large proportion of our legal documents affecting heritable property is still written on vellum or parchment; and strange to say, these are not made so well now as during the middle ages.

Vellum and parchment were also used by the Jews for their sacred and legal writings, and the legal documents employed in their synagogues are still composed of them. But the material was expensive, and hence arose the practice of erasing the writings and reselling the vellum. Doubly used pieces of parchment were called "palimpsets;" and about the fourteenth or fifteenth century, the restoration of old parchments had sprung into a regular trade.

Sheets of gelatine are much used now for ornamental printing, for fancy labels, and silk is very often employed to print play-bills and newspapers on for special presentation. A strong kind of paper has come largely into use of late for various purposes, under the name of vegetable parchment. It is made by dipping for a few seconds ordinary-made paper into sulphuric acid, to which one part of water to six of acid has been added. The parchment is then taken out and thoroughly washed to remove all traces of the acid. Parchment thus made of paper is nearly as good as the old animal tissue, which it closely resembles in appearance, and much cheaper.

A few other animal substances may be alluded to. We have long been accustomed to make notes on ivory pocket tablets. But now it is sought to utilise the shreds and clippings of ivory, which form a considerable waste in certain processes of turning, &c. These clippings contain some fibre, and it has been attempted to work them up into paper. An American Journal (these curious statements generally originate in America), we are told, has printed part of its edition on paper made with cuttings of ivory. The doctors will now, therefore, get less ivory-dust to make jelly for their patients.

Frequent attempts have been made to utilize fragments of animal substances for paper—woollen rags, old leather, hide cuttings, and such like.

In 1816, a patent was taken out in France for a paper-pulp of animal substances, by M. Fouvielle, and in 1818, M. Saragin also made a leather paper from the parings and waste clippings ; whilst some years later, MM. Rondeaux and Herme made paper in the same country from leather cuttings and rubbish. Flock-paper hangings are, to some extent, a utilization of animal waste—old wool being ground and dyed to powder the gummed pattern imprinted on the paper.

Cartouche paper (a Continental article), is all animal matter. Fish fibre has been suggested by some enthusiasts as a new paper material, shark and dog-fish being specially selected for commendation, though what arrangement the parties proposed with a view to secure the material in sufficiently large quantities, does not appear.

Barry's parchment paper is another invention of this group, and is remarkable for two reasons: the first is the fact of its being composed entirely of animal matter ; and the second, the fact of its having been the battle-ground of an argument, *What is paper ?*

The government contended that the material being ground up, made on a machine, and proposed to be used for some of the purposes to which paper is generally applied, the paper was liable to the duty—since abolished—and the maker, on the other hand, as stoutly maintained that, not containing any vegetable fibre, it could not be termed paper, and was, therefore, not liable to duty. A slight investigation will lead us to hesitate at any arbitrary definition of "paper."

The first sheet handled may probably be a compound from the three so-called kingdoms—animal, vegetable, and mineral. A sheet of good white blotting would probably be purely vegetable matter ; while a sheet of good English writing or account-book paper would contain 10 per cent. of animal matter in the size, and a varying per centage of alumina and smalt, or ultramarine, to give the familiar blue tint. Perhaps, observes an experienced manufacturer, the following would approximate to a definition of modern paper :—

"A substance made of disintegrated particles diffused through water, and subsequently felted together by the extraction or withdrawal of the water, capable of being easily written and printed upon."

According to the definition of the Lord Chief Baron, in the Court of Exchequer in April, 1859, "Paper may be described as a manufactured substance, composed of fibres adhering together, and in form consisting of sheets of various sizes and of different thicknesses, used for writing and printing or other purposes to which flexible sheets are applicable."

In 1846, the Commissioners of Excise were in doubt whether the asphalte felt, made of the raw hair of animals and the refuse of flax, and used for roofs and for sheathing ship's bottoms under the copper, did not come under the category of "paper," but the opinion of the law officers was against them.

ON THE CULTIVATION OF FLAX IN CANADA.

BY J. A. DONALDSON.

The importance of the cultivation of this valuable plant in Canada has, of late years, occupied a large share of my attention, more especially since the failure of the wheat crop, which has unfortunately become so general. It will be acknowledged by all that agriculture and home commerce are the pillars af national prosperity ; and when success attends the plough, the labourer and the artisan are employed. In proportion as agriculture is depressed, all the dependent branches of trade suffer ; and Canada being entirely an agricultural country, and labouring at present under great depression, universally acknowledged to be from the general failure of the wheat crop, it behoves, not only the farmer, but every member of the community, to apply himself and see if some remedy cannot be found, that may in some measure meet this serious evil. The farmer is recommmended to try many other descriptions of crops. Among these, hemp and tobacco present themselves. Both, no doubt, can be cultivated to great advantage, but flax has already been introduced to a very considerable extent, and for the benefit of those who may not have given this valuable crop a share of their attention, it may be as well to state, as an inducement to others to follow the example, that not less than from eight to ten thousand acres were devoted to this crop in Upper Canada last year, (1864), and a number of enterprising parties have embarked not only in its cultivation, but in manufacturing the raw material into manufactured goods fit for consumption in our own country.

The Messrs. Perine Bros. and Co., of Doon, whose operations extend nearly throughout the county of Waterloo, distributed seed to the farmers for sowing to the extent of nearly three thousand acres last year. Col. Mitchell, of Norval, county of Halton, also furnished seed to a large number of farmers in his neighbourhood. Parties desirous of going into the cultivation or manufacture of this product, would do well to visit one or other of these establishments. At St. Mary's, St. Thomas, Elora, Stratford, London, Woodstock, Goderich, Weston, Whitby, Uxbridge, Cobourg, Belleville, Kingston, Brookville, Mirrickville, Newcastle, Matilda, and many other places, a good beginning has been made.

Linen manufactories are also springing up. This branch of enterprise is certainly the greatest boon of all to this country, converting as it does, the raw material into manufactured goods of a description so much in common use in Canada, such as linen for bagging, brown holland, drills, towelling, bed ticking, shoe threads, saddlers' threads, wrapping twine, and cordage of every description. All these articles have hitherto been largely imported, and we have been paying upon them a duty of twenty per cent.

Cottonizing the fibre is also engaging the attention of the skilful artisan. This process may be seen at the Doon Mills. A two-fold benefit will arise from the production of this new class of goods. First, it will take the place of cotton batting, which like all articles of that class, is at war prices. Secondly, the farmer will be relieved of the most objectionable part of the labour which attends flax,—that of pulling, as it can be cottonized when taken from the field in any shape, without regard to its being made into sheaves, as is required if used for scutching, and producing a fibre fit for spinning yarn.

While endeavouring as briefly as possible to point out the most economical and profitable mode of cultivation and after-treatment of the flax crop, it is necessary to caution parties intending to give the new product a fair trial, not to expect too much at least, for the first year. In order to success, the directions about to be given must be carefully observed. If they cannot in all cases be followed to the letter, beginners should keep as near them as possible. At the same time there can be little doubt that experience from year to year will enable the farmer to make many improvements on the rules herein laid down. This has been the case in all flax growing countries, and Canada will hardly prove an exception.

I will now proceed to point out the description of soil best calculated for a crop of flax. All parties that have written on this subject are of opinion that a good clay subsoil, with a friable deep loam, is the best for this plant; but I have seen it grown in Ireland on almost every description of land. My belief is that in every county in Canada there are large tracts well adapted for flax. All the valleys along the rivers are admirably suited for its growth. Mr. Beck of Baden, county of Waterloo, where a scutching mill has long been established, sowed flax three successive years on a piece of rich flats near his mill, and the crop produced the last year was the best of the three. In order, however, to succeed in getting a good crop on any land, parties must not imagine for a moment that they can dispense with careful attention and thorough cultivation. The land should be well ploughed in the fall, twice if necessary, taking care in every case to pick off all the weeds or roots that may in any way obstruct the growth of the plant. After a preparation of this kind, when the land is in good tilth, many prefer sowing on the winter face, but at any rate a light ploughing will answer in the spring, or the application of the cultivator. Before sowing you require to harrow well with a heavy harrow; next the surface should be rolled; then pass a light harrow on the land; and lastly roll again. Let the ridges be as wide as possible. with as few furrows as can be made, since the flax is likely to be of unequal lengths when there are many furrows. With regard to the time for sowing, about the 10th of May is the best time ordinarily, but this is a point to be determined by the season and the state the land is in. Weeds are among the worst enemies we have to contend with in the culture of this crop, but we do not suffer so much in Canada in this respect as do cultivators in many other flax-growing countries. Vegetation is so much quicker with us, that if the crop is got in in good season, the flax plant comes on so rapidly that it outgrows the weeds, chokes them down, and renders them of such a delicate nature as not to injure the fibre to any extent when prepared for scutching.

It is often asked, Will it do to seed down with flax? This has often been done to great advantage, and some of the most experienced agriculturalists prefer it, as they maintain the clover plant is moulded by the pulling of the flax. Those who have not tried it have fears that the young clover plant will be pulled with the flax. This is not the case, however, for, as all farmers are aware, clover has a very long root, and is difficult to pull out of the ground. This is a matter for the agriculturist to experiment on for himself, and settle to his own satisfaction. In Ireland, land is considered best for a flax crop when it has been many years either in meadow or grass. It is usual, after breaking up, first to take off a crop of oats, and then sow flax. This will be found to answer well in this country, but it must not be forgotten that flax must not be sown the same year land has been heavily manured. After turnips, potatoes, or any root crop, the best crop of flax is likely to be had; or when a crop of fall wheat has been killed by the frost early in the spring, with careful cultivation, if the land is clean, a good crop of flax may be expected.

We now come to the pulling, the great bugbear with most of the farmers. I only wish some of our ingenious young Canadians would put themselves to work, and invent an implement that would get me over this difficulty, and the farmers too. And yet it is not so bad, especially if the younger branches of the family could be enlisted to take their share of this part of the labour. This might be encouraged by giving a direct interest in the share of the crop. In the German settlements a great deal of this part of the labour is done by the daughters of the farmers, and in a short time they become more expert at it than men at high wages. Four hands are allowed to pull an acre per diem, and at the worst it will only cost three dollars more than cutting an acre of wheat. Whether it be pulled by men or boys, great care should be taken to keep the root end as even as possible, and in every case when it is pulled before the seed is ripe, which is invariably the rule in Ireland, in order to procure the best quality of fibre. It should be taken immediately after pulling and put into the cesspool or vat, when it is intended to be steeped. This is, however, seldom done in Canada, dew-retting being the method usually adopted. When flax is allowed to stand in the stook with the seed on, it is necessary to turn the beets or sheaves, to prevent the action of the sun from injuring the fibre.

Both dew-retting and steeping have been carried on successfully here. The Messrs. Perine, Bros. and Co., who have done so much in the County of Waterloo, have followed the dew-retting system exclusively, and in almost every instance the farmers themselves have undertaken to do this part of the labour, after taking the seed off, which is done by a ripple. This is an implement simple in itself and can be made by any handy blacksmith. It consists of a row of iron teeth screwed into a block of wood ; the teeth require to be eighteen inches long, tapering to a point at the top, and placed about 3-16 of an inch apart at the bottom.

The straw or fibre is then carted to a meadow or grass field, spread abroad as evenly as possible, allowed to remain for about eight days, then turned over once, when at the end of other six or eight days, according to the weather, it is ready to lift. This is known by rubbing a few stalks of the fibre together between your fingers, and when the boon, or woody part, leaves the fibre freely, it is ready to lift.

Should the party have water convenient, and follow the steeping process, the same course must be pursued after taking the seed off as in the case of dew-retting—*i. e.*, the flax should be taken immediately to the cesspool or vats prepared for steeping. Vats are in common use at Norval Mills in the county of Halton. More depends on a proper knowledge of this particular process, than on any other part of the treatment of the fibre.

First, it is necessary, if possible, to have soft river water, free from the influence of any mineral bed. If it be spring water, this may be brought to a proper temperature by running it into the vats or cesspool several days or weeks before you require to put the flax into the water. In Ireland I have known parties to have the water dammed up for three or four weeks for this purpose. In this country less time will do, the action of the sun being so much more powerful. In putting the beets or sheaves into the vats; each one should be laid with the root ends in a line with the band of the other, after laying the first row in the bottom at an angle, say of forty-five degrees. The time for steeping in this state varies from eight to ten days according to the season of the year, but generally from eight to nine days will be found to answer, although I have known it ready in five days, when put in the water during the hottest season of the year. It is as well to begin to examine after it has been in the water that length of time. Great care must be taken to have it brought to a proper focus to yield the most profitable article for market. This is known by rubbing a few stalks between your fingers, as already directed for testing it on the grass. When the woody part becomes sufficiently retted, and leaves the fibre freely it is ready to take out. Great care is required here, and no little judgment, as so much depends on the state it is in when removed from the water, to secure a fine quality of fibre. It is preferable to take it out rather before it is quite ready, than allow it to be too much retted, as you can remedy the first evil by allowing it a little longer time on the grass, while if you allow it too long in the water, a heavy loss will be occasioned in waste. I have known parties of long experience visit the cesspools *three or four times in one day*, when it arrives at that stage at which a few hours may make a vast difference. Some may say, "Well, this is a great trouble." But it is a well-known fact, that with care and skill, more particularly while the flax is undergoing this particular process, one man will produce an article of fibre worth a hundred pounds per ton, while another with flax equally good when taken out of the field, will not get over fifty ; hence the necessity for being particular in this stage of the proceedings. In Belgium, flax is often steeped twice ; first it goes through the regular process already described, and after it has been dried, put into a stack, and allowed to remain for months, it is taken down and watered again. Of course it is allowed to remain a much shorter time than during the first watering. The consequence is an article is produced worth from 150 to 200 guineas per ton in the scutched state, and large quantities are exported to Ireland, where it is used for the finest cambrics ; while in France, it is worked into almost every description of silk goods. Let us, therefore, in Canada, endeavour to give it sufficient attention to make it pay. On the cheapest and simplest plan we can follow, this will only require a small outlay of time at the hands of the farmer, and he will become familiar with the process in a season or two. The grassing will require to be attended to in the same manner as in the case of dew retting ; but in few instances it requires to be turned, unless the flax may have been removed from the water before it was ready. In such case, it will be all the better for being once turned over. When ready for lifting, which is generally about the seventh or eighth day, the stalks are examined in the way already mentioned—viz., by rubbing the boon out. A little experience will enable the cultivator to ascertain the proper time for lifting off the grass. This is easily done by gathering it up into bundles and placing it in piles in the field, where it may be allowed to remain a day or two, in order that all dampness may be removed before putting it into the barn or stacks, as the case may be. Here a word of advice will be most opportune. Some may have grown flax where a mill is not in reach to have it scutched, and not knowing what to do with the straw, have perhaps thrown it out into the barn yard, or make use of it for bedding their cattle. This should not be done, as the party will find by putting it away and keeping it dry, he will in the course of a short time have a ready market for it. He has this consolation in the meantime, that the longer it remains in this state the more valuable it becomes. In many flax growing countries, such as Courtrai, Holland, &c., the straw is kept over from one or two years before it is manufactured. Throughout the whole of this process, from the pulling to the preparation for the scutcher, the point we have now arrived at,—it should be especially recollected when we complain that wages are high and labour scarce in this country at this season of the year, that in every stage the work is light and may be done by the younger members of a family. Suppose the head of a family offers a direct benefit from the proceeds of the crop when brought to market, depend on it he will soon enlist those advanced far enough in years to make themselves useful. In fact, in Ireland all this work is carried on by females, young boys, and girls, and is more suited to this class than those of riper years, there being a good deal of stooping attending it, especially in spreading and lifting off the grass. Since the cost of pulling seems to be such an obstacle, let us make the comparison between the cost of pulling an acre of flax and cutting an acre of wheat. Say an acre of wheat will cost 1 dol., four hands at 3s. 9d. per day each, will readily pull an acre of flax in a day. We will take credit for the difference in weight between a bushel of wheat and a bushel of flax-seed, which is 4lbs, and at 1·50 dols. per bushel, would amount to about 1·40 dols. This deducted from 3 dols., will leave only 1·60 dols. more for pulling an acre of flax than cutting an acre of wheat. Now let us compare the produce of an acre of each. Say the average quantity of wheat is fifteen bushels,—which it is to be regretted has not been always reached of late years,—and put the price at 1 dol. per bushel. This will give us 15 dols. Put the average quantity of flax seed at ten bushels, *two bushels* less than the average stated by Messrs. Perine Bros. and Co. in 'The Canada Farmer,' 15 Jan., 1864. Call the price 1·50 dols. per bushel, and we have the same result as from the fifteen bushels of wheat. The labour in either case will be about equal, as fall wheat requires two seasons to produce a crop when fallowing is necessary. Flax is a spring crop, put in and taken off in the short space of seventy or eighty days. Taking so much for granted, it will be seen that whatever is gained from the fibre will be net profit to the farmer; and while he gets ten bushels of seed, he may safely reckon on 300 lbs. of clean scutched flax, worth, at present prices, from 6 dols. to 8 dols. per 100 lbs.; but assuming it to be only worth 5 dols. there will be 15 dols. profit over wheat. Some argue that hay will produce more than a crop of flax; then I say, grow hay by all means. Others say barley will produce more; but they must not forget that, should the abrogation of the Reciprocity Treaty take place, the price of this grain may be seriously affected. Another consideration presents itself in connection with this crop. Should Mr. Dunkin's Bill become the law of the land, as it has already in the County of Halton and other parts of the country, may not the price of barley become seriously affected by it as well as by the abrogation of the Reciprocity Treaty, in case that measure should be carried out by the American Congress?

I do hope the Treaty may continue in force, but it is well to be prepared for all contingencies. Taking this view of the subject, the cultivation of the flax plant commends itself strongly to the notice of the promoters of the temperance cause, for neither fibre nor seed can be converted into any kind of intoxicating drinks. Linseed oil is extracted from the seed; while an article of food for cattle is also produced in the shape of oil-cake.

The fibre can be converted into a hundred different kinds of the most useful descriptions of goods in common use in the country, and of which we are large consumers ourselves, such as coarse linen of every description, brown hollands, bed-tick, linen drills, shoe threads, counter twines, whipcord, plough lines, bed-cords, ropes, coarse twines, in fact, cordage of every kind. On all such goods we are paying a duty of twenty per cent., which will be saved; while at the same time a new field of industry is thrown open where artizans and labourers will find ready employment.

The success of Messrs. Perine Bros. and Co., of Doon, and Col. Mitchell, of Norval, with others engaged in this new and valuable branch of Canadian industry, furnishes evidence sufficient to satisfy the most incredulous mind that this is one of the finest countries in the world to commence operations of this kind. The Messrs. Perine commenced only a few years ago with a few acres which they induced the farmers to grow for them, by offering the seed for sowing in the spring, and promising they would have a mill in operation in the fall of the same year, which would enable them to purchase from the farmers both seed and fibre. Since then it is well known they have largely increased their operations, and are at the present time carrying on no less than eight scutching mills in the county of Waterloo, in addition to a large linen manufactory, for which they deserve all credit. At Norval, Col. Mitchell, although not so extensively engaged, and carrying the business on a somewhat different principle, has invested largely in vats for steeping purposes, and is at this moment getting in machinery for spinning and weaving. It is very desirable for parties interested in the welfare of this country to visit either or both of these establishments. What has been done in the counties of Waterloo and Halton can be done elsewhere, and there need be no apprehension, for years to come, that we are going to produce more than we will consume. The articles produced are all staple goods, and in constant use. Our neighbours on the other side of the lines are alive to this new project. Only two years ago the Government offered the handsome sum of 20,000 dols. for the encouragement of the cultivation of flax in a single State. The Messrs. Barber Bros. and Co., of Lisburn, in the North of Ireland, known to be the largest linen thread manufacturers in the world, perhaps, are erecting a manufactory at a place called Patterson, nearly opposite New York, at a cost of some fifty or sixty thousand pounds sterling, for the purpose of commencing operations of a similar character with their present establishment at Lisburn, only on a smaller scale. There is no good reason why we should not have capitalists coming into this country to make similar investments, as we have inexhaustable water-power, climate and soil equal to any in the world, and a ready market at our own door for all the coarser descriptions of goods. Some will argue that labour is too scarce and dear in this country to carry on manufacturing operations successfully. When we take into consideration the price of provisions in Canada; beef and mutton being from four to six cents per lb., and other things in proportion, so different from the prices in Europe, where the same commodities cannot be had for even double their cost here,—we perceive that it only needs the sure prospect of employment to lead artisans to emigrate to this country. Moreover, when men are well paid, more work is done, and in Canada every man has an object in view, either to better his position as an artisan, or secure a tract of land for his family, which he seldom fails in doing. Have not our woollen manufactories succeeded remarkably? Where will you find a more prosperous business than is carried on at Streetsville, in the woollen manufactory of the Messrs. Barber Bros. and Co., where over one hundred hands are daily employed? Go to the mills of Mr. Hespeler, and there see his extensive works. Such establishments are a credit to Canada, and the enterprise of the parties carrying them on deserves the highest praise. What do we find at the Village of Preston, where the woollen manufactory of Messrs. Elliot and Hunt was unfortunately burnt down a short time ago? The best proof that can be adduced in favour of the flax project is shown there. Those parties are erecting a large linen manufactory with some twenty or thirty thousand dollars worth of machinery already laid down. These works will soon be in operation. Here, then, are parties with all the experience and knowledge of the woollen business at their hands, putting in linen works in preference. Look at those and other numerous woollen establishments carried on at present in the country; behold the success and prosperity that have attended these parties. Surely we may safely embark in the linen business without any apprehension. It is worthy of note that the one will prove of great advantage as a feeder to the other. At the present time, the Messrs. Barber Bros. and Co., of Streetsville, are using large quantities of yarns from the linen mills of the Messrs. Perine Bros. and Co., Doon, for warp and filling with woollen weft, thus producing a much stronger article for wear than can be manufactured with cotton and woollens. Hence our linen manufacturers have no more ground to fear want of demand than our woollen manufacturers. Some apprehension is felt at the probable state of things after the American war is over. Cotton it is urged, will again become cheap. But there are few who are prepared to admit that cotton will ever recede to former low prices, as it is likely it will be subject to a heavy duty along with all other commodities, to help to make up the war taxes. Meantime, I have no doubt our manufactures will have arrived at a stage of improvement in producing a quality of linen goods that will be less expensive and more durable than articles made from cotton. In Ireland, when the American war broke out, it was supposed the linen trade was ruined, from the loss of their customers in the Southern States. But not six months afterwards a market sprang up in France that fully compensated for this temporary drawback, and qualities of goods have since been introduced into that market, that will never be superseded by cotton.

The progress of flax culture in Ireland, and the present prosperous state of the manufactures there, is a strong inducement to parties to embark in it in Canada. First of all, the farmer in Ireland pays a heavy rent for his land. From one to two and three pounds sterling per acre is paid, and often for lands especially adapted for the growth of flax, I have known as high as eight guineas an acre paid. I may state that I was present when the party paying that amount was offered 30*l.* sterling per acre for his flax on the ground before it was pulled, which he refused, and I learned afterwards he made more of it. The manufacturers too, have often to invest large amounts in leasehold property where the land belongs to some estated gentleman ; and frequently at the expiration of such lease an additional rent is exacted, or perhaps the tenant is dispossessed, and loses his improvements altogether. We have no such occurrences to dread in Canada: here, parties own lands, have no rents to pay, a mere trifle for taxes, and their improvements remain in their own hands, instead of falling into the hands of other parties.

Apprehensions are entertained by some with respect to flax exhausting the land. On this head I would simply state that most writers on the subject maintain it does not exhaust the soil more than any other crop ; nor can I imagine that a crop put into the ground, say in the middle of the month of April or early in May, and taken off about the same time in July, can draw more largely on the land than a crop of wheat which is put in in the month of September, and not taken off before the month of August following. The one remains in the ground some eleven months, while the other is only in the ground three months, and often less time than that. However, be that as it may, if there is anything like the advantage I have endeavoured to show there is in growing a crop of flax, and it is feared it may exhaust the land somewhat more than any other crop, only add a few more loads of manure to the field you intend for flax the year before, or use a quantity of artificial manure such as Coe's Superphosphate of Lime, which is so highly recommended as a fertilizer, and your land will lose none of its producing qualities. There are plenty of farmers in the neighbourhood of Norval and in the county of Waterloo, who will tell you that they have sown wheat after flax, and succeeded in getting as good a crop as they would have had after any other crop. As already stated, the question is often asked, will flax do to seed down with ? This is often done, and that successfully. Before sowing it is necessary to have the ground in good order, as clean as it is possible to get it, and free from all kinds of weeds. This is just the state you are expected to have it in for a crop of flax, when grown by itself. In Ireland, seeding down with flax is often practised, and so it is in this country.

Having endeavoured to put a few of the most important facts before the reader relating to the cultivation of the flax plant, and the mode of handling it after it is matured, I will now offer a few suggestions with respect to the machinery for scutching and preparing the raw material for market. Most of those who have taken an interest in flax matters of late years, are aware that the Government authorised me, while in Ireland recently, to purchase a number of the best scutching-mills to be had, for the purpose of distributing them among the Agricultural Societies in both Upper and Lower Canada. Mr. Rowan's mill being a portable one, and highly recommended in many parts of Ireland, presented itself as likely to produce good results in Canada, the more so as it can be used by unskilled labourers, and the price, which is some 150 dols. each, being quite within the reach of any farmer to have one for his own use if he desired it.

In point of cheapness, efficiency, and economy, this machine surpasses anything that has yet been produced for cleaning and scutching flax. It is very simple in construction, occupies but a very small space 3ft. 9in. x 3ft. 4in.), and is easily driven and attended. It is worked by two persons, and will clean from 25lbs. to 30lbs. of flax per hour, when properly worked, in a superior manner, and with a great economy of fibre. The extremely low price of this machine brings it within the reach of everyone requiring flax scutched.

Description for Use. — The workman takes a "strick" of flax straw (*without being rolled, or other preparation*), holding it near the root end, and passes it into the openings at the side of the machine, when it is subjected to the action of the scutching apparatus. The "strick" is then withdrawn by the opening where it was entered, and the other side turned to the action of the beaters and re-entered as before. The flax is now partially scutched or "roughed," when two or three pieces are then put together, and again the same operation repeated as before described. When withdrawing the flax from the machine, let it be drawn slightly end ways; for, by attending to this, the flax is found thoroughly scutched, and with the ends perfectly finished—an advantage over the ordinary system. The operation is remarkably rapid, and there is no risk of accident whatever. The "boon" falls through the machine, and the tow, of which very little is made, is collected at the back. The machinery is so simple that it cannot go out of order, and has been fully tested to the complete satisfaction of competent judges.

The velocity of the machine to be driven to 460 revolutions per minute for average quality of straw. If the straw be hard and wiry, then the speed to be a little higher, and if soft, slower. The price of the machine is only 24*l.*, for which sum it will be delivered f.o.b. on any steamer at Belfast, or at any of the railway termini. The only attention the machine requires is to keep the bearings well oiled.

The mills purchased by me on behalf of the government, on arrival here, were distributed in the following order:—One at Quebec, one at Montreal, one at Sherbrooke, one at Kingston, one at Toronto, and one at London. Until of late, little use has been made of them, as parties engaged in this business had supplied themselves with the ordinary kind. Of the utility of those mills I have no doubt. There is every reason to believe they are calculated to do good work. I saw them tried several times in Ireland, and was present at the Sion Mills with several other parties when Mr. Herdman certified to their qualities as compared with other mills. Being portable and capable of being worked by the horse-power of the threshing machine, and not requiring rollers to break the flax, they are worthy of a fair trial. This, I fear, they have never had as yet in this country. Hemp was dressed on one of them at Kingston the year before last, and it was found they answered admirably for that purpose.

To return to the quality of lands best suited for flax, it will be found that on the fine, rich, flat lands in the Canada Company's Huron Tract, and lands of a similar nature in the counties of Kent, Essex, and Lambton, as well as the St. Clair Flats, flax may be raised to any extent. Lands that have been cleared a few years will also give good flax.

It will be observed that, in all the calculations made, I have only shown the prices for the common or ordinary qualities of scutched flax. But it must not be forgotten that, with proper attention, and the exercise of a skill which it is not difficult to attain, it is quite within our reach to produce an article of fibre worth at least fifty per cent. more than that which we are producing at the present time. Hence, there is great inducement for the farmer to give it every attention in his power. No doubt many will soon fall into the method of cultivation carried on in Ireland—*i.e.*, pulling before the seed is ripe, by which means a finer and more flexible article of fibre is obtained, in consequence of the oily substance in the stalk not being exhausted in the seed when allowed to ripen. By using a little extra attention and skill in the preparation of flax after pulling, an increase of many dollars in value may easily be secured.

Before closing, I would suggest the desirableness of every agricultural society throughout the province offering liberal prizes for flax-growing in their lists for the autumn; such prizes to be distributed as may seem best calculated to encourage the production of this crop. County councils, if it be within their province, could not do a more praiseworthy act than make a moderate appropriation for the same purpose. The parties competing for such prizes set the example to others, and hence a spirit of emulation is set on foot, as in all other branches of agriculture, and we would not only have much larger quantities produced, but better qualities.

It is also desirable that companies should be formed, as it is quite within the reach of a few individuals, with a very moderate amount of capital—say 1,000 dols.—to start a scutch mill with eight or ten stocks, and after preparing their own flax for market, a profitable business could be done in scutching for others.

What we require most of all is persons of capital and enterprise to give this matter their attention in cities and towns. In Toronto, within the last few months, a company has been formed to erect and start an oil mill, which, I understand, is doing a most successful business. Another company has been formed for the re-erection of the Rossin House. These are examples of what combined effort can accomplish. With such inducements as the manufacturing of linen presents, it is only a wonder the project has been allowed to remain unnoticed so long. Some may urge that water-power is required for such extensive works. There are, however, several small streams in the vicinity able to supply an engine that would drive any amount of machinery. If buildings were placed near the lake, sufficient water could easily be made available for that purpose. Another great advantage in connection with the use of steam in flax manufacture, is that sufficient fuel is made from the shive, or refuse taken from the fibre, to supply an engine of any capacity, with, perhaps, a trifling quantity of wood added.

On a recent visit to New York, I found our American neighbours quite alive to this new enterprise. They are entering with much spirit both into the cultivation of the plant and its manufacture. At Paterson, New Jersey, three large establishments are already at work, and some six or seven hundred hands are employed. The most extensive of the three has been in operation several years in the manufacture of *jute*, and the proprietors are now preparing to spin and weave flax and tow, which will create a demand for the raw material. At Schenectady there are also several mills at work. Here our Canadian flax has found a ready market. At one of these establishments a large quantity of coarse twine for tying brooms is manufactured, as the principal crop grown on the valleys of the Mohawk is broom corn. There is no reason why this crop should not be successfully grown in Canada, and, from the demand for the article, it is well worthy the attention of the Canadian farmer.

While urging the growth of the flax plant, too much cannot be said in favour of starting manufactories, as it is an acknowledged fact that, from the failure of the wheat crop for so many years in succession, farming lands, and property of every description in the country, has greatly depreciated. Hence the greater necessity for every one interested putting his shoulder to the wheel and helping on this important movement. Wherever companies can be started with any prospect of success, parties should not hesitate in taking stock, and encouraging the project in every possible way. Large companies ought to be organized in the large cities and towns, while others, on a smaller scale, can, with perfect safety, be established in the country. It is to be hoped capitalists in the old country, with experience, will soon find their way to Canada, and join those who have water-power and buildings, which they would readily turn in as so much stock, and, with combined effort, success would undoubtedly be achieved.

The cottonizing of flax is strongly recommended. Only the other day a party from Detroit sent me a sample, stating that his mill will make about 1,500 lbs. per day from *flax tow*. This is a most important feature in the case, as it proves that the very roughest and coarsest part of the flax can be turned to good account, and although parties may embark in this new project with comparatively little knowledge, by degrees they will arrive at a point that will give them complete control of their business and be most profitable. In all cases, it is best to commence with the coarser qualities of goods, and not on too extensive a scale. The great demand for seed for sowing this spring is sufficient proof that farmers are determined to give this new crop a fair trial. Those who have not engaged the quantities they require, will act wisely to do so before the season advances too far. When we speak of 40,000 or 50,000 acres as likely to be sown this year, we must not forget that this area will not be much more than the arable land in a single township. If there were only two acres sown on each 100 acres in every township in the province, what a vast quantity we might look for! Every farmer is perfectly safe in putting in from two to five acres at least. More than this, I do not hesitate to say he stands in his own light if he does not grow at least a small quantity of this promising product.

Toronto, Canada, West.

THE FISHERIES OF VICTORIA.

BY G. S. LANG.

BAY-FISHING.—From the information already collected as to a very limited portion of the coasts and seas within easy reach of Melbourne, it is established that the supply of fish is practically unlimited. In Port Phillip Bay there is an area of over 700 square miles, with coast line of about 130 miles well supplied with fish; and in Western Port Bay about 300 square miles, one immense fishing ground, and still more plentifully supplied with better fish, and with a coast line of 120 miles including French and Phillip Islands. Both bays are landlocked, and in every way favourable for fishing. The following are the description of fish found in these bays:—Schnapper, from 2lb. to 20lb., and even 30lb.; rock-cod, flathead, garfish, whiting, silver-fish, mullet, gurnet, ling, perch, mackarel, butter-fish, 10lb. to 20lb.; salmon-trout, white salmon, bream, plaice, flounders, and king-fish, also cray-fish, shrimps and oysters. It is very difficult to form even a near approximation to the number of boats and men engaged in fishing. There are 316 licences issued for tents and huts for fishing, and allowing only one boat for each licence, and two and a half men for each boat, this will give 790 men. There are thus, it appears, almost at our doors an unlimited supply of fish, plenty of men and boats to catch them, and a population anxious to purchase; yet the public cannot be supplied except at enormous prices, while the fishermen often cannot sell their fish at all, and then at prices they can barely exist upon. The reason is, that the fishermen have no capital beyond their boats and nets, and are at the mercy of one or two middlemen who keep the trade in their own hands, and fix their own price. If another buyer interferes, they raise the price till he is forced to retire, and then at once lower it to the old scale, tabooing any refractory fisherman, and not buying from him at all, while he is unable to take his fish to Melbourne, and most probably would not find a purchaser if he did. Capital will, no doubt, remedy this to a very great extent in time; but fishermen, as a body, are always poor (perhaps because men cease to be fishermen when they rise above poverty), and a remedy that will protect them without preventing the introduction of capital, should be at once applied and render unnecessary such an association as they have formed, with rules as unnecessarily severe as those of the ancient guilds—enough to destroy any industry. The first step is to establish a fish-market not only with retail stalls, but with licensed salesmen, conducting business in the same way as at Billingsgate, to whom any boat can safely consign its fish; and there is little doubt that the salesmen would combine with the poorer fishermen in removing the present difficulty, by establishing conveyances for their fish, even if coaches were not laid on for the profit of the carriage, which they most probably would be. It would also be a great boon to the fishermen if certain portions of land in suitable localities were marked off as fishery reserves, and fishermen were allowed to purchase at a fixed price, sufficient for a house, garden, and nets, after occupying it a certain time, say two years. The land would seldom be of much value for any other purpose, and it would benefit the public most materially, by encouraging men with families to establish themselves permanently as fishermen.

DEEP-SEA FISHING.—The colony will never have anything approaching the full advantage of our fishery resources until capital is applied on a large scale to the deep-sea fishing; and that will be only when the fishing-ground is proved of sufficient extent and there are sufficient capitalists whom the investment would suit. First, the fishing-grounds —Besides the Western Port and Port Phillip bays, where an ample supply is to be had during the summer months, there are fishing-grounds outside which will yield not only an equally ample supply during the winter months, when fish generally leave the bays for deep water, but supply for an extensive export trade. Besides the schnapper fishing at

Queenscliff, which now yields, during the summer, about 250 tons of schnapper alone, there is a bank outside where they can be caught at all times of the year. There is also an immense bank, extending S. and E. from the eastern entrance of Western Port, swarming with schnapper, rock-cod, and other fine fish, that would of itself even, as far as is now known, supply a large fishery. It has been ascertained that the banks extending to the eastward of King's Island, Rabbit Island, and Corner Inlet, besides soles, butter-fish, Jew-fish, and others, abound in flounders of large size and of the finest quality; and, as the Straits average less than forty-five fathoms, and with much sand and shell bottom, most favourable for trawling, we only require proper boats to give us as ample a supply in winter as in summer. In a strait between such rocky coasts as this and Van Diemen's Land, with islands cropping up in every direction, there must be extensive areas of rocky and broken ground below water, giving food and shelter, and forming banks for winter fishing as richly stocked as that to the eastward of Western Port. In the Straits the king-fish and barracouta, are in large shoals, and might be caught in quantities infinitely greater than at present. Again, on the south and east of Van Diemen's Land, there is a bank covered by the waters of the cold Southern Ocean, cold enough for the finest quality of fish, with which it swarms, and of sufficient extent to supply all the Australian colonies over and over again. This bank is known to extend from twenty-five to thirty miles from the end of Maria Island to Tasman's Peninsula—how much further is unknown. It abounds with trumpeter, running up to sixty and eighty pounds; arbouca, also a large fish, rock-cod, schnappers, flounders, and many other fish of fine quality. This bank is as near Melbourne as the banks that supply London with fresh cod, and traversed by every steamer passing between Hobart Town and Melbourne, so that it is as much Melbourne as Hobart Town fishing-ground. We have, in fact, sufficient data to prove that the deep waters off the coast are teeming with life. Fish have been found everywhere; and the entire bottom, where sounded, is mixed with shell and seaweed, and where the food is the mouths will be there to eat it. How universally animal life is disseminated in these seas was proved by the wreck of a French whaler, which came ashore to the east and west of Portland in 1848. She left Adelaide to fill up, and was never heard of for years, when she came ashore in pieces, the wood exposed to the water being covered deeply with mussels, &c., while the broken parts were perfectly fresh, showing that she had laid in still water till moved by some current or very deep commotion of the water, on the ground within reach of the surface waves. There is, in fact, every reason to believe that we have, under the waters as extensive a field for the profitable exertion of our energies as we have on the land, though hitherto left as utterly useless and unprofitable as were our pastures before a white man trod upon them. Second, the Capitalists. —These will be of two descriptions—first, individuals or companies with considerable capital, say 3,000*l.* and upwards, who will have one or more stations ashore, with every appliance for curing as well as fishing; and second—single fishing vessels, which will confine themselves to fishing, selling their fish, as far as possible, in the Melbourne market, and the remainder to the curers, unless when they can cure on board. The body of the fishing fleet will consist of such single vessels, fitted out by a few individuals, as in the Newfoundland and Scotch fisheries. The cost of a thirty-ton vessel with trawl, well, &c., would be about 400*l.* or 500*l.*, and there are many in this community whom such an investment would suit—men in various capacities, who have accumulated money beyond the requirements of their business, which they have now great difficulty in investing profitably. Mining has proved too much of a lottery for most prudent men; agriculture requires personal superintendence, and has generally proved ruinous at least to those not brought up to it; squatting requires too much capital; ordinary shares giving too small a profit. Whereas, a sound fishing-smack, fitted out by a few partners under the Limited Liability Act, insured, and under a skilful master, part owner, would be not only a safe but a profitable investment. Second, the pioneers, in establishing a natural deep-sea fishery, must encounter considerable risk and many difficulties, so that a company such as I have alluded to, and such as is now actually being formed, would be much more suitable for the enterprise than one individual. As this preliminary loss was incurred by me twenty years ago, I shall give the result of my dearly-bought experience for the benefit of these second pioneers. On arriving here in 1841, I had been struck by the fact that there was no article to exchange for the enormous quantities of sugar, tea, and rice, &c., imported from the East; and, further, I learned that the East India Company had for years found a most profitable market for a large quantity of Newfoundland cod, in Mauritius, India, China, and the Phillipines, &c., and had given up the trade only on account of the very long voyage then usual, during which the fish became unsaleable. Having partners to manage my sheep stations, I determined to establish a deep-sea fishery, and addressed a memorial to Lieutenant-Governor La Trobe, pointing out these facts, and the advantages that would arise to the colony. The government almost at once granted me a squatting licence at the mouth of the Yarra, where I established what I intended should be my head station. I set to work with a body of Scotch Highland fishermen and curers, and, before the season ended, proved, to my satisfaction, that the supply of schnapper was unlimited, and so cheaply cured that a most extensive and profitable export to the places above-mentioned could be established. The men then offered to hire the boats, and fish for the Melbourne market during the winter, and I agreed, for the sake of keeping them together; but this at once brought them into collision with the other fishermen, and led to my giving up the scheme altogether. These men did not object to the deep-sea fishing, but declared that no gentleman or company had any right to interfere in supplying Melbourne, and refused to supply any hawker who bought from the "company's" boats, and as my boats could not guarantee a constant supply, my men were stopped To meet this I established a depôt in Melbourne, and put one of their own countrymen to manage it, but, instead of confining himself to his own business when he did very well, he turned it into a general store. On my return from a long exploring voyage I found everything paralysed ; a regular war, by the fishermen generally, against my men, burning and cutting nets, setting boats adrift, &c. ; the men were so interrupted that they demanded daily wages, and the hawkers demanded to be guaranteed a supply, while considerable liabilities had been incurred in the store, and its contents distributed, on credit, to all the Highlanders in Melbourne. The crisis of 1843 coming, I wound up the fishery and went to the bush, but not before I had ascertained to, my perfect satisfaction, that there was an opening for a great national fishery. I would suggest that this pioneer fishing company should establish at first—not ten, as they propose—but two stations—one at Queenscliff and the other at the eastern entrance of Western Port, or near it ; each, of course, supplied with row-boats, seines, set nets, drift nets, crab pots, &c.; also appliances, for salting, drying, and smoking, and in due time preserving fish in tins, the modern substitute for salting. Each station should have one, or perhaps two, trawling cutters, or, rather fore-and-aft schooners, as being more easily handled, and first-rate sea-boats, so as to hold their own in any weather. They would thus be able to employ their men in almost any weather, in any wind, and at all seasons, either inside or outside the Heads, and in case of a large take, could always secure the surplus. In the schnapper fishing, alone, they would have a stand-by that would secure them a profit ; the hawkers and salesmen now object to this fish on account of its weight in proportion to the profit upon it, and only the smaller sizes are acceptable. Now, these are not suitable for salting, but a company could keep the curers, and preservers in tins, going with the large fish, sending the smaller to Melbourne with the general take ; in the same way, when the cutter is not trawling she can lay-to on the banks and fill herself with schnapper and rock-cod, either to cure on board or preserve on shore, besides, keeping the men employed in the winter when fish have left the bay for the deep water. They should strictly confine themselves to their own particular business on the sea and the beach ; they must certainly establish a means of rapid communication with the railway, but even that they should do by contract, if there is no public conveyance ; sell the fresh fish in the public market, and the rest through an agent, until the business is in full working order, when they may extend it as they please, and more particularly and legitimately by curing the fish caught by other boats. Let them be content at first with plain bush buildings ; they are cheap, and will serve for years. Companies generally neglect their men ; it is a great mistake in any business, but more particularly in a fishery, as it is of vital importance to retain men acquainted with the fishing grounds, tides and currents. House them comfortably, and give them the best of rations. Give the single men a comfortable barrack, with a cook to look after it, so that they may always be certain of a comfortable meal and dry clothes on coming ashore; they will thus secure the willing services of the best men to be had. A company so begun and prudently conducted will, I have no doubt, not only prove most profitable to the parties engaged but to the colony generally.

It is not the business of the government to force this or any other industry into existence, but as the fishing-grounds are at our doors, most bounteously stocked by Nature, while there are both money and capital to be employed upon them, it is the legitimate province of the governments of Victoria and Tasmania to clear the way by a survey of the coasts and straits. Private individuals cannot be expected to spend their capital in making discoveries which at once become public property, as fishing banks inevitably do. Where labour is so high it is of great importance to have the men constantly employed, but until the different banks are laid down they cannot be so. The trawlers cannot work in anything like a heavy sea, but if they knew of a bank in their neighbourhood they could with deep-sea line, as long as the vessel could hold her own, actually fill the vessel instead of lying-to idle. The survey of the bank off Tasman's Peninsula alone would well repay the expense of employing a sixty-ton vessel, which would be quite sufficient. There is no doubt that most of the fish come into the bays in summer to spawn, and it is most desirable that both governments should strictly enforce a close time, and regulate the size of the mesh in all nets, trawlers included, as the wanton destruction now is most sinful.

I hope when the Acclimatisation Society has the means that the Council will turn their attention to the introduction of the cod and the herring. Lieut. Maury, in his 'Physical Geography of the Ocean,' mentions that on the portion of the southern States of America touched by the Gulf stream on its way northwards, the fish are of bright colour but poor quality, and that these southern states are supplied by rail from the states further north, whose coasts are washed by the cold current which flows south from the Arctic Ocean inside of the Gulf stream. It appears from Maury's chart of these seas (No. IX. Seadrift and Whales) that the whole of the south coast of New Holland is bathed by the waters of the cold Antarctic, so that fish of the finest kind will retain their good qualities. The cod is not only a good fish of itself, superior to any of ours, but the salt-fish of commerce, and if established in these seas, would greatly facilitate the formation of an export trade, and, I think, quite as worthy of attention as the salmon. The roe is so exceedingly minute, that more than nine millions have been counted in one fish; being so fine, it would be laid among the moss in pieces, and one box might contain twelve millions of roe. The sea-water would be sufficiently cold during a great portion of the voyage, certainly after reaching eighteen degrees south, and as one cask per day of iced sea-water would be ample for a box of cod and one of herring, it appears to me that it is well worthy of a trial. But whether we introduce cod and herring or not, there is no doubt of the fact that, we have fish of such quantity and of such quality, that it only requires that capital and labour be applied with ordinary prudence and sagacity to make our fisheries one of the great interests of the colonies.

THE BAMBOO AS A PAPER MATERIAL.

In a paper by Dr. Williams on the "Uses of the Bamboo" (vol. 3, p. 120), incidental mention was made of the interior portion of the stem being beaten into pulp for paper. Bruised and crushed in water the leaves and stems form a good proportion of the common or Chinese paper, the finer qualities being improved by a mixture of raw cotton and a more careful pounding, and in some places the article is manufactured with such care as even to answer for foreign writing paper.

In the dearth of other paper materials, the Americans are now turning their attention to the culms of the bamboo from the West Indies for this purpose, and a new trade has sprung up for an hitherto useless product.

A late Jamaica paper observes :—"It must strike every person of a reflective mind that if there were anything like enterprise in Jamaica, there is now presented a splendid opportunity of exercising and displaying it. There is no simpler and cheaper process than the manufacture of paper, and therefore no very extraordinary amount of capital would be required for machinery, &c. We have here the raw material in excessive abundance, and it may be had for next to nothing. Why may we not set up a paper manufactory here—why, in fact, may we not have a dozen mills in different parts of the country ? If it can pay in other countries to manufacture paper from bamboo obtained from Jamaica, how much more should it not pay to manufacture the paper here ? We might not only supply our own needs—and we certainly consume a large quantity of paper in this island—but we might also export paper to other countries. It appears to us that we have a source of wealth which we are neglecting—a good opportuuity for exerting our enterprise which we are allowing to slip through our fingers. Without being too sanguine as to the advantages to result, we venture to predict that if care is taken and something like enterprise developed, this will prove a remunerative source of industry. As yet we know very little of the true value of this new staple. It is found in abundance in all parts of the country, and especially on the banks of our numerous streams, and is of most rapid growth. We have been informed that bamboo-sticks laid down on the side of a stream will grow readily and spread with such profusion that in six months it may be cut, and then the growth, as age increases, becomes more rapid and more profuse. But, as anyone who has travelled in the country will bear us out in saying, there is no need of planting, in other words, cultivating it, as it already abounds everywhere in the island equal to the demand, be that ever so great, that may be made for it. Hitherto it has been turned to no account, its greatest use being as fuel on the sugar estates; but of late we see it brought into Kingston in large quantities for exportation, it having been discovered in America to be an excellent substitute for rags in the manufacture of paper. An enterprising American here now has been purchasing and shipping it to New York. We have seen some paper of a coarse description made from it, and it appears to us superior to the common straw paper imported here; but it is not the inferior article that we have seen alone that it can produce: we have been assured that the finest descriptions of writing paper are manufactured from it. This fact being established it seems to us to require only a little exertion for converting into an exportable article of some value a product that has hitherto been utterly valueless. The war has forced upon the Americans the necessity for discovering a substitute for rags in the manufacture of paper; but in England and other countries, from a somewhat different cause, an equally pressing necessity also exists for a like substitute. The British paper-makers are complaining of the heavy duty upon rags as well as the scarcity of that material.—'We confess that we find it difficult to understand,' says a London paper dealing with the subject, 'how the amount of the foreign rag duty can possibly produce the disastrous consequences to the paper manufacture at home, which according to the representatives of the trade, have been visited upon it. Nor, in any case, does an appeal to the Treasury seem the rational way of meeting a commercial inconvenience arising out of the protective system of some foreign country. In most other instances when a difficulty has arisen about obtaining a full supply of a peculiar raw material from abroad, ingenuity has simply been bidden to go to work and find out some means of supplying the want by the invention of a substitute for the restricted article.' Ingenuity has not to go far, or to work long to attain its mission. An excellent substitute has already been found in the bamboo or hollow cane of Jamaica, which we doubt not could be forwarded to the British paper-makers at a much lower rate than that at which foreign rags can be obtained. At all events, let the experiment be tried. Let the fact be known in England that we have here, and are ready to supply it cheap and in abundance, the very article they desire, and if bamboo prove, as we are assured it has proved, the very best material for the manufacture of paper, then we shall have two markets—two distinct set of customers—for the raw material, which we can supply in abundance without trenching upon the labour required for the promotion of our other industries."

These gigantic grasses are very common in most tropical regions, many of the West India islands abound with them, they cover the sides and tops of the mountains throughout the continent of India and form one of the peculiar as well as most striking features of oriental and occidental scenery. The bamboo attains a considerable height, some seventy to eighty feet, and has been known to spring up thirty inches in six days.

ITALIAN EXHIBITS AT THE DUBLIN INTERNATIONAL EXHIBITION.

The official duties of the Editor at the Dublin Exhibition, in charge of the varied contributions from the Colonies, as in the Exhibition of 1862, have hitherto prevented his laying before his readers a *résumé* of such raw materials and products exhibited by foreign countries, as seem entitled to special notice. We now commence with a brief notice of the exhibits from Italy, which contributes a much larger collection of raw materials than any other European country. Most of the other States of Europe have restricted themselves to Fine Arts and Manufactures. The kingdom of Italy, on the contrary, comes out well in all departments, and makes a noble exhibit.

In the first section, ground and sublimed sulphur may be mentioned, and a fine collection of Sienna earths, shown by Carlo Corbi Zocchi, in the various tints of yellow, orange, and dark burnt. Various red, white, and dark-grey granites, used for building, are shown by the Royal Italian commission. Good specimens of salt are shown by the Sardinian Salt Company of Genoa. The works, which are situated near Cagliari, belong to the Government, but were leased for thirty years to the present company in 1852. The annual produce of table salt then was but 30,000 tons; now the produce is 140,000 tons, of which the Government purchases 52,000 tons, the rest being exported to Norway, Sweden, Prussia, and the United States of America; besides from 6,000 to 8,000 tons of crude sulphate of magnesia, and 2,000 or 3,000 tons of crude sulphate of potash. These two last products are obtained from the mother liquor after the deposition of the table salt.

There are many exhibitors of olive oil. One, Dr. Danielli, shows olives preserved in spirits, dried olives, strong olive oil, sweet olive oil, pure white for perfumery, yellow, common dark yellow, common green, common white, and other varieties of oil; olive skins pressed to extract the oil with sulphide of carbon; olive kernel oil for burning, and flour of olive kernels for fattening pigs. The oil obtained from the skin expressed cold, is used for dyeing, and for the manufacture of white soap; that expressed by heat for making mottled soaps. Fine olive oil is obtained from the same olives as those used for making lamp oil, the only difference being in the care with which the fruit is selected and prepared. The olives are plucked before they are over ripe, and the utmost cleanliness is observed in bruising them, as well as in filtering the oil through several layers of clean cotton wool; whereas, the lamp oil is made from the perfectly ripe olives which have fallen from the trees and placed in heaps, from which a certain quantity is taken at any time during the winter season in order to be pressed. The consequence of such treatment is, that the olives undergo incipient fermentation, and yield strong oil. The second system of manufacture prevails principally in the province of Lecce, the oil being mostly exported from Gallipoli for use in machinery. The more refined quality is manufactured in the province of Bari, and shipped from the ports of Bari, Monopoli, and Mola, for Leghorn and Genoa, and is then sold to foreign purchasers as oil of Lucca or Nice, with which it may well compete in taste and perfection. The olive trees in the province of Bari attain thirty feet in height, the trunks being frequently three feet in diameter; the branches spreading and the fruit excellent. A full sized tree yields about 2 cwt. of oil. The whole seaboard from Bari to Brindisi, a distance of seventy-five miles, for a breadth of seven miles, is a continuation of luxuriant olive yards. The railway from Brindisi to Bari is now open, and ere long, this will become the main line of communication between Europe and India.

Baron Enrico Janelli shows samples of best olive oil grown at Bragone, Termini Imerese (Palermo). The hills in the neighbourhood of Bragone have an eastern and southern aspect, and are situated close to the sea-shore. The ground is covered with pebbles and gravel, but the subsoil is deep, and in some places marly. The method of preparing the oil is simple. At the end of October, when the olives become yellowish and tinged with red spots, the peasants proceed on dry days to gather the fruit, putting it into baskets lined with linen. They are then spread out on a thin stratum on the wooden floor of a well-ventilated apartment, taking out all the over ripe or defective ones. After being dried in this manner for three days, they are bruised and then put in the press. The liquid is placed in covered vessels for twenty-four hours, and before fermentation has set in, it is filtered through linen into earthenware pans. In a week's time it is filtered again through cotton wool to separate the residual pulp which constitutes the colouring matter, and deteriorates the oil. In these operations the utmost care is necessary to keep all the vessels and matter with which the oil comes in contact extremely clean and dry, as it easily becomes rancid, undergoing a chemical change.

Mannite, from the olive, is shown by Professor De Luca, of the

Royal University of Naples, extracted from the green and mature leaves, from the unripe and ripe olive. Mannite exists in different proportions in every part of the olive tree; the leaves, flowers, and fruit containing the greatest quantity; the roots, wood, bark, and branches rather less. This saccharine principle is not always found in the same quantity at all stages of vegetation. At the period of blossoming, it accumulates in the flowers and diminishes in the leaves, the fallen flowers having once completed the phenomena of fecundation, no longer contain any mannite; it has likewise been found impossible to obtain the slightest traces of it in the yellow fallen leaves. Mannite exists in the fruit as long as it continues green, diminishing in proportion as it ripens, and disappearing entirely when it becomes perfectly ripe, and contains the greatest quantity of oil. The leaves, with which the olive tree is always covered, and which it is reasonable to suppose must fulfil some important function, are never devoid of more or less mannite as long as they continue green, and as soon as they begin to turn yellow, others have already taken their place, and would appear to accumulate, so to speak, the materials elaborated by their predecessors, and assume their functions. Many other substances are found in the leaves of the olive tree besides mannite. There are colouring matters, and especially the chlorophyl, which accompanies the mannite and follows its changes; saccharine principles, which have the property of facilitating fermentation in contact with yeast, as also of reducing tartrate of potassa and copper; organic acids and other matters not well-defined. The leaves of the olive tree, which have the property of accumulating mineral substances, contain a large quantity of water, varying according the period of vegetation, and sometimes amounting to 50 per cent.

Honey and honeycomb is shown by Bartolomeo Bottamini: the following is the method of rearing bees pursued by the exhibitor in the Alpine Valleys of Bormio:—

"The bees are placed in wooden hives about a foot wide, and rather more than three feet long, perfectly closed in front and rear, except that in the former case a small aperture is left at the bottom, three inches long and 1·3 inch in height.

"Great care is necessary at the commencement of the spring to provide sufficient food for the insects, and if they cannot procure it for themselves, two or three ounces of honey are placed in each hive.

"As soon as the mountains become covered with flowers, the bees are smoked out of the hives, by burning a roll of linen rags at the back part, so as to drive them towards the front aperture. The old honey, being invariably of inferior quality, is then removed, taking care not to interrupt the workers, which have begun to make the pure new honey, and even after this operation the bees should not be deprived of honey in case of bad weather intervening, when they must be artificially fed as mentioned above.

"The plan followed during the period of swarming offers nothing worthy of remark, beyond the observation that the hives should be well filled, so that when the swarms are small two should be placed in the same hive. These latter are always washed with honey and wine before making use of them. Even at this period it is essential to feed the bees artificially whenever the weather is unfavourable.

"About the middle of July, the honey is taken from the hives in the same manner as that already described. The white combs are separated from the darker ones, as they furnish honey of superior quality. It is necessary to extract the virgin honey without the use of any pressure. The honeycombs are placed in boxes divided by a perforated tin plate, through which the fine honey drains, provided the room be kept sufficiently warm. That which remains is of inferior quality, and is pressed out mechanically. A third of the honey is always left in the hives for the sustenance of the inmates in case of inclement weather intervening.

"The neighbourhood of Bormio being very elevated, all plants have ceased to flower at the beginning of August, so that it is necessary to take the bees down to the lower part of the valley, where they may feed on the buck-wheat planted there in the middle of July, this being a plant which continues flowering for a long time, though the honey which it produces is of an inferior kind, and rarely serves for anything beyond the use of the bees themselves during the winter months.

"The hives are removed at night on spring carts, in order to prevent the honeycombs from falling or being in the least degree shaken. During the journey, the front covering of the hives is likewise removed, and substituted by throwing over them a light piece of linen to allow the bees to breathe freely, otherwise they would become overheated and suffocated, especially in the very full hives.

"During the two last months of the year, the bees are placed in their winter quarters, that is to say, in a dark corner of an inhabited room, where the cold never descends to the freezing point. Each hive should contain 4½ lbs. of honey, which is otherwise added, taking it from one of the others which happens to be fuller. The combs should be close together, and the apartment be kept perfectly quiet and dry.

"The hives are also left in the open air during winter, but in such cases at least 20 lbs. of honey must be placed in each one, instead of the quantity mentioned above. It is not safe to leave the smaller hives out of doors as the bees generally die.

"The bees begin to come out in March, provided the weather is fine, but otherwise it is essential to keep them in by covering the hives, lest they should be injured in their excursions by the cold or be destroyed by a fall of snow."

Turin vermouth or bitters, furnishes a large trade. One house, that of Martini, Sola, and Co., carries on a considerable business in it both for Italy and abroad. In 1864, they exported 20,000 cases to South

America alone. There are many producers of cordials and liqueurs. A great variety of wines are shown. A mild and dry Riminesi wine, grown at Port Ercole or Mont Argentale, partakes of the nature of Madeira and sherry. It is supposed that the vines were introduced by the Spaniards while they occupied the Presidii.

The Royal Œnological Commission of Turin exhibit a large collection of choice Italian wines on behalf of thirty-five proprietors and manufacturers, thus distributed by provinces :—

Province.	No. of samples.	Province.	No. of samples.
Alexandra	88	Noto	2
Aquilla	2	Palermo	2
Cagliari	1	Pavia	23
Capitanata	1	Placenza	8
Coni	46	Ravenna	9
Florence	2	Rome	10
Genoa	4	Turin	18
Naples	2		

Although only ten provinces out of fifty-nine are represented, the collection contains a type of the principal wines drunk at the table of the wealthy and the homely board of their less opulent neighbours, dry, white wines, red table wines, full-bodied red wines, white, and red sweet, and effervescing varieties ; each sample being labelled with the price at which it is obtainable on the spot.

Some of the most important of these exhibitors are the following :—

"Count della Torre gained the prize and much commendation at the National Exhibition of wine held in Turin in 1864, as offering the best of those made at Caluso. The wines of this exhibitor are made of *erbaluce* and *pelleverde* grapes. They are somewhat analogous to Frontignan and Lunel, but have more body and a different aroma. At present they are sold at a very high price, but there is reason to believe that shortly the proprietors, profiting by the increasing favour which they find, will cultivate them on a more extensive scale, so that the prices will fall proportionally.

"Esuperanzo Buelli, of Bobbio, a district which belonged to the late kingdom of Sardinia, but annexed in 1859 to the Province of Pavia, exhibits a variety of wines made from vines cultivated by himself, the greater part of which are foreign, as the very names themselves will show. He sells annually about 12,000 bottles of wine, carrying on his business with increasing diligence, intelligence, and success ; his white wines, however, are more highly thought of than the red.

"Count Manfredo Bertone di Sambuy is extending his vineyards yearly more and more in the vast champaign in which the battle of Marengo was fought sixty-five years ago, and where both climate and soil combine favourably to the production of excellent wines of various kinds. The vines have been brought partly from France and partly from the Rhine, others are indigenous. The exhibitor is turning his attention to the study of the particular variety of vines for which the soil is best adapted. The *Marengo* wine made with Bordeaux vines, the *Neretto Cortese* and Malmsey were most approved of at the Turin Exhibition of 1864.

"Francesco Varvello purchases grapes grown in the province of Alexandria as well as in the Langhe and in that of Coni. He stands first in importance of all manufacturers in the kingdom as regards quantity; his wine has received prizes at nearly all the exhibitions lately held.

"Chev. Luigi Oudart has large stores in Genoa, though he makes his wine at Neive in the Langhe (*Coni*), where he purchases the grapes. The collection of this manufacturer was considered equal to that of any other represented at the Turin Exhibition of 1864. The grapes he employs for the red wines are *Nebbiolo*, *Nerano*, and *Barbera*, and for the white, *Malvasia*, *Cortese*, and *Pignolo*—all indigenous. With these he manufactures numerous kinds of excellent wine.

"The wines of the other sixteen manufacturers were also much approved of at the Turin wine exhibition, both for their taste and wholesomeness. Some of these may be regarded as types of special cultivation, and could they once be made known, would find general favour abroad, especially the white *Muscat* from Cassiene, the Vesuvian *Lagrima*, and the *Nebbiolo* from various localities."

Centerba is a kind of liqueur which is produced to the extent of several thousand bottles by Benjamin Toro and Son. The strong centerba is an excellent stomachic, and besides its medicinal properties when taken inwardly, is very useful applied externally for cuts and wounds. The mild kind is a delicious liqueur. Both are distilled from aromatic herbs growing on the Majella mountains, a spur of the Appenines facing the Adriatic, and in the province of Abruzzo Citeriore.

There is a very fine display of Italian grown cotton, and great progress has been made in this culture in the last few years. Formerly, Italy produced a good quantity of cotton. In 1859, attention was again given to the production, and the yield that year was of the value of fifty million francs. In 1864, the production reached 302 million francs. There are about eighteen exhibitors of cotton. The Baron Donnafugata shows seven kinds of cotton in the pod and cleaned, grown on his estate Passotalo, Ragusa. The Baron Ricasoli shows raw Siamese cotton, of which he cultivated thirty-seven acres in 1864. The Marquis Rudini is probably the most extensive cotton grower in the whole of Italy, having devoted last year no less than 930 acres to its cultivation. The cotton of this exhibitor was grown at Pachino. It is the variety generally known as Siamese cotton, the seeds of which originally came from Malta at the beginning of the present century, since which time the plant has been acclimatised in Sicily.

The soil at Pachino is volcanic and clayey, partly calcareous and partly alluvial.

The exhibitor planted his cotton in two different ways, of which it may be interesting to append a short account: one called the 'trench' system, the other the 'plough' system.

"As soon as the autumnal rains begin to set in, the ground is ploughed two or three times, according to circumstances, but before the soil has become too moist; this operation is repeated several times until the month of March, taking advantage of the dryer days, so that all the weeds may be thoroughly destroyed, which is rendered more certain by finally hoeing the ploughed surface.

"No change has been made in the form of the plough used in Sicily since the time of the Romans; the depth reached by which is about a foot. The exhibitor has, however, introduced on his estates the plough with a voltorecchio share, and also the harrow, and reports that he has found them very serviceable.

"Having prepared the ground in the manner described, the cotton is sown about the middle of April. A third part of the seed is placed in water and subsequently rubbed lightly with a mixture of pulverized sheep's dung and ashes, in order to strip it of the down still adhering after the operation of ginning. Two furrows are made between which the sower throws the cotton seed broadcast, the same as is practised for corn. It is at once covered up by the ploughs which follow the sower, but meanwhile, a boy, who walks between the two ploughs, throws into the furrows, at intervals of three feet, ten or a dozen dry seeds, in addition to the former ones. The expense of sowing comes to about 8s. 6d. per acre, 136 lbs. of seed being employed for the purpose. Such is the method adopted in soil sufficiently tenacious to preserve the humidity essential to the germination of the seeds.

"In the dryer and more porous volcanic soil a different course is followed. At the end of April, furrows are made, distant about twenty inches apart, and seven inches deep. The labourers having made the furrows, each provided with an earthen pot of water, containing the seed, first water the furrows and then throw in the middle about fifteen seeds, fixing them firmly in the ground by pressing them down with the back of the hand, and then covering them up with loose and moist earth. This method of sowing is more expensive than the former, costing 18s. per acre, but it only requires 120 lbs. of seed.

"When once the plants have come up, fresh seeds are sown wherever these are deficient, in all cases adopting the plan of making furrows, even in the fields sown in the first instance with the plough.

"By the time the little plants have got four or six leaves they are thinned, leaving the strongest ones at proper intervals in the fields sowed by the plough method, and in the other case groups of three or four plants, and rooting out all the rest.

"The cost of performing this work is about 2s. per acre; the plants are then hoed up three times at equal intervals until August, at a cost of 7s. 2d. per acre.

"The cotton begins to ripen in September, and on account of the frequency of the rains is not entirely gathered in before January. The cost of gathering is 2s. per cwt.

"Irrigation has not hitherto been practised at Pachino, from the want of perennial springs, though now the Marquis Rudini has canalized the little river Randeci, and brought the water into his estate of Bimesca, so that he will in future be able to irrigate a large extent of land.

"The produce of raw cotton per acre in 1864, following the plan just described was about 175 lbs.

"Ginning is usually performed at Pachino by the use of a rough, wooden apparatus, introduced by the Maltese colonists. As it naturally crushes many of the seeds, thus injuring the cotton, the proprietor has purchased improved ginning machinery, manufactured by Dobson and Barlow, Durand, and Platt and Co.

"Formerly, the ground now planted with cotton was sown with corn, grass, and leguminous plants; but although admirably adapted for this kind of cultivation, cotton, at the present prices, is far more profitable.

"Last year the plants suffered very considerably from the ravages of an insect which in some districts entirely destroyed the crop. Various plans were resorted to in order to exterminate them. The plants were sprinkled with quicklime, sulphur, and tobacco, but to no effect, the insect being in no way injured, but continuing its ravages as before.

"Having ascertained that Louisiana cotton is the variety best adapted for the climate and soil at Pachino, the exhibitor obtained a quantity of seed last spring from the government, but this being old and bad did not germinate. Other seeds, furnished from the Royal Industrial Museum at Turin, by Commander Devincenzi, President of the Royal Commission for the Cultivation of Cotton, came up, but unfortunately the plants were completely devoured by the insect spoken of above."

The Royal Industrial Museum send a fine collection of samples of Italian cotton, exhibited at the first cotton exhibition held at the Museum in Turin, in 1864. Professor Tornabene, Director of the Botanical Gardens, Catania, has sent a beautiful collection of 157 different samples of cotton grown in 1864, in his gardens, each labelled. Pods and dry plants, together with a specification of the country from which the seeds were obtained, the botanical names and synonyms.

The exhibits of silk and cocoons are not large, but they are interesting. Dr. Giovanni Pisani sends the following account of the silk manufacture of the province of Milan:—

"Milan, besides holding incontestably the first rank among the cities of Italy for its silk trade, contains within its walls numerous important commercial houses, which likewise reel and spin the silk they sell. The province of Milan is, moreover, one of the first for the production of cocoons, both as regards quantity and quality; those of the upper part of the province, and known as Brianza cocoons, being the best. Previous to the ravages of the silkworm disease, which has been so general of late years, the production of cocoons in this province varied from 3,500 to 4,000 tons, according to the season, representing at the lower prices at which they were then sold, a value of from 420,000 lire to 480,000 lire.

"The Milanese silk manufacturers, however, not only possess and superintend numerous mills for reeling and spinning tram and organzine, but carry on a great many others in the neighbouring provinces, especially in that of Como. Not to speak of the vast number of small silk reelers who have only from two to eleven basins, there are in this province 140 reeling mills (*filande*), containing from twelve to 140 basins, twenty-eight of which are heated with steam, the rest by water. These are in operation for about two months annually, giving occupation during that time to no less than 12,000 persons, half of whom are women and half girls; the former earning about 9½d. per diem, the latter half that sum. The spinning or twisting mills (*filatoi* or *torcitoi*), amount to ninety-five, containing a total of 18,968 spindles, and giving employment to about 11,000 men, women, and children, whose wages daily may be taken respectively at 1s. 6d., 8d., and 4d.

"Since the introduction of the silkworm disease into Lombardy, the produce has fallen to half, a third, a quarter, and to even a fifth of that previously obtained, varying according to the province, the locality, and the year itself. Incalculably great as this loss may be to the country, but especially to the silkworm rearers and landed proprietors, the reeling and spinning mills have not suffered by this deplorable misfortune, owing to the intelligence and activity of the manufacturers. The Milanese houses, in fact, supply work for their reeling mills by purchasing largely Asiatic cocoons at Venice, whither they likewise resort for the Asiatic raw silk which they spin with the most admirable success into tram and organzine.

"Silk reeling and spinning is an art which has existed in Lombardy from very remote times, and it has become, so to speak, a kind of property in some families, passing for generations from father to son, so that it is by no means uncommon for such houses to date back many centuries. It can easily be understood how this circumstance ennobles the occupation, producing a love for the art, a skill which increases with time, a feeling of emulation tending to produce the best result with the least expense, and an enterprizing spirit which invites to study and carry out modifications adapted to every kind of silk, and thus attain the highest degree of perfection.

"It may be safely said, without fear of exaggeration, that the Milanese reeling and spinning mills have reached this point, and the assertion is fully confirmed by facts, seeing the esteem in which they are held by the manufacturers on the Rhine, in Switzerland, and even in France, where silk is likewise spun in the most admirable manner;—the medals awarded to nearly all the Milanese silk spinners and reelers at the Italian Exhibition in 1861 and the International Exhibition of 1862;—and lastly the great gold medal conferred on the Milan Chamber of Commerce at the Paris Universal Exhibition in 1855, as representing the general silk interest of the province.

"Although exceptional circumstances have prevented that concurrence of Milanese manufacturers at the Dublin International Exhibition as was at first anticipated, three of them, Keller, De Vecchi, and Ronchetti are houses of the most important class, and the samples of raw and spun silk which they have sent will show the perfection they have attained in winding, spinning, and throwing this precious fibre. The first mentioned of these manufacturers likewise exhibits silk obtained by a process of his own which he states to be more expeditious, economical and useful, combining as it does two operations in one. Another exhibitor has sent sewing silk, which having been prepared from silk made by double cocoons, cannot be twisted uniformly, so as to present the various degrees of size without accurate study and careful examination to assure the smoothness of the thread and regularity of the work in the preceding operations, as well as a judicious choice of the silk itself. This exhibitor annually manufactures about ten tons of sewing silk, for the most part sold in France and Germany for making fringes.

"Another exhibitor shows with what success he is able to card silk waste by hand and power, and what progress has been made in this art during the past few years. This waste has little intrinsic value, but when carded with intelligence and accuracy, and spun very equally, serves either alone or mixed with other silk, wool, or cotton, for the manufacture of goods of such beauty as to appear entirely made of silk. Silk carding is carried on by ten manufacturers, large and small together, and employs about 2,000 men, women, and children. The total annual production may be taken at 200 tons.

"In the twelve silk dyeing works existing within the walls of Milan, upwards of 240 men are employed, who dye annually not less than 220 tons of silk. Without pretending for a moment to assert that the Milanese silk dyers can compete with the French, especially in new colours and half tints, it is but just to say that great improvements have recently taken place, while, on the other hand, Milanese dyers are celebrated for their mineral black, which they sell in great quantities to Swiss and Rhenish manufacturers.

"Bruni's dyeing works are very ancient, having been founded about a century ago. The exhibitor assumed possession of it in 1821, and has directed his attention with diligence and care to his own art. Aided by the progress of chemistry he has been enabled to introduce great improvements, heating by steam, and having in the works steam engines and all the most improved kinds of machinery. He has been awarded several medals at different exhibitions, and dyes for foreign sale alone upwards of thirty tons of silk annually.

"As far as regards the consumption of dyed silk for the Lombard silk manufactories, which are confined to the two provinces of Milan and Como, the dyeing works receive less commissions than formerly, owing to the severe blow the weavers have sustained by the government having suddenly taken off the import duty on such goods since the late treaty of commerce, rendering it extremely difficult for them to compete with French manufacturers, even for plain silks, which would not have been the case had sufficient time been allowed for adopting measures necessary in order to keep their ground."

ON THE TREATMENT OF BEES IN POLAND.

BY COLONEL STANTON.

I HAVE succeeded in procuring a paper on the treatment of bees in this country, written expressly for me by Mr. Mieczynski, one of the chief authorities on the subject in Poland, and I forward, herewith, a summary of this paper, translated from the original Polish by Mr. Morris, the clerk of this Consulate.

Mr. Mieczynski in his paper mentions the titles of several works published in the Polish language, which treat on the subject of bees and bee-keeping; but of these only one (that of Dzierson) appears to have been translated into French or English; but, as the system introduced by this author is looked upon as one of the most successful, it may be presumed that all the details necessary for the complete explanation of the most approved methods of bee-keeping are to be found in the published work of that author."

The manner of treatment of bees in Poland may be divided into two heads.

The first, or routine method, is practised chiefly among the ignorant peasants, and as these are the most numerous class, this method holds the first place in the amount of produce of honey and wax, and with regard to the manipulation and rearing of bees may be classed into two subdivisions:—

1. The system of hives (made of trunks of trees, either standing or felled), which is generally used in Poland, Galicia, Posen, Lithuania; and

2. The system of bottomless hives, generally used in Ukraine and Volhynia, as well as the system of basket hives called straw hives, used

for the most part by the small proprietors and some peasants in Poland, as well as in a part of Lithuania, called Polesie.

The second system (the rational one) of rearing bees, though not universally adopted, may be subdivided into three methods :—

1. The swarming method, as represented in the hive of Dzierzon (Jerzon), and his method of rearing, generally used in Poland and Volhynia, as well as in the greater part ot Galicia.

2. The system of the Englishman Nutt but little used in Posen.

3. A combination of the two methods above mentioned, introduced by the priest Dolinowski, from the Government of Lublin, uniting in a hive of his contrivance the swarming method of Dzierzon, and the method of Nutt.

The three last systems are generally adopted by the wealthier proprietors, and are rather the result of interest in bees, than the object of greater economical produce.

Besides the routine and progressive systems before mentioned, there exists a third method of rearing bees in excavated trunks of trees in forests, commonly used in the Government of Plock, in the district of Ostrolenka, and in the woody part of Lithuania, called Polesie.

It is hardly possible to describe all the above cited systems, but the works on this subject by Znamirowski and Dolinowski, in which all the particulars are presented, are here worth mentioning.

The improved management of bees in Poland may be dated from 1850. At that time the public became acquainted with the works of Mieczynski, Dolinowski, Lubieniecki, and Znamizowski, and with the methods of Dzierzon and Nutt. In many places, the rational management of bees was adopted, and the following bee gardens were established—viz.: By Count Czapski in Miropol; Priest Wiktor in the district of Lowicz ; Pawlowski in Gawartowa ; Wola in the district of Piotrkof ; Bielang near Warsaw ; Kurakowski near Warsaw ; Priest Dolinowski near Lublin ; Lubieniecki in Galicia ; Florkiewicz near Cracow ; Count Bobrynski in the Ukraine ; and Prince Sanguszko in Volhynia. In all these and many other places, the rearing of bees was carried out according to the system of Dzierzon, whilst Mr. Obrzycki, in the Government of Augustovo, adopted the method of Nutt, which, however, appeared totally unsuitable to this climate, notwithstanding, that in the duchy of Posen this method is more extensively used.

The following are the chief plants from which the bees in Poland gather honey :—*Plantago media, Nigella, Verbascum, Sinapis, Brassica, Trifolium, Medicago, Papaver, Cucumis melo, Calendula officinalis, Cucumis sativus, Carduus, Leontodon taraxacum, Reseda odorata et luteola, Tussilago farfara, Melissa, Brassica napus, Hedysarum, Helianthus, Salvia officinalis, Polygonum tartaricum,* and *Erica vulgaris.*

With regard to the latter (heath), which is of great importance to bee-keepers in Western Europe, it must be observed it is of very little significance in Poland, as it blossoms late in the autumn, when the other plants cease to yield pollen, and although the bees gather much honey from heath, they do not procure what is necessary to vault up their cells.

Of the trees which materially assist the keeping of bees, especially for the forest bee-keepers in private estates in the Government of Plock, Lublin, Augustovo, and Lithuania, the following are worth mentioning:—*Tilia*, *Syringa vulgaris*, *Acer*, *Pinus larix*, *Pinus sylvestris*, *Prunus cerasus*, *Pyrus sylvatica*, and *Rubus idacus*.

It must be observed that the famous honey from Koono is indebted for its flavour chiefly to the lime, which abounds in the forests of Lithuania, and in the south of the Government of Lublin, parts of the country inhabited by Ruthenians, whose cemeteries, according to their religious rites, must be surrounded by that kind of tree. This sort of honey derives its name from those trees "Lipiec."

In Poland, properly speaking, there is but one sort of bee (*Apis domestica*). From this kind, however, may be distinguished the so-called black-bee, reared in the forests. In the course of the last ten years Italian bees were introduced into Poland, which kind, as is well known, do not use their stings, and which are much larger than the common bee. Experience has, however, shown that this kind of bee soon begins to degenerate.

In the peasants' hives the bees are left for the winter in the open air, and one-third of the swarms in consequence perish. In progressive bee-keeping, sheltering-houses are constructed for winter.

In Podolia and some parts of Volhynia, the bee-gardens in forests or places remote from villages, consist occasionally of a thousand hives in one place, which are managed by men exclusively destined for them, and whose practical knowledge on the treatment of bees is passed from father to son. In the Ukraine, where the system of bottomless hives is used, the treatment of bees is in a state of most primitive management.

The honey-gathering depends chiefly on the locality, and begins about the middle of Spring, and particularly when the willows begin to blossom, which is about the beginning of May. The common bee-hives are then cleaned, and the improved hives taken out of their winter places and arranged for the summer. The first swarm takes place about the middle of June, and lasts a whole month.

In the improved bee-hives of Dzierzon, Lubieniecki, and Dolinowski, no natural swarming is allowed; but an artificial one is arranged, which chiefly depends on forming artificial queen-bees and joining swarms, the details of this method are described in their works.

The cutting out of honey-combs is performed twice a year, in July and September, the first giving the more abundant yield, the second consists merely of taking away the quantity deemed superfluous for their winter use. In October the hives are taken in for the winter, and every attention is given to preserving them from frost. One hive of the method of Dolinowski produces on an average 40 lbs. of honey and wax and two new swarms ; one of the methods of Dzierzon yields an average of 8 lbs. of honey and wax and five swarms ; a common peasant hive produces 3 lbs. of honey and wax and two swarms.

The average price of honey in the kingdom of Poland is ten p. florins a gallon (7 lbs.). In Ukraine, and further in the interior of Russia, this price diminishes to five p. florins.

The following are the works on the treatment and management of bees, written in the Polish language, which are of practical value—viz : 1. 'Bee-gardens, with the Hives of Dzierzon,' by Lubieniecki, Lemberg, 1852. 2. 'Rules of Treatment of Bees,' by Dolinowski. 3. 'Polish Treatment of Bees,' by A. Mieczynski, 1862. 4. 'Lessons for Bee-keepers,' 3 vols., by Lubieniecki, 1860 .5. 'The Good Bee-keeper,' by A. Mieczynski, 1859. 6. 'The Polish Bee-keeper,' by J. Znamirowski, 1863.

The work of Dzierzon had three Polish translators, namely, Lompa, Witowski, and Twarowski. In England, Dzierzon's method must be known, as A. de Fraleire in his work 'Les Abeilles et l'Apiculture,' Paris, 1855, mentions that the work of Dzierzon is translated into all European languages. It may, therefore, be presumed to be in the English likewise.

Finally, it must be mentioned that there exist in Poland special schools established by private gentlemen for expounding the treatment of bees to peasants. In 1851, Dzierzon himself arrived here, and during several months explained his method to numerous audiences. Many other gentlemen practically acquainted with the treatment of bees also devote their time to acquainting the country people with this important science, which in a great measure tends to the augmentation of bee-keeping over the whole kingdom, as the Polish peasants show an inclination for this branch of industry.

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THE NATURAL CAPABILITIES OF BRITISH COLUMBIA, AND THE CONDITION OF ITS PRINCIPAL GOLD-FIELDS.*

BY LIEUTENANT H. S. PALMER, R.E.

The discovery of gold in the extreme west of British North America, in the year 1858, was destined to prove an event of more than passing importance in the history of modern colonial progress. Upwards of 200,000 square miles of savage territory were at once erected into the colony of British Columbia, and the new region became hastily peopled by hordes of eager gold-seekers from the neighbouring States.

The shallow "bars" of the Fraser and Thompson Rivers soon ceased to be profitable; but step by step, with varying success, yet unabating vigour, the alluvial gold was traced upwards to its parent sources in the hills, and, in 1861, three years of patient toil were rewarded by the discovery of the now famous gold-fields of Cariboo. The productiveness of these new mines has, during the last two years, been so great as to place them in the first rank of modern gold discoveries; and, indeed, a comparison of their returns with those of the most notorious districts in California and Australia, encourages the belief that the auriferous riches of Cariboo are the greatest hitherto discovered. While the gold-miner's incursions have been thus rapid and extensive, civilization and enterprise have not been far behind him, and the young colony now attracts attention by its various commercial and agricultural, as well as its mineral, advantages. During the last five years, the writer has had frequent opportunities of travelling somewhat extensively in British Columbia, and the object of this communication is to describe, with as much detail as a short paper will admit of, its physical geography and natural capabilities, and the condition of its principal gold-fields.

The seaboard of British Columbia, commencing at the international boundary-line (lat. 49° N.) extends for some 500 miles in a general

* From the 'Journal of the Royal Geographical Society.'

northwesterly direction. Foremost among its peculiarities is the extraordinary length of shore-line, bearing, indeed, an enormous proportion to the actual span of the coast, and due to the existence of a continuous series of long arms of the sea, which everywhere pierce the coast, and, in some instances, penetrate inland to distances of eighty and even 100 miles. Numberless archipelagos of rocky islets stud the whole seaboard, and, bordering closely upon the mainland, furnish protection to its shores; and further still to seaward, Vancouver and Queen Charlotte Islands, separated only by narrow straits from the Continent, form huge natural breakwaters which shield it from the full force of the Pacific. Thus, the entire seaboard, with its inlets, and numerous outlying islands, presents an extraordinary net-work of sheltered water-communication, so continuous, indeed, that the experienced navigator, familiar with its intricacies, and perplexing tidal-irregularities, may work his way along shore from end to end of the coast, and rarely, if ever, be forced to seek the open sea. The inlets are everywhere deep and narrow, and, although subject to strong winds and tides, and by no means abounding in anchorages, they present scarcely any material obstacles to navigation by steam vessels of the largest class. Piles of giant mountains rise everywhere abruptly from their shores, and snowy peaks and glaciers, pine-clad slopes, rugged cliffs, and precipices, gloomy valleys and picturesque waterfalls, combine in endless succession to form an aggregate of sublime and wild, though desolate and unattractive, scenery.

According to the most recent Parliamentary enactments, the colony of British Columbia, apart from its numerous island dependencies, comprises all the territories stretching from the 49th to the 60th parallel of latitude, and from the culminating ridge of the Rocky Mountains to the shores of the Pacific, a small strip of Russian territory along the extreme northern seaboard alone excepted; and beyond the parallel of 56° N., that portion of the soil to the east of the Rocky Mountains, extending as far as the 121st meridian, is further included within the bounds of the colony. But, of the immense area thus circumscribed, all that portion lying to the north of the 54th parallel remains, and is likely to remain, an uninhabited wilderness. Little only is known of these extensive solitudes. Indeed, the officers and servants of the Hudson's Bay Company, who dwell at fur-trading posts widely scattered throughout the district, and are, with the exception of scanty native tribes, its sole inhabitants, are the only white people possessing any personal acquaintance whatever with its geography and natural capabilities.

From them we learn that, although not entirely devoid of attractive features, and occasional patches of good soil, this portion of the colony is on the whole cheerless and uninviting, and especially ill-adapted for occupation by man. Moreover, its high latitude, and extreme elevation, and the rigorous climatic influences to which it is subject, are elements little likely to encourage its speedy development; and, coupling, with these drawbacks, the circumstance that settlement is but slowly creeping northward from the southern bounds of the colony, it may fairly be inferred that the region north of the 54th parallel presents a very slight prospect of early occupation. On this account, and in the absence of fuller and more perfect information than is at present to be had, the whole country north of this line will be purposely omitted from consideration in the following remarks upon the interior.

Looking inland, then, from the sea, the southern and explored part of the colony is found to be naturally divided into three great zones, or belts, of nearly equal areas, differing in their physical features, as well as in soil, climate, and vegetation; and bounded by lines generally parallel in direction to the coast on the one hand, and the great backbone of the continent on the other. The first great belt may be defined as extending north-westerly from the international boundary line to the 54th parallel, and inland to a distance of 120 miles from the coast. The area comprised within these limits is almost wholly occupied by a combination of the great Cascade range of Oregon and Washington Territories. Indeed, the estuary of the Fraser in the extreme south, where the hills recede to a distance of forty miles from the coast, is the only patch of any size that can fairly claim the character of lowland and level country. Elsewhere, the Cascade range, with its countless spurs and outlying ridges, occupies the whole of this broad strip of territory, and forms a massive sea-wall of pine-clad mountains, descending, as has been described, almost perpendicularly to the very shores of the inlets. The principal crest of this chain attains to an elevation of from 5,000 to 6,000 feet above the sea, at a mean distance of seventy miles from the coast. It is faintly marked by peaks rising but little above the neighbouring ranges. The magnificent isolated peaks, which, to the south of the boundary line, tower up to altitudes of 15,000 and even 20,000 feet, and serve to indicate distinctly the general bearing of the range, are wholly wanting in British territory. The western slope, open to mild winds and genial showers from the Pacific, is everywhere clothed with pine forests of remarkable grandeur, stretching from the valleys to almost the highest hill-tops, and concealing at the lower elevations a massive, impenetrable undergrowth of deciduous bushes. On the opposite slope the climate is drier, the forests are less dense, and the pines of smaller proportions; and, as we approach the eastern limits of the range, underwood becomes more rare, the general profile less rugged and abrupt, and the country begins to assume a more attractive aspect.

But it is to be feared that, throughout the coast-range, no portion of the soil holds out any hope of extensive agricultural improvement; with few exceptions, the rivers which drain the hill-system are short and impetuous, and, pouring down the western slopes, find their way through inconsiderable valleys to the coast, and discharge themselves at the heads of the inlets. Even the larger streams, which, rising in the interior, thread their way through the heart of the range, are confined in narrow, precipitous passes, or "cañons," through which they rush at prodigious velocities on their passage to the sea. So that, dismissing from consideration the small fertile patches in the river bottoms, which are so contracted and thickly-timbered as to be of little avail for purposes of cultivation, the whole of this great belt under discussion, the Fraser estuary alone excepted, can only be regarded—from its inaccessibility, and its mountainous and forest-bound character—as an inhospitable wilderness, practically unsuited to purposes of agricultural settlement. Its mineral resources (and the region is not wanting in indications of vast metalliferous wealth), have yet to be explored. But, although comparatively valueless at present to the white settler, and, in fact, almost altogether unoccupied by him, except in its southern extremity, this mountainous belt is not without its substantial attractions to the native Indian. Many varieties of furred animals haunt its vast forests, and are hunted and trapped in the winter months for the sake of their skins and their meat. Indeed, the furs taken in the northern part of the Cascade range are of the most valuable kinds, and the hunters find a profitable market for them at the various ports and trading stations along the coast. Besides these, countless varieties of fish and water-fowl frequent the rivers and highland lakes, and furnish the Indian with both summer and winter food; beavers valuable also for the sake of their skins, abound at high altitudes in the swamps, and wholesome berries and wild fruits grow in great profusion in the valleys and river bottoms.

Emerging from this cheerless tract of mountain and forest, the traveller enters the second or midland belt, stretching from the southern bounds of the colony to the 54th parallel, and inland to a mean distance of about 110 miles from the eastern limits of the Cascade range, and comprising an area of at least 45,000 square miles. The region thus defined, exhibits a marked contrast to the coast district in its scenery and physical aspect. It may be described in general terms as a lofty, undulating table-land, traversed by numerous low ranges of hills, which enclose broad, well watered, and not unfertile valleys.

A group of rivers in the extreme south flow across the border towards the Columbia, but the Fraser is the main artery which receives nearly all the streams that drain the central and northern portions. Besides the main stream, many of the largest of its tributaries, such as the Chilcotin, the Thompson, the West River, and the Quesnelle, flow in deep valleys and chasms, far below the general level of the table-lands. All these rivers are beset by a constant succession of rapids, shoals, and waterfalls, and are, therefore (with the single exception of the Fraser), wholly unnavigable; and they exhibit throughout their course river scenery of the grandest description. But the brooks and smaller rivers, which traverse the more elevated portions of the plateau, are entirely different in character, winding sluggishly, at high altitudes, through comparatively level districts, and communicating fertility to the neighbouring soil. In common with the larger tributaries, they occasionally spread out into picturesque lakes, which are frequented by beaver, and by many varieties of fish and waterfowl. They are marked by no rapid changes in level until the last few miles of their course, when, arriving at the vallies of the principal arteries, they break abruptly away from the highlands, and descend swiftly in narrow gorges by a succession of rapids and waterfalls.

The scenery of the whole midland belt, especially of that portion of it lying to the east of the 124th meridian, is exceedingly beautiful and picturesque. The highest uplands are all more or less thickly timbered, but the valleys present a delightful panorama of woodland and prairie, flanked by miles of rolling hills, swelling gently from the margins of the streams, and picturesquely dotted with yellow pines. The forests are almost entirely free from underwood, and, with the exception of a few worthless tracts, the whole face of the country—hill and dale, woodland and plain—is covered with an abundant growth of grass, possessing nutritive properties of a very high order. Hence, its value to the colony as a grazing district is of the greatest importance. Indeed, the "bunch grass," so called from the circumstance of its growing in large bunches or tufts, is probably unrivalled as a natural pasture. Cattle and horses are found to thrive wonderfully on it, and to keep in excellent condition at all seasons; and, except when required to do work of an unusually hard nature, they need no other food. In the woods, and on the highest portions of the table lands, this grass deteriorates in quality, attaining to its greatest perfection at the lower elevation, but the whole area is more or less available for grazing purposes. Thus the natural pastures of the midland belt may be estimated by hundreds, or even thousands, of square miles. Moreover, large portions of the soil possess properties very favourable to agriculture, and, although influences of climate and altitude are somewhat discouraging, they are by no means formidable obstacles to the energetic settler. But the climate of this district, and the capabilities of its soil, will be more fully discussed hereafter.

On the whole, the possession of this fertile belt is of considerable importance to British Columbia. From its salubrious climate, its varied agricultural and pastoral capabilities, and its proximity to the lucrative markets of the gold-fields, it promises to become a pleasant and profitable, if not a very extensive, field for settlement; and there can be no doubt that it holds out far greater inducements to the agricultural settler than the low woodlands of the Fraser estuary, where it is both costly and laborious to prepare the soil for tillage.

The third and last belt of territory, extending from the eastern limit of the table lands to the watershed of the Rocky Mountains, needs no more than a very general description. Entering it from the west, the transition from level to hilly country is somewhat abrupt, and, advancing eastward, the general profile rises steadily, until it gains the level of the great backbone of the Continent. In this tract, the features of the coast district are repeated, though even on a grander scale—and, as a remark generally accurate, it may be stated that, with slight interruptions, the entire area is covered with a sea of towering pine-clad mountains, enclosing gloomy valleys—that it contains a smaller amount of agricultural land than any other district in the colony, and is wholly uninhabited by white men, except at the mining district of Cariboo, in its northern extremity. Yet, although thus outwardly unattractive, this region claims importance as the depository of vast mineral wealth, and the birthplace of the great streams that distribute their auriferous treasures throughout the whole western area. To these phenomena, however, it will be necessary to refer in a future paragraph.

Of the rivers of British Columbia, the most important by far is the Fraser, which traverses the colony from north to south, and receives, on its passage, almost every other stream of importance. It takes its rise in the Leather Pass of the Rocky Mountains, and discharges by two principal mouths into the Gulf of Georgia, a few miles north of the international boundary; and, together with its tributaries, draws an area that may be roughly estimated at 90,000 square miles. From its source, the Fraser flows an impetuous torrent, in a general north-westerly direction for 180 miles, reaching its extreme northern latitude at the parallel 54° 30″. Issuing near this point from one of the great valleys of the Rocky Mountains, it takes a bold sweep to the southward, and entering a more open region, soon assumes the proportions of a broad, navigable stream. Its course, however, is not entirely free from obstructions. Dangerous rapids, some of them wholly incapable of improvement, occur here and there, though fortunately the intermediate stretches of unbroken water are of considerable length; and it is at any rate interesting to know, in connection with the subject of a future route across the continent by the Leather Pass; that no less than 200 miles of this upper portion of the Fraser can be made available for steam navigation at the seasons when the stream is free from ice—viz., from April to October inclusive. At Fort Alexander its average breadth is about 300 yards, the mean velocity of the current five miles an hour, and the extreme breadth of the valley, measured between the points where it breaks from the table-land on either side, is from three to four miles. And here, for the first time, is noticed the remarkable terraced formation of the river-banks, peculiar to nearly all the great water-courses of the central districts. This formation consists of a series of perfectly level terraces, or "benches," rising in steps one above another, to altitudes corresponding on either side of the streams, and is due, no doubt, to successive sudden degradations of the river-levels at remote periods, occasioned by the removal of large barriers of rock or other obstacles in the defiles further down the valleys.

Twenty miles below Fort Alexander, the Fraser valley contracts in breadth, and the course of the stream, for 150 miles further south, lies in one of the deep, narrow chasms of the central table-lands. Here the river, already increased in volume by the accession of numerous large tributaries in the upper portion of its course, again becomes unnavigable and its continually swelling waters, limited to a narrow channel, soon form a boiling torrent, increasing in velocity at every mile. At Lytton, the Fraser is joined by the Thompson, one of its largest affluents, and, entering the heart of the Cascade range, rushes for fifty miles through a stupendous gateway, replete with all that is grand and terrible in mountain and river scenery. The valley gradually narrows in, until, at its intersection with the principal crest, it dwindles down to a mere cleft in the range. Here the features of the pass attain to their most gigantic proportions. The river itself seems a mere brook in comparison with the huge mountains which project upwards on either side to altitudes of 6,000 and 7,000 feet. Not unfrequently the slopes are almost wholly devoid of timber, and rise abruptly from the valley, massive, unbroken walls of granite and trap, standing in stupendous contrast to the forest scenery on the river-banks and islands. Here and there naked cliffs rise perpendicularly out of the water ; elsewhere the slopes are covered with immense slides of disintegrated rock, and countless waterfalls, thundering down the crannies and crevices of the mountain sides, contribute to the wonders of the scene. At the ordinary stage of the river, the velocity of the current is from twelve to fifteen miles an hour ; but in summer, when its waters are swollen to twice their ordinary volume by the melting of the winter snow, it rises, in this portion of the pass, to as much as sixty feet above its usual level, and, tearing down a rocky narrow channel at the rate of twenty miles an hour, exhibits a terrific succession of rapids, falls and whirlpools. At Yale, the Fraser again becomes navigable, and forty miles lower down emerges from the tangled network of hills, and sweeps in bold curves and with diminished velocity through the level lands of its estuary to the sea.

Unlike any of the other large rivers in British Columbia, the Fraser, throughout its entire course of 700 miles, nowhere expands into a lake. Its waters, therefore, arrive at the sea laden with sand and alluvium, and, being there met by the cross-tides of the Gulf of Georgia, the particles hitherto borne along by the current are deposited outside the entrance proper of the river. Thus, a series of shoals have been formed at the mouth, extending five miles to seaward, and right and left to distances of eight or miles ten along the coast.

Fortunately, however, the great volume and impetus of the stream ensure one navigable channel through those shoals, and, at present, vessels drawing as much as twenty feet of water can pass easily upwards to the capital, and even to some twenty miles beyond it.

New Westminster, the capital, stands on a commanding eminence on the right bank of the Fraser, fifteen miles from the mouth. The population is small, seldom exceeding 500 whites, and the city itself has not advanced with the rapidity usual in new countries, a circumstance arising, in some measure, from the difficulty of clearing the site for building, and from the absence of considerable tracts of land in its neighbourhood available for inexpensive tillage. Indeed, throughout the whole estuary of the Fraser, and more than anywhere, perhaps, in the neighbourhood of New Westminster, the forests attain to a greater luxuriance than in any other part of the colony. Foremost among the productions of the forest, in point of splendour and economic value, are the Douglas pine (*Abies Douglasii*), and the cedar (probably *Juniperas occidentalis*). The former grows to the enormous height of 200 and even 300 feet, and possesses qualities that render it especially valuable as a timber both for planking and spars. The cedar, though not so lofty, possesses an immense girth, some of the finest trees measuring between fifty and sixty ft. in circumference at a height of four or five ft. above the ground. This wood is more especially valuable for roofing and other building purposes, for cabinet work, and for all structures exposed to the action of water; and the natives turn its bark to profitable account in a hundred different ways. These, together with some half-dozen other valuable varieties of pine and fir, form the bulk of the larger and evergreen growth. There are also the alder, the dog-wood and crab-apple, two varieties of maple, the cotton-wood (probably *Populus balsamifera*) of the marsh lands, and many other varieties of deciduous trees; and a dense array of wild fruit berry bearing bushes, which form a luxuriant and impenetrable jungle. The forests thus composed are almost universal in the Fraser estuary, and extend with but little variation in character, over the whole of the Cascade range. The only open tracts of land are those which are liable to periodical inundations at the seasons when the streams reach their highest levels, and the low marshy districts at the mouth of the Fraser, where the land is seen actually in process of formation.

But on crossing the mountains, and entering the central districts of the colony, the magnificent varieties of timber met with in the neighbourhood of the coast entirely disappear. Nevertheless, there is wood sufficient for all the requirements of the settler, and the symmetrical yellow pine (*Pinus ponderosa*), peculiar to this district, dots the grass-lands of the valleys and slopes, and forms a conspicuous and attractive feature in the landscape. In the interior mountainous belt the forests of the coast district are repeated, though on an inferior scale, in consequence, no doubt, of the increased elevation and the rigour of the climate; and the undergrowth is far less dense.

The whole of the inlets, bays, rivers, and lakes of British Columbia, abound with varieties of delicious fish. The quantity of salmon that descend the Fraser and other rivers on the coast every summer is almost incredible. The first enter the Fraser in March, and are followed in rapid succession by other varieties, which continue to arrive until the approach of winter; but the greater run occurs in July, August and September. During these months, so abundant is the supply, that it may be asserted without exaggeration that some of the shallower streams can hardly be forded without stepping upon them. Apparently propelled by an undying desire to deposit their spawn at the head-waters of the various streams, vast shoals of these fish force their way annually to distances of 500 and 600 miles into the interior. Thousands perish from fatigue during this laborious ascent, and, on the subsidence of the waters, are left dead and decaying on the margins of the streams. On their way through the country they supply food for thousands of the natives, who, in fact, depend upon them, in a great measure, for their very existence, and, at the time of the great runs, repair by whole tribes to the favourite fishing-grounds. The salmon are caught in a variety of ways. In the small rivers on the coast a dam is built, stretching from shore to shore, and rising high enough to create a considerable waterfall. On the top of the dam, and half immersed in the water, is placed a rude but ingeniously constructed weir, which entangles the fish as they jump the falls. At the mouths of the large rivers, where the currents are slight, and the banks low, spearing from canoes is resorted to, and seine fishing has been recently introduced by the whites. But in the "cañons" of the Fraser, and these are by far the most lucrative fishing grounds in the whole colony, rude stages are built out from the cliffs, on which the natives stand with large scoop-nets, and thus bale the salmon out by hundreds, as they steal upwards in the eddies along shore. Occasionally, however—once perhaps in every four or five years—the supply almost fails; and although, by a wise dispensation, the natural fruits of the country are at such seasons proportionally more abundant, the natives nevertheless suffer fearfully from the dearth of their staple food.

Sturgeon, of as much as 500lbs. in weight, abound in the lower part of the Fraser. As these fish usually lie at the bottom of the river, the Indian allows his canoe to drop quietly along with the current, and holds perpendicularly in his hand a long pole armed with a barbed trident fitted loosely on the lower end. The points of this trident are kept a few inches above the bottom. The moment the native sees a sturgeon, he strikes—the trident slips off the end of the pole, but, as it is farther attached by a long running line to the canoe, the fish is eventually secured. The sturgeon are not confined to the Fraser; and instances are known of their having been caught in some of the far inland lakes. In the interior the brooks and highland lakes swarm with perch and several kinds of trout. Myriads of herrings frequent the bays and inlets on the coast, together with cod, flounders, halibut, &c., and many varieties of cetaceous and shell-fish.

But, while the waters of British Columbia thus teem with life, its soil, on the contrary, is by no means so thickly inhabited. It is generally believed here in England that its vast forests are overrun by numberless wild animals, and afford magnificient hunting-grounds for the sportsman. This belief, however, is almost wholly erroneous; and the comparative absence of all but insect life in the forest is one of the first peculiarities that attracts the stranger's attention. Some twenty or five-and-twenty varieties make up the catalogue of the animal kingdom; and the individuals of each species are far from numerous in proportion to the enormous area they inhabit. Small, furred quadrupeds predominate, many of them being of the most valuable kinds, such as the marten and the silver-fox. Besides these, there are brown and grizzly bears, the elk, the black-tailed deer and reindeer, mountain sheep and goats, panthers, and some few other varieties. Birds are not much more numerous. Of these, which probably number one hundred varieties in all, water-fowl and birds of prey are by far the most abundant, though several descriptions of grouse frequent both the woods and plains. But, from the lack of food suitable for their support, birds of song are almost wholly wanting—a circumstance which, coupled with the scarcity of gay flora, materially heightens the natural gloom of the forests. Reptiles are still more rare. A few rattlesnakes are met with in the arid portions of the central belt, and several kinds of harmless snakes in the forest, and bull-frogs abound in the swamps; but the whole colony is utterly destitute of worms.

Travellers in British Columbia in the summer months will, however, all bear testimony to the abundance of insect life with which the air then teems. Foremost in numbers and powers of annoyance are the mosquitoes, which, on the subsidence of the rivers after the early summer floods, rise like a vast army from the earth, and invade almost every district in the colony. In the months of July and August these insects can only be described as forming a dense, humming, living cloud, which covers the country to a height of twenty feet above the ground. In the swamp-lands and along the margins of the water-courses, so multitudinous and venomous are they that horses and cattle have been known to die from the torment of their stings, and the loss of blood. Although in open country, the sun's heat and glare drive them by day to seek the nearest shelter, in the shade of the jungle they swarm both by night and day. Men and animals, alike, are thus powerfully harassed; and as the most fertile lands are generally also the most infested, the mosquito evil proves upon examination to be far more serious than at first sight appears. There are, moreover, other insect-pests, such as horse-flies, sand-flies, and a small, black, bloodsucking fly peculiar to high altitudes. House-flies are very plentiful, together with many brilliant varieties of butterflies, dragon-flies, and beetles.

The territories of British Columbia, extending over a wide range of latitudes, and rising from the sea-level on the west to an altitude of 10,000 feet on the east, possess a correspondingly wide range of climate. They will be found, however, to present a marked contrast in their general thermal conditions to places in corresponding latitudes on the eastern side of the Continent. This may be attributed, in the first place, to the absence of important Arctic currents on the Pacific Coast, and the general influence of the prevailing westerly winds—elements which serve to moderate the cold of winter; and, in the second place, to the neighbourhood of two great snow-covered ranges, which, although not without their chilling influence in winter, serve, nevertheless, to temper the summer heat. Thus, the maximum annual range of temperature is far from excessive when circumstances of latitude and altitude are taken into consideration. The climate along the seaboard closely resembles that of Great Britain.

To a short spring succeed four months of beautiful summer weather, usually terminating about the middle of September. During this delightful season little rain falls, and the days are generally bright and clear. Sea-breezes, blowing with great regularity from eleven A.M. until five P.M. temper the heat by day, the thermometer in the shade rarely rising above 80° in the hottest part of the summer; and by night, land-breezes blowing from the hills render the air deliciously cool and fresh. The break-up of settled weather is somewhat rapid; but in general the early frosts do not set in before the middle or latter end of October. About this time the heavy rains commence, the first snows soon appear on the hills, and thenceforward, until the middle of March, rain, fog, snow, and frost divide the days pretty equally between them.

The whole country to the west of the dividing ridge of the Cascade Mountains shares in the general humid and temperate characteristics of the climate of the Fraser estuary; but, on crossing the range, the eastern slope and the central belt beyond are found to exhibit some marked differences in their atmospheric conditions. Here but little rain falls, and some of the districts are exceedingly arid; indeed, in a narrow slope of territory lying immediately to the east of, and parallel to, the Cascade range, the annual rainfall is incredibly small. And here again, notwithstanding the increased elevation, the seasons exhibit no remarkable extremes of temperature. The winters, though sharp enough for all the rivers and lakes to freeze, are calm and clear; so that the cold, even when most severe, is not keenly felt. Snow seldom exceeds eighteen inches in depth; and in many of the valleys of moderate elevation even weakly cattle often range at large during the winter months, without requiring shelter or any food but the natural pastures. In spring and early summer the weather is more rainy and unsettled than at any other time of the year; but calm, cloudless skies prevail in July, August, and September; and although at this season the heat by day is somewhat greater here than on the coast—a circumstance arising, in a great measure, from the more open nature of the country—it is more than compensated by the extra coolness of the nights. Of the climate of the eastern belt very little is known, though the superior elevation and mountainous character of the whole region impart to it a greater rigour than is experienced in other parts of the colony. Yet even here the influences which serve to modify the temperature of the central and western districts seem to be not wanting; for all testimony concurs in assigning to the western slope of the Rocky Mountains a more temperate climate than is met with on the eastern side.

Judging from present experience, there can be no doubt that, in point of salubrity, the climate of British Columbia excels that of Great Britain, and is, indeed, one of the finest in the world. Moreover, it possesses elements peculiarly favourable to the European constitution,—an essential recommendation in the case of any British colony, but more especially of value when the wandering, open-air, and self-dependent habits of a gold-mining community are taken into consideration. There is an entire absence of pestilential localities, and in the pure, bracing mountain air men of even delicate frames soon acquire surprising vigour and healthiness of constitution. Thus the miners are enabled to face habitually, and without fear of detrimental effects, hardships, and exposures, under which in less favourable climates, they would inevitably break down.

With the advantage of a magnificent climate, the rapid development of all the available resources of British Columbia may be with reason anticipated ; and, as any but the most general remarks upon the qualities of the soil have been thus far omitted, it may not be uninteresting to conclude this hasty geographical sketch with a brief outline of the colony's agricultural and pastoral capabilities. With this object it will be necessary to return once more to the central belt, or rather to that portion of it lying to the east of the 124th meridian, which has been already spoken of as the most attractive district in the colony. Here, in sheltered and well-irrigated valleys, at altitudes as much as 2,500 feet above the sea, a few farming experiments have been already made, and the results have thus far been beyond measure encouraging. The soil, when well watered, is found to possess properties exceedingly favourable to the growth of nearly every variety of our English cereals and vegetables. At farms in the St. José and Beaver valleys, situated nearly 2,200 feet above the sea—and, again, at Fort Alexander, at an altitude of 1,540 feet—wheat has been found to produce nearly forty bushels to the acre, and other grain and vegetable crops to be abundant in like proportion. Again, at Papillon, in the dry zone immediately to the east of the Cascade range, the soil, aided by artificial irrigation, has proved to be prolific to a remarkable degree ; the potato-crop having reached as high as fifteen tons to the acre, and single turnips having been known to attain the enormous weight of twenty pounds. In Cutoff valley also, on the shores of Okanagan Lake, and in many other favoured localities, equally astonishing results have been obtained.

The district, however, is not without its drawbacks. The farmer suffers occasionally from night-frosts extending far into the summer, from long droughts in the latter part of the season, and, still more often, from the difficulty and expense of irrigating the soil in the arid districts. Nevertheless, without going further into details, there is already abundant proof that many portions at least of this fertile belt are not wanting in most of the elements that conduce to successful agriculture. It will be remembered, too, that the experiments hitherto made are but first steps in husbandry, conducted under all the disadvantages of pioneering settlement at a few fertile spots in the immediate neighbourhood of the existing highways. And when it is further borne in mind that there are scores of valleys scattered up and down this region, now lying absolutely waste, which possess extensive tracts of suitable soil, the results of these early efforts furnish encouraging proof of what may be expected from an improved and more extensive system of agricultural settlement.

The pastoral capabilities of the central belt bid fair to be no less a source of future prosperity to British Columbia. Millions of cattle might graze over its luxurious pastures, and exact but little tribute from the stock-farmer in the way of expenses for their maintenance. For, whatever precautions may hereafter prove to be indispensable in the more lofty portions of the grass-lands, experience thus far goes to prove—as has already been remarked—that at moderate elevations it is unnecessary to provide cattle either with shelter or additional food at any season of the year.

It may be asserted then, without hesitation, that two-thirds, at least, of this eastern division of the central belt may, when occasion arises, be turned to good account either for purposes of grazing or tillage. Small though it may be, indeed, it is not more than one-fifth of the entire area treated of in this paper, this fertile tract is, nevertheless, of enormous value to British Columbia. This will be better understood when attention is drawn to the position of the Cariboo and other gold-mines, which are cut off from easy communication with the sea-board by a lofty range of mountains, and lie in the heart of a country lacking facilities for inexpensive transport. It then becomes evident that the possession of productive lands in the neighbourhood of the mines, capable of supplying them at moderate rates with the ordinary productions of the soil, is one of the first essentials to the proper development of the mineral wealth of the country. Moreover, it is obvious that, without productive lands, the colony can never hope to retain any but the most insignificant feature of its auriform treasures, and must for ever continue to be dependant upon other countries for its supplies. From its central position with reference to the mining districts, the fertile belt is well adapted for the supply of their markets, and, remembering that a country with but limited agricultural resources, will feed a small and slowly increasing population, such as that of British Columbia, it may fairly be anticipated that, in the course of a few years, every available portion of the soil will be brought by degrees under cultivation, and the whole region to the east of the Cascade range be found to possess within itself ample resources for its own support.

We may search in vain throughout British Columbia for other inviting fields for agricultural settlement. The valley of the lower Fraser, with its jungle and dense pine-forests, is but little likely to attract a large population for, at least, some time to come; though possibly enough land for the growth of apples for the immediate neighbourhood may, ere long, be brought under cultivation ; and the district is, at any rate, a limited one. Elsewhere nearly all is mountain, and forest, and worthless land ; so that, practically speaking, farming and stock-raising operations will, for the present, be almost wholly confined to the central districts. It would be unreasonable, therefore, to claim for British Columbia any comparison, in point of its agricultural and pastoral capabilities, with the more favoured possessions of our colonial empire, such as New Zealand, the Cape Colonies, and Australia, or the United States' territories, with their vast rock plains. Nor can it be pretended that the colony is likely ever to export grain, or to attract and retain a large population solely on account of its agricultural advantages. Yet there remains, at any rate, the gratifying assurance that, so long as gold continues to attract emigration, British Columbia can provide easily for the requirements of a considerable population, and at the same time contribute every facility for the further development of its mineral wealth.

Without pausing to dwell at any length upon a description of the native tribes, their language, habits, and superstitions, it may be remarked briefly that the statements which have been put forth in England to the effect that British Columbia swarms with bloodthirsty savages are almost wholly untrue. Although it cannot be denied that upon some occasions, when exasperated by drink or by interference with their lands, their women, or their superstitions, they have committed fearful crimes ; it may be positively asserted that by nature they are a harmless, peaceful, and by no means bloodshedding people. The writer has travelled among them for years, and only once met with annoyance or interference. Degraded and immoral they certainly are, and, indeed, the whites, are communicating to them vices likely to degrade them still further ; but as faithful guides through the forests, untiring travellers, and expert canoemen, they are worthy of a great deal of our admiration. With these remarks it is proposed to pass on to the description of the goldfields.

Cariboo—or as it should have been more correctly spelt, "Caribou" —so named from its being the abode of that description of the reindeer, is at present the principal centre of gold-mining in British Columbia. This district lies within the great northerly elbow formed, as has been previously described, by the upper waters of the Fraser, and although mining operations have hitherto been limited to a small space on and about the 53rd parallel, the name may be considered as generally applicable to the whole area bounded at the south by the Quisnelle River and Lake, and on all other sides by the Fraser. Cariboo, so far as it has yet been examined, is found to be crowded with mountains of great altitude, very confused and irregular in character, and presenting thickly-wooded slopes. Here and there tremendous isolated masses tower above the general level, rising, in their most elevated parts, to altitudes of 6,000 and 7,000 feet above the sea. At these high elevations forest-vegetation becomes dwarfed and scanty. Their summits and the upper parts of their slopes may be described as steep downs, clothed with tolerable grass, and dotted with small pine-plantations, an aspect presenting so marked a contrast to the dense forests of the valleys and lower slopes as to have earned for them amongst the miners the not inappropriate title of "the Bald Hills of Cariboo." Of these the best known are Mounts Agnes and Snowshoe—the former commonly called the Bald Mountain of William's Creek—which rises to altitudes of about 6,200 feet, and are fair types of the great hill-features of the district. Each, from its comparative isolation, is the nucleus of its own miniature hill-system, consisting of long subordinate ranges, shooting out in every direction from the central mass, and becoming in their turn the parent stems of innumerable still smaller spurs and ridges. Thus Cariboo, in its physical configuration, presents a confused maze of peaks and ranges, spurs, ravines, and valleys, preserving no distinct arrangement and bewildering alike to the topographer and the traveller.

Numberless streams of all sizes, from tiny rivulets to moderate rivers, drain the hill-system. The smallest are the "gulches," as miners call them—mere rivulets at ordinary times—which pour down narrow gullies and ravines on the mountain sides, and any of which may be jumped over. The next are the "creeks," rapid streamlets about the size of an ordinary English brook, which drain the smaller valleys and are at present the scenes of the most active mining. The largest are the "rivers," into which the others fall, and which, from the peculiar position and drainage of the district, although flowing towards every quarter of the compass, eventually conduct the whole of the Cariboo waters to the Fraser.

The forests of the region, which, though very dense and extensive, bear no comparison in point of splendour or luxuriant growth with those of the Cascade range, nevertheless contain many excellent varieties of pine and fir-trees. They abound with martens, marmots, black bears, and some other varieties of furred animals, and the "Caribou" deer is found at the higher elevations. In winter, bands of Carriers—a scattered, intelligent Indian tribe, who occupy a large district north of the parallel 52° 30′—resort to Cariboo from their summer abodes on the large lakes and rivers, and hunt and trap in the mountains, following there game on snowshoes.

While presenting, as will be hereafter described, many phenomena that enlist the interest of the geographer and the geologist, Cariboo is not without features to attract the artist and the lover of wild scenery. Pages might easily be filled with descriptions of the magnificent views to be had in clear summer weather from the summits of any of the loftier hills. In the foreground, a tumbled sea of mountains ; narrow gloomy valleys ; forest-clad slopes ; and here and there the bleak, unwieldly masses of the bald hills patched with snow ; far off to the south and west, the softer outlines of the central table-lands; to the east, a cheerless, rugged region, crammed with serrated ranges of hills; and away behind them, the peaks and ridges of the Rocky Mountains, glistening with eternal snow, and visible through the clear air at almost incredible distances. These are some of the scenes that reward the tourist in this remarkable region, and furnish the artist with all the elements of grandeur he can desire.

It is late in the morning, even in Midsummer, before the sun shines down on the mining-settlements of Cariboo; brisk, thriving little wooden towns, lying hemmed in by hills in the deep valleys of the mining creeks, at altitudes of from 3,000 to 4,000 feet above the sea. Here are assembled a motley population of adventurers of every class in society, and from every country in the civilized world: traders, diggers, and idlers, and not a few gamblers and desperadoes,—men for the most part habituated to a frontier life and inured to its attendant discomforts. Indeed the miners' life among the mountains and streams is fraught with hardships and danger. Few would imagine the amount of patience and endurance exhibited by the hardy pioneers or "prospectors"—those whose especial province it is to prosecute the search after gold. Cold and hunger, inclement weather, weary mountain-marches, constant exposure, and occasional isolation from all companionship, are a few of the discomforts habitually experienced by these sagacious men in their exploration of the country. Strange and touching tales might be told of their adventures in Cariboo, where, from the bewildering nature of the topography, they are frequently lost for days, if not altogether, in the dense forests of the hills and slopes. Not the least touching history is that of one poor fellow, a native of Scotland, who thus became separated from his comrades, and, after wandering about hopelessly for days until his strength failed him, lay down at last in utter despair, and then, after scratching his own epitaph on his tin cup, composed himself quietly to die.

The inclemency of the weather in Cariboo, and the rigour and length of the winter season are serious barriers to the proper developement of its mineral wealth. At the end of September the first snows fall in the valleys, the mining "claims" can be "laid over"—that is to say, the laws which oblige miners to be at work on the spot are remitted for the time—and the greater part of the population retire to spend five or six months in the milder climates of the south. The winter weather consists of a succession of severe snow-storms, and fine clear intervals; the thermometer sometimes falls as low as 40° below zero (Fahrenheit), and every stream and lake becomes solid ice. Snow lies on the ground to a depth of about six feet in the valleys and accumulates in tremendous masses on the hill-tops, and all travelling, except on snow-shoes, is suspended. During winter, surface-digging is naturally discontinued, though, from the absence of floods, deep underground excavations can then be prosecuted with all the more advantage, the auriferous gravel being brought to the surface and heaped in readiness for "washing" in the spring. Towards the end of March the streams begin to melt and by May the thaw is at its height. Then Cariboo is by no means an enviable locality. Steaming mists envelope the forests in gloom, and the trees drip perpetual rain; trails and mountain-slopes become swampy and abominable to the last degree; creeks overflow their bounds, diggings become flooded, and the miners embarrassed by surplus water; and travelling is a toilsome operation for both man and beast. At this season hundreds of animals, carrying in the first convoys of provisions to the miner, succumb to want of food and exhausting journies over wretched mountain-paths; and to this day the most loathsome, if not the saddest sights that greet the traveller in Cariboo are the numberless carcases of horses that have thus been literally tired to death, and generally left to rot on the wayside where they fall. On the 1st of June miners are compelled by law to be present, and at work on their "claims." Then succeed two months or more of mild weather and drenching rains, notwithstanding which digging goes briskly on. In August and the early part of September a few weeks bright sunny weather may be expected; the region now wears its most favourable aspect, the creek falls rapidly, and the miners' harvest is at its height.

The radiation of groups of streams from within small areas on the upper slopes of the bald hills, is one of the most peculiar features of the topography of Cariboo. From within a circle of not more than three miles in diameter, on the summit of Mount Agnes, issue the head-waters of five of the most notorious creeks in the district, their directions being towards every quarter of the compass. Similarly the sources of no fewer than six others are contained within a small area on the summit of Snowshoe Mountain. The ancient and existing channels of these streams, are the great depositories of the alluvial gold of the region, the richest accumulations being found immediately over the bed-rocks, or rocks *in situ*, which lie at all depths down to 150 feet below the surface of the soil. In Cariboo these bed-rocks are metamorphic clay-slates, traversed by broad bands of quartz.

It is probable that all the particles of gold now found in the water-channels have, in the course of ages, been loosened, by water action and other natural processes of disintegration, from their position in matrix in the native rocks of the region, and been eventually transported by the torrents to the localities where they are now found accumulated. As yet, the alluvial deposits in the immediate neighbourhood of the two great bald hills above mentioned, have proved to be so extensive and remunerative, and, withal, so comparatively easy of access, as to have almost wholly engrossed the miners' attention. Indeed, it is confidently asserted by the most experienced diggers from California and Australia that, on three miles of William's Creek—the present focus of Cariboo mining—more gold has already been extracted from the earth than from any corresponding stretch of mining ground in those countries.

For reasons which will presently appear, no extensive system of "prospecting" the whole region has as yet been attempted. But, judging from analogy, there is every reason to conjecture that the slaty gold-bearing rocks will be found to be distributed over a far greater area than has hitherto been examined, and that an extended system of exploration cannot fail to result in the discovery of fresh groups of streams, issuing from the slopes of neighbouring bald hills, and containing their rich hoards of alluvial gold. It would certainly be difficult to believe that the half-dozen water channels which have yielded nearly all the gold hitherto exported from Cariboo can be the only rich spots in the region, or that William's Creek can have no associates of its own calibre; and, hence, it may fairly be inferred that the alluvial diggings of Cariboo promise, of themselves, to afford lucrative employment to a large mining population for many years to come.

Apart, however, from the question of alluvian wealth, it may be assumed with almost absolute certainty, that the auriferous veins which permeate the parent ranges—and are believed to have supplied by their partial disintegration the gold found in the river-beds—are not yet wholly exhausted of their treasures; and that, eventually, the more costly and elaborate operations of quartz-mining will, under an improved condition of civilisation and commerce, engage the attention of capitalists. If this assumption be correct—and there is little room for doubt as to its accuracy—Cariboo, even as it stands at present, and without reference to the other unexamined localities in the immediate neighbourhood, must be regarded as one of the richest and most inexhaustible known gold fields in the world.

William's, Lightening, Antler, and Lowhee Creeks, are the most remarkable in the district. On each of these, the gold, though all of the description termed "coarse," nevertheless differs materially both in appearance and intrinsic value. On William's Creek, for instance, the particles are smooth and water-worn, and contain a large amount of alloy; whereas, on Lowhee Creek, not five miles off, they are more crystalline in structure and exceedingly pure; the latter, when assayed, being found to yield nearly 8s. per ounce troy more than the former. And on no two creeks do the particles bear an exact resemblance in character to one another. A no less remarkable feature of the auriferous districts is the unevenness with which the alluvial deposits are scattered over the bed rocks. The larger particles are generally found to be accumulated in detached heaps, in rich "pockets," in crevices and angles of the rocks, and the "leads," or strata of highly auriferous gravel, are marked by a constant succession of wide intervals and abrupt changes in level and direction which baffle the most experienced miners. From this peculiar inequality of distribution it arises that, whereas those who are lucky enough to alight upon rich "leads" or "pockets," rapidly amass considerable sums of gold; the less fortunate miners, who happen to possess "claims," or allotments of mining ground, in neighbouring, though comparatively unproductive areas, derive but little benefit from their labours. Enormous sums are thus being constantly squandered in fruitless mining operations, and cases of utter failure are, as a consequence, exceedingly numerous.

Nevertheless, the gross annual proceeds from the mines continue year by year to increase, and have at length reached to an enormous sum. It is estimated that, during the height of the last summer season, the average daily harvest upon William's Creek amounted to no less than 2,000 ozs., or over 6,000*l.* sterling. The principal partner in the notorious Cameron claim, returned to his native town in Canada, three months ago, with 30,000*l.* in his pocket, all amassed in one year. And an almost incredible instance of rapidly-acquired wealth, is that of the three partners in the "Hard Curry" Company, who, one evening in the spring of last year, returned to their tents with 102lbs. weight of gold (about 4,000*l.* sterling), as the result of a single day's labour on their claim. These, it need hardly be mentioned, are exceptional cases, but they are of interest, as serving to indicate the amazing wealth of some of the rich "pockets" before alluded to. In this manner, numbers of miners have, during the last three years, been enriched in the course of a few weeks, or even days. Hundreds, on the other hand, have realised but little at the end of their season's work; and it is to be feared that by far the greater proportion have, with difficulty, cleared their expenses. Hitherto, indeed, the cost of working claims, and prospecting water channels, has been so enormous as to have proved a very serious detriment to the general prosperity of the district. Nor are other drawbacks wanting. The severity of the weather, the shortness of the summer season, the peculiar hardships of life in the wilderness, and the fatigue and expense incident to the journey from New Westminster to Cariboo, are elements little conducing to rapid occupation or successful mining. But, in the main, the tardy advancement and expansion of the mining districts, has been due to the exorbitant prices of "labour, food, and material." The tax upon the clear profits of steadily paying claims has thus been enormous. For example, one famous company on Williams Creek, extracted 40,000*l.* worth of gold last year from their claim, yet were only able to declare dividends to the extent of 20,000*l.*; exactly one half of the entire proceeds having been swallowed up in the shape of expenses. And this is but one of many instances of the same kind. They will excite but little surprise, however, when it is explained that the gold field is situated 500 miles in the interior of a young colony, hitherto unprovided with good roads, and almost wholly destitute of any but imported supplies. Until quite recently, nearly every pound of provisions for consumption at the mines—fresh animal and vegetable food alone excepted—to say nothing of the necessary supplies of tools and material, was carried for hundreds of miles into Cariboo on the backs of mules and horses, and even of the miners themselves. Hence, the price of every imported article rose to an enormous figure at the diggings. Even flour has for years past cost on an average 4s. a pound. Twenty shillings have been given for a pound of common nails, and half as much again for a mess of fresh vegetables. This high tariff of provisions and material created a correspondingly high scale of pay for labour. The ordinary navvy received from 30s. to 40s. for his day's work, while the mechanic might earn from two to three guineas; and, in the experience of the writer, a hair-cutter at Lightening Creek charged at the rate of about 7d a minute for his services.

While exacting heavy tribute from the richest and most successful diggers, these enormous prices, together with the limited and frequently overstocked condition of the labour-market, fell upon the needy and unsuccessful with an effect that was absolutely ruinous. Men of slender means, and others who had quickly sacrificed their capital in fruitless mining-operations, unable to get employment, or to support themselves in a country, where it cost from 15s. to 20s. a day to procure the bare necessaries of life—hurried away almost as soon as they came, without pausing any longer to "prospect" in so expensive a locality. In this manner anything like a deliberate examination of the country has been completely prevented. Moreover, by reason of the extravagant cost of every commodity, continuous mining operations have hitherto been practically limited to the very richest spots in the district; and, even then, to the most productive strata of auriferous gravel. In localities where hired labour cost 40s. a day, it became obvious that it would never pay to work diggings which would not yield at least that amount to the individual labourer, over and above all contingent expenses. On this account, the operations of working claims have been confined to the gravel lying immediately upon the bed-rocks, where the richest deposits are found; and the upper strata, containing amounts of gold, which, but for the enormous price of labour, would have well repaid the cost of working them, have been left altogether untouched. In like manner, surface diggings—capable under more favourable circumstances of supporting a large mining population—remain as yet undisturbed.

It is no wonder, then, if in the face of all these impediments the actual profits of Cariboo mining have, in the majority of instances, been far from considerable. Nevertheless, there can be no doubt, upon a consideration of the history of the region up to the present time, that it teems with productive gold-mines, practically boundless in extent, and promising lucrative employment to thousands so soon as an improved system of communication and commerce shall admit of ther fuller development, and of the introduction of the many economical appliances of civilisation.

Cariboo, however, is by no means the only auriferous district in British Columbia. The bars of Fraser River, throughout the greater part of its course, are not nearly stripped, as yet, of their accumulations of "fine" gold. Moreover, the accuracy of a theory long ago advanced by the present distinguished President of the Royal Geographical Society, to the effect that gold in the matrix would be found distributed all along the hilly districts bordering on the western slope of the Rocky Mountains—is yearly being more and more satisfactorily established. Desultory explorations, made at different times within the last four years, have resulted in the discovery of a chain of auriferous deposits, extending at intervals from the southern boundary of the colony to the 56th parallel of latitude, and preserving a direction parallel, or nearly so, to the crest of the Rocky Mountains.

Rock Creek in the extreme south, the head-waters of the Okanagan, the tributaries of the north and south branches of the Thompson River, the south and north branches of the Quesnelle River, Cariboo, and, finally, Peace River, near its intersection with the meridian 122° W., are so many successive points in this chain, at all of which gold in varying quantities has been found. These and other intermediate discoveries have established, almost beyond a doubt, the existence of a vast auriferous zone or belt of country, more than 500 miles in length, comprising within its limits the sources of all the great gold-yielding streams that water British Columbia; and forming, in all probability, the depository of incalculable wealth.

Should this range indeed prove, upon future examination, to be the matrix of the auriferous wealth of the colony, there can be no doubt that British Columbia must in time become, steadily but surely, one of the most important dependencies of the British Empire.

The certainty of the possessions of extensive and practically inexhaustible gold-fields along the immediate districts of the central belts would at once impart a wonderful stimulus to the settlement of its agricultural and pastoral lands, and, at the same time, improved communications would, ere long, be established. Thus, the enormous prices of labour and commodities on the gold-regions would rapidly disappear, and full scope be afforded for the proper exploration of the mineral wealth of the land.

The first steps towards improvement have been already made. Settlement, as has been before remarked, is gradually creeping over the midland districts; and, even now, Cariboo, one point in the auriferous range, is beginning to enjoy the advantages derivable from cheap communication and the cultivation of neighbouring districts. The efforts of the local government, within the last five years, have at length resulted in the completion of a system of excellent waggon-roads, leading through the most promising districts of this colony to within a short distance of Cariboo. Miners or others, to whom time is of value, need no longer perform weary journeys on foot or on horseback over wretched trails and through an uncivilised, if not totally uninhabited, country. A steamer voyage of ninety miles from New Westminster terminates at Yale, the head of steam navigation on the lower Fraser. Throughout half this distance the river winds among the gorgeous forests of its estuary, slight clearings here and there revealing native villages and shanties of the woodmen who prepare fuel for the steamers. Higher up, the hills approach the stream, the currents become rapid, and small Chinese mining-camps dot the banks and bars.

From Yale upwards, a noble road executed at vast labour and outlay, enters the passes of the Fraser, and traverses the faces of cliffs and precipices, and slides of disintegrated rock, that two years ago, seemed to bid defiance to any efforts of the engineer. For sixty miles upwards, it winds through the magnificent scenery of the Cañons, crossing over to the left bank of the river by a suspension bridge thrown across the chasm at a point where it is only ninety yards in width. Soon after passing Lytton the forest is left behind, and the road approaches the belt of pastoral country, and, gradually emerging from the Cascade range, reaches the green hills and valleys, and the picturesque country of the central districts. From a point twenty miles below Fort Alexander, the Fraser may again be ascended in a small steam-vessel built on the spot, for which all the machinery and fittings were carried up on mule's backs, long before the road was finished for waggon-traffic. Disembarking at the mouth of the Quesnelle, the traveller reaches William's Creek by a ride of sixty miles, over the one good trail in Cariboo. A westerly loop of this route branches off forty miles above New Westminster, passes through a low gap in the Cascade range, along a chain of lakes connected by roads, and rejoins it 150 miles south of Fort Alexander.

It has been considered questionable whether the Fraser River is likely to continue to be the great avenue for the conveyance of all traffic towards the mining districts, and several of the more northerly inlets on the coast have been recently examined, with the view of discovering a shorter route to Cariboo. The results of these examinations are, on the whole, discouraging. It appears, from reports on the subjects, that while the rivers which discharge into these inlets, are unnavigable for steamers, and facilities for the establishment of seaport towns almost wholly wanting, the districts which would be traversed in crossing from the coasts to the mines are generally sterile, and unattractive, and lie at too high an elevation to admit of the establishment of really good permanent routes. Moreover, it is shown that the actual shortening of the amount of land communication would be almost unappreciable, since the Fraser admits of navigation both in the lower and upper portions of its course. Those and other drawbacks are likely to lead to the abandonment of any projects for the establishment of coast-routes, for at any rate some time to come, and, keeping in view the probable extension of the gold-fields, southward from Cariboo, it seems likely that the existing routes will in future be adopted as the permanent highways of commerce.

The journey from New Westminster to Cariboo, by either of these routes, may now be easily accomplished in from six to seven days. As yet, the benefits arising from improved communications, have hardly had time to become manifest, for it was not until the close of last summer that the new roads were thrown entirely open for traffic; but already inns and incipient farms, dotting the wayside at almost every turn, mark the first growth of settlement, and begin to break the solitude of the journey. With new roads, a new day has dawned upon British Columbia. Already the foundations of its ultimate prosperity seem to have been securely laid, and it only remains to hope that in days to come its rich harvests may be participated in by British subjects much more largely than they are at present.

From its advantages of geographical position, its vast mineral wealth, its salubrious climate, and valuable natural products, it seems but fair to anticipate that, under good government, and by a process of gradual development, British Columbia will ere long take rank as not the least important of the colonies of the crown.

THE MANUFACTURE OF COMPRESSED PEAT.*

BY C. HODGSON.

THE author commenced by stating that improvements in the ordinary mode of preparing peat fuel have attracted much attention for many years, the chief difficulty lying in drying the wet turf taken from the bog. A system which had in it all the elements of success was proposed by Groynell and others about fifteen years ago. Their idea was to cut turf in the ordinary way, and to dry it to the extent possible during the summer, then to grind it, and complete its dessication whilst in a state of powder, and subsequently to compress it in a machine pointed with a reciprocating ram, and several moulds capable of being brought successively under the ram. A beautiful sample of hard fuel was thus obtained, bnt the quantity made was limited to samples, the machine being complicated. The practical difficulties which beset all early attempts in the manufacture of peat fuel have now, however, been overcome by the system of machinery at present employed at the Derrylea Peat Works. The system in use at these works is based on the principle that the drying of the peat is the main difficulty of the manufacture, and this is accomplished by operating continually on thin surfaces of disintegrated peat, instead of on compact sods or blocks, and the using compression only as a means to render the already prepared peat transportable and marketable. The plan of obtaining the peat from the bog by successive harrowings and scrapings forms also a part of this system of drying by thin surfaces. Having described the position and

* A paper read before the Society of Mechanical Engineers.

extent of the bog at present operated on, the author next detailed the apparatus in use at the works. They consist of a railway formed of thirty-six-pound rails, well fished at the joints, runing along the centre of the drained piece of bog. It is laid on sleepers of native timber, and carries an eight-ton locomotive. On these rails runs a six-wheeled truck, across which, and reaching the entire width of the drained ground, lies a square box lattice girder, which is formed of half-inch angle iron at the corners, latticed on each of the four sides by one and a half inch by one-quarter inch iron, with two feet spaces. It is six feet square at the centre, where it rests on the waggon, and tapers to one foot square at each end, and is assisted perpendicularly and laterally by wire rope stays, set in taut. This apparatus is propelled by the locomotive at the rate of four miles an hour, with its great arms stretching over the bog at each side to the distance of nearly one hundred and fifty feet, and to it are attached ten harrows, each six feet square, which by repeatedly passing over the ground scarify the surface to a depth of from one to two inches. This operation is performed during any moderately fine weather, and in the mornings and during the day the light powdered surface, which readily dries to a certain extent, is wheeled to the road by men, and waggoned into the works for manufacture. In dry weather the upper surface of the bog, thoroughly drained as it is, will always contain much less water, perhaps less than half what the general mass retains ; and as by this mode of operation a fresh upper surface is being daily exposed, it follows that peat in the most favourable state for drying is being constantly operated on. As soon as the harrowing begins rapid and continuous drying takes place, and a very large portion of the water which is not removed by drainage is evaporated by a few hours' exposure. The mull when waggoned into the factory is generally found to consist of about forty per cent. peat, and sixty per cent. water. Bog in its natural state consists of ninety parts water and ten peat. When drained as described, after some hours of an average dry day, it consists of sixty parts water and forty peat. At Derrylea, the only artificial heat used is that obtained from the waste steam of the compressing engines and the smoke and gases of the boiler fires. These are applied to heat very extensive surfaces formed of sheet-iron, on which is spread a thin layer of peat mull, kept in continual and progressive motion by machinery. The drying kilns consist of brick buildings, five hundred feet long by thirty feet wide, having an upper and under floor of one-eighth inch sheet-iron, extending the entire length. The buildings are of brick, roofed with tiles. Under the lower floor, which is placed about two feet from the ground, is blown the smoke and waste heat of the boiler, and instead of the ordinary chimney a large fan is used to urge the fires, and force the products of combustion under this sheet-iron table. The upper floor is carried on cast-iron girders, and stands four feet high above the lower one. It is made double, with a distance between the sheets, about four inches, for the purpose of being heated by waste steam from the compressing steam-engine. By the time the whole of the sixty per cent. of water is evaporated, an arrangement of bands and elevators conveys the peat to a loft over the compressing machine, where it is subjected to the action of an apparatus, the result of which is to pass the peat down a tube by the action of a ram. As the peat is driven forward in the tube it becomes so wedged, and so powerful a resistance is offered by the friction against the sides of the tube, that each successive charge is consolidated into a separate hard block before the whole mass in the tube yields. The outer end of the tube is entirely open, and the compressed peat is delivered from it in a continuous cylindrical bar, which can be readily broken up into separate discs of one inch thickness each, which are formed at each stroke of the ram. Each block *in transitu* remains one minute under pressure, and the quality of the compressed peat as fuel is further improved by its being made to pass along an open shoot, continued from the end of the tube, some 300 feet from the machine, to the store or waggon, without rupturing the continuous cylindrical bar in which the peat issues from the machine. Peat thus prepared, being so free from moisture, is well adapted for the boilers of stationary engines and for brewers' work, and has found a ready sale for household purposes, its great cleanliness and freedom from smoke being a strong recommendation. A very good gas is made by using one-third of Cannel coal and two-thirds of this compressed peat, but it is probable that from its application to the manufacture of iron the most useful results will yet be derived.

CULTIVATION OF THE MULBERRY.

BY A. MARTELLI.

One simple statistical fact will justify attention to this subject. Twenty-five millions of acres in Piedmont and Lombardy, after supplying the full wants of the inhabitants, export silk and cocoons to the value of six millions sterling. More than twice that quantity of land in Victoria alone, superior to the Italian both in soil and climate, could in twenty years double that export. The obstacle to this success is, however, not confined to silk only. The great evil of all countries is the listlessness that pervades the monied classes in all matters relating to agricultural interests, and it is against this apathy that we should endeavour to fight, by setting an example of activity to the poorer classes of the community, and by raising up an intelligent body of men fitted to carry out the projects designed for the furtherance of the cultivation of the soil. Complaint is useless where work is necessary to build up the future greatness of a country. Give a just direction to agricultural produce, especially by promoting the more industrious cultures, amongst which that of silk may be considered as one of the greatest sources of riches to a country by the large returns on the distribution of a comparatively small capital amongst the labouring classes, and you will have been worthily assisting in the great work of the erection of the edifice of social happiness and well-being. It will now be necessary to bring under notice some of the principles of vegetable physiology, in order that we may draw deductions from them for the practical cultivation of the mulberry. Every tree that grows draws the element of its existence from the decomposition of mineral and organic substances, by the action of the atmosphere and the dampness of the soil in which it is planted. This is done not only by the exterior, but also by the leaves and the skin of the younger branches, Nature beneficently providing the trunk of the tree with a thicker skin to withstand the rigour of the elements. There exists such harmony in the provisions for the growth of trees, that the leaves and roots are working simultaneously in the absorption of the principles necessary for the protection of their vegetation. Those principles materially aid in the circulation of the sap, which is very rapid in the summer under favourable circumstances, but it is nearly suspended during the winter months, and the powers of the tree recruited and strengthened for the production of vegetation during the next season. There are two saps continually ascending and descending. The ascending saps pass through the wood and give nutriment to the branches and leaves, and the descending ones pass through the skin to the roots, and produce new wood from season to season as the tree grows older. The preservation of the leaves is not so necessary to the existence of a tree as its roots, as from these it derives its principal support and nourishment; it will therefore be gathered from these remarks, that it is impossible to propagate mulberry trees for silk culture by cuttings, but that they must be raised naturally from seeds in order that perfect roots may be formed for the sustenance of the tree in the future periods of its existence, and when it shall be necessary to gather its leaves for the education of the precious worm. As the grand object of the cultivation of the mulberry tree is to fit it for the production of leaves in the least possible time, nothing must be neglected by its cultivator to attain that object not so much by the expenditure of a large amount of capital as an assiduous study of the necessities of the plant, as no tree in the world yields so large a return as this one. The good quality of the ground is certainly of great importance to the prosperity of the tree; but the judicious training and pruning of the branches is of far greater moment, and the excuse of the bad cultivator as to the indifferent quality of the soil only tends to betray his ignorance of the art of cultivating the mulberry. The time for pruning and training the branches greatly depends on the climate and the situation in which the trees are placed. From great experience in the cultivation of the mulberry, I am convinced that the establishment of plantations of these trees will yield large returns, and be of great benefit not only to the agriculturist, but to the whole community. The demand for silk produced from the worms fed upon the leaves of the mulberry is always increasing, and I cannot foresee any but the most beneficial results in its general adoption to this country. In the composition of the leaves of the mulberry tree there are five different substances—viz., solid or fibrinous, colouring matter, water, and saccharine or resinous and silky matters. The three first substances are not absolutely necessary for the life of the silkworm. The saccharine matter nourishes and aids in the formation of the animal, and the resinous matter imbibed by the worm from the leaves is accumulated and purified by its peculiar organisation, and collected in the two reservoirs of the worm to be discharged afterwards through the mouth in the form of silk. The yield of silk will be found in accordance with the presence of more or less of the saccharine and resinous matters in the leaves on which the worm is fed. For instance, the silk produced by the leaves of the black mulberry, which are hard, rough, and tenacious, and which was the principal food of worms in the warm countries of Europe, such as Greece, Spain, Sicily, Calabria, &c., is abundant, the thread strong, but very coarse. The worms fed on leaves of the white mulberry (which has been planted on elevated situations and exposed to a dry wind) produce abundance of silk, strong, very pure, and of very fine quality. It is almost unnecessary to state that the less nutriment there is in the leaves the greater will be the quantity required to perfectly develope the worm. The result is that the worm which is fed on leaves which possess great nutritive power will grow large, and produce less silk than that which is fed on those containing a large amount of resinous matter, although not attaining the same size as the former is liable to become sick, and its productive powers put out of order. Of the white mulberry there are many varieties, but of these the following sixteen are in general use in Italy for grafting stocks—viz., 1. A foglie nervose ; 2. Bathiany ; 3. Columbassa ; 4. Flava ; 5. Giazzola a foglia doppia ; 6. Integrifolia ; 7. Latifolia ; 8. Macrophylla ; 9. Macrophylla grisea ; 10. Mascula pedemontana ; 11. Ovalifolia fructibus albidis ; 12. Piramidale ; 13. Roseo di Lombardia ; 14. Rose lævigata ; 15. Rouillardi ; 16. Vainissi. For sowing, two are principally used—viz., Morrettiana and common alba. Of those used for grafting, the three most generally in favour are the Giazzolo a foglia doppia, Mascula pedemontana, and the Roseo di Lombardia, as being more rich in saccharine and resinous matters, and containing less water, &c., than the others. From experiments made with one hundred ounces of the fresh-gathered leaves of each of these three varieties, the yield after being properly dried was found as follows :—Roseo di Lombardia, thirty ounces ; Giazzolo a foglia doppia, thirty-one ounces ; and Mascula pedemontana, thirty-six ounces. Another variety of mulberry, the Multicaulis, that was imported from the Island of Luzon, is also very much used for the early education of the silkworm, but owing to its large leaves it is not adapted to all climates, although it is a splendid stock to graft on any other variety, well-fitted for the formation of hedges, and is excellent food for the very young worms. Having called attention to the physiological principles and different varieties of the white mulberry in greatest repute, I shall endeavour to give directions towards making plantations of this valuable tree.

First.—With respect to the selection of the ground. A spot of ground should be selected in a situation sheltered from the south wind, dug to the depth of eighteen inches, and afterwards mixed with a little stable manure, and the surface made perfectly level.

Secondly.—With regard to the method of sowing the mulberry. The best time in this climate (Victoria) will be found between the middle of March and the middle of May. The objection I have to spring sowing in the case of the mulberry, is the long drought and prevalent hot winds of the Australian summer, which would require a vast amount of attention and diligence in watering the seedlings. The winter rains, on the contrary, may be easily prevented from injuring the young plants by covering them with straw ; but the choice of season is a matter which may very safely be left to the intelligence of the farmer. A suitable spot being fixed on and prepared for the reception of the seed, the surface of it should be laid out in beds about three feet wide, sufficient space left between each for the passage of a man. The seed should be steeped in water for about twenty-eight hours before sowing, to accelerate its tendency to germinate, and afterwards well mixed with about one-third part of dry sand. This mixture is then to be sown broadcast over the beds, the earth carefully raked over it, and gently patted down with the back of a spade. If the soil is rather hard, a little cut straw sprinkled over it will tend to remedy this defect. If the season is wet, with cold nights, it will be found beneficial to prepare a blanket or canvas to be thrown over the ground already sown, supported by pegs, to protect the seeds and young plants from the inclemency of the weather. In the absence of rain, they must be watered with a hand watering-can ; and in the event of too much rain, protected with straw or in the manner above stated. As a matter of course, no weeds must be allowed to remain in the beds.

Thirdly.—The mode of transplanting. The young plants, after attaining the age of from eighteen to twenty-four months, may be transplanted to a proper nursery, or in ground prepared for the formation of hedges, according to the following directions. For the nursery it will be necessary to cut longitudinal trenches fifteen inches deep by fifteen inches wide. The bottom of the trench should be covered with dead branches to the depth of two inches or three inches, and afterwards filled in with earth nearly to the level of the former surface for the reception of the roots of the young plants. These plants have generally a fusiform root from which a piece of about two inches must be cut off. The plants so prepared should be laid on the surface of the ground in the trench in such a fashion that their upper portions should be supported by the unbroken ground, and the lower portion covered in with some of the earth taken from the trench, which must be slightly compressed with the hand ; on this should be placed a layer of stable manure, and finally, the remaining portion of the earth taken out of the trench. After the young plants have been set according to these directions, the tops of them should be cut to within six inches of the ground, for the purpose of increasing the strength of the young plant. All the suckers springing up from the plant must be removed except the two strongest, which should be left for the purpose of giving support to the foot of the tree, and when they have gained sufficient strength they should be banked up with earth all round. The distance at which the plants are to be set should be in accordance with the fertility of the soil, but they may be set at a general average of three feet from the lines and fifteen inches from each other. No care, trouble, or expense must be spared to keep the ground well moved round the foot of the mulberry, in order to maintain the humidity of the soil, so necessary for the production of the vegetation of the tree. Most cultivators are aware that loose earth will retain its natural moisture for a longer period than that which is compressed ; it would, therefore, be advantageous to the growth of the tree to move the earth with a rake, in order that the rays of the sun might penetrate its roots. Heat and humidity are the most effectual natural agents in the rapid development of vegetation, more especially with regard to the mulberry, which is indigenous to warm climates. In seasons of drought, it will be necessary to irrigate the ground along the trenches, and a few days afterwards to rake it over to admit the penetration of the heat, which had been nearly destroyed by the previous irrigation, because the evaporation of the water is creating cold. These directions may, perhaps, appear minute to persons unacquainted with the greater importance of the matter, but I consider they are essential to the successful rearing of the young plants, and if they grow well and prosperous the first year they will be fit to be grafted in the second, and the graft will usually spring up a young tree in the course of the next season.

PROGRESS OF COTTON CULTURE IN EGYPT.

FROM no other available source of cotton supply can we now obtain cotton of such good quality as that grown in Egypt. It has a fineness and strength which make it suitable for the best goods, and a length of staple adapted to the machinery now in use in the Lancashire cotton-mills. It has borne a high price since the stoppage of shipments from America, but it is found that we can now depend upon large quantities of Egyptian cotton at prices at which it is doubtful if the American planters will for a long time be able to compete. The Egyptians have shown an energy and thoroughly commercial enterprise in dealing with their golden opportunity, even beyond what might have been expected from a people far more advanced in modern civilization. They have drained and irrigated and planted, they have encouraged the construction of railways, and every work of public improvement, and they are now availing themselves of every mechanical means which European ingenuity has placed at their disposal for the cultivation of cotton. It is extraordinary how large are the orders already executed, and still in course of execution, for steam engines, centrifugal pumps, steam-plows, and cotton-gins, for the Egyptian cotton farms. There are now upwards of two hundred steam-plows at work in Egypt; the number of steam-pumps is probably still greater, and the cotton-gins are countless; there being several towns and villages having from twenty to thirty ginning factories each. The Viceroy has 150,000 fedans, or acres, of land under cultivation with cotton; his uncle, Haleem Pasha, who has sixty steam engines and fourteen steam-plows at work, is cultivating 50,000 acres, and others of lower rank, or of no rank at all, are, in the aggregate, working a still larger acreage. The cotton plant is most productive in Egypt, and although the proportion of cleaned lint to seed cotton is considerably lower than in the case of American cotton, some of the irrigated lands of Egypt have produced as much as 900 lbs. of clean cotton per acre in one year, a quantity which is tenfold greater than the average yield of cotton fields in India. The Egyptian cotton lands pay an annual tax of 1*l.* per acre to Government, and their ordinary rental is 5*l.* per acre. These are charges quite beyond anything known to the American planters of former days, but they are in part compensated for by the greater yield and superior quality of the Egyptian staple, and by the aid derived from steam. In no country in the world is cotton again likely to be grown by slave labour, and hence, whatever the effect upon the future price of the article, the greatest advantage enjoyed by the American planter is gone for ever. Whether he will now avail himself, as the Egyptians have done, of steam machinery, or the next best resource, remains to be seen; it is, of course, for the interest of this country that he should. We cannot have too many or too abundant sources of supply. But with the exception, perhaps, of America, the cotton-growing countries cannot do without British machinery, and the result in Egypt shows what the demand upon our engineers is likely to become. We have not yet reached, if it be indeed possible that we shall in this century ever reach, our maximum production of cotton goods, for the demand is constantly increasing, and every spindle manufactured corresponds but to the natural increase of the means of supply.

English engineers when abroad are often struck by the adaptability shown by people of inferior civilization in the management of machinery. On many of the Egyptian cotton farms, the engine-drivers, firemen, and even those entrusted with the repairs of the engines, are Arabs. As for repairs, it has not yet apparently occurred to the Egyptian mind that they are requisite. In many cases, as soon as a fire-box is burnt out, or a cylinder scratched so as to defy the care of the driver in adjusting his packing, the engine is practically condemned, being left out in the weather, and a new one ordered, we will say from England. This may not seem a matter of regret here—although even those who thus obtain orders which ought not to have been given, must know that it is for their own interest, in the long run, that their customers should be careful, economical people, as if they are not they cannot go on for ever ordering machinery and paying their debts. But it is likely that engine-mending, like engine-driving, will yet be learned by the Arabs.—'Engineer.'

ON TRUFFLES AND TRUFFLE CULTURE.

BY C. E. BROOME.

THE numerous varieties of fungi that are exposed for sale in the markets of France and Italy must induce a feeling of surprise that so little attention has been paid to their culture by the horticulturists both of Great Britain and the Continent. The mushroom is the only species at all commonly made use of in this country; the Blewitt may sometimes, indeed, be seen in Covent Garden, but it is a species far inferior in flavour to many others of our fungi, and it is certainly not the produce of our gardens. Truffles, which are frequently seen, and so highly esteemed in Continental markets as to command a high price, are comparatively rarely to be met with in our own, and even Covent Garden can boast but of one native kind, and that an inferior one—viz., *Tuber æstivum.* There are, however, various reasons for this neglect of nature's benefits that operate with us, that do not apply with equal force to our Continental neighbours, such as distressing cases of poisoning from the indiscriminate use of fungi gathered by persons ignorant of the qualities of the various species, a danger in great measure guarded against abroad by the appointment of an official person capable of determining the noxious or innocent nature of the species brought for sale. What tends, however, still more perhaps to increase our objection to their use, is the natural inaptitude of our countrymen to acquire the art of cookery, which is a very important element in suiting these plants to human digestion ; added to which, there is the difficulty of adopting new customs, or changes of diet. Were a taste for these productions, however, once established, we should soon find numerous species brought forward as valuable additions to our means of sustenance.

Notwithstanding that truffles have been considered articles of luxury, and have commanded a high price from the time of the Romans down to the present, and that it has ever been the aim of horticulturists to bring them into the number of regular garden crops, they seem hitherto to have defied all efforts to reclaim them, and to resemble, in their intractable disposition, the wild ass, "whose house has been made the wilderness, and the barren land his dwellings, who scorneth the multitude of the city, and the range of the mountains is his pasture." If this, then, be a correct representation of their character, it is a question whether it would not be easier to cultivate them by assisting Nature in her own way, than to restrict her within our limits by forcing these denizens of the forest to occupy a place in our kitchen gardens. It would seem indeed, that the amount of shade they demand is such as to be incompatible with the requirements of a garden. But let us see what has been done hitherto in the various endeavours to grow truffles by the assistance of art. And here we cannot do better than give the information with which the Messrs. Tulasne present us in their beautiful work on Hypogæous Fungi. They mention four species of truffles exclusively in use in France—viz., *T. melanosporum*, *T. brumale*, *T. æstivum*, and *T. mesentericum*, of which two, or perhaps three, occur in Great Britain. *Tuber æstivum* is apparently the only species to be met with in a recent state in our shops ; *T. mesentericum* may at times occur, but it has not yet been noticed there. *T. brumale*, if our plant be identical with Tulasne's, has hitherto been found in England of too small a size to be worth sending to market. In Italy there are other kinds, one of which, *T. magnatum*, commands a higher price than any other ; and in the southern parts of Italy, Sicily, Syria, and Africa, another species, *Serfezia leonis*, is of common use as an article of food.

The true truffles have rough seeds, which, seen under the older and imperfect microscopes, resembled somewhat a truffle in miniature, and early writers concluded that the mature plant was merely one of these seeds largely developed in all directions. The Tulasnes have proved, however, by careful observations that they germinate in the same way as do those of most other fungi—viz., by giving origin to delicate threads, which spread in the surrounding soil, and that from such threads the young truffles arise, probably after some kind of impregnation, which is as yet, notwithstanding the researches of recent observers, involved in obscurity. The fact of the existence of a mycelium in truffles, resembling that of mushrooms, must be taken into consideration in any attempt that may be made to cultivate them.

The soils in which edible truffles are found in France are always calcareous or calcareous clays, which accords generally with my own experience. *Tuber mesentericum* occurs, however, in ferruginous sands, as is also the case with another species, *Hydnotrya Tulasnei*, which, or a closely allied kind, is largely eaten in Bohemia, under the name of Czerwena Tartoffle. Messrs. Tulasne describe the soil of a truffle district near Loudun, Vienne, as composed of rolled fragments of calcareous matter, mixed with fine quartzose sands, lying on a thick bed of compact marly clay, which easily splits up into thin layers. It contains, in 1,000 parts, 500 of calcareous matter, 325 of clay and iron, 150 of quartzose sand, and 35 parts, more or less, of vegetable mould But they attribute a still greater influence in the production of these plants to the presence of trees—a condition necessary perhaps to their growth, in order to keep off the heat of the direct sun-rays. Our authors testify, indeed, that this is not always indispensable ; and I have seen truffles dug up on the bare sloping sides of the Italian mountains.

Some persons have supposed that these fungi are parasitic on the roots of trees. This the Tulasnes expressly deny, on the strength of observations and inquiries instituted to that end ; and I can confirm them in this matter, and would remark that the frequent presence of certain galls attached to the small roots of the oaks, resembling young truffles so strongly as often to deceive me for a time, may have given origin to this error.

Some trees appear to be more favourable to the production of truffles than others. Oak and hornbeam are especially mentioned ; but, besides these, chestnut, birch, box, and hazel are alluded to. I have generally found *Tuber æstivum* under beech-trees, but also under hazel, *Tuber macrosporum* under oaks, and *T. brumale* under oaks and *Abele.* The men who collect truffles for Covent Garden obtain them chiefly under beech, and in mixed plantations of fir and beech. The truffle-grounds of France are remarkable for the sterility of the surface, the cause of which has given rise to many conjectures—viz., that truffles exercise a prejudicial influence on all plants in contact with or proximity to themselves, by appropriating their nutriment in a manner similar to the *Rhizoctoniæ ;* but a more probable reason of this sterility is the frequent digging to which the truffle-grounds are subjected by the collectors ; for, as truffles are not truly parasitic, it would attribute an inconceivable amount of influence to their mycelium to suppose them capable by its means of destroying all the surrounding vegetation. And we may remark, that some species occur in grassy places, as in the forest of Vincennes, according to Tulasne ; and so with *T. macrosporum* and *T. brumale*, as I find them. It seems to be a better explanation of this sterility, so generally accompanying truffles, that they can only succeed well where they find a comparative freedom from other vegetable growth, arising from causes independent of themselves, and that they are the result, and not the cause, of this sterility.

In common with many other fungi, truffles do not bear to be disturbed in their early stages; so that the collectors are careful in their researches after the summer species, as *T. æstivum* and *T. mesentericum*, not to stir the ground more deeply than is absolutely necessary, as by so doing they would destroy the winter crop of the more valuable kinds, *T. melanosporum* and *T. brumale.* Any disturbance of the soil in the winter, when the latter are mature, does no harm, but rather aids in their culture, by rendering the mould more suitable for the germination of their spores and the growth of their mycelium. From Messrs. Tulasnes' observations it would seem that three or four months suffice for the development of these plants; they state that they have met with *Tuber mesentericum* about as large as grains of millet in the beginning of October, which must acquire their full size before the end of December; for about that time they find this species in its mature condition alone. And it is supposed that the warm rains of August are highly conducive to the fertility of the truffle-ground, and that the abundance or scantiness of the crop depends very much on the nature of that period. These plants grow without any special care or tendance; but as they are not unfrequently found, both in France and Italy, on the borders of corn-fields, where they are ploughed up in the cultivation of the land, it would seem that they succeed as well in ground that has been stirred and manured, as in that which has been left in its natural condition.

Some notion may be obtained of the extent to which the trade in truffles is carried on in France, when we read that in the market of Apt about 1,600 kilogrammes (about 8,500 lbs.) are exposed for sale every week in the height of the season, and that the lowest estimate of the quantity sold during the winter amounts to 15,000 kilogrammes (nearly 33,000 lbs. weight). According to another account, the Department of Vaucluse yields from 25,900 to 30,000 kilogrammes annually. The vast quantity that must, therefore, be procured and sold in all the French provinces where they grow, and the large revenue arising therefrom should be a great inducement to the proprietors of suitable localities to attempt their cultivation in England.

Many trials have been made to subject these vegetables to a regular system of culture, but hitherto without success. We owe to the Count de Borch and M. Bornholtz the chief accounts of these attempts. They inform us that a compost was prepared of pure mould and vegetable soil, mixed with dry leaves and sawdust, in which, when properly moistened, mature truffles were placed in winter, either whole or in fragments and that, after a lapse of some time, small truffles were found in the compost. But the result was discouraging rather than otherwise. The most successful plan consisted in sowing acorns over a considerable extent of land of a calcareous nature; and when the young oaks had attained the age of ten or twelve years, truffles were found in the intervals between the trees. This process was carried on in the neighbourhood of Loudun, where truffle-beds had formerly existed, but where they had long ceased to be productive—a fact indicating the aptitude of the soil for the purpose. In this case no attempt was made to produce truffles by placing ripe specimens in the earth ; but they sprung up of themselves, from spores probably contained in the soil. The young trees were left rather wide apart, and were cut for the first time about the twelfth year from the sowing, and afterwards at intervals of from seven to nine years. Truffles were thus obtained from a period of from twenty-five to thirty years, after which the plantations ceased to be productive, owing, it was said, to the ground being too much shaded by the branches of the young trees, a remedy for which might have been found by thinning out the trees ; but this would not be adopted till all the barren tracts, called "galluches," had been planted. The brushwood, by being thus thinned out, would be converted into timber-trees, and the truffle-grounds rendered permanent like those of Poitou, which are commonly situated under the shade of lofty trees. It is the opinion of the Messrs. Tulasne that the regular cultivation of truffles in gardens can never be so successful as this so-called indirect culture at Loudun, &c. ; but they think that a satisfactory result might be obtained in suitable soils by planting fragments of mature truffles in wooded localities, taking care that the other conditions of the spots selected should be analogous to those of the regular truffle-grounds ; and they recommend a judicious thinning of the trees, and clearing the surface from brushwood, &c., which prevents at once the beneficial effects of rain and of the direct sun-rays. It is added that this species of industry has added much to the value of certain districts of Loudun and Civray, which were previously comparatively worthless, and has enriched many of its proprietors, who now take periodical sowings of acorns, thus bringing in a certain portion of wood as truffle-grounds each year. At Bonardeline, for instance, the annual return from truffles in a plantation of less than half an acre was from 4*l.* to 5*l.* Another case is adduced in the Arrondissement of Apt, where several proprietors have made plantations : the trees are left about five or six yards apart ; and so soon as their branches meet and shade the ground too much they are thinned out.

The districts of England especially suited to produce truffles would thus appear to be situated on the great band of calcareous beds which run diagonally across the island from the south-eastern corner of Devonshire to the mouth of the Wash in Norfolk, occupying all the country that lies to the south-east of such a line, including the counties of Somerset, Dorset, Wilts, Gloucester, Hampshire, Berkshire, Kent, Hertfordshire, and parts of Northampton, Norfolk and Lincoln ; and it is to the proprietors of lands in those districts that we must look for any successful attempts to cultivate these fungi.

A great proportion of the truffles exposed for sale in Covent Garden come from Wiltshire and Hampshire, and the opinions of those who make it their busines to collect them coincide completely with those of Messrs. Tulasne cited above. I have been informed by one of these men, that whenever a plantation of beech, or beech and fir, is made on the chalk districts of Salisbury Plain, after the lapse of a few years truffles are produced; and that these plantations continue productive for a period of from ten to fifteen years, after which they cease to be so. It has been observed that the species most available for culinary purposes with us is *Tuber æstivum*, a species considered in France as of far less value than *T. melanosporum* and *T. brumale*, and it might be worth while to obtain well-matured specimens of these species from France, and distribute them while quite fresh in some locality producing our indigenous kinds, to ascertain if we could not thus obtain a superior race of truffles. *Tuber æstivum* is commonly worth about half-a-crown per pound in Covent Garden, whilst in Italy *Tuber magnatum* fetches from fifteen to seventeen francs, and *T. melanosporum* almost as much. Should horticulturists be tempted to try their skill in the artificial production of these fungi, they should bear in mind the conditions most suitable to their nature, as above recorded. They might succeed, for instance, in producing them in filbert-plantations, or in gardens thickly set with fruit-trees, and they should plant mature specimens in well-trenched ground on a calcareous substratum, and be careful not to stir the soil to any depth till the autumn or winter of the following year, in order not to disturb the mycelium; and it would be well, perhaps, in case they find a successful result, not to take too largely of the crop for the first year or two, but to give them time to establish themselves thoroughly in the locality. It would seem, however, that, when once established, deep stirrings of the soil would tend rather to encourage than to check their increase, as giving the mycelium a lighter soil in which to vegetate, and preventing the growth of roots of surrounding trees, &c., which might deprive the truffles of the requisite nutriment.

It might be well to try the growth of *Tuber macrosporum*, as it is an indigenous species, and might become a source of profit, notwithstanding its garlic odour. Those who possess woods or plantations of beech in calcareous soils, which are not already productive of truffles, might succeed perhaps in rendering them so, by trenching patches of ground beneath the trees, so as to clear away the brushwood, grass, and roots for a considerable space. and planting ripe truffles in the trenched spaces, and then allowing time for them to produce their mycelium. And when the roots of surrounding trees again encroach on the selected spots, they might be checked by deep digging around their margins.

THE FIBRES OF COMMERCE.

BY THE EDITOR.

ALTHOUGH we have for many years past been largely increasing our imports of all materials suited for the purposes of textile fabrics, the manufacture of cordage, matting, paper, &c., yet the wants of commerce increase so rapidly with the advance of civilization, the extension of shipping, the progress of wealth, the general comforts of the people, and the increasing trade we carry on with other countries, that the demand still exceeds the supply. Our imports of cotton are quite insufficient for our wants. And so with the materials for our paper supply, the 25,000 tons of rags we import, added to the 50,000 or 60,000 tons obtained at home, are found quite inadequate for the mills of the manufacturers, even with 44,000 tons of raw vegetable substances added, the average consumption of paper being about 80,000 to 100,000 tons per annum, with a largely-increasing demand.

To go fully into all the details respecting the production and sources of supply of old staples and new fibrous materials, would here be impossible. We, however, greatly require detailed and accurate information as to the modes of cultivation and the best localities for producing many of the plants proposed as suitable for supplying fibre. And more especially is it essential to obtain particulars as to the preparation of the fibre, the cost at which it can be furnished, the quantity at present produced and available on demand, the capabilities for extending the culture, and what are the chief difficulties that may stand in the way of supply, such as distance from the sea-board, cost of labour, and expense of transit. The means of extracting fibre cheaply and expeditiously from plants upon a small as well as a large scale, notwithstanding all the announcements and all the promises of machinery for the purpose, made at the several International Exhibitions, is still a desideratum. 1,000,000 cwt. of foreign-grown hemp, 2,000,000 cwt. of jute and other vegetable substances of the nature of hemp, 1,800,000 cwt. of foreign flax are imported, besides our home grown supplies.

The stoppage in the supply of hemp and bristles during the Russian war led to large demands being made on India and other countries, for suitable materials to supply the deficiency, and commerce soon brought to the aid of the manufacturer many new substances adapted to his wants, and pointed out others which might be largely and cheaply produced. The late Dr. Royle, with the magnificent resources of the East India Company at command, threw his vast knowledge into the gap, and in his work "On the Fibrous Plants of India," and his lectures before the Society of Arts "On the Indian Fibres fit for Textile Fabrics, for Rope, and for Paper-Making," accompanied by the very interesting collections of fibres which he exhibited, together with their commercial products, proved their suitableness and applicability for all the purposes required. The only question now is as to the price, condition, and quantity in which they can be supplied in our ports.

The quantity of hemp and other vegetable substances of the nature of undressed hemp imported from the East Indies and the Philippines was in 1851, 589,460 cwt., and in 1864, 2,306,752 cwt.

Besides the above, there were 79,693 cwts. of coir-rope, twine, and strands, valued at 109,429*l.* received from India in 1863, and 37,485 cwt., valued at 51,884*l.* from Ceylon.

For the use of the brush-maker the kittool fibre, obtained from a palm, the *Caryota urens*, was found to answer admirably, and this, with coir from the cocoa-nut husk, Mexican grass, so called, (*Agave sisilana*), and various other stout vegetable fibres, have entered largely into the manufacture.

It is singular how quickly science and the skill of our manufacturers supersede one article by another of totally different material. The instances of this of late years have been very numerous, and will occur to the recollection of the reader. Wood for building purposes is being fast supplanted by iron. Gutta-percha and caoutchouc have very generally taken the place of leather in many manufactures. And we may shortly expect to be completely independent of the hog, at least, for his skin and bristles, however much we may still make use of his carcase.

Vegetable fibres, as we have just seen, are now very generally and effectively used in brush-making, but another revolution has lately taken place in the substitution of fine metallic wire for brushes. A large manufacturer in the neighbourhood of Manchester, not content with the extensive production of wire cards for carding wool, cotton, &c., has applied delicate machinery to the preparation of wire-brushes, for all the various uses to which brushes are put—very fine and flexible for flesh-brushes, which are much more delicate and efficient in promoting the healthy action of the skin than the harsh horse-hair gloves; for cattle brushes, instead of the hard and coarse curry comb, for hair, clothes, hat, sweeping, and all other kinds of brushes. Truly, there is no end to novelty of invention, and in this metallic age, iron will have the mastery, although its rival, gold, in its abundance and utility, runs the baser metal hard.

During the ten years, from 1840 to 1850, the average import of foreign hemp and flax was about 70,000 tons per annum. Last year, (1864) including flax, hemp, jute, and other vegetable substances of a similar character, it reached 245,046 tons.

The immense increase of our manufacturing industries, dependent upon textile substances for the raw material, is best shown by the following quantities which were worked up at different periods, stated in pounds:—

1855.	1860.	1864.
lbs.	lbs.	lbs.
99,300,446	300,000,000	437,737,330
8,904,508	7,000,000	8,513,673
145,541,088	180,227,488	342,493,200
205,344,720	336,000,000	408,000,000
890,159,872	1,140,510,112	893,304,720
8,960,000	9,884,112	

Let us next glance at the immense extent of the carrying trade and traffic in fibrous substances. The annual quantity of these articles produced here, or imported and manufactured and transported over the kingdom, exceeds in weight one million and three quarter tons, and amounts in value to fully 213,000,000*l.*, judging by a revision of the figures given in Poole's "Statistics of British Commerce."

Quantities and Value of the Principal Fibrous Articles and Textiles.

	Weight Tons.	Value.
Bagging	10,600	£320,000
Canvas	6,500	546,000
Coir, &c.	6,000	162,000
Cordage	50,000	2,000,000
Cotton (wool)	621,954	34,839,935
„ manufactured	270,000	52,000,000
Flax	183,000	10,920,000
Hemp, &c.	152,898	2,644,937
Lace	1,500	3,680,000
Linen	90,000	18,000,000
Palm leaves	630	19,000
Piassava fibre	150	2,000
Rags, &c.	70,000	1,500,000
Silk (raw)	5,000	11,000,000
„ manufactured	5,000	16,000,000
Wool	200,000	22,500,000
Woollen cloth	60,000	34,000,000
	1,733,232	210,133,872

To which may properly be added the following other fibrous substances:

	Tons.	Value.
Baskets	9,130	£210,000
Bass mats and bass ropes	3,250	78,000
Bonnets and straw	104	135,000
Brooms and brushes	26,200	2,180,000
Bulrushes	700	7,000
Mats and matting	15,000	150,000
Straw and grass for platting	750	6,000
	55,134	2,766,000

Having estimated the aggregate value of the trade in these substances, let us now examine more in detail a few of them, although it will be only possible to treat them superficially. And first as to flax:—

Without going into the discussion why flax has not been more generally cultivated in the United Kingdom, and leaving the mooted point of its exhausting properties on the soil, I may state, in the words of one of its panegyrists, "that to innumerable individuals of the great human family, flax supplies the various items of clothing, writing materials, bedding, fuel, medicine (external as well as internal), manure, material to aid the painters' art, and indirectly, animal food of the highest nutritive qualities, and, above all, when duly appreciated and properly managed, it affords that inestimable blessing to a population—a constant source of remunerative employment." (Delamer "On Flax and Hemp.")

An equally long string of useful properties might, however, be made of many other fibrous substances, whether of cotton, the cocoa-nut, or the plantain.

Flax culture occupies but a very small degree of attention in Scotland, the acreage under culture with this crop not, I believe, exceeding 3,000 acres. For England we have no details; but in Ireland the breadth of land under flax culture last year was about 300,000 acres.

The produce may be calculated at 75,000 tons, valued at 3,750,000*l.* for the fibre, exclusive of the seed.

The land under flax has more than trebled in the last twelve years, but it fluctuates considerably. The quantity of flax, hemp, jute, and tow consumed, can only be stated approximately, because we are deficient in any returns of the quantity of flax produced at home.

There was imported in 1860:—

	Cwts.
Flax	1,464,810
Hemp, &c.	787,283
Jute and Sunn	821,891
	3,073,984.

To this must be added the estimated quantity of flax grown in the United Kingdom, and of the old materials broken up to be re-manufactured (in the same manner as woollen rags are torn and re-converted in the shoddy manufacture), probably 1,500,000 cwt., making a total of 4,573,984 cwt. In 1864, the imports were nearly doubled.

Numerous inquiries are now making by our manufacturers and merchants as to the possibility of obtaining new and suitable vegetable fibres, adapted to the manufacture of articles which are at present made from hemp.

One of the most promising materials for certain purposes is the fibre of the plantain, which has often engaged the attention of the tropical cultivator and merchant; but until of late years there was no great demand for new textile or cordage substances. The process of disengaging the fibre is so simple, compared with the elaborate processes attending the separation of hemp and flax, and the expense and labour so trifling, that it is surprising the raw material has not before this been made an extensive article of commerce.

When we perceive how large the traffic in coir, the short prepared husky covering of the cocoa-nut, has become, it is an earnest of encouragement for those who choose to embark in new undertakings for the supply of commercial fibres.

The coir or fibre obtained from the husky covering of the cocoa-nut is even now of great commercial importance, and might be made more so in conjunction with the equally valuable pulp or kernel for food and for oil. Coir and coir-rope to the value of 30,000*l.* or 40,000*l.* is annually imported in the three Indian Presidency towns, while we receive as much as 162,000*l.* worth. The nuts grown at the sea-side yield most fibre; three of them will produce a pound of coir, while ten from the interior give no more in weight, though the coir will be purer. For stuffing mattrasses this substance is considered better in India than hair. Sail-cloth, oakum, and much of the coarse baling cloth so much in use, are made from it; and coir cables are coming into more general service in Europe for their strength and elasticity, and are ever replacing chain cables for large ships.

Although coir ropes have been employed in the East from time immemorial, it is scarcely a quarter of a century that they have been introduced into this country, and now we use up at least 6,000 tons a year of cocoa-nut fibre for various purposes—cordage, matting, brush-making, stuffing bedding, &c. For ships' cables it is especially esteemed, being very durable, elastic, and buoyant, and not chafing by friction.

Forty years ago, the House of Assembly of Jamaica tried to stimulate the production of plantain-fibre rope by liberal rewards, but the want of suitable machinery to prepare it, and the more profitable return of sugar and coffee production there at that time, caused the subject to be neglected as a commercial speculation. However, experiments made in the Port Royal Dockyard with ropes of the Government dimensions, showed that the breaking weight of various samples ranged from 3½ to 6½ cwt.

The manufacture of cloth and rope from the plaintain is no new discovery, for the Indians and natives of South America have long been in the habit of using the fibre for these purposes. The celebrated circumnavigator, Dampier, notices the process as common in the Indian Archipelago, more than a century ago, as follows:—"They take the body of the tree, clear it of its outward bark and leaves, cut it into four quarters, which put into the sun, the moisture exhales; they then take hold of the threads at the ends and draw them out; they are as big as brown thread; of this they make cloth, in Mindanao, called 'saggen,' which is stubborn when new, wears out soon, and when wet it is slimy."

Like many of the misnomers of commerce, which are very difficult to correct, and which lead to sad confusion, the fibre of the wild plantain (*Musa textilis*) of the East, is commonly termed Manila hemp (Abaca by the Spaniards), and I am obliged, therefore, to keep to the term here. This so-called hemp is the material so much used for making strong white rope for ships. The usual mode of preparation is as follows :—When the stalk or stem has attained its full size, which is indicated by throwing out its fruit branches, it is cut close to the ground and the stem which will be eight or ten feet long below the leaves, again divided. The outer coating of the herbaceous stem is then stripped off, until the fibres or cellular parts are seen, when it undergoes the process of rotting, and after being well dried in houses and sheds, is prepared for market by assorting it, a task which is performed by women and children. That which is intended for making cloth is soaked for an hour or two in weak lime water, again dried and put up in bundles.

Some enterprising American merchants have of late years almost monopolised the manufacture and trade of Manila rope, for which there is a large demand in the United States for the use of their mercantile marine.

By the introduction of machinery the cordage has been greatly improved. The plan now adopted in the manufacture may be thus described :—The first floor of the factory is occupied with the dressing machines, three of which are cylinders of wood covered with points of iron two inches in length, distant from each other about one inch and a half. These first open the fibre which then passes to another machine under a cylinder of much larger diameter, of which the points (cards) are smaller and placed together. By these the fibre is separated into a fine thread and divested of the woody or refuse particles. After this preparation the hemp passes between two iron cylinders which compresses it very strongly. From thence it is conducted to a smaller machine which gives the first twist, and winds it on a bobbin of about six inches diameter. The dimensions of the cord are increased or diminished by means of an iron screw which adjusts the diameter of the hole, through which the fibres pass, to the required size.

The demand for Manila rope has been largely increasing and as much as 6,500 tons per annum are often shipped from Manila to Europe and America. Recently, owing to the American disturbances, there has been a glut of this fibre in the London market and the prices have fallen.

The culture of this particular species of plantain has been carefully extended of late years in the Philippines and also in the northern part of Celebes.

The magnificent herbaceous plantain forms a marked feature in the varied and profuse vegetation of tropical countries, and possesses a very widely extended range. The broad leaves overhang gracefully the succulent huge stem, which attains an elevation of from eight to fifteen feet, with a diameter of stalk from one foot to two feet. The stem is formed partly from the united petioles of the leaves; and they contain such a quantity of spiral vessels, that they are capable of being pulled out by handfuls.

The *Musa textilis*, unlike the cultivated species of plantain, which can only be propagated by suckers, is easily raised from seed.

Finlayson ("Journal of a Mission to Siam") tells us that unlike the luscious and delicious fruit raised by the hand of man, the fruit of the wild plantain contains scarcely any pulp whatever. Its leathery sheath incloses numerous series of large black seeds, attached to a pithy central stem, and immersed in a gummy substance resembling bird-lime. The seeds of the plantain having been but rarely seen by botanists, doubts have been expressed on the subject. In none of the cultivated varieties are there any seeds discoverable; though at times we may observe minute black points in the pulp disposed in longitudinal rows. These are probably the feeble traces of seeds, not yet quite extinguished by cultivation, the black perisperm being the last to disappear. In the wild plantain the seeds are numerous, covered with a thick, black, brittle shell, and as large as those of the custard apple (*Anona reticulata*), but of a more singular shape.

About fourteen years ago, a patent was taken out in the United States, for the manufacture of paper from plantain fibre, and a good, strong, fine wrapping paper was made from it.

Some years ago a Colonial Fibre Company was incorporated by charter in London, for the cultivation and purchase of fibrous plants in Jamaica and British Guiana, for obtaining from them the valuable fibres which they contain, and for converting the same into marketable products. Owing, however, to difficulties on the question of the patent rights for new machinery, or failing in obtaining the necessary capital, the company broke down.

The younger stems of the plantain, and the inner heart leaves of the Agave, furnish strong filaments of a silky character, which are naturally of a silvery whiteness, and which may be dyed of any colour, retaining their lustre and brilliancy; deprived also of their gummy or resinous matter, and split or carded by the ordinary processes, they may be extensively adapted to many of the wants now supplied by flax and cotton. They are used at the present time for weaving into light fabrics, and also for damasks, the finer sort of furniture-hangings and upholstery, &c., generally.

The weight of a plantain stem will sometimes be 70 or 80lbs., of which 50 per cent. will be water. It is, therefore, too expensive to cart the stems to any considerable distance for preparation, and, in the colonies, machinery would require to be erected contiguous to the provision grounds, or "plantain walks," as they are termed.

It is extremely desirable to know the quantity of fibre that can be obtained per acre, and the following calculations, which are the result of careful experiments, are worthy of record :—

Cotton in America is an annual plant, subject to many deteriorating influences, particularly from frost or excessive rain, and a full average crop is considered to be one bale per acre, or about 4 cwt. Flax, an annual, is regarded as a good crop at 6 cwt. per acre ; and hemp at 7 cwt. per acre.

The plantain will yield of the best quality of fibre, 48 cwt. per acre, besides the coarser qualities, consequently its produce will be, as compared with that of cotton, twelve-fold ; of flax, eight-fold ; and of hemp, seven-fold. Moreover, the produce of the plantain, from 500 acres, would require, to obtain the same quantity in cotton, 6,000 acres ; in flax, 4,000 acres ; and in hemp, 3,500 acres. But flax and hemp, being exhausting crops, cannot be grown upon the same land oftener (at the utmost), than in a five year rotation. Therefore, to produce annually, and every year, 1,200 tons of flax, would require the use of an estate of 20,000 acres. And for hemp in the same way, 17,500 acres. Whilst the plantain not being an exhausting crop, would continue to produce its 1,200 tons of fibre per annum, without replanting, for a term of twelve or fifteen years upon 500 acres.

The New Zealand flax produces 1,792lbs. per acre, the Moorva, or Marool (*Sanseviera*), 1,613 to 3,226lbs. in two crops.

Several of the nettle family of the East yield fibres of extreme value, especially the *Urtica* (*Boehmeria nivea*), from which the Chinese grass cloth is made, and for which 120*l.* a ton has been given ; and the Rhea of Assam (*Urtica tenacissima*) identical in properties and value. The softest flax is excelled in fineness by this fibre, and the strongest hemp in tenacity by the Himalayan hemp.

The China grass cloth, *Boehmeria nivea*, is a plant equally as susceptible of cultivation as the sugar-cane, and on similar principles, increased readily by seed and suckers. In rapidity and luxuriance of growth it vies with the rankest tropical weed, and will grow in any soil, but seems to thrive best in a moist climate. So rapid is the growth of this plant, that, by careful observation, the colonial botanist of Jamaica, found one of its shoots attain the height of six and a half feet in fourteen days, and, ultimately, eight and a half feet ; but in good land it would exceed this by two feet, while in China and the East Indies, where it is highly cultivated, eight feet is the height mentioned it now makes, from which fibre six feet long is obtained. This is the plant from the fibre of which is fabricated the finest cloth in the world. It has also been ascertained to be not only the finest, but the strongest of every fibre submitted to test by the East India Company. This fibre is now beginning to be known in the market, and commands an exorbitant price ; on the continent especially, attention has lately been much drawn to it.

The *Sansevieras* are liliceous plants, long known and cultivated, as holding an important place among fibre-producing plants, in the East

Indies and Africa, where they are indigenous, and largely cultivated. The fibre is called Bowstring hemp, Moorva and Marool in Madras. The succulent leaves of these plants grow from three to four feet in length, and abound in fibre remarkable for fineness and tenacity. The species are readily propagated from suckers and slips, which are produced in abundance, and will grow in any soil, with little or no care, requiring no removing, as the plants are perennial. The species *Angolensis* has been but recently sent to England, and introduced into the West Indies from Angola in Africa, where it is extensively used for making ropes, being superior to every other species of the same genus for that purpose.

The Yuccas are well-known and approved fibre-producing plants, and not less so the *Hibiscus*, or Malvaceous tribe.

The Pinguin, and all the *Bromelia* tribe, like the plantain, are perennials, requiring only one planting in twelve or fifteen years, and throwing off two crops of leaves a year. Some of the aloe tribe too, and the *Aloe variegatur*, for instance, yield fibres, not to be excelled, if they are equalled by any foreign product.

The term Pita is a kind of generic name, used very generally in Mexico, Central, and South America, for almost all vegetable fibres whencesoever obtained, thus the fibre of numerous species of Agave, yucca, and other filamentous plants of the genus Bromelia fall under this common denomination.

The *Yuccaaloe folia* and *Y. filamentosa* afford a very rich silky fibre, and assimilate in their growth and other characteristics to the Agave species. The leaves of the *Bromelia karatas* of Mexico and South Brazil attain a length of from nine to twelve feet or more, and yield a mass of fibre, of about the same length, of great strength, and of a silvery whiteness, one-sixth lighter than hemp. In the State of Panama the best and whitest rope is made from the fibre of the "Corteza" (*Aphebia Tibourbon*, of Abul); a brownish-looking rope, easily affected by dampness, probably because the tree from which it is taken has saline properties, is manufactured from the "Majagna de playa" (*Paritium tiliaceum*, Adr. Juss.) In Ceylon, this is called Peli.

This hibiscus-like plant is very common in fences and swampy places in Ceylon. They make in Tahiti fine matting of its bark, and also ropes and lines, from the size of an inch, to that of a small pack thread, and fishing lines.

The *Pachira Barrizon*, Seeman, and the Malagueto hembra (*Xylopia frutescens* of Aubl.) in Central America, yield a fibre fit for ropes. Seeman, in his "Flora of Panama," states that the hammocks of Veraguas, consist of the fibres of the Cobuya, a species of Agave, and those of a palm called Chonta. A strong fibre is contained in the leaves of the "Pita di Zapateros," a species of Bromelia, which is prepared like flax, woven into bags, or "chacaras," by different Indian tribes, and extensively used by shoemakers for sewing. The fibre surrounding the Cucua, or Namagua, forms a close texture of natural material, which the natives soak in water, beat and make into garments, beds, and ropes, or use as sails for their canoes. The mats which the poorer classes have to sleep upon are manufactured from the fibre of plantain leaves.

The fibres or filaments vary according to the age of the stems or leaves of the plants.

When they are obtained from the full-grown plantain stem, and the exterior leaves of the agave, aloe, and other similar plants, they are very strong and coarse, and are best adapted for cables, cordage, rope, canvass, sacking, the warp of carpets, and indeed for every description of this class of manufactures, where strength and durability are required.

Ropes and cordage made from these are much stronger and more durable than those made from hemp, lighter and more pliable, do not require tarring, by which hempen ropes lose much of their strength, bear the alternation of dryness and moisture with little injury, and the difference in hygrometric action is considerable.

There are several fibres obtained from the Malvaceous tribe of plants which deserve to be better known and more attended to. These are, according to their mode of preparation, strong, of different shades of colour from greyish white to brown. Some of the fibre is of great length, particularly the *Hibiscus cannabinus* and *H. esculentus.* The latter, the "bayndee" of the East, and the "ochre" of the West Indies is held in great esteem for its mucilaginous fruit as a pot-herb. Both these are grown abundantly all over India, and if found to answer for rope-making any quantity could be furnished, as more attention would be given to it if a commercial demand existed for the fibre, which is now wasted. Dr. Riddell, from experiments made on it, considers that the fibre, which he obtained almost white, would form an admirable paper-material, and prove a substitute for rags. The roselee plant (*H. sabdariffa*) produces a strong brown-coloured hemp; and though when hackled the fibre is short, it might be converted into good rope. The preparation of the fibre, however, could never become very remunerative, unless the plant were cultivated in large quantities, and some simple crushing and scraping or combing machinery were substituted for the manual labour now employed in cleaning it. The fibre appears to be an important and useful article of commerce, the preparation of which on a large scale would probably prove remunerative. The points which would require to be carefully attended to, are, that the steeping and rotting process of cleaning should not be followed, but that the pulp should be separated from the fibre, if possible, the very day on which the leaves of the plant are cut. Should the fibres be required in large quantities for cordage or coarse purposes, they ought to be boiled in some tanning solution the day after they are cleaned. Tanning appears to answer better with fibre than tarring, and care must be taken in spinning into rope or string, that it be not too much twisted, as it then yields a stiff cordage that is apt to snap when suddenly twisted.

THE TECHNOLOGIST.

THE SUPPLY OF RESIN.

We drew attention in a former number, (vol. 5, p. 370) to the declining supplies of turpentine and resin, and stated that the Secretary of State for the Colonies had circularised the colonial governors with the view of if possible stimulating production in new sources. We have now before us a valuable series of reports from our consuls in foreign countries on the quantity, quality, and value of the resin produced within their consular districts, from which we are able to quote much new and interesting information. It is, however, satisfactory to notice that the supplies are beginning to increase to the satisfaction of manufacturers in various branches of trade. The imports have been in :—

	Turpentine.	Resin.
1864	353,824	52,968 cwt.
1865 (7 months) . .	193,181	20,175 „

Austria.—Mr. Acting-Consul General Valentine, Venice, reports that a considerable quantity of turpentine, or of the resinous matter from which resin or colophony is extracted, might be obtained from the extensive forests of the Tyrol and Friuli, which abound with firs, larch, and other resinous trees, were not the tapping of the trees prohibited by the forest laws, to prevent injury to the growth and perfect quality of the timber.

Should, however, the present profitable prices offered for resin continue, affording full compensation for the deterioration of the quality of the timber, there is no doubt that the production of resin would be very greatly increased.

Previous to the war in America the production of resin in the Tyrol was limited to the requirements of the local trade ; but since then the scarcity and consequent high prices of colophony have caused greater attention to be paid to the cultivation of this resource of the country, and the turpentine to be collected and purified to an increasing extent, not only for the use of the immediate neighbourhood, but also for the consumers of it in Germany, who have obtained it direct from the Tyrol, where the refining of it seems hitherto to have been confined, in consequence of the facility of transport by railway.

Of the refined resin, resembling "Burgundy pitch," the actual production cannot be estimated to exceed 3,000 to 4,000 Vienna centners, or about 200 British tons; but could confidence be placed in the continuance of actual prices, the quantity produced would be very greatly increased.

The present value of this refined quality is twenty paper florins per Vienna centner, which may be calculated as equal to 36s. 6d. per English cwt., free on board in Venice, in cases of about 3½ English cwt. gross, with an allowance of 10 per cent. for tare of case.

Larch turpentine, formerly known in commerce as "Venice turpentine," is procured from the same resinous produce, and is likewise sent to Germany in kegs of 1½ English cwt. gross, with 15 per cent. tare of cask, and could at present be purchased at a price equal to about 41s. 6d. per English cwt., delivered free on board in Venice. The quantity cannot be estimated at present at more than 1,200 to 1,500 kegs, but a certainty of the continuation of the actual prices would likewise ensure a greatly increased production next season.

Borneo.—Mr. Acting Consul-General Callaghan writes from Labuan that the ordinary resin of commerce is not to be found within his Consular district.

There is, however, a resin produced in considerable quantities, and of several varieties, which is called by the natives "dammar."

One variety only, the "dammar batu," is produced in any large quantity in that part of Borneo within his district.

About 500 tons of this kind could be collected within a short time in the neighbourhood of Brunei, and sold there for about 7*l.* a ton.

The other varieties are produced in very small quantities.

Mr. Consul Ricketts writes from Sarawak that resin is to be found in all parts of the Province, the best being, however, obtained in the vicinity of the Rejang river.

There are three qualities—viz., the flesh resin, or "dammar dagging," the cat's eye, or "madah kuching," and the common "dammar." They are all the products of large jungle trees.

The flesh resin can be purchased at the town of Sarawak for about 4*l.* a ton.

The cat's eye, or "madah kuching," being far more valuable than the above, is also more scarce; it is very useful for making fine varnish, and its market-price at the town of Sarawak is 28*l.* 15s. a ton; its supply may be termed moderate.

The common "dammar," which is used for making pitch, costs at the town of Sarawak about 2*l.* a ton; there is a plentiful supply to be had of this as well as of the flesh resin or "dammar dagging."

Bahia.—Mr. Acting-Consul Baines states that the article has hitherto not attracted the attention of people in the interior as being one worth the trouble of obtaining for the purpose of exportation. I have endeavoured to induce persons living in the woods near the small seaport town of Canavierias, where it is said resinous trees abound, to occupy themselves with the production, and I shortly expect to receive samples of resin from various trees, which I shall send to London to be valued, and if they are approved of, and the price offered will leave a profit to the producer, I have not the slightest doubt that a considerable quantity could and would be exported in the course of next year.

The circumstance that the woods of this country, such as rosewood and Brazil wood, have depreciated so much in value of late in Europe, that the prices offered here do not even pay for the labour of cutting and transport to this market, has made persons hitherto employed in the wood trade both anxious and eager to devote their attention to the production of any article that would be remunerative, and as the labourers employed in the wood trade are principally Indians, born and brought up in the forests, no persons could be better suited for the employment of collecting resin.

List of Brazilian Trees which yield Resin.

Icica heptaphylla . . . . . Almecegueira.
„ Icicariba . . . . . Ubira-siguá.
„ guianensis . . . . . Icicariba.
„ altissima . . . . . . Tciy.
Hymenæa Courbaril, *L.* . . . . . Jetahy, Jataky.
„ stilbocarpa, *Hayne* . . . Jetai, Jetai-üva.
„ Martiana „ . . . . Tatoba, Tetaiba.
„ Olfersiana „ . . . Abati-timbaty.
„ stigonocarpa „
„ Sellowiana „
Trachylobium Martianum, *Hayne.*

N.B.—The last seven species yield copal or anime.

Araucaria Brasiliana, *Lamb.* . . . Cari-y, Cari-üva. Pinheiro.

N.B.—The turpentine is used the same as the European.

Bursera leptophleos, *Mart.* . . . Trubarana. Bahia.

N.B.—Greenish yellow resin, with the same smell as turpentine.

Astronium concinnum, *Schott.* Guarabá.
Schinus antarthritica, *Mart.* Aroeira.
„ Molleoides. Velloso.
„ terebenthifolius.
„ rhoifolius, *Mart.*
„ munorivilatus ? *Mart.*

Para.—Mr. Acting-Consul Blandy reports, there is but a small quantity of resin gathered in these Provinces, never amounting to over 300 arobas, or 9,600 lbs. This amount is seldom reached, being principally picked up beneath the trees bearing this gum. There are three varieties, known in commerce as the black, yellow, and white. The two first are commonly used in the manufacture of soaps, and for glazing a soft earthenware made in these Provinces. The last is used more in ceremonials and for fumigating apartments, as it has the odour of incense, much esteemed by the natives.

The price varies from 3½*d.* to 7*d.* per lb., according to its colour and purity.

The whole country is an inexhaustible variety of trees producing these resinous gums, as well as of oils; but labour is expensive and difficult to be obtained, and the greater value of other wild products have and will prevent the increase of the supply of resin in this district until its price should equal the remuneration from other products.

This would seem impossible, as the same labour is required to extract an arroba of resin, whose highest price is 7 milreis, as an arroba of rubber, worth 28 milreis.

Under this state of things, I am unable to furnish any reliable suggestion for the increase of its production.

Untold riches are thus buried in vast forests, from the great value of the rubber crop, and will so remain until a more general supply of this article releases the small amount of labour for the pursuit of other products. Resinous extracts would then be produced in immense quantities in these districts.

PANAMA.—A small quantity of resin is actually extracted from some of the woods on the Isthmus, but not in sufficient quantity to form an article of exportation, or in fact for the local consumption, resin being imported to supply the deficiency.

EGYPT.—Mr. Acting Consul Ayrton writes from Cairo:—

No resin is produced in Egypt.

Of analogous substances (taking resin as of the class of hydrocarbons) petroleum is found at a place called Gebel Zeit (Oil Mountain), near the entrance of the Gulf of Suez, on the Egyptian shore. The late M. Barbaroux, a French subject, to whom his late Highness Said Pasha had conceded the privilege of working the springs whence the petroleum issues, informed me that the yield was so small as scarcely to defray the expense of obtaining it. It is, however, possible that a larger supply might be procurable with larger and better appliances than those available to M. Barbaroux.

About Hodeida (the seat of government, and great coffee port of Yemen) a vegetable tar is produced. I only know it as used for marking the coffee bales. But were a demand raised for it, the quantity procurable might be found larger than at present.

FRANCE.—*Report by Consul-General Churchill, Algeria.*—The province of Algiers, of the three that constitute this important colony, is the only one in which the pine tree grows abundantly. There are upwards of 160,000 acres of land in this province covered with the pine and the cedar tree, and the average distance of these forest lands from the coast is from 70 to 100 English miles.

Several French capitalists have of late directed their attention to the manufacture of resin, and have obtained from the French Government concessions of pine forests for that purpose; but very little resinous produce has hitherto been brought to the market of Algiers, and still less has been exported.

Having placed myself in communication with M. Léon Lesca, of Orleansville (Algeria), one of the "concessionnaires," I am informed that this, the first year of his labours, he calculates on producing 150 tons of resin in different shapes, and hopes to double and quadruple this quantity in the course of a few years.

The tree from which the resin is extracted is the Aleppo pine, and its resin, from specimens sent to Marseilles and Bordeaux, has been pronounced to be at least as good as that of the Southern States of America.

The system adopted by M. Lesca in the manufacture of resin is the "Systéme Hugues," which requires both care and skilful labour. His colophcny is apparently of the best description.

This year M. Lesca has confined his business to the production of tar, pitch, and colophony, but he proposes to himself to attend more particularly to those descriptions of the latter commodity that enter into the manufacture of paper and varnish.

M. Lesca is anxious to enter into direct communication with the manufacturers of Great Britain; but although he affirms that his resins are bought up at Marseilles as fast as he can produce them, he makes another statement that would tend to show that nothing is to be done with Algeria in this article of trade, namely, that the resins sold at Dax and Bordeaux at 146f., 150f., and 154f. in cask, fetch 165f. at Algiers without cask.

From another source, I learn that a sample of Algerian resin was sent to Liverpool this year, but that its cost price was found to be too high for the English market.

M. Lesca writes from France that in order to induce the British manufacturers to take his resins, he is prepared to give them at more advantageous terms than those of Bordeaux; trusting that this, together with the superior quality of his produce, will draw the attention of the British manufacturers, who will, he reiterates, find it more suitable to place themselves in direct communication with his house at Orleansville or Algiers.

Report by Acting-Consul Graham, Bayonne. — From 70,000 to 80,000 barrels of dry resinous produce, weighing on an average 250 kilogrammes each, are annually sold in the market of Dax, which town is the depôt within this Consular district of the article in question. From 4,500 to 5,000 tons of essence of turpentine are likewise disposed of. The quality of the resin may be classed as follows :—

1st. Hugues's colophony.

2nd. Ordinary ditto.

3rd. Light-coloured pitch.

4th. Black pitch.

The above may again be subdivided into the undermentioned classes and denominations, according to the colour and the care used in the fabrication of the primary materials :—

Hugues' colophony, No. 2.

Ordinary ditto, No. 2.

Screened light-coloured pitch.

Ordinary ditto ditto.

Half light-coloured ditto.

The prices at present are—for essence of turpentine, 150 francs, (6*l.*) the 100 kilogrammes ;

Hugues' colophony, 78 to 82 francs (3*l.* 2s. 4d. to 3*l.* 5s. 7d.) per ditto.

Ordinary colophony, 65 to 70 francs (2*l.* 12s. to 2*l.* 16s.) per ditto ;

Light-coloured pitch, 60 to 64 francs (2*l.* 8s. to 2*l.* 11s. 2d.) per ditto ;

Black pitch, 54 to 56 francs (2*l.* 3s. 2d. to 2*l.* 4s. 9d.) per ditto ;

Report by Acting-Consul Hiver, Bordeaux.—The average quantity of "gemme" or resinous matter produced annually, of late, in these departments, amounts to 50,000,000 kilogrammes, equal to 49,261 tons English—viz.,

	Kilog.		Tons.
One-third in the "Gironde" . .	16,666,666	=	16,420
Two-thirds in the "Landes" . .	33,333,334		38,841
	50,000,000		49,261

"Gemme," or natural resinous matter, is but seldom exported in its primitive state ; it is generally distilled in order first to obtain oil or spirits of turpentine, and then it is submitted to further process, the result of which gives the different sorts of resin.

The first operation on 50,000,000 kilogrammes of "gemme" (49,261 tons) gives about 8,000,000 kilogrammes (7,882 tons) of oil.

The remaining 34,500,000 kilogrammes of matter (33,990 tons), about 15 per cent. being lost by evaporation in the manufacturing of oil, gives three sorts of resin in equal proportions.

	Kilog.		Tons.
One-third first sort	11,500,000	=	11,330
One-third light	11,500,000		11,330
One-third brown	11,500,000		11,330
	34,500,000		33,990

VALUE (Average Prices).

"Gemme" or raw Resinous matter.

50,000,000 kilogrammes, or 49,261 tons, at 65 francs the 100 kilogrammes (2*l.* 12s. per 221 lbs.,) = 32,500,000 francs, or 1,300,000*l.*

Oil or Spirits of Turpentine.

8,000,000 kilogrammes, or 7,882 tons, at 160 francs the 100 kilogrammes (6*l.* 8s. per 221 lbs.,) = 12,800,000 francs, or 512,000*l.*

Resin.

First sort, 11,500,000 kilogrammes, or 11,330 tons, at 70 francs the 100 kilogrammes (2*l.* 16s. per 221 lbs.,) = 8,050,000 francs, or 322,000*l.*

Light, 11,500,000 kilogrammes, or 11,330 tons, at 65 francs the 100 kilogrammes (2*l.* 12s. per 221 lbs.,) = 7,475,000 francs, or 299,000*l.*

Brown, 11,500,000 kilogrammes, or 11,330 tons, at 57 francs the 100 kilogrammes (2*l.* 5s. 7d. per 221 lbs.,) = 6,555,000 francs, or 262,200*l.*

Thus, the value of resin, &c., given by the 50,000,000 kilogrammes or 49,261 tons of raw matter produced annually by the pine forests of the departments of the "Gironde" and of the "Landes," amounts to 34,880,000 francs, or 1,395,200*l.*, as follows :—

	Francs.		£.
Resin—First sort . . .	8,050,000	=	322,000
„ Second sort, light .	7,475,000		299,000
„ Third sort, brown .	6,555,000		262,200
	22,080,000		883,200
Oil or spirits . . .	12,800,000		512,000
	34,880,000		1,395,200
And as the prime cost or value of the raw matter is only	32,500,000		1,300,000
The profits on manufacturing amount to . . .	2,380,000		95,200

Previous to the American troubles the demand for all descriptions of resinous matter being very limited, a great portion of the pine forests in this and in the neighbouring department was left unproductive. The owners of these forests and the manufacturers of resin assert that the production was then nearly two-thirds less than at present. They also state that should the demand increase, a much larger quantity could be readily obtained, considerable portions of the forests being still available for production.

Report by Consul Brackenbury, Charente.—The production of resin within the Department of the Lower Charente is limited to the Canton of La Tremblade, on the River Sendre. The quantity obtained is small, and is entirely consumed on the spot by the poorer inhabitants, who manufacture a very coarse description of candles from it. The price is regulated by the market value at Bordeaux, from whence, as well as from La Teste and Bayonne, the largest supplies of this article are drawn.

The French Government have recently ordered extensive plantations of pine to be formed on the coast of Arvert, near La Tremblade, as well as on the Isle of Oleron, and in the course of a few years there is reason to expect that this department will be enabled to vie, to a certain extent, with the Landes in the production of resin.

Report by Consul Smallwood, Corsica.—The forest most productive of resin in Corsica at present is that of Valdoniello, situate in the arondissement of Calvi. It is cultivated by MM. Chaton and Co., and is expected to yield this season 2,500 quintaux métriques of resin.

The forests of Melo and L'Ambuste, situate in the arrondissement of Corté, are cultivated by MM. Decheneux, Cadet, and Co., and produce annually 1,200 quintaux métriques of resin.

Small tracts of the Forests of Asco, Pineto, and Serraggio, situate in the arrondissement of Corté, and cultivated by M. Renaud, yield annually 800 quintaux métriques of resin.

The Forest of Rostonica, situate in the arrondissement of Corté, and cultivated by M. Castelli Pochon, produces yearly 400 quintaux métriques of resin.

In the arrondissement of Ajaccio a cultivator offers this season 200 quintaux métriques of resin.

Abstract.

Site and Name of Forest.		Total Quantities.	
		French weight.	English weight.
		Quintaux.	Tons.
Calvi.	Valdoniello . . .	2,500	246
Corté.	Melo and L'Ambuste .	1,200	118
"	Asco, Pineto, Serraggio .	800	79
"	Rostonica . . .	400	39
Ajaccio	. . . . .	200	18
	Total	5,100	500

Additional tracts of forests are being brought into cultivation for resin. Some cultivators are about to subject the Red *Larix* to double tapping, wherefrom a considerable increase in the supply of resin is expected; and it may not be unreasonable to anticipate that next season the quantity of resin produced in Corsica will not fall short of from 700 to 800 tons.

The superiority of the sample of resin from the Forest of Valdoniello may be accounted for from the improved treatment of the tree adopted in the forests of the arrondissement of Calvi by experienced cultivators from the French "Landes" and "Dunes" between the Gironde and Bordeaux, who have introduced the process of receiving the resin from the pine in appropriate vessels; whereas in the other arrondissement it is left to drop into pits dug at the base of the tree.

All persons whom I have consulted as to the quality of Corsican resin concur in asserting that it is equal, if not superior to that of the French "Landes" or to American resin.

The price obtained this year at the port of Marseilles for Corsican resin ranged from 55 to 60 francs per 100 kilogrammes. At Leghorn it ranged from 55 to 62 francs per 100 kilogrammes.

The producers of resin in Corsica are, with few exceptions, in needy circumstances. I am assured that a capitalist who would tender cash for small lots, and who could be relied upon for ready money on their delivery at Bastia, Calvi, or Ajaccio, would obtain advantages in price. This plan might be carried out through agents and merchants at these ports, and the small parcels warehoused until in bulk for shipment.

Cash advances to the needy producers would not only secure the supply, but would go far to stimulate exertion to augment the produce.

Report by Consul Mark, Marseilles.—In this part of France there is no resin available for exportation; on the contrary, considerable quantities thereof are imported from Algeria, Corsica, and Greece; the neighbourhood of Bordeaux likewise furnishes a large part of the resin required in these southern departments of France. The resin produced in this neighbourhood is very limited in quantity, the pine woods being more directly valuable for the timber and fuel they afford. The forests likewise have been so excessively drained for many years past, that the government has recently found it requisite to call the attention of the public and the local authorities to the necessity of replanting extensive districts which were formerly wooded, and whose present bareness has caused long-prevailing droughts.

Large quantities of resin are used in Marseilles in the manufacture of soap, which is most extensively carried on here. The resin imported from abroad arrives here in a rough state, very inferior to that received from Bordeaux. That produced in this neighbourhood is also of a very unsatisfactory description. It is now sold, nevertheless, for treble the price demanded before the commencement of the American War. The present price, however, is not likely to stimulate any great production in this part of France, and as, if necessary, an unlimited supply of resin might be drawn from the Landes in the south-west of France, no one in this Consular district appears disposed to start an enterprise of this nature.

Report by Consul Lacroix, Nice.—Notwithstanding the rich resinous forests which cover the Maritime Alps, and also a very large extent of the adjoining Department of the Var, no industry exists in this place or its neighbourhood for collecting the resinous juice from the different species of trees which form these forests.

The resins used at Nice are mostly derived from Dax, near Bayonne. The resinous forests of the Maritime Alps are formed of two species of pines (*Pinus maritima* and *Pinus sylvestris*), the fir (*Pinus Picca*), and the larch (*Pinus Larix*).

These forests cover a surface of about 40,000 hectares (100,000 acres) of land, and yield annually from 12,000 to 13,000 trees, which are cut for timber.

The price of a well-grown, straight, and healthy tree averages from 15 to 16 francs ; badly-grown and ill-shaped trees, unfit for building purposes, are valued from 2 to 3 francs each.

The larch tree principally grows on the summits of the mountains ; the pine and the fir tree extend in many localities as far down as the sea. The Estrel Mountains, which border the sea in the Department of the Var, are covered with the *Pinus maritima.*

The principal forests in the Maritime Alps are situated in the communes of St. Martin de Lantosea, Valdeblora, Isola, St. Dalmas le Sauvage, Roubion, Clans, La Bollène, Lonbosca, Saorgio, Le Molinet.

Most of these forests belong to government ; some few are private property. A company wishing to hire these woods for collecting resin would have to apply to the maires of the different communes, the proprietors, and also to the Bureau de Conservation des Forêts, established in Nice.

Some years ago the distillation of the resinous substances collected from trees was tried in the vicinity of Menton ; but the company working this distillery having then to contend with great difficulties and expense occasioned by the want of carriage-roads—all communications in those mountainous parts being carried on by mules—and also to compete with the resinous productions derived from the Southern States of America, the attempt proved unsuccessful, and was consequently abandoned.

At the present time, in the absence of supplies from America, which has quite doubled in this market the price of all resins, and with the many new roads which have been lately made, and are still in the course of construction, opening an easy access to the principal mountain communes, a company would not meet with the same obstacles and difficulties.

The attempt, however, should not be made without previous study and investigation on the part of the companies which may feel disposed to work these forests, and a minute inquiry into the details.

GREECE.—*Report by Consul Ongley, Patras.*—Resin is extracted from the pine in various parts of the Morea.

	Okes.
The province of Corinth produces about . .	700,000
" Ellis "	30,000
" Messenia "	50,000
Other parts produce about	220,000
In all about	1,000,000

Equal to 1,250 tons.

Of this about one-half is used to put into the wine of the country, which absorbs part of it, and the remainder unites with the tartar, and attaches itself to the sides of the casks.

This mixture of resin and tartar has lately been subjected to distillation, but it yields but a very small quantity of spirits of turpentine, the residuum being black resin, or colophony, and argol.

The other half of the resin produced is exported to other parts of Greece and to foreign countries, part in its natural state and part, after distillation, as spirits of turpentine.

Resin is now worth here about 60 leptas per oke, or 17s. 2d. per cwt., and spirits of turpentine 2 drachmas per oke, or 57s. per cwt.

The increase in value will augment the production. Mr. Vice-Consul Pasqualigo writes from Pyrgos, in Elis, that, with high prices, it might be increased threefold. Some small parcels of resin have lately been exported from this port of Patras to England.

Report by Consul Lloyd, Syra.—Resin is produced from the pine-tree, called by the natives of Greece, *pefkos*. There are two sorts of resin—that which naturally exudes and dries of itself, and which does not contain so much spirit, and that which exudes from incisions made in the same tree, and is more liquid. Of this latter, in 1862 Greece produced 1,000,000 okes, half of which was used in the fabrication of wine in Greece and Turkey, and the other half was distilled for the spirit of turpentine, and for the resin, its product, all of which was consumed in Turkey and Greece. In 1863, 1,500,000 were produced ; 700 tons went to England, and the rest was consumed in Greece and Turkey for wine and distillation for the spirit of turpentine, and resin, except small quantities which were sent to France and Italy as experiments. 1864, it is expected, will produce about 4,000,000 okes. About 2,000 tons have probably been already sent to Great Britain, exported from Syra, Piræus, Chalchida, and Patras; a portion also has been kept for wine in Greece and Turkey, and a portion has also been sent to France and Italy ; the remainder will all go to Great Britain. This year a distilling apparatus, brought from England on purpose, has been established at Chalchis, in Negropont. The resin is chiefly produced in the forests from the pine-trees, and from one kind of tree only, namely, that which is used for ship-building. After Negropont, Attica produces the next greatest quantity, the trees being more scattered there, as the woods have been destroyed, and they destroy them still for the cultivation of the ground ; next, Eastern Greece—that is, Megarida, north of the Isthmus of Corinth, where the woods are also scattered—and near Corinth itself, and from between Lutraki and Calamaki ; also Argeo, near Patras; near and opposite Zante and the Ionian Islands, and about Sparta. The inhabitants of certain villages had the business of making the incisions in the trees from old times, and were called *Koulouricks*, from Koulouri, the name of a village, and this occupation they followed in Attica, anciently called Eleusina. The incisions are made in the month of June, in the trunks and branches of the trees. The turpentine runs into a hole made for the purpose, and continues running during about six weeks, according to the weather. In hot weather it runs most; but in wet and cold weather it does not run. As in Greece, it is hotter, and there are less rain and damp than in Turkey, so Greece produces most. A young and strong tree, say of twelve years, produces seven okes. The first year the tree is cut it produces little, and the expense is greater the first year; the second, third, and fourth year more runs, and with less expense, as it exudes from the old cuts as well. In 1865 it is expected 40 per cent. more will be produced, as they have now begun to cultivate the trees and take care of them, instead of cutting them down; and the Greeks calculate that, even with peace in America, they can produce it cheaper. It costs now about 40 leptas per oke in the raw state on the spot, and 52 in Syra, plus the expense of barrels. No duty is levied on its exportation from Greece.

Translation from 'Travels in Greece, in 1834-37,' by Dr. Fielder.

Pinus maritima, Πεύκη, Dioscorides (Πεῦκος of modern Greeks), is the tree most extensively distributed over Greece; and a shore so desolate and rocky as not to produce some of these pines is rarely to be found. Where it exists alone it is generally stunted, from the rocky soil and exposure to wind and storms; but where they grow thickly on the moist declivities among the hills, or in the sloping plateaux of the mountains, the stems of those of eighty or ninety years' growth are straight and large, being near 100 feet high, and from two to three feet in diameter. It likes a dry rocky soil, but succeeds best in loose calcareous or sandy clay soil, which need not be very deep, the roots then spreading wide and not penetrating far downwards. It grows as far as 3,000 feet above the level of the sea.

At fifteen years it bears seed, but retains the cones, which frequently are produced direct from the bark of the trunks, and boughs; they ripen, shed their seed, become dry, and remain on the tree, and hence three kinds of cones are to be found on it at the same time. The open cones are four inches long and three inches in the greatest diameter. These clusters of the old cones, which from a distance appear like great birds' nests, disfigure the tops of the pines.

This tree contains much resin, and on that account is generally cut in such a manner as to impede its growth. If the tree be required to use for its resin it should be left growing for ninety years, and in the last ten or twelve years only the resin taken from it in a regular manner. The collected resin, or the half-ripe and even green cones, are cast in great quantities into the newly made wine, in order by the oil of turpentine contained in them to prevent the wine from becoming acid. The ancients did this, and hence the pine was sacred to Bacchus. The so-called pine-wreath or garland for the victors in the Isthmian games was made from this species of pine.

The pollen of the blossoms affords wax to the bees, the bark serves for tanning, but is as yet little used; it contains according to Nardo 52 per cent. tanning substance, consequently considerably more than the common pine; the bark can also be used for dyeing a red-brown colour. It contains a good deal of resin, from which particularly good oil of turpentine, resin, pitch, tar, and very fine pine blacking (Kienruss) can be made. Thin straight stems afford most excellent masts. The wood is used for house and shipbuilding, and is esteemed for many other useful purposes. It makes excellent firewood, and its charcoal is better than that of the common pine.

According to the same author *Pinus Pinea*, *Pinus Picea*, and *Pinus Abies*, all of which exist in Greece, produce resin and oil of turpentine.

GUATEMALA.—*Report by Consul Hall.*—Various descriptions of resin, most of them in their natural state, are here to be obtained, no use having hitherto been made of them by the efforts of industry.

Here are to be found different descriptions of balsams, turpentines, liquidambar, vegetable wax, a substance of a candent nature, and which serves for the preparation of candles, wherewith a soft and brilliant light is obtained.

The balsams, which in particular are exported on the coast of Sonsonate, situated on the Pacific of the neighbouring Republic of Salvador, are those which most frequently make their appearance in commerce, and are the only ones that may be considered articles of exportation at present. Each gallon is worth 5 dollars, more or less.

The liquidambar, which is likewise exported and is of good quality, bears a varied price; it may, however, be estimated at 3 dollars per gallon. The trade in these articles is conducted on a very small scale, but it is susceptible of great extension if carried on with sufficient means and intelligence. The Indians are those who attend to this source of industry.

The pitch pine, from which is extracted the turpentine, is abundant in this Republic, but it is incomparably more so in Honduras. Large quantities might be obtained therefrom, and not at much cost. I cannot state the fixed value, because I know no one who has dedicated himself to this speculation, but on noticing the large number of trees, and loaded as they are with turpentine, it may be calculated that the price of a gallon would be from 4 to 6 rials, but more particularly in the Republic of Honduras, where the forests are near the coast and in a virgin state.

ITALY.—*Report by Consul Craig, Cagliari.*—The imports of resin into Sardinia are very limited, and the only resin collected in the Island is from the Bastard Olive (*Oleaster*), at Orosei, on the east coast; but it is only in small quantities, and is disposed of as presents, and used in perfuming apartments.

JAPAN.—*Report by Acting-Consul Enslie, Hakodadi.*—The nearest parts of Japan whence this article is to be procured are Sendai and neighbouring provinces. Small quantities of an inferior quality also come from Nambu and Isugaru.

The average prices, if bought here, are—best quality, ¼-boo, or, taking the Mexican dollar at 5s. and 2½ boos, gives 6d. per "kin" or 1⅓ lb.; second quality, 300 cash, or 4½d. per kin.

A considerable reduction in prices is, however, experienced in contracts made in the above mentioned provinces through the Hakodadi brokers and agents, and the cost would then vary from 2½d. to 3d. per kin for the superior quality, and 2d. for the inferior resin.

Judging by the information I have obtained, I think that contracts for 500 or 1,000 piculs might be made to be delivered during the summer months.

Report by Acting-Consul Gower, Nagasaki.—Notwithstanding the numerous variety and abundant resinous trees in this country, the demand for the article is apparently so small that only two kinds are prepared.

The "thiang," or red transparent sort, is the most expensive, and costs 60 taels per picul, or (at 5s. per Mexican dollar) 2*l.* 7s. 11d. for 100 lbs.

The opaque resin is called "mazu-yani," and can be purchased for 40 taels per picul, or 1*l.* 12s. per 100 lbs.

I have found it impossible to ascertain what quantity might be procured; but I feel sure that if even a large supply was required for exportation to Europe, the Japanese could soon prepare enough to meet the demand.

The first quality is used principally by the natives for the caulking of their junks and preparation of cables, &c., as we use tar.

The cheapest resin is used in the preparation of plasters for medical purposes, and for tinker's work, which is but a very small branch of manufacture in Japan.

Mexico.—*Report by Consul Glennie.*—As it is only very recently that turpentine has come into general use in Mexico for purposes of lighting streets and houses, the source of supply of this ingredient, and consequently of resin, from the apparently inexhaustible pine forests by which the valley of Mexico is surrounded, might naturally be supposed to be undiminished; such, however, is far from being the case, for although there do exist laws for the protection of Mexican woods and forests, they are very seldom enforced, and the Indians, left to themselves, whilst cutting timber or tapping for turpentine, waste a hundred times more than they need to do. In fact, the work of destruction has been carried to such an extent during the last few years that serious complaints have recently been made to the government by individuals and by corporations; and it is expected that a special and very stringent law will ere long be promulgated, with the view of protecting the forests of this district from such wholesale demolition.

With regard to the quantity of resin in my immediate district, there is at this moment a stock on hand of about 250,000 quintals, and I have been informed by persons possessing practical knowledge of the subject, that the forests within a radius of thirty-five miles from the capital are capable of producing 200 quintals of resin per month.

With respect to quality, I have merely to say that the resin produced in this district, and sold in the shops of Mexico, is of a dark colour, and may safely be termed an inferior class of produce ; susceptible, however, of improvement by refining.

	Dolls.	c.
Cost.—The wholesale price of resin delivered in this city is, per quintal	0	87
Freight to Vera Cruz, per quintal	3	0
Ditto from Vera Cruz to England, per quintal .	0	25
Packing, shipping, and other charges, 5 per cent .	0	4
Making in all, per Mexican quintal	4	16

Consequently, 1 cwt. of resin, the produce of the forests of this district, would cost, at the exchange of 48d. per dollar, 18s. 4d., placed in any port of the United Kingdom.

The excessive cost of transport will I imagine, render this produce of the table-land of Mexico unavailable for English manufacturers.

Persia.—*Report by Consul-General Abbott, Tabreez.*—Resin is not an article produced in this province, nor have I ever heard of it as a production of Persia, which, with the exception of the strip of country lying on the western and southern shore of the Caspian, which is densely clothed with forest, and certain districts in the interior possessing a low growth of wood, is a vast tract of bare mountain, plain, and desert.

Turpentine, however, which is employed for some of the purposes to which resin is applied, is produced in Koordistan, and is brought here from thence in some quantity. It is the production of a tree of close, hard grain, and of small growth. I am assured that about 1,000 mule loads, or about 2,600 cwt., of this article, of the several qualities, may be purchased here in the course of the year. The prices at Tabreez are at present $3\frac{4}{20}$th to $\frac{12}{20}$th kesans per maun of 640 misculs, which would be equal, at the present exchange of kesans $21\frac{12}{20}$ths per 1*l.*, severally to about 48s., 51s. 3d., and 56s. per cwt.

The carriage from hence by camels to Erzeroum, and thence by mules to the sea cost at Trebizond, would amount to about 35 kesans per load, or about 12s. per cwt.; and there would be five per cent. customs duty here and 3 per cent. transit duty in Turkey to pay, besides minor expenses of packing, &c., which would probably be covered by 2 per cent. more on the purchase price.

Peru.—*Report by Mr. Jerningham, Lima.*—I find from a conversation which I have had with a gentleman here, Mr. Nation, who is well versed in botany, &c., that there are two trees in Peru, namely, the "guiacum" and "copal," from which resin, if required, could be produced in great quantities.

The "copal," is found in the districts on the eastern side of the Andes, and the "guiacum" in North Peru, in the country beyond Pinra.

In Chile he tells me there are large forests of the *Auracaria imbricata*, which gives resin; this, however, is different from the *Auracaria Braziliensis* that abounds, I think I have been told, near the Brazilian frontier of Paraguay.

I am not aware that resin from the "copal" or "guiacum" is used in Peru, for what is required here appears to be imported from the United States of North America.

RUSSIA.—*Report by Consul Renney, Archangel.*— Notwithstanding the unusual facilities for obtaining resin in this part of Russia, the article is only collected and manufactured in the Velsk district of the Vologda Government. Many years ago the quantity produced amounted to above 8,000 cwt., but the introduction of more stringent forest regulations had the effect of reducing the production to about 1,500 cwt. Under the stimulus of high prices for home consumption, caused by the want of American resin, the quantity has this year again increased to about 3,000 cwt., and next year it will probably be more, but still nothing in comparison to what it might become were the production to extend to other districts.

Besides the Velsk there are other large districts, both in the Vologda and Archangel governments, where almost the sole employment of the people is the manufacture of tar, and where the tar is principally produced from growing trees, namely, pine. In order to fit the wood for the purpose, its bark is, during several years, gradually stripped off to some height from the ground, and during this process the resin exudes. In the Velsk district the resin is scraped off and collected for manufacture in the autumn; but in the districts to which I allude it is allowed to remain, and is, I may say, wasted. The additional quantity of tar which the trees may produce in consequence of the resin not being removed must, I am led to believe, be very trifling indeed, for in felling and carrying the trees from the forest and in cutting them up, the resin is knocked off.

As there are several pitch works in these districts, the resin could be easily manufactured. The attention of the pitch manufacturers has either not been directed to the article, or their capital may be insufficient to engage in the manufacture of resin. For their pitch they find a ready market at this port, and obtain advances of money on the article during winter; whereas resin has hitherto only been saleable in Moscow and St. Petersburg, where it has to be sent by land carriage.

By a reduction of the excise duty on resin the government might stimulate the production of the article. This would not cause even a temporary loss to the revenue, for the same trees that now produce tar alone would produce both tar and resin. Regulations might also be issued by the government which would tend to cause the resin to be extracted in the first instance from trees felled for export.

With some such encouragement on the part of the government, combined with an export demand, I am convinced, that in a few years a very large quantity of resin could and would be produced in my Consular district; but, for the present, the supply being insufficient for the home consumption, no demand for export can be met. There is a coarser sort of resin, however, made from tar in the same manner as pitch, of which a large quantity could at once be furnished for exportation, the quantity of pitch exported hence this year having been about 90,000 cwt.

The quality of the resin produced in Velsk is inferior to the American, probably owing to carelessness in the manufacture. The difference of value between the two is, I am informed, about 3s. per cwt. The colour of the Russian is almost black. The kind produced from tar is but a superior sort of pitch and has the same colour. Previous to the war in America the value of resin in Velsk did not exceed 9s. per cwt.. but this year as high as 25s. per cwt. has been paid for it. There being water communication to this port from all the districts which could furnish resin, the cost of delivering it in England would be about the same as the transport to Moscow and St. Petersburg, say about 3s. 6d. per cwt.

The value of the resin from tar is from 20 to 25 per cent. above that of pitch, and may be named at present at 12s. per cwt. free on board ship, or at 14s. per cwt. deliverable in Great Britain.

SALVADOR.—*Report of Consul Hall, Sonsonate.*—The Governor of Chalatenango reports that any quantity of excellent resin may be supplied at that department at the price of one dollar per arroba (25 lbs.). He mentions the names of fourteen districts within his jurisdiction abounding in pine forests which might yield an unlimited supply. The mountains of that department bearing this tree are situated at distances of from five leagues and upwards from the town of Chalatenango. The distance from this town to Libertad is only forty leagues over good roads.

In the vicinity of Santa Anna, distant twenty leagues from the Port of Acajutla, there are also extensive forests of pine trees capable of yielding good resin.

The Governor of Sonsonate reports favourably of the quality of the resin brought for consumption in this town from the mountains on the border line of Guatemala, and gives the price of that sold here at 3 cents per lb.

The Governor of San Salvador states that he has had personally much experience in this article, which he considers of great importance to the country, and can testify to the excellence of the quality of that brought from the pueblos of Tejutla and La Palma, in the department of Chalatenango, which he has bought at the price of 3 dollars per quintal (100 lbs.), and even as low as 2 dollars, and he believes that in large quantities it might be obtained cheaper.

Some samples have been brought to me which I have had inspected by intelligent persons, and they report very favourably of their quality.

PHILIPINES.—*Report by Vice-Consul Webb, Manila.*—Resin is not produced in the Philippines, and at present there is not an ounce of that article in the market. I believe that nearly the entire quantity of resin in the world, except a small amount that is procured from Sweden, comes from the United States, and principally that of North Carolina.

There is, however, abundantly produced in the Philippines an article known in commerce as almaciga, or mastic, and which is obtained like resin from a tree. It is exported to some extent, and is used in Great Britain and Europe in the manufacture of varnish. I think it may be substituted for resin should the scarcity of the latter continue. It is produced in nearly all the provinces of the Philippines; and if the importers of resin in England be desirous of giving it a trial, the cheapest and most expeditious way of obtaining it would be to order it through Her Majesty's Vice-Consuls at Sual and Iloilo.

The price of almaciga, or gum mastic, here varies with the demand. It generally averages from 4 to 6 dollars the picul of 140 lbs., according to the quality.

SWEDEN.—*Report by Consul Engström, Gottenburg.* — Of native Swedish resin the production is small, the quality very inferior, being quite black, opaque, and impure, and the price nearly equal to the foreign.

It is brought down here from the north of Sweden in small parcels only according to the demand, and the present stock at this place is not more 2 or 3 cwt.

Were a good market open for the sale of Swedish resin, the production in the northern parts of the country might be greatly extended, and with a little more care in preparing it, the quality also improved.

The present price of Swedish resin is about 30s. per cwt. English.

Report by Consul Hunt, Stockholm.—Hitherto, resin has been an import, not an export; notwithstanding that the vast forests of Sweden are composed almost entirely of resin-producing spruce and fir, and that the wood cut in them, for most of its present uses, would be improved by the abstraction of its juices.

The high prices of the article, which have risen from about 10s. to 30s. per cwt., have now induced some persons to embark in its production; and there is a probability that this, once commenced, may lead to a regular trade of importance. There is at present no stock for exportation.

Resin is obtained by stripping the growing tree of its bark in spring when the substance exudes, in greater or less quantity according to circumstances, and yields about 1 lb. for every ten or fifteen square feet of bared wood, or between 7 and 10 lbs. of liquid resin per tree.

As the cutting of the forests has been computed by Swedish statistical writers to be 10,000,000 of tons yearly, it follows in this case, that the production of resin might be carried up to 500,000 or 1,000,000 cwt. It is in favour of such a trade that it requires no great permanent investment; but it is impossible to say to what extent even the present strong inducements will establish it.

Resin may be exported in its liquid form, as produced, or used for the distillation of turpentine spirit yielding about one-half of its weight of the hard brown resin of commerce. In either case, it would be best shipped in casks containing $2\frac{1}{2}$ cwt.

TURKEY.—*Report by Acting-Consul Heidenstam, Aleppo.*—The annual produce of resin in this district may be computed at about 225 cantars equal to about 1,125 cwt. There are two different qualities. The superior kind, of which about 25 cantars, or 125 cwt., are annually sold at Aleppo, and is known in trade here as "dufr resin," is almost all exported to England. It is worth at present in the Aleppo market from 1,800 to 1,900 piastres per cantar, about 2*l*. 10s. per cwt., free of all charges, except the Custom duty of 8 per cent., if exported. The second quality, of which a very small portion is exported to England, is valued at 1,000 piastres per cantar, or 1*l*. 14s per cwt., and is principally used by local manufacturers, or exported to other towns in Turkey.

Report by Consul-General Kemball, Bagdad.—Resin in the form of inspissated turpentine is imported into Bagdad from the Kurdish Mountains and Persia; and the supply, hitherto limited to the demand in this market, is said to be abundant, and susceptible of large increase for purposes of exportation. The quality I understand to be superior. The price, hitherto subject to little or no fluctuation, is $2\frac{1}{2}$d. and 3d. per lb.

Distillation not being practised in this country resin divested of oil of turpentine is imported from India to the small extent required for local consumption.

Report by Consul-General Longworth, Belgrade.—Resin is prepared in small quantities by the Servian peasants from the fir tree, principally in the forests on the Bosnian and Albanian frontiers. There is, however, no regular manufactory; what is made is of a very crude sort, and is entirely consumed in the country itself, none being exported. By a recent proposition of the National Assembly the destruction of the forests in Servia, by the indiscriminate cutttng of timber and the manufacture of potash, was sought to be prevented. These circumstances may stop the manufacture of the present small quantity made, which does not now average more than 100 tons yearly. Its value here is about 5*l*. the ton. The rate of freight between the south of Servia, where the resin is made, and England, *viâ* the Save, Sissek, and Trieste, is about 11*l*. the ton.

Report by Consul Sandison, Brussa.—Resin is procurable here from the forests on the skirts of Mount Olympus, and usually to the extent of 120 to 200 tons annually. But on demand the supply could probably be very considerably increased up to the amount of labour at command The forests partly belong to the Porte and partly to the villagers; but except in regulating the rights of parties by personal title or licence as renters, the trade is under no restriction, and the authorities profess their readiness to facilitate its extension. There are three sorts, the two inferior respectively worth 25 and 40 per cent. less than the best, which is good quality, costing 2 piastres the oke, with ⅗th piastre more of carriage to the coast, in all 112 piastres, or 20s. 8d. the cwt. delivered there (exchange 112 piastres per 1*l.* sterling). An extra demand might of course raise the price, and contracts must be made in advance; best from March.

During the fine season it may be shipped from the open roadstead of Mundania; but Ghio or Ghemlex, at the bottom of the gulf, is the safe accessible port at all times. Vessels freighted on purpose might load the article direct for England, or it might be forwarded across to Constantinople by the station steamers, or small craft, for transhipment from thence to its destination, as most convenient. The export duty from March 1865 will be 5 per cent., or about 5½d. per cwt., on the white or best resin, with the annual reduction of 1 per cent. till it falls to that.

Report by Consul Callander, Dardanelles.—No resin had been exported from this Consular district previous to the present year (1864). The quantity expected to be exported up to the end of the year is estimated at 120 tons.

This resin is collected by the Yourouk tribes, but from the scarcity of labour and the difficulty of conveyance to the port of shipment the supply is likely to remain limited; otherwise it is capable of being increased to 800 or 1,000 tons and upwards a-year. The quality of the resin is not very good; it is mixed with pieces of bark and adulterated with water. The price, free on board, has fluctuated from 5*l.* to 12*l.* a ton. Rate of freight to Great Britain about 30s, a ton.

Report by Consul Stuart, Janina.—The quantity of resin annually collected in Epirus is very limited, but it might be increased to a considerable amount. From the mountain forrests in the Arta districts about 800 lbs. weight is obtained every year, all of which is used in the country, as it has heretofore been in no demand for exportation. But I have been assured that under the stimulus of a brisk foreign demand the same forests could be made to yield as much as 50,000 lbs. Inclosed are two specimens of this Arta resin, from which its quality may be judged; that marked No. 1 sells in the country at 5d. per lb., No. 2 at 4d.

At present but a very imperfect idea can be formed of the quantiy of resin that might be obtained in this country, as, in the absence of profitable demand, this valuable article is but little sought after; but it may be fairly presumed that considerable supplies of it are left to waste in the pine forests which abound in most of the mountain districts of Epirus.

Report by Consul Calvert, Monastir.—The only locality producing resin in this Consular district is the pine-forest of Poretch, situated in the vicinity of Krushova, a large village in the Cazà of Kritchovo, to the north of Monastir. During the month of October the bark of the pine trees is slit, and the resinous gum allowed to flow into pits excavated at their foot. The gum is then carried to the manufactories, of which there are four, namely, one at Krushova and one at Perlépé, both eight hours distance from this town, and two in the town of Monastir. Each of these manufactories turn out 6,000 to 8,000 okes (150 to 200 cwt.) of resin annually, just sufficient for local consumption, since none has ever hitherto been exported. The manufacture of resin consists in boiling the gum as it comes from the trees, and thus separating the turpentine. The residue is a dirty yellow-coloured resin, which is made up by hand into balls the size of an orange. Its wholesale price on the spot is 25 paras the oke (about 4s. 6d. per cwt.). If there were a demand for it abroad it could be run into boxes containing about 140 lbs. weight, two of which would form a horse-load : it would then cost about 6d. per cwt. less. Its transport to the nearest shipping place (Salonica) would be 15 to 20 paras the oke (2s. 8d. to 3s. 7d., nearly, the cwt.) according to the season, it being cheaper in summer than in winter. The manufactories, according to present requirements, work only three months in the year, opening early in October and closing early in January.

The aggregate quantity of resin now produced at the four manufactories above-mentioned amounts to only 600 to 800 cwt., and its value 135*l.* to 180*l.* This quantity could easily be doubled if there were a demand for it, subject however, to the condition that the buyer of any quantity in excess of what is required for local consumption should also purchase the turpentine with the resin, there being but a limited demand in the country for turpentine. The proportion of turpentine to resin is, as nearly as I can ascertain, about ten per cent. Oil of turpentine sells on the spot at 10 piastres the oke weight, or 73s. 6d. per cwt.

Report by Consul Reade, Scutari.—Resin comes from Porece, in the province of Uscup, five days distant from this, where it is collected from the fir and pine trees that abound in that district. It is extracted in the month of May, and is brought here during the cold months, as in the hot weather it is difficult to transport, from its melting.

The quantity that could be had per annum I have not been able to ascertain.

I am assured that it might be contracted for, free on board in one of the ports of this province at about 4 piastres per oke (about 3d. per lb.)

Contracts for the resin in question should be made as early as possible, so as to afford sufficient time to collect the materials for the extraction of the resin before May.

Report by Consul Cumberbatch, Smyrna.—The Ottoman government has forbidden the collection of resin in Olivali and the neighbouring districts. There are, however, vast tracts of resin pine forests in this district, also at Adrimiti, Avdjilar, Casak, and Avunia, as well as in the vicinity of Mount Ida ; if the Ottoman government permitted the destruction of the trees, and a large and abundant supply of resin might be obtained from these districts.

Although there are vast tracts of resinous pine plantations, the people of the island of Scio, have never extracted any, except for their own private use.

It is stated that 100 to 150 tons might be collected in six months on the island of Mytilene.

No doubt, if permission to extract were given, and a better method adopted for collecting the resin, a much larger supply might be obtained from this district. The quality of the resin is good, though not so clear as the American resin.

The price is about 1½ piastres per oke, or about 11*l.* per ton.

ZANZIBAR.—*Report by Lieutenant-Colonel Playfair.*—Of the common resin of commerce, the produce of coniferous trees, there is none obtainable here; but other valuable resins are found on the East Coast of Africa, and exported to India, England, and the Continent of Europe.

Of these the most important, and almost the only one exported from Zanzibar, is copal, which is found both in a fossil and a recent state; the average price is about 6 lbs. for one Austrian dollar, and during the year 1863-64 163,353 dollars worth was exported to the following places:—

	Dollars.
United Kingdom	30,030
British India	50,044
Kertch	500
United States	5,000
Hamburgh	30,000
Italy	2,339
Total	163,353

The quantity of other resins, principally oblibanum or frankincense, was hardly appreciable; that is exported from the African Coast, west of Cape Guardafui, principally to the Aden and Bombay markets.

WOOD PULP FOR PAPER.

BY THE EDITOR.

AMONGST the multitude of materials which have been proposed for the manufacture of paper, perhaps wood has been suggested the greatest number of times. On several occasions the manufacture has been successfully carried out, and we saw some years ago really good paper for printing purposes produced from deal shavings by the patent of J. and C. Watt. We are induced to take up the subject now by finding attention prominently drawn to wood pulp for paper in the 'Paper Makers'

Monthly Journal,' and from the fact that this wood pulp is advertised for sale in London. We have specimens in our collection of many wood papers, and also of wood pulp which was shown at the Exhibition in 1862 from Sweden and Germany.

A French lady has succeeded in manufacturing excellent paper from wood, and at a price much lower than that made from rags. Her method consists chiefly in the use of a new kind of machinery for reducing the wood to fine fibres, which are afterwards treated with the alkalis and acids necessary to reduce them to pulp, and the composition is finally bleached by the action of chlorine. By means of a series of parallel vertical wheels, armed with fine points, which are caused to pass over the surface of the wood in the direction of its fibres, the surface of the wood is marked, and the outer layer is formed into a kind of net, without woof, composed of separate threads. This layer of fine threads is afterwards removed by means of a plane, which is passed across the wood, and the portion thus removed, which resembles lint or flax, is then treated with chlorine, &c. Specimens have thus been made consisting of a mixture of 80 per cent. of wood pulp, and 20 per cent. of rag pulp, and sheets have been tried by printers, lithographers, and others, with very satisfactory results. It is the unanimous opinion of the engravers and lithographers who have used it, that paper made according to this method, from wood, and which costs only 16*l.* per ton is quite equal to the China paper, which costs 214*l.* per ton. It is confidently expected that experiments upon a large scale will confirm the results already obtained.

The range of choice of wood for paper making is by no means limited; the pine family contributes, however, most largely to the manufacture. But another question of economy arises which has excited much inquiry and invention, namely, the most advantageous method of reducing solid wood to the requisite degree of fineness for subsequent treatment.

The most ingenious method of disintegrating the fibre of wood which we have yet heard of is a Yankee "notion." Wood is placed in a cannon, the mouth of which is plugged up. High-pressure steam is then forced in through the touch-hole, and when the pressure rises to a sufficient degree, the plug, together with the wood, is blown out, the latter being reduced to the appearance of wool by the expansive force of the steam, with which its pores have been filled whilst in the cannon. Experiments conducted by Mr. Robertson, at the Albion Foundry, Hobart Town, to illustrate the practicability of thus exploding bark into fibre by steam power, proved highly successful: the bark, which was inserted in large solid masses into what we may call the steam-digester, being discharged in the shape of a fine fibre.

In some Belgian paper-mills wood is now used as a substitute for rags, to the extent of from 20 to 30 per cent., for printing papers.

Early in 1826, the brothers Cappucino, papermakers of Turin, discovered the means of supplying the want of rags by the fabrication of paper from the thin bark of the poplar, with one or two other kinds of wood. The Academy of Sciences having examined the specimens of writing, printing, and wrapping paper thus produced, acknowledged their goodness and praised the invention. The King granted to the brothers an exclusive privilege for ten years for the manufacture of paper from ligneous materials.

In 1838, James Vincent Desgrand took out a patent in this country for making paper and pasteboard with wood reduced into a state of paste, and of the different sorts of wood that came under the denomination of white woods, he found poplars answer the best. In 1855, William Johnson was granted a patent for improvements in the application of various substances containing woody fibre to the manufacture of white paper pulp, as the inner bass of the lime tree and other Tiliaceæ, the willow, birch, and elder.

In 1857 and 1858, Mr. W. E. Newton took out patents for improved methods of preparing wood pulp. The wood pulp on Volter's patent has been tried in America, and a very satisfactory article produced from it. The Boston papers have already printed on it, and from some stray copies that have reached this country it seems to be successful in its result. The colour is white and the body is tough, which cannot be said of American newspaper generally, while it prints well.

A very excellent method of manufacturing paper and pasteboard pulp from wood, originally invented by M. Hartmann, has been improved upon by Mr. Schlesinger, of Bradford, who, after taking much trouble to introduce the plan into this country, is now, as the working partner of the inventor, conducting the process with great success. As the manufacture of paper is a subject at present forcing itself upon public attention, it seems desirable to give prominence to every good improvement relating to it. *Process* :—Cut a tree (say 6 feet long and 2 feet diameter) into nine lengths of 8 inches by 2 feet diameter each ; place these blocks into the boxes, with the fibres running in the same direction as the stone turns ; lever them ; then start the stone at the rate of about 200 revolutions per minute. By the foregoing process a fibrous pulp is obtained equal to that of ordinary rag pulp, and lower in price. Moreover, this wood pulp has the advantage of absorbing a greater quantity of mineral than ordinary rag pulp, without deteriorating the srtength of the pasteboard or paper. Light or hard woods will take the dye of even the most delicate colours as readily as rag pulp. According to Mr. Schlesinger's calculation, he produces a pound of dry wood pulp at about one penny, and makes no doubt that, in districts where wood and power can be had cheaper than at Bradford, it may be made at five-eighths to three-fourths of a penny per pound of dry pulp. The cheapest classes of wood, as fir, pine, poplar, willow, &c., suit his purpose best. We have had highly satisfactory specimens of the papers and pasteboards above enumerated submitted to our inspection.

We see that the idea of making a paper pulp out of wood is not new, but the trials to which such pulp was subjected at first did not succeed well, as the inventors only aimed at the production of a fine sawdust, or wood powder, which, by the shortness of its fibre, possessed no felting property, and had therefore soon to be rejected.

Mr. Völter, paper-maker of Heidenheim in Germany, who commenced twenty-five years ago to use wood pulp for his papers, succeeded after many trials with sawdust and wood powder in making an efficient pulp, by separating the wood into its elementary fibres, and this pulp is capable of being used largely with ordinary and middle fine papers. It has been generally employed in Germany and Belgium; and Mr. Gratiot, President of the French Paper-makers' Club, called the attention of French paper-makers to this pulp in his speech lately delivered with reference to the abolition of the export duty on rags in France.

Besides the above-named countries, these machines are at work in France, Denmark, Austria, Russia, Switzerland, and Sweden, altogether sixty-one having been sold by Mr. Völter during the last three years. We have also seen some samples of wood pulp prepared by these machines, the purity and fineness of which is really surprising. Fir wood pulp shows a somewhat yellowish colour, but aspen wood pulp is white.

We let Mr. Völter speak for himself about the capabilities of his pulp :—

" Wood pulp can be used with rag pulp according to the quality of the rag pulp and the quality of the paper required, in quantities of 15 to 80 per cent.; generally the following proportions are taken :—

"Fifteen to thirty per cent. for middling writing and printing papers.

"Thirty to fifty per cent. for common writing and printing papers.

"Fifty to eighty per cent. for paper hangings, mill boards and paste-boards can be made entirely of wood pulp.

" The application of wood pulp does not in the least exclude the use of China clay, analine, or pearl white, wherever these substances are admissible; fir and pine wood pulp especially bear China clay extremely well.

" For printing papers wood pulp is very well fit, because

" 1. It prevents in a great degree the transparency of the paper.

" 2. The papers containing wood pulp show a clear, sharp impression, and consume less ink.

" 3. The types are less worn out than with other papers, because wood pulps contain no hard, impure parts.

" For thin and tissue papers, where China clay is totally unfit, wood pulp can be taken in large quantities.

" The sizing and colouring of the paper is in no way hindered by an addition of wood pulp, as it takes size and colour just as well as rag pulp. Although wood pulp cannot be bleached cheaply, it is not excluded thereby from the manufacture of better papers, as a small admixture of China clay or the overbleaching of the accompanying rag pulp does hereby good service.

"A paper-manufacturer working with water power can easily augment his yearly production by the use of wood pulp. In the summer months when the water supply of many a factory often sinks to the half of its normal state, and the rag engines cannot be worked for want of power, the production of paper can be kept on a corresponding height by using wood pulp, its proper mixture with the rag pulp requiring little labour and consuming little power. But in regular times, those that know how to use wood pulp also find it easy to augment their daily production to a certain degree, by giving to the paper machine a higher speed than it is commonly worked at.

"The advantages to be gained by the application of wood pulp may be summed up as follows :—

"1. Its cheap price compared to that sort of rags which wood pulp is capable of replacing.

"2. Its great natural purity and fineness of fibre, in which qualities the wood pulp far surpasses common rag pulp, and it is made wholly by mechanical operations, untouched by any chemical process.

"3. Its capability of quick application, as it leaves the wood pulp machine as a ready ground pulp, and can be used without any further manipulations.

"4. Rag pulp, which is mixed with wood pulp, requires less washing than unmixed rag pulp to obtain a paper of equally light tint ; there is consequently less waste, and a saving of time and power.

"5. Paper manufacturers using wood pulp require less rag engines, and by the power they save thereby can increase their production.

"6. Wood pulp paper can be made with less expenses than other paper."

At the Dublin Exhibition this year Mr. C. A. Koether of Cassel received a medal for the excellence and cheapness of his wood pulp and the samples of paper made therefrom shown in the Zollverein department. Mr. W. K. Sullivan in his report for the jury states—"Many years ago, several attempts were made to employ wood as a material for paper. It was only, however, within the last fifteen years that the peculiar difficulties which wood offers to being converted into a good uniform pulp, free from lumps and capable of flowing evenly on the guage of the paper machine, have been successfully overcome. Two manufacturers appear to have obtained this practical success, M. Chauchard, of Paris, and Herr H. Völter, (H. Völter's Söhne) of Heidenheim, in Wurtemberg. Mr. Völter especially seems to have made wood one of the regular raw materials of paper, for several pulp manufactories on his system have been set up in Germany, France, and elsewhere.

Mr. Koether seems to work upon Völter's system. He exhibits samples of different qualities of "stuff" made from four woods, the linden, the aspen, the pine, and the Scotch fir. These samples, which are of excellent quality, are of very moderate price. He charges for fifty kilogrammes or 110 lbs. the following prices :—

	No 1.	No 2.	No 3.
Linden, aspen, and pine stuff.	$5\frac{1}{3}$ Thalers or about 16s.	$4\frac{1}{2}$ Thalers or about 13s.	$3\frac{1}{2}$ Thalers or about 10s.
Scotch fir stuff.	$4\frac{1}{2}$ Thalers or about 13s.	$3\frac{2}{3}$ Thalers or about 11s.	3 Thalers or about 9s.

The samples of paper made from mixtures of rags with different proportions of these pulps are excellent, and show a decided progress in wood paper manufacture since 1862. Among them may be specially mentioned a good writing paper, containing 45 per cent. of Scotch fir stuff; an excellent tough lapping paper, containing 65 per cent. of the same material; and a coloured lapping tissue paper, which is exceedingly strong, containing 50 per cent. of wood pulp.

The Hobart Town 'Mercury' draws attention to the bark of the "Tea-tree" (the broad-leaved is a *Leptospermum*, and the narrow-leaved a *Melaleuca*), which abounds in the forests of Tasmania, as admirably adapted for the manufacture of paper. Nature manufactures paper from it "of her own accord." "During the summer months, when the trees shed their leaves and bark, these accumulate in the gullies and dry creeks. So soon as they are brought into contact with the water they form of themselves a thick pulp, which spreads itself over the uneven surface of the water-courses, and which, after it has been deserted by the water, remains spread out into a huge sheet of stiff brown paper. The supply is inexhaustible. The rough bark peels off in numerous thin membranous folds.

A species of *Eucalyptus*, the Stringy-bark tree (*E. obliqua* or *E. fabrorum*), constitutes, in very extensive mountain districts of Victoria, the principal part of the forests. Hence it is not improbable that its bark, which is readily separable, thick, and fibrous, although not tenacious, will not merely continue to supply the roof for the first rustic dwellings of the settlers, but may eventually be drawn into use for the manufacture of a coarse paper, although neither this nor other native products, (*Isolepis nodosa*, *Stipa crenata*, *Leptospermeœ* and *Lavatera plebia*) are likely to yield a paper comparable to the available maize leaves and stalks in Australia.

The bark of the large-leaved Nettle-tree of Australia (*Urticu gigas*), a tree very plentiful in the cedar brushes upon the banks of the Clarence, in New South Wales, might be utilized. The bark is from $\frac{1}{4}$ to 1 inch thick, and consists of a large proportion of fibre, the interstices of which are filled with a watery juice and soft vegetable matter, both of which are easily removed by crushing or beating the bark until it becomes nearly dry. Steeping in water will not succced: the whole of the bark rots together. Should this material be found suitable for making ropes, bags, or paper, a large quantity might be procured at from 3d. to 4d. per pound, provided some cheap and portable machine could be found to prepare it readily.

Two pairs of rollers, worked by a horse, would do the work effectually : one pair of the rollers to bruise the bark moderately in the first instance, and the second pair sufficiently close to squeeze out the watery and pulpy matter. This, with washing and drying, would partially prepare it ; or some scutching or tearing machine, which would separate the fibres, might be found best adapted for the purpose.

In the year 1800, Matthias Koops patented a method of extracting ink from printed and written paper, and re-converting such pulp into writing and printing paper. In the following year he also obtained a patent for manufacturing paper from hay, straw, thistles, waste and refuse of hemp and flax, and different kinds of wood and bark.

The graceful and useful bamboo is the source of paper supply in China. The paper made from its culm is sufficient to meet the common demands of the Chinese. It is, for the most part, of a quality unfit for European books and newspapers, but in some places the article is manufactured with such care as to answer even for foreign writing-paper. The Anglo-Chinese newspapers, however, find it better to import their material from England. The paper mulberry also contributes to the paper demand in China, and so does rice-straw. Does the reader inquire what becomes of the cast-off or, rather, fallen-off garments of the uncounted millions of China ? The world of letters can derive no aid from Chinese rags until leather becomes more abundant in that country. Crispin claims them all for soles : the shoes of China have soles an inch thick, formed of suitably-prepared paper rags, fixed with a thin strip of leather.

The leaves of Indian corn (*Zea mays*), have often been experimentalized on, and recommended as a paper material, but have not yet come into general use. The supply of this waste substance might be very large. The chief use of the leaves, &c., hitherto, has been for packing purposes, stuffing mattresses, and wrapping oranges. When we consider the enormous crops of maize in North America alone, the material, if husbanded, might become profitable. Recent experiments have proved it to possess, not only all the ordinary qualities necessary to make good paper, but to be in many respects actually superior to rags. Indian corn, it is true, cannot be grown except in countries with a certain degree of temperature—at least, not with the prolific result of warmer climates ; yet the plant is of frequent occurrence all over the continent of Europe, and can be easily cultivated to a degree more than sufficient to satisfy the utmost demands of the paper market. Besides, as rags are likely to fall in price before long, owing to the extensive supply of material resulting from this new element, the world of writers and readers would seem to have a brighter future before it than the boldest fancy would have imagined a very short time ago. This is not the first time that paper has been manufactured from the blade of Indian corn ; but, strange to say, the art was lost and required to be discovered anew. As early as the seventeenth century, an Indian-corn paper-manufactory was in full operation at the town of Rievi, in Italy, and enjoyed a world-wide reputation at the time; but with the death of its proprietor the secret seems to have lapsed into oblivion. The manifold attempts subsequently made to continue the manufacture were always baffled by the difficulty of removing the silicious, resinous, and glutinous matters contained in the blade.

The recovery of this process has at last been effected, and is due to the research of one Herr Moritz Diamant, a Jewish writing-master in Austria. Having busied himself for some time in experiments on Indian corn, the ingenious discoverer has at length been rewarded with the desired results of his labour; and a trial of his method on a grand scale, which was made at the Imperial manufactory of Schlögelmühle, near Glegnitz (Lower Austria), has completely demonstrated the certainty of the invention. Although the machinery, arranged as it was for the manufacture of rag paper, could not, of course, fully answer the requirements of Herr Diamant, the results of the essay were extremely favourable. The article produced was of a purity of texture and whiteness of colour that left nothing to be desired; and this is all the more valuable from the difficulty usually experienced in the removal of the impurities from the rags. Knots, and other inequalities of surface, so frequent in the ordinary paper, and which give so much trouble in printing, the new product is entirely free from, and this without the material undergoing any special process to attain the desired end.

Another great advantage, and this in an economical point of view, is the reduction of the steam power required in the manufacture by *one-third* of its present amount, in consequence of the material being reduced to pulp by chemical, and not, as at present, mechanical agency. The present proprietor of the invention is Count Carl Octavio Lippe, of Wessenfold, who has bought it from the originator, and from several experiments deduced the following results:—

1. It is not only possible to produce every variety of paper from the blades of Indian corn, but the product is equal, and in some cases even superior, to the article manufactured from rags.

2. The paper requires but very little size to render it fit for writing purposes, as the pulp naturally contains a large proportion of that necessary ingredient, which can at the same time be easily eliminated if desirable.

3. The bleaching is effected by a very rapid and facile process, and, indeed, for the common light-coloured packing-paper, the process becomes entirely unnecessary.

4. The Indian corn paper possesses greater strength and tenacity than rag-paper, without the drawback of brittleness, so conspicuous in the common straw products.

5. No machinery being required in the manufacture of this paper

for the purpose of tearing up the raw material and reducing it to pulp, the expense, both in point of power and time, is far less than is necessary for the production of rag paper.

Count Lippe having put himself in communication with the Austrian Government, and imperial manufactory for Indian-corn paper (*mais-halm papier*, as the inventor calls it) is now in course of construction at Pesth, the capital of the greatest Indian-corn-growing country in Europe. Another manufactory is already in full operation in Switzerland ; and preparations are being made on the coast of the Mediterranean for the production and exportation, on a large scale, of the pulp of this new material.

It is not merely the blades of Indian corn, but the leaves, the tassel, the sheathing of the grain, the cob, and the stalk might all, I believe, be utilized by the paper-manufacturer. A reference to the list of paper materials patented, already given, shows that this substance has often been taken into consideration, but never as yet been obtained in quantity, or manipulated upon satisfactorily. Let us hope that a great traffic will arise in this cheap, and useful material, and that English vessels will, before long, be freighted with ship-loads of books and papers *in futuro*. In Brandenburg, with its indifferent soil, and where the temperature is certainly not higher on the average than that of Great Britain, Indian corn, though a novel introduction, may now be seen on many a sandy acre rearing up its broad leaf-blades to a height of half a dozen feet or upwards.

Another wild plant which has lately come into general use for paper manufacture is one known as Alfa (*Stipa tenacissima*), esparto, sparto, or spartum. Several species of this grass grow wild on both shores of the Mediterranean for about five degrees of longitude, and are particularly abundant in some of the seaboard provinces of Algeria. They are found upon arid, rocky soils, having bases of silica and iron. In Spain the herbaceous stalks of esparto have been used as a textile for centuries, for ropes, mats, sandals, baskets, &c. ; also in the manufacture of a coarse paper. *Lygeum spartum, Stipa gigantea, S. barbata,* and other species, are also employed.

The attention of the French Government has for years past been directed to this plant 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. In consequence, however, of the difficulty of transport, and the imperfect methods then employed in its preparation, little progress was made ; but the recent legislative enactments in England respecting paper, and the increasing prices of rags abroad, have caused the manufacturers here to pay more attention to this plant, and experience has proved not only its superiority to straw, but its perfect adaptability to making paper, either by itself, or when mixed with straw or rags.

The efforts which have been made to utilize more generally the herbaceous stalks of this grass have been attended with the most beneficial results, and for paper pulp it has been found exceedingly valuable producing paper of great strength and tenacity. A large paper-mill has been established at Arba, near Algiers, and the *Akhbar* daily paper, one of the oldest journals of Algeria, is now printed on paper of African origin, made of the fibres of alfa, diss (*Arundo festucoides*), and of the dwarf palm (*Chamœrops humilis*), all wild plants, met with in abundance.

The prosecution of an export trade in these fibres was long retarded by the stringent customs regulations of France.

M. Michel Chevalier, some years ago, pointed out that the man of business-enterprise and capital in Algeria was placed in the same tantalizing situation as Sancho Panza in the island of Barataria: in the presence of a table covered with dainty viands, he was continually arrested by the command of the doctor, who prohibited his touching the various delicacies which tempted his appetite.

"The plains of Algeria," wrote M. Chevalier, "offer, without culture, a plant excellently adapted for making paper of the first quality: this is alfa, or esparto. The importation into France is permitted in the rough state—that is, with the stalks or stems tied up in bundles, like forage. From their excessive bulk, it is scarcely possible to transport them profitably any great distance, or to ship them; but when, by maceration, it is made into a pulp, and greatly diminished in weight and bulk, so as to be conveniently transportable, it is prohibited in France. The time is coming, however, when France will be open without duties to all Algerian productions."

Recent measures, taken by the Minister for Algeria, have greatly modified the customs regulations for French colonies. All its natural products, and a great many of its industrial and manufactured products, are now freely admitted.

The alfa, in its wild state, grows in a tuft or clump, of which only such stalks as have come to maturity and are full of sap ought to be gathered. If gathered too green, it produces a transparent fibre, with immense waste; if, on the other hand, too ripe, the constituent elements of silica and iron are with difficulty removed. The proper months for the harvest in Africa are, therefore, 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 40 per cent. of its weight; but even in this latter condition it is so cumbersome that when shipped in loose bundles, one ton weight occupies from four to five tons space. When placed under a hydraulic press, however, it can be packed into bales, with iron hoops, which reduce it to half the above volume, as far as space is concerned, each bale averaging about $2\frac{1}{2}$ cwt., and 10 bales weighing $1\frac{1}{4}$ ton. When thus compressed, the alfa 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.

In the above manner, considerable exports have lately taken place to France and Belgium, where its use is every day increasing; and it is now introduced upon the English market in the same form, with the conviction that the superior advantages of packing, as well as condition and quality, will not fail to attract the notice of paper-manufacturers. The method of treatment for paper is now so well known that any detailed statement is unnecessary.

The chemical constituents of the plant are as follows:—

Yellow colouring matter	12·0	
Red " "	6·0	26·5
Gum and resin	7·0	
Salts, forming the ashes of the Alfa ...	1·5	
Paper fibre...		73·5
		100·0

M. de Paravey, in a recent communication to the Academy of Sciences, Paris, called the attention of the members to a plant from which an excellent kind of paper is made in Upper Scinde and to the north of the Himalaya Mountains. This paper is much used in Thibet, and amongst the native bankers of India; and its employment is referred to by Moorcroft and other travellers. When it has become soiled and written upon, it can be made up again and rebleached. The plant in question is the *Ruscus aculeatus*, commonly known in this country as butcher's broom, which is met with in considerable quantity in most woody districts.

A paper read by Chevalier Claussen, at one of the meetings of the British Association for the Advancement of Science, on plants which can furnish fibre for paper pulp, contained some interesting information.

"The paper-makers are in want of a material to replace rags in the manufacture of paper, and I have, therefore, turned my attention to this subject. To make this matter more comprehensible, I will explain what the paper-makers want. They require a cheap material with a strong fibre, easily bleached, and of which an unlimited supply may be obtained. I will now enumerate a few of the different substances which I have examined for the purpose of discovering a paper-substitute for rags, containing about 50 per cent. of vegetable fibre mixed with wool or silk, which are regarded by the paper-makers as useless to them, and several thousand tons are yearly burned in the manufacture of prussiate of potash. By a simple process, which consists in boiling these rags in caustic alkali, the animal fibre is dissolved, and the vegetable fibre is available for the manufacture of white-paper pulp. Jute, the inner bark of *Corchorus Indicus*, produces a paper-pulp of inferior quality, bleached with difficulty. Agave, *Phormium tenax*, and banana or plantain fibre (Manila hemp), are not only expensive, but it is nearly impossible to bleach them. The banana leaves contain 40 per cent. of fibre. Flax would be suitable to replace rags in paper-manufacture, but the high price and scarcity of it, caused partly by the injudicious way in which it is cultivated, prevent that. Six tons of flax straw are required to produce one ton of flax fibre, and by the present mode of treatment all the woody part is lost. By my process the bulk of the flax straw is lessened by partial cleaning before retting, whereby about 50 to 60 per cent. of shoves (a most valuable cattle-food) are saved, and the cost of the fibre reduced. By the foregoing it will be seen that the flax plant only produces from 12 to 15 per cent. of paper pulp. All that I have said about flax is applicable to hemp, which produces 25 per cent. of pulp, Nettles produce 5 per cent. of a very beautiful and easily-bleached fibre. Palm-leaves contain 30 to 40 per cent. fibre, but are not easily bleached. The *Bromeliaceæ* contain from 25 to 40 per cent. fibre. *Bonapartea juncea* contains 35 per cent. of the most beautiful vegetable fibre known ; it could not only be used for paper pulp, but for all kinds of manufactures in which flax, cotton, silk, or wool is employed. It appears that this plant exists in large quantities in Australia, and it is most desirable that some of our large manufacturers should import a quantity of it. The plant wants no other preparation than cutting, drying, and compressing like hay. The bleaching and finishing may be done here. Ferns give 20 to 25 per cent. fibre, not easily bleached. *Equisetum* from 15 to 20 per cent. of inferior fibre, easily bleached. The inner bark of the lime-tree (*Tilia*) gives a fibre easily bleached but not very strong. *Althæa* and many *malvaceæ* produce from 15 to 20 per cent. paper pulp. Stalks of beans, peas, hops, buckwheat, potatoes, heather, broom, and many other plants contain from 10 to 20 per cent. of fibre, but their extraction and bleaching present difficulties which will, probably, prevent their use. The straws of the cereals cannot be converted into white-paper pulp, after they have ripened the grain: the joints or knots in the stalks are then so hardened that they will resist all bleaching agents. To produce paper pulp from them they must be cut green before the grain appears, and this would probably not be advantageous. Many grasses contain from 30 to 50 per cent. of fibre, not very strong, but easily bleached. Of indigenous grasses the rye-grass contains 35 per cent. of paper pulp ; *Phalaris*, *Dactylis*, and *Carex*, 30 per cent. Several reeds and canes contain from 30 to 50 per cent. of fibre easily bleached. The stalk of the sugar-cane gives 40 per cent. of white pulp. The wood of the *Coniferæ* gives a fibre suitable for paper pulp. I made this discovery accidentally in 1851, when I was making flax-cotton in my model establishment at Stepney, near London. I remarked that the pine-wood vats in which I bleached were rapidly decomposed on the surface into a kind of paper pulp. I collected some of it, and exhibited it in the Great Exhibition ; but as, at that time, there was no want of paper material, no attention was paid to it. The leaves and top-branches of Scotch fir produce 25 per cent. of paper pulp. The shavings and sawdust of wood from Scotch fir give 40 per cent. pulp. The cost of reducing to pulp and bleaching pine-wood will be about three times that of bleaching rags. As none of the above-named substances or plants would entirely satisfy on all points the wants of the paper-makers, I continued my researches, and at last remembered the *Papyrus* (the plant of which the ancients made their paper), which I examined and found to contain 40 per cent. of strong fibre, excellent for paper, and very easily bleached. The only point which was not entirely satisfactory was relative to the abundant supply of it, as this plant is only found in Egypt. I directed, therefore, my attention to plants growing in this country, and I found, to my great satisfaction that the common rushes (*Juncus effusus* and others) contain 40 per cent. of fibre, quite equal, if not superior, to the papyrus fibre, and a perfect substitute for rags in the manufacture of paper, and that one ton of rushes contains more fibre than two tons of flax-straw."

Colonel Jenkins, in a communication made to the Agri-Horticultural Society of India, observes :—" We have no end of allied plants in the families *Cyperaceæ* and *Juncaceæ*, and if it were found practicable in this country to reduce the plants to a pulp, we might be able to import it in large quantities in a dried and packed state ; or the plants might be dried only and then be pressed into bales to be reduced to pulp at home by machinery. Of nearly all the *Cyperuses*, mats are made by the natives, and some of them are beautifully white, and there seems but little doubt we might send them home in the state as prepared for being woven into mats with no small profit if found to be well adapted for making paper. Mats are also made of various Juncuses, and they are so similar that I have no doubt they can be equally used. I think it also likely that our common *Phrynium dichotomum* (Calcutta mats) might be found serviceable, and other plants of the families of *Marantaceæ* and *Zingiberaceæ :* the *Alpinias*, for instance, and *Costuses*, of which plants there are no end throughout the eastern districts. In Herring's work, " On Paper and Paper Machinery," there is a brief mention of the mode in which pulp is manufactured from the bamboo by the Chinese, p. 31 ; but though the bamboo paper may be useful for many purposes, the cheapest article and the best will be found amongst the grasses. If wheat-straw affords a good pulp for paper, I should think rice-straw would give a better, for it is apparently a much tougher substance.

Another waste product which has been attempted to be more extensively utilised is that pest to agriculturists, the thistle. A number of persons, it is stated, have been lately employed in the neighbourhood of Sens (Yonne) in collecting thistle-heads for a paper-manufacturer, who uses them as a substitute for rags. There is abundance of this raw material to be obtained at a cheap rate in many countries. An Australian paper observes :—"It is so customary to think and speak of the thistle only as a nuisance to be extirpated, that the settler is slow to believe this much-despised plant can be of any value. It is a fact, however worth noting, that horses and cattle are exceedingly fond of the thistle. It is true they will not crop it as it grows from the ground, but this is simply because the sharp spines or prickles with which the plant is studded injure the animal's lips and prevent him from chewing it. But let the thistles be cut down or rooted up, and allowed to lie exposed for a day or two ; the spines will then droop and become quite soft, and in this state horses or cattle will prefer the thistle to almost any kind of green food. Within these few days past we have seen horses rejecting rich grass-feed indulge themselves on thistles which had been rooted up a few days before, and had become soft, and there was no mistaking the relish with which the animals were feeding. A gentleman in this neighbourhood who had noticed the fondness of the horse for the thistle in this state, and observed the fattening qualities of the plant is accustomed to leave a quantity growing in his paddock, which he cuts when young for use. Both horses and cattle, with an exercise of instinct which almost amounts to reasoning, have been known to trample on the thistle when growing in the ground, for the purpose of crushing the spines, after which they will eagerly eat the plant. It may be observed that the thistle which abounds in these districts is of the variety known as the Pampas thistle, and was originally introduced from South America, the seeds having been probably conveyed entangled in the manes of imported horses. The plant is of a very succulent nature ; and, since it seems almost impossible to extirpate it, it would be good policy, at all events, to turn it to some useful account, as may easily be done by anyone who will be at the trouble to try the experiment."—'Goulburn Chronicle.'

In Head's "Rough Notes of Journeys across the Pampas," he states that he passed through a region covered for 180 miles with clover and thistles. In winter the leaves of the thistles are large and luxuriant, and the whole surface of the country has the rough appearance of a turnip-field. In spring, the clover has vanished, the leaves of the thistles have extended along the ground, and the country still looks like a rough crop of turnips. In less than a month the change is most extraordinary : the whole region becomes a luxuriant wood of enormous thistles, which have suddenly shot up to a height of ten or eleven feet, and are all in full bloom. The road or path is hemmed in on both sides ; the view is completely obstructed ; not an animal is to be seen ; and the stems of the thistles are so close to each other, and so strong, that, independent of the prickles with which they are armed, they form an impenetrable barrier. The sudden growth of these plants is quite astonishing ; and though it would be an unusual misfortune in military history, yet it is really possible that an invading army, unacquainted with the country, might be imprisoned by these thistles before they had time to escape from them. The summer is not over before the scene undergoes another rapid change: the thistles suddenly lose their sap and verdure, their heads droop, the leaves shrink and fade, the stems become black and dead, and they remain rattling with the breeze one against another, until the violence of the pampero, or hurricane, levels them with the ground.

In the Russian steppes the wormwoods and thistles grow to a size unknown in the rest of Europe; it is said that the thistle-bush found where these abound is tall enough to hide a Cossack horseman. The natives call all these rank weeds, useless for pasture, *burian*, and, together with the dry dung of the flocks, this constitutes all the fuel they possess.

According to a patent taken out in July, 1854, by Lord Berriedale, all varieties of the thistle are applicable for paper-making, but more particularly the large Scottish thistle, which grows much too luxuriantly in many parts of Great Britain, attaining a great height and thickness of stem, and which furnish in each plant fibre of great tenacity to a large amount. This, when duly prepared, is stated to be well suited for the preparation of a paper pulp, which will cohere very powerfully, as well as prove useful in textile manufactures. It may be used either green or dry; if for paper it goes through a process similar to that which rags are subject to, and if for manufactures, like flax.

The common stinging-nettle has a splendid fibre, and in Germany has been made into first-class paper. The world is so prosperous, so well to do, and well dressed, that commerce cries in vain for rags to feed the paper-mills. And here are millions of reams of the green material—the much-abused and long-neglected nettle—idly growing in our very ditches. And now this thing of ditches shall be gathered and steeped, and daintily manipulated, and come forth to the world in its revealed self, the whitest, purest paper! Beauty that would squeal at a touch of the saw-edged leaf of the nettle, calling it a cruel odious thing, may now lay her hand on the purified leaf, and, tracing thereon gentlest thoughts for eager, happy eyes, may bless the common stinging-nettle.

It has been proved, then, that paper can be made of almost anything,—from the bark of trees, the down of the Asclepiads, whose rankness is one of the greatest nuisances the gardener has to contend with,—silk, flax, or cotton waste,—seaweed, the tendrils of the vine, beetroot refuse, cabbage-stalks, potatoes, wood-shavings, and sawdust,—ferns, grasses, nettles, and peat, a substance covering hundreds of thousands of square miles in Ireland and other parts of Europe. I have seen samples of beautiful drab-coloured paper made in Western Canada, from scraps of leather, straw, and rags.

There are thousands of fibrous materials in the world of nature that the art of man can macerate into pulp, and shape into paper. The very wasps with their weak mandibles construct their paper nests as a lesson for him; while ocean and river, by their action on vegetable substances, show him the adaptability of certain plants to felt and cohere into paper material. A hundred substances are ready for trial round anyone's country residence, some of which would succeed. Much of the great pressure might be relieved as to material, if coarse and coloured papers were more generally used. In America many substances are used that paper-makers in England never dream of; such as marsh-hay, oat and barley straw, cane-brake, Indian corn stalks, and woollen refuse. These are mixed up with a little strong fibre, and every pound of such substance releases a pound of materials fit to purify and bleach for fine papers.

Varieties of fibres adapted to replace rags in the manufacture of paper could be had in great abundance in Trinidad. The coarser qualities are obtainable in enormous quantities from the palms and other indigenous plants. A systematical botanical examination of the colony would allow its natural products to be favourably contrasted in quality and quantity with those of a similar nature from the Baltic, with whose shores communication, at all times uncertain, is occasionally liable to interruption from natural or political causes.

The uses of paper in Japan are innumerable, of which the large collection sent home by the Japanese Government, through Sir Rutherford Alcock, to the International Exhibition of 1862, affords a striking example.

The Japanese paper handkerchiefs will be coming into use here soon; at least, paper neck-kerchiefs, scarfs, or neck-ties, "in almost every colour and pattern," are among the latest of those inventions for which Mr. Gladstone and his removal of the tax on paper must be held responsible. It is not paper neck-ties alone, however, that are now advertised as the latest novelty in the paper-drapery line, but "paper bands for clergymen and members of the bar,"—especially those "members of the bar" we dare say, who have plenty of room in their empty brief-bags for a stock of paper-drapery. There are also "paper-shirt-fronts," "paper waistcoats," "paper hats, waterproof," and "paper bonnets of the latest fashion, trimmed with paper lace and paper flowers;" besides "paper lace," and "paper lace collars, cuffs, and stomachers for ladies," and various other forms of paper-drapery, millinery, and mantua-making.

Of the paper neck-ties the 'Critic' says:—"They are printed in imitation of silk and gingham, with such exactness as to defy detection, save on close inspection!" The same paper states that, at a recent meeting of the paper-manufacturers, "some extraordinary samples of newly-imported Japanese paper were exhibited, one of which was of such prodigious strength that the material of which it is composed might be manufactured into ropes; and another which is fit for bed-hangings and wearing apparel, so much resembles stuffs of wool and silk that it is often taken for them." Thus, like so many others of our

Western novelties, we see that paper-drapery, or linen shoddy, is an Eastern invention, and probably not a new one at all. There seems to be a prospect, too, of a return to the papyrus of ancient Egypt, as one of the very best materials for the anticipated great extension of the paper-manufacture.

Waste newspaper is now very generally collected to be worked up again, as well as envelopes, old letters, &c. The Military Finance Department at Calcutta recently issued an order to the offices subordinate to it about the sale of waste paper. It seems that all the rubbish in the shape of torn envelopes of letters received, &c., &c., is to be collected carefully every evening, and stowed away in some secure place. This is to be done daily until the close of the month, when the month's accumulation has to be brought out and sold to the *Bickree wallas*, the proceeds of such sale being credited to the Government.

The waste paper of the Government Offices, which is collected and sold by Her Majesty's Stationery, produces about 7,000*l.* a year. This is independent of the "blue books," printed but not read, which, after the lapse of a certain time, are disposed of as waste paper by Mr. Hansard. Many members of Parliament from time to time make a clearance of the files of Parliamentary papers which accumulate on their shelves, which are handed over at waste paper price to booksellers and dealers. A new application of waste paper has recently come into use—namely, the re-working up of newspaper-sheets, either remaining on hand, or bought up in quantity for the purpose. These serve to print broadsides and posters, the large prominent black letters obliterating or obscuring the smaller newspaper type.

In the offices of bookbinders and paper-makers the clippings and shavings are sold either for re-working or filling fire-grates in summer, &c. They are sometimes used for filling pillows and cushions. In Austria this is often done, and at the Economic Exhibition of Brussels paper cushions were shown. The amount realized for the clippings in many paper warehouses reaches a large sum annually. There are many waste dealers in the metropolis who clear out wholesale the paper from news-rooms, merchants' counting-houses, public offices, &c., and retail it to cheesemongers, butchers, and others.

THE MANUFACTURE OF GLUE.

Ordinary glue is made by boiling the scrapings and clippings of hides, hoofs, horns, or the feet of horses, cows, sheep, and pigs, which has the effect of converting a certain substance, known to chemists as *osseine,* and existing in those parts of the animal, into gelatine or glue.

The raw material is first placed in large pits or tanks, containing milk of lime. The lime, being a strong alkali, removes the hair from the skin in the course of a few days, the time varying with the heat of the weather and the age of the stuff. When all the hair is removed, the skins are taken out of the lime-pits, and washed with large quantities of water to free them from the lime, which would act upon the skin in the same way it acted on the hair. When sufficiently washed, they are placed under a powerful hydraulic press, and as much of the water as possible squeezed out of them. Sometimes, instead of being washed after their immersion in the lime-bath, they are simply spread upon frames in the open air to dry. The action of the atmosphere soon converts the lime into common chalk, which being perfectly neutral, has no further corrosive action on the skin. Manufacturers appear to be divided as to which of these methods of preparation is the better one.

The whole of the hair and most of the fat being removed from the skins, they are next thrown into a huge wrought-iron boiler full of water, which has a false bottom provided with a light framework of iron, to prevent the smaller pieces from sticking to the bottom and sides. Some manufacturers put the skins into a large network bag, made of rope, which is wound in and out of the boiler by a windlass,—but generally, they are thrown in without this accessory.

The hair and waste pieces of the skin and fat left in the lime-pits are collected into heaps, allowed to rot, and then sold to the manure manufacturers.

The boiling gradually converts the *osseine,* which, as we have before stated, exists in the skins already formed, into gelatine, which dissolves in the water. The solution of gelatine thus made is, when sufficiently strong, run off into a settling vat, where, while still being kept warm, the mechanical impurities gradually fall to the bottom. When pretty clear, the solution is run off into a long trough, which communicates with a number of smaller ones, six feet long by two feet deep and one foot broad. As it runs into the trough a little alum is added, which appears to have the effect of clarifying the solution still further. As the solution cools in the trough, it forms a firm mass of the consistency of calf's foot jelly. The troughs are then carried into the cutting-up shed, where a man runs a knife round the sides to separate the glue from the wood, and afterwards divides it into "bricks," two feet deep by one foot long, and about eight or nine inches wide. These "bricks" are then taken out, and cut with a wire or a sharp knife into slabs about two inches thick. The slabs are carried on piles to the drying-houses, where they are laid upon network frames, a thorough draught of air being constantly maintained over their surface, by the sides of the shed being open to the four winds of heaven. The slices are turned from time to time, and gradually dry into the hard compact form in which glue enters the market.

This part of the process is a most critical one, a slight variation in temperature being sufficient to spoil a whole batch in a very short time. In winter, a sudden sharp frost will do a hundred pounds worth of damage in a few hours, by freezing the soft cakes, and cracking them into an infinite number of fissures. A sudden rise in temperature will have a disastrous effect from the opposite cause. The rise in the heat will sometimes increase the solvent power of the water contained in the glue to such an extent, that the cakes partially liquify and drop through the meshes of the network. Again, in damp, foggy weather, a sort of fungoid vegetation is apt to form on the surface of the cakes, destroying the transparency of the glue, and rendering it unsaleable. Several remedies have been tried for this latter misfortune, but none appear to answer perfectly.

To transform glue into the gelatine of the shops, it is simply necessary to dissolve it in water and allow it to settle. Clarifying agents are also used to destroy the last vestiges of colour.

There is almost as much fashion in glue as there is in bonnets—workmen showing themselves absurdly ignorant and capricious in their choice of various *forms* of glue. We say forms designedly, for many carpenters are not aware of the fact that the best glue is that which is made with the greatest care, whether in London, Salisbury, or Scotland; whether it is in long, broad, or thin cakes: has a piece of string run throught it, or is destitute of that appendage. Others, again, have a fancy that the *darkest* glue is the strongest; but this is also a decided error. Thus, the principal difference between "Scotch" and "London" glue is, that the former is cut a little narrower than the latter, and has a string run through several cakes.

Size is a weak solution of glue allowed to gelatinize. About size, too, the most erroneous notions have obtained credence among workmen, most of whom fancy that the *darkest* is necessarily the best. This absurd notion has led certain manufacturers to adopt artificial means of colouring their size.

The cakes being dry and hard, they are taken off the nets, the marks made by the meshes appearing in cross-barred impression on the surface. If the glue has caught the "mildew," or has become dusty, each cake is scrubbed with a brush and hot water, to give it a clean and polished appearance. The cakes are then stacked in stores, in which every particle of moisture is driven out of them by artificial heat.

Such is the simple process of glue-making, the real secret of success in which is care and cleanliness.—'The Ironmonger.'

HOW PAPER COLLARS ARE MADE.

At the end of the first room are piles of pure white paper, awaiting their turn to be guillotined in a machine furnished with twenty-two shear blades, which cut the paper into the requisite strips for the collar, on precisely the same principle as a gigantic pair of scissors, thus leaving no rough edge. The product of two paper mills is consumed in this factory, at the rate of a ton to a ton and a half per day—the average production being about one hundred thousand collars per day, which find a ready sale, despite the numerous imitations with which the market is flooded. From the hands of the attendant who turns out the pure, even strips of paper, they pass into the hands of another fair executioner, who brings the incipient collar nearer its birth by passing it through another pair of knives, by which it acquires shape in an instant. Still, another machine marches relentlessly up and down, and as the collar leaves its iron embrace, the three button-holes are visible —large, clean cut, firm holding, and easily handled.

The collar is now placed between two dies or clamps, passed under a quick heavy pressure, and emerges again stamped with that close imitation of stitching, which renders it so perfect in imitation of its linen brother that the difference can hardly be distinguished : it is stamped also with the size and corporate mark. Next comes the crimping machine, which draws the curved line on which the shape of the collar turns, and which, by allowing space for the cravat, insures a smooth fit. They then pass through the nimble hands of a damsel, who with deft fingers flying with lightning-like rapidity, turns the collar over as no machine has yet been able to do. From these hands it passes to the moulding machine, where it is bent round into perfect shape and finished as a perfect collar.

This process is an important one, requires skill in the operator, and strength in the paper, which must be of the best, to resist the immense strain required to mould the collar into perfect shape.

The collar is now, as it were, born shapely, trim, and elegant, and ready to adorn the neck of the most fastidious, having passed through seven distinct processes in its manufacture. It is once more taken in hand by women and packed into boxes by the hundred, or in the well-known little round boxes of ten each, which are so convenient to toss into a valise when off for a week in the country or elsewhere. For the item of the boxes, the company expend over 60,000 dols. per annum. The first machine turned out the collar entire, performing the whole work at once, but slowly and imperfectly; but the genius of the inventor, quickened by the rapidly increasing demand for the article, added improvement after improvement, by one machine after another, until the manufactory is now capable of turning out five millions of collars per month.

The American Model Collar Company employ in this manufactory seventy neatly-dressed intelligent looking American women, most of whom are young. These women earn a dollar per day, and their work is clean, healthy, and not very laborious. Mr. Gray, who first commenced to manufacture in the spring of 1863, has now eight patents on collars and machines, having previously secured them in Europe; three of the directors of the company went there this summer with skilled mechanics and American machinery, to take measures to establish the manufacture in England, France, and Belgium, where they will probably soon attain that popularity which the American model collar has achieved in this country.—'American paper.'

THE CULTURE AND USE OF TEASELS.

ALTHOUGH teasel heads are now very generally superseded by belts of fine wire cards, worked by machinery, yet it may be interesting to furnish a few particulars about this special culture, which is still carried on very generally in this country, in North America, and on the Continent.

The fuller's thistle (*Dipsacus fullonum*), is cultivated in Yorkshire and other woollen cloth manufacturing districts for its rough flower heads, which are used in raising the nap upon cloths, which is done by means of the rigid hooked awns or chaff of the heads. The teasel throws up its heads in July and August; these are cut from the plant with a peculiarly formed knife, and then fastened to poles for drying. When dry, they are picked and sorted into bundles. Upwards of twenty million teasel heads are annually imported into the United Kingdom from France. The use of teasel heads is to draw out the ends of the wool from the manufactured cloth, so as to bring a regular pile or nap upon the surface, free from twistings and knottings, and to comb off the coarse and loose parts of the wool. The head of the true teasel is composed of incorporated flowers, each separated by a long, rigid, chaffy substance, the terminating point of which is furnished with a fine hook. Several of these heads are fixed in a frame, and with this the surface of the cloth is brushed, until all the ends are drawn out, the loose parts combed off, and the cloth ceases to yield impediments to the free passage of the wheel or frame of teasels.

Should the hook of the chaff, when in use, become fixed in a knot, or find sufficient resistance, it breaks, without injuring or contending with the cloth; and care is taken, by successive applications, to draw the impediment out. The dressing of a piece of cloth consumes from 1,500 to 2,000 heads. They are used repeatedly in the different stages of the process; but a piece of fine cloth generally breaks this number before it is finished. There is a consumption answering to the proposed fineness, prices of the best kinds requiring 150 to 200 runnings up.

It is worth while for farmers to consider whether teasels as a crop are not worthy of more attention. We have seen it stated that a fair average crop is 200,000 burrs per acre, and a fair average price is $1\frac{1}{2}$ dols. a thousand. Their cultivation is not a new thing in the States, though but little attended to. Nor is it difficult. A Mr. Wills, of East Windsor, Connecticut, grew them many years and found them profitable. The most suitable soil is a rich, clayey loam, of rather a moist nature, such as would produce two tons of hay per acre. The time of planting is when the ground is in good order, about the 1st of June. In about two weeks the rows can be seen, when a hand or horse hoe must be put to work. At the second hoeing the plants may be thinned out, leaving them four or five inches apart.

The after culture is to keep the ground absolutely clean till about the middle of November, when the plants are covered with straw, held in place by earth, to remain till the 1st of May, or till freezing might have past, when the plants are uncovered and the weeds kept down till the plants grow, as they soon do, to cover the ground closely. Soon after the flowers drop the burrs must be cut with stems about four inches long, and carried to the drying-house, where they are spread upon open work shelves of poles or small rails, in tiers one above another, so as to give a free circulation of air. They may be placed a foot thick upon shelves of this sort. A good hand can cut 15,000 or 20,000 a day, but the harvest should commence by the time half the flowers in a field are off. The top burrs drop their flowers first; these are called "kings," but are not quite so good as the burrs next below, which are called "queens." A stalk has from four to six No. 1 teasles, and twenty to thirty, and sometimes fifty which are merchantable. The most common method of disposing of the teasel stalks is by mowing, drying, and burning on the ground. Two crops in succession generally do well, but more than that is not recommended.

The growing of fuller's thistles in Austria, was commenced as far back as 1827, and furnishes a yearly produce of about forty to sixty millions of teasels, representing a value of about 100,000 florins, and the gross profit is 200 to 300 florins per yoke of land. In commerce, these teasels, which rival the Styrian and Bavarian in quality, are packed in boxes, and sell at one to three florins the thousand. The heads of the wild plants are less strong and serviceable than those of the cultivated plant. The fuller's thistle is indigenous in France as in England, and the bees find an abundant harvest in the fields where they are grown; as each head contains more than six hundred flowers, there are necessarily millions of flowers on an acre of land.

In France, the culture is carried on around Louviers, Elbeuf, Sedan, Carcassone, and other seats of the woollen manufacture, and the teasel heads of the wild plant are utilized to some extent in the factories. The harvest there commences about the middle of July, when the flowers have fallen from the heads, and the teasels are of a whitish colour. The heads are sorted according to their size, the finest being termed "males" and the others "females." The best are those which are long, cylindrical, and armed with fine hooks. The produce of each head is about five teasels; but in good soils and favourable seasons it reaches seven to nine, which would yield twenty to thirty bales per hectare. P. L. S.

PETROLEUM LAMPS.

THE immense development of petroleum, commonly but erroneously, called coal oil, beginning practically in August, 1858, in western Pennsylvania, and amounting in the year 1863, in the United States, to 6,000 barrels per day, or 2,190,000 barrels per annum, (of which one half is exported and the remainder consumed at home,) has directed American inventors, within the last three years, to the construction of a large number of lamps intended specially for its consumption. This will best be seen by reference to the number of applications presented to the American Patent Office during the three years ending 1863, as compared with the number for the three preceding years.

Patents applied for during the three years, ending 1861, 193; in three years ending 1863, 623.

This oil is rich in carbon and hydrogen, but void of oxygen; and from the excess of carbon evolved, one main object to be attained was to command the oxygen of the atmosphere to affect that degree of combustion most productive of illumination, and thus at once economise oil, obtain a pure white flame, and avoid smoke and unpleasant odour. To this end various devices have, within the last three years, been patented.

1. The deflector previously in use has been materially altered in form, and in some lamps two or three deflectors within each other, used in throwing successive currents of air against the flame above each other.

2. The flat wick has been very generally adopted, being more simple and exposing a larger surface of flame to the air.

3. The glass chimney previously in use, to shield the flame from currents of air and to increase the draught and consequent quantity of oxygen to the flame, has largely maintained its place. In some models the chimney has been extended below the flame, and shortened above it; in others the deflector and chimney have been united; and in others

oval chimneys, either of glass or mica, have been made to correspond with the flat flame.

4. The liability of glass chimneys to break from unequal heat, or accident, as well as their expense and inconvenience, have made it a *desideratum* to construct a good hand-lamp without a chimney, for which purpose many patents have been granted, of very various forms, with more or less success. Some have used numerous very small wicks, others very thin wicks; others have made, in effect invented, metallic chimneys below the flame. To keep the oil in the lamp as cool as possible, so as not to throw off more gas than the flame can consume, various non-conductors have been interposed between the burner and the reservoir, such as porcelain, glass, gypsum, wood, gutta percha, &c. Other inventors have effected the same object by isolating, in a great measure, the burner, by resting it on slight metallic points, &c. In a few examples oxygen has been ingeniously and effectively, but rather expensively, supplied to the flame by a revolving fan-wheel propelled by machinery enclosed within the base of the lamp.

5. Other improvements have been introduced, removing the chimney vertically, horizontally, or obliquely, so as conveniently to turn and light the lamp or supply it with oil; others effecting the same objects without removing the chimney at all. Mica and glass deflectors have been used instead of metallic ones, and glass cylinders surrounding the flame and below it, so as to avoid the shadow around the base of the lamp.

6. The necessities and demands of the great American railway system have originated improvements in locomotive *head-lights*, so as to obviate the effect of the motion of the engine and counteract strong currents of wind; also in *lanterns*, so as to avoid extinguishment by sudden motions, vertically or laterally, and so that the lamp may be easily fastened in or removed from the case and the wick regulated without removal therefrom.

7. Finally, great improvement has been made in the machinery for the manufacture of every part of the lamp, so that for a few cents a good and convenient and even elegant lamp for burning this cheap and highly valuable native oil is now within the reach of every family in the land.

Scientific Notes.

Paper as a Material for Sugar Moulds.—The mould, used in sugar-refineries are sometimes made of clay, sometimes of zinc, or of plated copper, occasionally of glass, but, at least in France, most frequently of sheet iron, either printed or enamelled. The great disadvantage of such moulds is that the paint or enamel upon them invariably cracks after a time, where upon, if the defect be not instantly remedied, the portion of the metal which the crack lays bare rapidly oxidises, causing the mould to deposit upon the sugar spots of rust, which very greatly deteriorate its value. This disadvantage on the part of the moulds in common use, led MM. Dufournet and Co., of Clichy, about seven years ago, to turn their attention to papier maché as a material for sugar moulds, and it is stated by M. Clemandot, in a paper on "The industrial applications of Stiffened Pasteboard" which he lately read before the society of Civil Engineers of France, that nearly a hundred thousand of their paper moulds have now been in use for nearly six years, without any one of them having required repair. The first cost of the paper moulds is somewhat greater than that of iron moulds, but iron moulds cost an average of a franc and a half each per annum for repairs, so that, to set against the excess of first cost on the hundred thousand paper moulds, is the saving of the nine hundred thousand francs which six years' repairs of the same number of iron moulds would have cost. The paper moulds are still in excellent condition, so that the saving already realized does not represent by any means the full amount of the economy to be effected by their use. This is the first instance we believe, in which papier-maché has received any extensive industrial application, but it is not likely to be the last. The lightness and cheapness of this material together with its non-liability to breakage and its power of resisting the action of chemical agents, render it well adapted to replace glass, porcelain and gutta-percha for a great many purposes. MM. Dufournet and Co. have begun to make of it basins and funnels for photographers, cells for electric batteries; and many other similar articles.

British Association.—The following are abstracts of papers read at the meeting of the British Association at Birmingham:—

On the Adulteration of Essential Oils with Turpentine, and Means of its Detection. By H. Sugden Evans.—The adulteration of essential oils is well known to be extensively practised, and though numerous tests have been proposed for the detection of the fraud, all have proved unsatisfactory, giving at the best, evidence only of the fact of adulteration without indicating its extent. Availing himself of the power most essential oils possess of rotating the plane of a polarised ray of light, Mr. Evans had arranged a polariscope, by means of which the exact amount of this rotatory power could be measured. The application of this test was simple, and the apparatus easily and inexpensively constructed by anyone possessing a microscope provided with polarising prisms. Having determined the amount of rotation in degrees possessed by well-accredited samples of pure oil, and also of the supposed or possible adulterants, it becomes a simple matter of calculation to determine the amount of adulteration; for it is proved by experiment that the degree of rotation recorded is the mean of the combined rotating force of each of the components. The subject was illustrated by tables of values of pure and adulterated samples of various essential oils.

On Cotton-seed Oil, and its Detection when Mixed with Other Oils. By R. Reynolds.—The author stated that large quantities of cotton seed were now being pressed for oil, the whole of this seed having, until the last few years, been thrown away or returned to the soil as a fertiliser. The weight of seed produced by each plant was three times as great as that of the cotton which it yielded. Hence large quantities might always be relied on, and the cheap price of the oil might be expected to continue. The refining of the oil by an alkaline solution presented some singular features, and hopes had been entertained of producing available dyes, but hitherto these had been disappointed. Mr. Reynolds reported his experiments on the detection of this oil when mixed with olive oil, and considered that a solution of nitrate of mercury, known as Poutet's test, was sufficient for this purpose, if certain precautions were taken. With olive oil the test produced a hard friable mass: with olive oil adulterated with the cotton-seed oil it produced a more or less pasty substance.

On the Amount of Tannin in British Galls at Various Periods of their Growth. By W. Judd.—Old galls which had remained on the oaks till after Christmas, and had, of course, been perforated by the fly, were found to contain 16 per cent. of tannin. Mature galls, but from which the fly had not escaped, yielded between 17 and 18 per cent., while half-developed galls afforded only 13 to 14 per cent. Though Aleppo galls contain two or three times this amount of tannin, still English galls, the author thought, could be economically used in dyeing, ink-making, tanning, &c., if collected at the proper period of the year.

Note on Italian Castor Oil. By J. Phillips.—This colourless, inodorous, and almost tasteless variety of castor oil was prepared, the author said, in the summer time from seeds collected the previous autumn. The outer skin of the seed was removed by slight blows of a hammer, the seed being placed on a marble slab; the decorticated portions were then submitted to gentle and continuous pressure, and the exuding oil filtered with as little exposure to air and light as possible. This oil was expensive, and, therefore, seldom exported. A much cheaper variety, made with far less care, and often partly from East Indian seeds secretly imported for the purpose, was, however, sent to England and elsewhere; even this was a superior article to that sent direct to England from India and America, but far inferior to the genuine Italian oil. Mr. Phillips thought the absence of the usual nauseous flavour in real Italian castor oil to be simply due to the use of unbruised seeds not older than above mentioned, the avoidance of heat, and the careful manipulation observed in the whole operation.

Beetle's Wings.—The jewellers are now doing a considerable trade in Brazilian beetles by setting them in gold or silver to form bracelets, necklets, brooches, &c. The beetles chiefly used are found in immense numbers at Bahia, and they are brought to England in the Brazilian mail packets. The beetles are of small size, and their colours are green and gold. They are caught in nets to prevent their mutilation. They are sold at about 1s. each in this country. Large numbers of the elytra or green beetle wings are used in India for ornamenting embroidered muslins, basket-work, &c.

Titanium.—This most valuable metal has hitherto been found in only small quantities; it is of the greatest service in hardening iron, and rendering it steel-like, or rather of a harder character than steel, and at the same time more flexible. It is said to render the surface of rails almost everlasting, and that it is almost free from oxydization. We understand that a company is being established for mining it extensively, and that it is likely to lead to great results in the manufactures of the world in various shapes and forms of metallic structure, for which iron and steel are not so appropriate as they are when mixed with new metal.

THE TECHNOLOGIST.

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THE ARMS TRADE OF BELGIUM.

BY MR. BARRON,

HER MAJESTY'S SECRETARY OF LEGATION AT BRUSSELS.

THIS industry stands perhaps the first of all, not in the aggregate value but in the celebrity of its produce. This produce has obtained a footing upon every market of the world. Wherever fire-arms are used the Liége proof-mark will be found in circulation. I cannot refrain from stating the obligations which I am under to Captain Nicaise of the Artillery, attached to the Ministry of War, and to M. A. Polain, Director of the Liége proof-house, for assistance and information.

The manufacture of fire-arms in the principality of Liége dates from the middle of the fourteenth century. Cannon, or as they were then termed *bombards, were the most ancient fire-arms.* They were made of iron bars, hooped together with iron rings. The French used some at the siege of Puy-Guillaume in 1328, the English at Crécy in 1346, the first authentic instance of their use in the field. The Liégois used bombards at the siege of Hamalle in 1346, the first appearance of fire-arms in Belgian history. Besides bombards, a portable kind of ordnance named hand-cannon came into use at an early period. They were so small and light (from 25 to 50 lbs.) that one of them was carried by two men. The 400 cannon (or most of them) with which and English army besieged St. Malo in 1378, as mentioned by Froissart, must have been of this kind, as also the 300 guns used by the Gantois against the Brugeois in 1380, and by the Liégeois at Othée in 1408.

There is no doubt but that *England has derived much knowledge of artillery from this country.* Dr. Henry even conjectures that hand-cannon were first introduced into England by the Flemings, who accompanied Edward IV. on his return to England in 1471. Both Henry VII. and Henry VIII. employed a number of Flemish gunners for the purpose of fostering the science of artillery. Among others, one Peter von Collin is mentioned in Stowe's Annals as employed by King Henry in 1543 for making mortars and shells, "to be stuffed with firework or wild fire." Cannon were first cast about the middle of the fifteenth century, in England in 1521, when brass was used for the purpose. Iron guns were cast about 1547. Both kinds were then and down to the middle of last century cast hollow, the bore being formed by a core which was kept suspended in the centre of the mould.

Portable or hand fire-arms did not appear till the fifteenth century. The earliest were the *hand-cannon and hand-guns,* both with straight stocks and ignited by hand matches. Next came the *arquebuse and musque, both on the match-lock principle* ("serpentin"), a contrivance suggested by the trigger of the cross-bow to convey with instantaneous action the burning match to the pan. The arquebuse is first mentioned by Philip de Comines in his account of the battle of Morat in 1476. The wheel-lock ("rouet") invented at Nuremburg, or in Italy about 1517, soon supplanted the matchlock. It was a small machine for exciting sparks of fire by the friction of a furrowed wheel of steel against a piece of sulphuret of iron, and was moved by a spring like that of a match. The wheel-lock arquebuse was generally given to the cavalry, while infantry retained the matchlock on account of its greater economy. The snaphaunce again was an improvement on the wheel-lock, and was a near approach to the modern flint-lock.

The flint-lock the capital improvement in fire-arms, originated in France about 1635, and has descended with little alteration to our own times. The simplicity of this new agent, the cock and flint, first allowed the use of fire-arms to become general. To this invention the Liége armourers' trade owes its prosperity and even its existence as a separate denomination. The first exporters of arms from Liége were chiefly nail merchants, a class who possessed already commercial relations from time immemorial with distant countries. The first barrel makers were smiths and the first stock makers were carpenters. Subsequently the latter ("faiseurs de bois d'arquebuse") seem to have become one of the thirty-two recognised guilds of the city, but gunsmiths ("garnisseurs de cannons") remained a sub-denomination of the smiths ("bon métier des febves"), governed by special very stringent laws.

The first regulation of this trade now extant dates from the year 1672, when the Prince Bishop Maximilian Henry ordered that the municipality of Liége should provide a suitable place for the proof of fire-arms, where dealers should be obliged to bring all gun-barrels, whether imported or forged in the city, together with the powder and bullets necessary for their proof; the barrels were to be loaded by a sworn prover with a bullet of their calibre and a charge of powder equal to the weight of the ball, and then if found good, stamped with the arms of the city. Garnishers, stockers, and dealers were forbidden to work, sell, or export any barrel not thus stamped. All infractions of this ordinance were to be visited with a fine of a gold florin; a forgery of the city mark with a fine of 100 florins. Two further ordinances issued in 1700 regulate the conditions necessary for exercising the trade of a "maître garnisseur de cannons," as well as the prices to be paid to them by the merchants ("marchands d'armes") for every description of barrel or part of an arm. The same stringent regulations prevailed in France and England from a still earlier date for the proof of gun-barrels. The earliest "banc d'épreuves," that of St. Etienne, dates back as far as the reign of Francis I. The London Armourers' Company was authorized by a Royal Charter of 1637 to prove and stamp every description of portable gun-barrel. The Birmingham Proof-house was established in 1813.

The wars of the French Revolution had, of course, a great effect upon the fortunes of Liége. The decisive battle of Jemmappes, on the 6th of May, 1792, opened all Belgium to the army of Dumouriez. The French entered Liége on the 28th of November; and being left in rags by their own government, supported themselves by pillage. Four Commissioners, presided over by Danton, were sent by the Convention to restore order, but far surpassed the soldiers in the extent of their depredations, which they amply atoned for by their revolutionary ardour. The Belgians generally showed great indifference to being made free and happy. Liége, however, was a marked exception, and imitated, on a small scale, the saturnalia of Paris. The Austrians, under the Prince Josias, of Saxe-Coburg, grand uncle of the present King, recovered all Belgium, for fifteen months, by the battle of Neerwinden (18th March, 1793), but again had to retreat before Jourdan and Pichegru after the battle of Fleurus (June 1794). For a year Belgium was again a prey to wholesale rapacity, disguised under the most fervid eloquence, till the country accepted as a relief its annexation to France, decreed by the French Convention on the 1st of October, 1795.

During the French domination the manufacture of arms was much hampered by the law. No arm or piece of an arm of the military calibre could be manufactured outside the government factory without a special authority. Slave trade guns were alone excepted. All others were prohibited from export if their calibre exceeded that of twenty-two to the pound. *In 1810 the Emperor issued a decree on the proof of fire-arms,* which, with some modifications, is still in force here. By it all manufacturers, dealers, and gunsmiths were prohibited from selling any barrel, without its having been previously marked, under a penalty of 300 francs for the first offence, and double that fine for the second, besides the confiscation of the barrel. Arms destined for commerce were declared seizable if they did not vary at least 2 millimètres from the military calibre, which was 0·0177 of a mètre. An exception was made in favour of slave trade guns, which, however, were not allowed to circulate in France, but were to be deposited in the seaports.

In 1814 the system of monopoly ceased with the entrance of the Allies. The arms trade became free, and divided itself into *three great categories, those of military arms, of commercial arms,* and of *high-class fowling-*

pieces ("arms de luxe"). The Dutch government neglected nothing calculated to develop this trade. The Liége proof-house was maintained for the new kingdom. A new tariff of fees was drawn up in 1818, reducing considerably the former fees for proving barrels. During the present reign some further reforms have been introduced in the organization of the proof-house by the Royal Arrêtés of 1836, 1846 and 1849. These regulations were fortified and completed by the *Arrêté of the 16th June*, 1854, which form the chief authority in this matter, and by further Arrêtés of the 16th February, 1863, and 20th June, 1864.

All fire-arms made or repaired in the kingdom must now be proved at the Liége "*banc d'épreuves*." The same rule applies to those imported from abroad, unless they have been proved and stamped in the maker's country. The proof-house is governed by an administrative commission, composed of the bourgmestre or his delegate as president, of six syndics elected by and among the "principal" gunmakers of the arrondissement—viz., those who are assessed in the rolls of the "patente" among the nine first classes of tax payers (there being seventeen classes in all). The syndics are elected for three years, two of them retiring on the first of January of every year. Their special duty is to watch over the interests of the trade. They have access to the proof-house at all times; they have an unlimited control over the details and accounts of the establishment; and they have the power of enforcing every possible improvement in the proof of barrels.

Under this commission a director is appointed by the Minister of Foreign Affairs (commerce being one of the departments in this ministry), from a list of three candidates presented by the principal gun-makers. He has to deposit a caution-money of 6,000 francs, and receives a salary of 4,000 francs, which is to include the interest of his caution-money. His duties are to act as secretary to the administrative commission, to enforce regularity in the service, and the strict execution of the rules; and to have the custody of the punches. All the other officials are appointed annually—viz., the comptrollers by the governor of the province on the recommendation of the commission, the revisers, the book-keeper, the foreman, the caretaker, gauger, loader, and prover, by the commission. The director may appoint any clerks or workmen under the approbation of the commission.

The "*banc d'épreuves*" is composed of a strong stone bench, with sixty grooves for the barrels, of a heavy fixed beam at the rear, called "pièce de recul," and of a large moveable beam, which is suspended above the bench, and is let down upon it by pulleys, to keep the barrels in their places. Sixty barrels are fired at once by a train of gunpowder connected with their touch-holes, and ignited by means of a large gun-lock and trigger pulled by a cord from outside. There are two of these benches, and one for pistols, working uninterruptedly every day at the Liége proof-house. The number of barrels approved in 1864 was 859,496; to these are to be added about 3 per cent. more which are rejected, and the numerous barrels which are proved two or three times, but are only recorded once. More than 1,000,000 shots are thus fired.

All barrels brought to the proof-house are first visited by a comptroller in order to verify that their state of fabrication is sufficiently advanced to enable them to be completed without impairing their solidity. They are then handed to the gauger, and are stamped each with the figure denoting its calibre. They then pass on to the loader in order to receive the charges of powder and ball proportioned to their calibre. All arms are tested with a charge of powder equal to at least two-thirds of the weight of the bullet; but military barrels have to bear a charge of powder equal to the full weight of their bullet—viz., 27½ grammes (2 ounces), for the regulation musket of 0·688 inch bore. The bullets used fit very loosely, a windage of six-tenths of a millimètre being allowed by law. After proof, each barrel goes back to a comptroller, who examines it closely, and affixes to it his private mark if it shows no fault. It then receives from the foreman the mark of provisional acceptation, consisting of the interlaced letters EL. The barrel is then carried away to be mounted and finished; after which it must be brought back to the proof-house in order to be again scrutinized, and to receive the mark of definitive acceptation. At this stage the comptroller, if he suspects that the barrel has been weakened in any way, may refuse to mark it without giving any reason, and may require another proof. Percussion guns, breech-loaders, and all others which, after proof, have undergone any alteration whatever in the fire, are by law proved a second time, and then receive another provisional mark, called the "Péron de Liége," a kind of column. A double-barrelled gun thus undergoes two proofs; the first on each barrel separately, the second when they are welded together. A breech-loader must be proved again when fitted with its joint. The powder used is good sporting gunpowder, and must be approved by the commission. Imperfect barrels are returned to their makers to be repaired; those which burst and are considered irreparable are sawn asunder.

In point of stringency, the *French system of proof* is below that of Liége. The English proof is as strong as that of Liége, for muskets even stronger; but the penalties on fraud and forgery are lighter. France is still governed by the Decree of 1810, which there has even become relaxed in practice, while in Belgium the same decree has been materially strengthened. Thus, in France, the barrels of certain Paris makers, and pocket-pistol barrels in general, are dispensed from all government proof. At Liége every barrel of a pistol and every chamber of a revolver must be proved separately. Single-barrelled ramrod guns are proved once. Double-barrelled guns have to undergo two, and if breech-loaders three, proofs. At St. Etienne there is only one proof for gun-barrels, which evidently offers no guarantee of strength if the barrel is subsequently altered.

Another great guarantee for the strength of Liége workmanship lies in the *ancient trade customs of the place.* The utmost division of labour prevails in this manufacture. Each class of mechanics has its own speciality. The master alone possesses the collective knowledge necessary for making a gun. But the first thing which every workman is obliged to acquire is a knowledge of barrels, and this for the following reasons :—A double-barrelled breech-loader is subjected to three proofs, the first on each barrel separately, the second on the barrels when welded together, the third when percussioned and jointed. If the barrel bursts on the first proof, the barrel-maker must replace it, and loses, therefore, the fruit of his labour. If a barrel bursts on the second proof, the garnisher is also made responsible jointly with the barrel-maker. If the barrel bursts on the third proof, all those who have assisted in the work—viz., the barrel-maker, the garnisher, and the "systémeur" (percussioner), must suffer, and all lose the fruit of their labour, unless the defect can be traced to the fault of any one of the three in particular. The whole price of the job is stopped from their account in the manufacturers' books. Thus every workman is made responsible for the quality of the barrel, and he is therefore in self-defence obliged to scrutinize it thoroughly before beginning to work on it. Such a severe system would be vainly attempted elsewhere. It is sometimes even unjust, but affords the highest guarantee of the soundness of a barrel. It is submitted to by all as an immemorial usage. This docility of the working class, combined with an abundant supply of labour, is one of the main causes of the astounding development of the Liége arms trade.

It is true that *for a time great laxity crept into the administration of the proof-house,* to such a degree that the Liége mark came into disrepute even among the negroes, for whose benefit the cheap muskets called "bords" are manufactured.* A former director was obliged to abscond in 1852 on being detected of a long course of malversation by which he contrived to appropriate 50,000 francs of the public funds. These frauds were at last discovered by the banker of the commission, and led to the appointment of a commission of inquiry, and then to the revised code of 1853. An occasional charge against the trade is that after proof the bore of a gun is fraudulently enlarged (to remove some inner flaw, &c.), and the barrel thus weakened. This fraud is now impossible, and could not have been practised if the law had been honestly executed, as the stamp of calibre has always existed since 1672.

Through the vigilance of the present director, M. Polain, a novel fraud was discovered in 1862. Rough gun-barrels were being exported under the name of gas-pipes on a large scale without any proof. Some thousands found their way to England, and from thence probably to

* These are distinguished from military muskets ("armes de guerre") by having the definitive mark stamped four or five inches up the barrel, instead of at the breech as on the regular musket. They are proved like fowling-pieces, with a two-third charge.

America. A large consignment was suddenly stopped at Antwerp, and became the subject of a long correspondence. Great influence was used to allow them to pass, on the argument that, being unstamped, they could not compromise the reputation of Liége. The director, however, advised their seizure as being manifestly contraband, and ultimately succeeded in preventing them from being exported. Another incident resulting from the American War was the purchase in Germany, by Belgian speculators, of 100,000 Austrian refuse muskets at an average price of 5½ francs. These were rifled, repaired, and percussioned at Liége, exported without any proof, having already the Austrian mark, and sold in America for from 27 to 30 francs. This abuse led to the Royal Arrêté of 20th June, 1864, ordering that arms repaired or percussioned in this country should be submitted to proof. It may be doubted whether this decree is strictly enforced, as infractions of it are difficult to detect. Cases of arms are never, without special cause, opened or searched by the Customs' officers on export.

The present system of proving rifled muskets, the only kind now used, is somewhat illusory. They are proved before being rifled, and then with spherical bullets. It will certainly be admitted that the operation of cutting three or four grooves through the whole length of a barrel must somewhat impair its strength, and that the strain exercised by a common round bullet, fitting loosely and wrapped in paper, is very different from that of a long cylinder double the weight of the former, and pressing hermetically, not on a single point, but on half an inch of the barrel. Muskets ought to be proved after being rifled, with a triple charge of powder, and also with the elongated bullet which they are intended to carry. Many governments, including our own, when contracting for muskets at Liége, require a second proof after rifling; others, as for instance the Russians, do not. Most governments enforce a strict inspection of their arms, and of every separate piece of them, by comptrollers of their own sent for that purpose to Liége.

SECTION II.—*State of Manufacture and Exports.*

Of the numerous manufactures flourishing in Belgium, *this one stands seventh in the number of hands which it occupies.* The census of 1856 sets down the number of persons employed in it at 9,675. Other estimates bring the numbers directly or indirectly engaged in it up to 20,000 or even 30,000. This industry is confined solely to the arrondissement of Liége. It is this local concentration, together with the division of labour which prevails in the trade, and the pre-eminence which it has acquired in the markets of the world, that render it comparable only to the watch-trade of Geneva. One feature in the arms trade, proving how much it develops the intelligence is, that many of the improvements in it are due to working men. At the same time, being practised at home, it is not so demoralizing as that carried on in large factories. By another rare privilege, it is proof against political convulsions, thriving in war as well as in peace. Every successive innovation brings a rich harvest to Liége—such as, for instance, the percussion-lock, the breech-loader, and the rifled musket.

Forty years ago the average production of Belgium was only 132,292 barrels. It now amounts to six times that number, 859,498 *being the number of barrels approved in* 1864. This is a greater number than ever before passed through the proof-house in a single year. The great bulk of these barrels were newly manufactured ; a small fraction only were old barrels, obliged to be proved on being repaired or percussioned. Of the barrels proved, 3 per cent. on an average burst, and are not included in the above figure of 859,498 ; neither does it include the arms manufactured by the government. The production of 1864 is large when compared with that of 1863 ; enormous if compared with the decennial period from 1841 to 1850. The greatest increase has been in single guns and pocket-pistols. Double guns and holster-pistols have somewhat increased. The production of muskets of both kinds, whether "bords" or military arms, fell in 1864 below that of any year since 1859.

*Statement of the Value (in Francs) of the Arms exported from Belgium during the Following Years.**

Years.	Total.
1850	5,253,123
1851	6,313,595
1852	7,201,085
1853	8,815,841
1854	9,812,249
1855	10,311,394
1856	13,858,315
1857	11,245,906
1858	10,194,750
1859	10,158,560
1860	12,106,172
1861	18,264,181
1862	23,457,566
1863	19,412,979
1864 (small and side-arms)	16,358,803

The statistical data concerning this trade are few, and somewhat conflicting. With reference to this table, the first remark to be made is, that the value of the exports is generally understated, the only authority on which they are based being the merchants' declarations. On the other hand, it is also to be remarked that the exports of recent years must include large amounts of foreign arms imported into Belgium free of duty to be repaired or altered. Formerly these

* The above table does not include powder, shot, or percussion caps.

arms were imported *en franchise provisoire*, under the law of 1846, and when exported were not included among Belgian produce. The old duty of 7·20 per cent. *ad valorem* was repealed by the Franco-Belgian Treaty, and a large importation of foreign arms has since taken place. These imports were in—

1861	1,903,870
1862	1,602,995
1863	1,025,625
1864	1,135,372

which of course became confounded with Belgian produce, and when exported could not be distinguished from it. This will partly account for the exceptionally large exports of 1862. The decrease of exports of 1864 is probably more apparent than real, considering that the manufacture of barrels has increased so largely. The records of exports are not so ample as might be wished, the value alone, and not the quantities being stated. This will be partially remedied in future by recording the gross weight of exports, as in France.

Comparative Statement of the Small Fire-Arms exported from Belgium, Great Britain, and France during the last Eight Years.

Value in £ Sterling.

	1857	1858	1859	1860	1861	1862	1863	1864
Belgium .	415,536	396,960	400,116	475,676	716,184	919,296	765,176	654,352
Gt. Brit. :								
Number.	299,243	223,718	171,529	272,948	315,509	702,254	439,122	260,986
Value £ .	409,789	325,543	168,897	358,847	515,[illegible]61	1,573,706	856,009	344,47[illegible]
France :								
Kilogr. .	224,863	237,15[illegible]	460,276	476,032	1,397,496	1,101,984	929,309	473,906
Value £ .	123,464	121,880	243,824	280,948	760,648	596,796	522,532	280,024

This table includes guns and pistols, excepting in the English return for 1857, wherein pistols are not included. The numbers of fire-arms exported are recorded in England alone. The weights and values are recorded in France. In Belgium the values alone.

In attempting a comparison like the above, the want of exact and uniform data is seriously felt. In Belgium there is no record whatever of the quantity of arms exported. In England and France the quantities are recorded, but on such different principles as to baffle all attempts at comparison. The three statistics agree in showing a great and sudden increase of exports in 1861, caused no doubt by the American demand. The exports reached their climax in 1862, and have receded ever since. Belgium is certainly gaining upon her two rivals, having exported last year a greater value of arms than England and France united. Where they all go to cannot be ascertained. The official returns afford no index of their ultimate destination. The great bulk are cleared for France and England, but evidently only for transit or transhipment, Antwerp being deficient in trans-Atlantic steam communication. With the exception of France, Austria, and Prussia, most European as well as American Governments, buy more or less of their muskets at Liége. The best customers have been the United States and the United Kingdom. Their demand has now entirely ceased. Large orders are now on hand for Russia and Italy.

The following distinct trades are employed in the manufacture of a musket. The barrel-maker, band-maker, percussioner ("systémeur"), ramrod-maker, lock-maker, trigger-guard-maker, bayonet-maker, locking-ring-maker ("embagleur"), screw-maker, stock-maker, setter-up, and nipple-maker. None of these use machinery properly so called. All but the first do their work at home by manual labour. The barrel-makers use small water-mills for the purposes of forging, grinding, and boring the barrels. This industry is carried on all over the arrondissement wherever water-power is available, by a thriving class of artisans called "usiniers." They generally buy their own iron and sell the barrels to the "fabricants d'armes," thus often amassing good fortunes. A few "fabricants" of the highest standing buy their iron and have it forged themselves. Barrels ought to be made of tough charcoal iron, the best of which is supplied by the furnaces of Chimay, Couvin, Piéton-sur-Meuse, Bouillon, and Annevoye. It is sold in the form of short flat slabs.

These slabs are hammered by water power into long flat quadrangular slabs or "skelps" called "lames à canon," about three feet long, thicker and wider at one end. The skelp-forger ("marteleur") with two assistants can forge about eighty or ninety skelps in ten hours. The next operation, that of welding the barrel, is accomplished by hammering the skelp on a grooved anvil, thus turning up the edges over a mandril and welding them together in lengths of two inches at a time, each length being exposed to three or four welding operations with alternating high and low heats. A good workman will weld three barrels in ten hours' labour. The lump or nipple-seat is next welded on. The price of a rough barrel in this state is about 5 francs. It then undergoes a series of operations called "usinage," (chiefly boring, grinding, and straightening), which, as practised in the Royal Factory, will be described below. Boring as now practised is assisted by the pressure of the workman's body. It is so severe a labour as often to induce deformity. Grinding is attended with some danger from the occasional rupture of the mill-stones.

When the barrel comes from the "usine" it has to go to one man to be breeched, to another to be garnished, to a third to be percussioned, to a fourth to be drilled for the touch-hole, to a fifth to be rifled, to a sixth to be stocked, to a seventh to be polished and set up. The stocker and setter-up come to the counting-house with their wives and apprentices to fetch their pieces of work, thus losing a day on the journey and at the tavern. Women are constantly seen in the streets of Liége carrying bundles of gun-barrels on their heads. The guns come back to the manufacturer after six or seven months. The setter-up brings twenty or twenty-five at a time. Another loss of two or three days occurs in examining these arms. Two or three guns will be rejected, and this loss will fall on the workman, who is probably in debt, having been so long without receiving any wages. The wages of several months' labour are paid to him at once, exposing him to temptation and robbery. It is not surprising if these two classes live in a state of chronic pauperism. They are generally ill-lodged, ill-provided with tools, stinted of air and space. It is common to see a stocker or a setter-up obliged to work and sleep in the same room, surrounded with a family, and perhaps 100 guns.

The only hands employed on the gunmakers' premises are a few lock-filers, to assist the comptroller in inspecting the guns when they come from the stocker, and to put the locks into working order. This class of men are called "rhabilleurs," or "platineurs de recette." The lock-filers are generally a superior class, each master having often a workshop in the country and a number of journeymen. It is a trade somewhat trying to the chest. In case of an excessive demand, over-work often induces consumption, from the pressure of the centre-bit on the chest. The gun furniture is all made likewise in little forges round the town. Of course, in cases of pressure, the gunmaker has to send repeatedly to get in all these pieces. A gun has to go in and out of the maker's premises about two hundred times before it is finished, and to pass through twenty different hands. Such a system must be often productive of inconvenience and of heterogeneous styles of workmanship.

Liége possesses five factories, properly so called, for the manufacture of arms,—viz., the Royal Cannon Foundry, the Royal Gun Factory, the Barrel Works of Val-Benoit, the Musket Factory of Messrs. Falisse and Trapman, the Revolver Factory of M. Francotte. Val-Benoit is the only mill in Belgium where barrels are rolled by machinery. It was first established by the Cockerill Company, but was closed in 1835. The great difficulty was to obtain a good coke iron for barrels, such as till lately Mr. Marshall, of Wednesbury, alone produced. This was at last achieved by the celebrated Iron Works of Seraing. Their barrel iron is described by some as superior even to charcoal iron. Thanks to this result, Val-Benoit was again opened, and is now organised so as to turn out about 400 barrels per day. They are made from slabs ten or twelve inches long. These are first bent in their whole length by means of grooved bending-rolls until they assume the form of short rough tubes, called there "carottes," their opposite edges being brought to meet without overlapping. They are then laid on the hearth of a reverberating furnace, brought to a full welding heat, and then repeatedly passed between grooved rollers of gradually decreasing grooves. The barrels of Val-Benoit are not considered to be quite equal to hand-forged barrels; but in seasons of pressure they are employed promiscuously with these, even for first-class muskets. One hundred and fifty men are employed here.

Good sporting barrels are always made of iron and steel rods, twisted together on various principles, and forming various patterns, called ribbon-twist, wire-twist, stub iron, Damascus, &c. The latter is the most expensive kind, being made of compound strips of iron and steel, forged into small quadrangular rods, which are first twisted upon their own axes, then wrapped spirally round a mandril and forged into a continuous tube. The two metals, assuming different colours (the iron white, the steel black), form little knots, called here "flowers," which are reproduced with greater or less regularity all over the surface of the barrel. These flowers are often counterfeited by a corroding substance applied externally. A pair of true Damascus barrels can be bought at Liége for from 20 francs to 25 francs ; the best for 35 francs and 40 francs. Bernard, of Paris, who has acquired a European reputation for these barrels, charges from 110 francs to 120 francs for a pair of No 16 bore, and 135 francs for No. 12 bore. They are proved by himself alone. His mark passes current in France and Belgium in lieu of an official mark, there being no Government proof-house in Paris. He and three others in Paris make about 2,000 barrels per annum, which are generally sent to Liége to be mounted.

M. Falisse has in his factory some admirable machinery for boring, rifling, and stockmaking, all manufactured on the premises, and some of it quite unique of the kind. As a pin to be made cheaply must be made by fifty men, so each stock is here made by twenty machines and thirty workmen, at a cheaper rate, he says, than the common stock made by one man. His rifling machinery is the most perfect in Liége. He has also established a manufactory of percussion caps and nipples at Beaufays, near Liege, which has now passed into other hands, and is still the only private one in Belgium. He has invented some machines employed in this fabrication, and has organised similar factories for several foreign governments.

M. Francotte makes breech-loading revolvers on a large scale by machinery, for prices varying from 40, 45, and 50 francs to 100 francs. Each of these pays a fee of 5 francs to the heirs of the late M. Lefaucheux, the inventor of the favourite system of breech-loading both for pistols and fowling-pieces. About 60,000 Lefaucheux revolvers were made at Liége last year, which must have produced a revenue of 300,000 francs to the patentee. The Lefaucheux patent for guns has expired. Few other guns are now used here for sporting purposes. Caps and ramrods are now things of the past. Empty cartridges of pasteboard and brass, with an interior fulminating cap, are made all over Belgium, but none so good as Eley's. The best fulminating powder is not made here.

The progress of Liége is mainly owing to the incredible *cheapness of its workmanship.* This cheapness has, of course, increased the demand. The increased demand has again reduced the cost of production. The following are some of the comparative trade prices of Liége and St. Etienne :—

	Liége.	St. Etienne.
SINGLE BARREL GUNS.	Francs.	Francs.
Youths' guns, the commonest .	5·50	Not made.
Men's „ „ .	6·85	„
„ of false ribbon twist . .	8·40	12·60
„ „ Damascus twist .	11·55	14·10
DOUBLE BARRELLED GUNS.		
Of the commonest quality . .	14·51	Not made.
„ common quality	17·50	22·10
„ false ribbon twist	21·50	22·90
„ false Damascus twist . . .	26·05	27·26
„ iron ribbon barrels	27·95	35·72
„ steel ribbon barrels	31·50	40·52
„ Damascus barrels	55·56	60·16
Lefaucheux gun, with Damascus barrels	71·50	98·76
Superior qualities, from . . .	100 to 400	100 to 500

The annual production of guns at Liége is now about ten times as great as that of St. Etienne. The number here manufactured has fallen to about 30,000 fowling-pieces annually ; therefore not half as many as are bought at Liége by the French alone, notwithstanding the duty of 220 francs per 100 kilos. The Paris gunsmiths buy three-fourths of their guns at Liége, finish them carefully, and sell them as Paris workmanship. The superior qualities are about equal at Liége and St. Etienne ; the produce of the former being superior in style and appearance, that of the latter in real finish. The Belgian talent for imitation is here conspicuous. The taste of every market is carefully studied ; the trade marks of other nations and makers are, I am sorry to say, counterfeited. Thus Liége has supplanted Birmingham to a great extent in the important market of North America. A stringent law on trade-marks in Belgium is a great desideratum for British industry.

The best double-barrelled Lefaucheux gun costs at Liége 16*l.* sterling. To the eye this gun will be quite identical with a 30*l.* gun of Paris, or a 40*l.* gun of London ; but in some parts it will be found inferior to either. If selected, however, with care and put into the hands of a gunsmith to be examined and "finished," it will do excellent service. From the immense scale of manufacture, a gun seldom comes from Liége thoroughly finished and regulated. The iron work will require to be case-hardened ; the lock will require the closest scrutiny, and perhaps re-tempering Here it is that England defies all competition. A pair of Wolverhampton locks will cost 3*l.*, therefore as much as an average Belgian gun, but will last for a lifetime. The Belgian lock will appear quite equal, but in a year or two the mainspring will become relaxed. English iron, coal, and workmen have been brought to Belgium in order to make English steel, but in vain. This is consequently attributed to the nature of the Sheffield water.

The British Board of Ordnance has bought about 150,000 stand of arms at Liége. The contracts were passed about 1854 with an association of four great houses, and were finally completed in 1863, to the entire satisfaction of the War Department, as officially notified. Of this order, some 1,500 were rolled barrels from Val-Benoit. The locks were all of Liége manufacture, excepting some for the navy rifles. The prices were—for the Enfield rifle musket, with bayonet, complete, 2*l.* 13s.; the artillery carbine, with sword-bayonet, 3*l.* 3s.; the naval rifle, with sword-bayonet, 3*l.* 8s. 5d. All these arms were made under the inspection of British artillery officers, and were subject to an inspection unusually severe for Liége. All the parts were made interchangeable, an object very difficult of attainment by manual labour. These arms were found from 8 per cent. to 20 per cent. cheaper than those supplied by the English gun trade, and at least equal in quality, but were inferior in regularity to the machine-made arms produced by the Enfield factory. During the same period some 20,000 stand were also supplied to Her Majesty's government by the Imperial Factory of St. Etienne. This would seem to show a decline of the English gun trade since 1830, when Birmingham was the great arsenal of the world. She then was able at a short notice to supply the French government with 140,000 muskets at 23s. each; but seems, from strikes and other causes, to have lost ground so much as to have been hardly able to supply 28,000 Minié rifles to our own Government in two years, 1852 and 1853.

Liége was well represented at the Exhibitions of Paris and London in 1855 and 1862. At the former she certainly occupied the first place for military arms. The house of Lemille there exposed a collection of 392 different specimens of fire-arms. One great medal of honour was awarded to the Liége arms trade collectively; three personal medals of honour, besides eight medals of the first class, seven of the second class, and three honorary mentions. The charge of imperfect straightening has been brought against Liége barrels. A great number of first and second class barrels were on this occasion examined by the Jury, and were most of them found defective in this respect. The London Exhibition received fewer contributions from Liége; there being only nineteen exhibitors in Class XI., Section C, Arms and Ordnance. *Seven medals were awarded to Belgian exhibitors,*—viz.; To MM. Simonis, of Val-Benoit, for their laminated gun-barrels; to MM. Lezaack, Dumoulin, Jansen, and Malherbe, for guns; to M. Ladry, for his rifle-rest; to MM. Coopal, for the purity of the raw materials used by them in the manufacture of gunpowder. Eight honorary mentions were awarded to Belgians in the same section. In another class a medal was awarded to

M. Amand, of Ermetton, for the excellence of his charcoal barrel-iron. In ornamental arms suitable for display Liége cannot of course, produce such works of art as are always exhibited by Paris gunmakers. Yet, in the decoration of saleable guns, her engravers work so cheaply and well that it is not uncommon for the Paris gunmakers to send their stocks and furniture to be engraved at Liége, notwithstanding the cost of duty and carriage. Many Liegois settled in Paris have risen to eminence in the gun trade, as, for instance, M. Leopold Bernard.

Another Belgian factory, the powder-mill of MM. Coopal, at Wetteren, claims here a special mention, as having earned a European reputation. All the powder used by the Belgian army is there manufactured by contract, under the inspection of artillery officers. From 1855 to 1857 Wetteren supplied the British Government with 2,400,000 lbs. of powder. As England has always enjoyed the reputation of making the best powder in the world, the selection of this and other Belgian powder-mills must be considered as highly honourable to this industry. Wetteren has always kept pace with, and sometimes originated, the leading improvements in this art. One of these which is due to Wetteren is the carbonization of wood by means of a super-heated vapour, invented here in 1842 by M. Castillon. This happy innovation enables charcoal to be calcined to the precise degree which may be required. By employing the two other ingredients in a state of absolute purity, it is now, therefore, possible to make powder always identical in quality. Thus, from an empirical it has risen to be a scientific process. This factory employs 100 hands and a steam-power of 100 horses. Though founded so long ago as 1778, it has, by good management, been preserved from explosions—an instance rare, if not unique, in the annals of this dangerous industry.

(To be continued.)

THE OAK SILK-WORM OF CHINA.

BY THOMAS TAYLOR MEADOWS.

In the journey to the Corean borders of the autumn of 1863, I found myself, so soon as I had crossed the watershed of the Leaou Mountains, travelling through a silk-producing country. I had, indeed, heard before of silk being produced at and near Fung-hwang city, but had considered it merely an amateur domestic occupation not capable of being developed into a trade. That it is much more than this, and that it may furnish in time what the port greatly wants, an article of export to Europe, may be seen from the details published in the TECHNOLOGIST, vol. v., p. 368.

It is difficult enough to extract good information from Chinese when in the midst of the things inquired of: at a distance it is next to impossible. As an instance of this, I may state that in spite of all my frequent inquiries made both when in the silk-producing district and at this port from natives of that district, it is only within the last few months that I have learnt of another tree besides the oak on which the large worm feeds. The oak bush is called locally *Po lih ko tsi.* The other bush is called *Chien tso tsi.* Its leaves are narrow and long as compared with those of the oak bush. Its bark is of a greenish white hue and is smooth, and its trunk and branches straight and ungnarled as compared with those of the oak. It produces a seed or fruit on which pigs feed. It must, I think, be a species of beech. The silk produced by worms fed exclusively on this bush is said to be stronger than when they are fed on the oak.

It is, I fear, beyond doubt that the oak leaf-eating worm, the *shan keen* or mountain worm, as the Chinese here call it, is of a different species from the mulberry leaf-eater, which is here called the *kea keen* or domestic worm; and that, therefore, the hope hinted at by Mr. Major, of a beneficial crossing, cannot be indulged in. On the other hand, the mulberry leaf-eater or domestic worm of the New-chwang Consular district does seem to be of the same species as that of middle China; and it might be desirable to try the effects of a crossing with an insect that has probably for many generations been a separate inhabitant of this widely different climate.

As the cocoon produced by the mountain worm is about three times the size of that produced by the domestic worm, so the worm itself is about thrice the thickness, though little if anything longer. It is of a brown or dry earth colour, and has on its back little knobs or protuberances. In its flying stage the "mountain" insect is a large and richly coloured butterfly, measuring from tip to tip of its expanded wings some seven to nine inches, "as large as a swallow." A native of the silk country now here professes to have once fed a few mountain worms on mulberry leaves. They ate as much as five or six times the number of domestic worms: and the cocoons they spun did not at all differ in their appearance from those spun by mountain worms fed on oak bushes. The same man tells me that the stuff made from the cocoon of the mountain worm will take only a black or a purple dye, and that those who desire to make with it a stuff of other colour are obliged to use some proportion of cotton threads.

Looking to the three great classes of textiles, cotton, wool, and silk, the produce of the mountain worm must be classed with the latter, inasmuch as it neither grows on a shrub nor on an animal's back, but is produced by a leaf-eating worm, and viewed as "silk," it is manifestly of an inferior quality. But if we choose to look at it simply as a new textile, there is some reason to believe that it may prove to have useful qualities not possessed by either silk, wool, or cotton.

Should it be found to possess some such peculiar quality so useful as to make it specially marketable, then it will become a matter of interest to ascertain whether a cocoon-forming worm which exists in a wild state in British North America—near the Canadian lakes I think,—is not the same animal as the New-chwang "mountain" worm. The climate of the two regions is essentially the same, and if the cultivation should seem desirable in Canada, the difficulty of want of experience as well as want of sufficient labourers might be got over by introducing Chinese emigrants from the New-chwang silk-districts. Be that as it may, the produce of the mountain worm spun into thread or as cocoons should, if the provincial authorities are not allowed to interpose barriers to foreign adventure, prove a fairly remunerative export from this port town, and that for the reason that it has for generations back paid Chinese dealers to send it seaward in junks.

The silk region of the New-chwang Consular district may be described as the valleys of the Yang, and other small rivers which empty themselves into the head or northern extremity of the Yellow Sea; but the region extends as far north as the parallel of Moukden; the hilly country lying due east from that city, and which is drained by the affluent of the Leaou river which passes it, also producing silk. No other part of the Leaou valley produces silk, nor is any, so far as I can learn, produced in the hills which lie between it and the great wall.

The silk region, as I have defined its limits, is about 100 miles broad from east to west, and about 150 miles long from north to south. Its southerly position, that nearest to the Yellow Sea, is probably the most suited for the cultivation, and it is from that that the accompanying cocoons, with the twigs and leaves of the bush the grub feeds on, have been procured. The pieces of stuff that accompany them were woven in the same region, whether with or without admixture of cotton, which is also produced in that quarter, I cannot tell.

I have traversed the silk region twice. A water-shed, composed of the mountains that comes down from the north-east of Moukden and stretch away to the Meaou-taou Straits, forming the Leaou Peninsula; this water-shed intervenes between the silk region and this port town. But there are certainly two, if there be not more, roads practicable for the heavy goods' carts used in this province. Heavy articles of small value, as pulse, bean-cakes and oil, could not with profit be brought over these mountains to this port. On the other hand, a considerable portion of the foreign cotton-manufactured goods, which supply the fairs held near the Corean frontier, are taken in carts over these mountains from this port, showing that, in articles of no greater value in proportion to their weight than cottons, this foreign-shipping port can compete favourably with the junk ports at the head of the China Sea, the longer land carriage being counter-balanced by the cheaper freights, and quicker passages of foreign ships, with the power of insuring goods conveyed by them. Therefore, the cocoons have been sent southward through the junk ports at the head of the China Sea: none, so far as I can learn, have ever been brought to this port (New-Chwang); but as the light cocoons could be brought from that region with less cost, in proportion to their value, than cotton goods can be taken thither, it is plain that, in so far as the land transit is concerned, there is no reason why this port should not become a port of export of the silk region; and if it has paid Chinese dealers for generations back to take it away southward, there would seem to be no reason why, in the present dearth of textiles, foreigners might not also take it away with profit.

The southern dealers arrive at the junk ports as the navigation opens, about the end of March, and proceed up into the silk valleys, where they give advances to the silk farmers. The first crop is usually taken to ports, mostly to one called "Ta-koo-shan," about July; a second crop is shipped just before the navigation closes, *i.e.*, about the beginning of November. The cocoons are taken away in large baskets. The price in some seasons goes down to four or five mace of silver for 1,500 cocoons; in others, it rises to six or seven mace for 1,500, advances being in every case made to the cultivators.

Mr. J. Major, of Shanghai states, I have first seen this kind of cocoon some fifteen years ago, in the Museum of the Chamber of Commerce and Arts at Lyons. It had been sent there (likely 100 years ago) by the Roman Catholic missionaries, as the produce of a worm in the north of China, feeding on the leaf of the oak tree. No experiments had been made therewith in France, because the quantity sent had been too small. Since I have been in China I have received a letter from Lyons, asking me to look after this cocoon; but it was only once, two years ago, that I succeeded in getting a few of them from Japan, which I then reeled off.

The first impression on seeing these cocoons and the cloth woven from their produce is, that this can never come in for silk. The manufacture is the rudest that can be in all respects; the thread is as coarse and unequal as well can be; the whole has no gloss whatever, although no cotton is mixed, both the warp and woof are made of the raw material as taken from the reel, without any attempt at tram or organzine, therefore necessarily left in the gum. I have attempted to boil off the half of the cloth sent to ascertain the quantity of gum the animal may use in spinning, which with the silkworm is twenty per cent., but I have not been able to reduce it in weight at all; this can only be accounted for by the cocoons having undergone a degree of fermentation in the process of killing the grub which has been adopted. You will also see from the piece of cloth I return you, together with the other piece unboiled, that the colour has remained unboiled, that the colour has remained nearly the same (it would therefore, in dyeing, take no other colour than black), whereas, if this had been made of usual yellow silk, it would have turned out white from boiling.

I have, however, boiled off half the skein of silk of my reeling from such cocoons, which I add to the other skein of raw, which you will perceive has become nearly white, and will take any colour. I therefore am persuaded now, after seeing this silk boiled off, that it really is silk, and might well be used for tram in European manufacture, if reeled equal to this sample.

NOTES ON COAL AND FUEL.

We think that a few general observations upon the descriptions of coal most commonly used in England for domestic and steam purposes, may not be out of place. For domestic use, those coals that do not corrode the fire-bars, and leave the least quantity of ashes, are the best; but for steam purposes the value of them depends upon their power of converting water quickly into steam—that is, if a given weight of coal in a certain time converts a larger proportion of water into steam than the same weight of another kind of coal in the same time, the evaporative power of the one would be greater than that of the other. Coal for steam purposes should burn rapidly, should not be too bituminous and produce much smoke, should have a cohesive power so as not to fall to pieces by the rolling and pitching motions of a ship, and should have such a density and structure as to bear stowage in as small a space as possible; it ought not to contain a large proportion of sulphur, nor be subject to quick decay, for in either case it might lead to spontaneous combustion. No coals as yet discovered, unite all these conditions. Several attempts have been made to convert anthracite coal into a patent fuel, but at present the tar used to cement the coal burnt so much more rapidly in the furnaces than the anthracite itself, that the latter accumulated on the bars and obstructed the draught, or escaped through the grates unconsumed.

The component parts of coal are principally carbon or charcoal, and bitumen. Some kinds of coal are laminar, others compact. They in general burn freely, with a bituminous odour, and leave a considerable residuum.

This invaluable mineral is found in beds, or strata, frequently betwixt clay, slate, and sandstone, and seldom betwixt those of limestone. It occurs in great quantities in Great Britain, Siberia, Germany, Sweden, France, North America, the northern portion of China; and, in smaller quantities, in Australia. Dr. F. Krauss, of Stuttgard, met with it in great abundance during his travels in South Africa, specimens of which were exhibited on his return to England. No fewer than seventy different kinds of coal are now brought to the London market, the value and prices of which greatly differ. Of these the coals called Wallsend, from the name of the pit, near Newcastle, whence they are obtained, usually bear the highest price.

Common Coal or *Pit Coal*, is of a black colour, and has generally a slaty structure and foliated texture. When handled it stains the fingers; and when burnt it cakes more or less during combustion. Its component parts are usually charcoal and bitumen, with a small portion of clay, and sometimes with pyrites, or sulphuret of iron. What is called slaty coal contains a greater portion of clay than other kinds.

Some foreign writers have ascribed the great wealth possessed by England to the coals which are there found in such abundance, and which facilitate, in a very essential degree, nearly all its manufactures, and consequently are a means of promoting its commerce to an extent which is possessed by few other countries. All Britain's great manufacturing towns, Birmingham, Sheffield, Leeds, Glasgow, &c., are situated either in the midst of coal districts, or in places to which coals are conveyed, with little expense, by canal carriage.

The extraction of saleable coal from British mines approaches a hundred millions of tons per annum, and the waste of coal involved in getting this quantity is probably more than one-fourth part more. Coal weighs rather less than a ton to the cubic yard, and we are therefore removing and using, or destroying, from the portion of our own small island to which coals are limited, 125,000,000 of cubic yards every year of one of the most valuable substances in existence. Assuming a coal seam to have an average thickness of two yards, it would take twenty square miles of such a seam to supply one year's consumption. It behoves us, then, to look around and consider the resources we possess, whether we can afford to expend this portion of the capital stock of our national wealth, and what chance there may be of this local supply becoming exhausted.

Coals in England are principally obtained from the neighbourhood of Newcastle-upon-Tyne, Sunderland, Derby, and Stafford. Glamorgan likewise furnishes a considerable supply of coal: it having been estimated that the coal fields of South Wales extend over 1,200 square miles; and those of Northumberland and Durham 732 square miles. The particular places whence they are obtained have the name of "collieries," and the mines from which they are dug are called "pits." The deepest of these are in Northumberland, and are worked at more than 900 feet below the surface of the earth. At Newcastle there is a coal-pit nearly 800 feet in depth, and which, at that depth, is wrought five miles horizontally, quite across and beneath the bed of the river Tyne, and under the adjacent part of the county of Durham. At Whitehaven, the mines are of a great depth, and are extended even under the sea, to places where there is above them sufficient depth of water for ships of great burthen, and in which the miners are able sometimes to hear the roaring of the water. On the contrary, in some parts of Durham the coal lies so near the surface of the earth that the wheels of carriages lay it open, and in such quantity as to be sufficient for the use of the neighbourhood.

The beds of coal are of various thicknesses, from a few inches to several feet; and in some places, it is found advantageous to work them at a very great depth, although their thickness does not exceed four or five feet. The thickest bed of English coal, of any extent, is that of the main coal in the mines of Bilston and Dudley, Staffordshire, which measures from thirty to forty feet. In many places there are several beds above, and parallel to, each other, separated by strata of slate, sandstone, and other minerals. Coal is never found in chalk, and very rarely in limestone.

At Whitehaven, the principal entrance to the coal mine, both for men and horses, is by an opening at the bottom of a hill, through a long passage hewn in a rock. This, by a steep descent, leads to the lowest bed of coal. The greatest part of the descent is through spacious galleries, which intersect other galleries, all the coal having been cut away, except large pillars, which, in deep parts of the mine, are three yards high, and about twelve yards square at the base, such great strength being there required to support the ponderous roof. There are three distinct and parallel strata of coal, which lie at a considerable distance above each other, and which have a communication by pits that are sunk between them. These strata are not always regularly continued in the same plane. The miners occasionally meet with veins of hard rock which interrupt their further progress, and at such places the earth on one side of the vein appears to have sunk down, while that in the opposite side has its ancient situation. These breaks miners call "dykes." When they come to one of them, their first care is to discover whether the coal, in the part adjoining, be higher or lower than that in which they have been working; or, to use their own terms, whether it be cast down or cast up. For this purpose they examine the mineral strata on the opposite side, to see how far they correspond with those which they have already passed through. If the coal be cast down, they sink a pit to it; but if it be cast up, the discovery of it is often attended with great labour and expense.

In general, the entrance to coal mines is by perpendicular shafts, and the coal and workmen are drawn up by machinery. As the mines frequently extend to great distances horizontally, beneath the surface of the earth, peculiar care is needed to keep them continually ventilated with currents of fresh air, for the purpose, not only of affording to the workmen a constant supply of that vital fluid, but also to expel from the mines certain noxious exhalations which are sometimes produced in them.

Some writers have imagined coal to be the remains of antediluvian timber, which floated upon the waters of the deluge, until several strata of mineral substances had been formed; others conceive it to have been antediluvian peat bog. It is now, however, universally admitted, that coal is nothing more than vegetable matter, which flourished when

Great Britain must have been at a considerably higher temperature than at the present time ; and which vegetables must have been washed down by rivers probably in the form of forests, and deposited, together with sandstone, clay, limestone, &c., in the situations where we now find coal. The question then arises, from whence did the mass of vegetable matter come ?—was it supplied by forests in any part of our own island ?—or was it obtained from land now beneath the sea, in the Northern and Western oceans ? It is called " pit coal," from the circumstance only of its being obtained from mines and pits ; and in London, for no better reason than its having been conveyed thither by sea, it has the name of " sea coal."

Its uses as fuel are too extensively known to need here any observations. By the distillation of coal, an inflammable gas is produced. The gas is conveyed by pipes, from the reservoir in which it is collected, to great distances ; and the light which it yields is peculiarly brilliant and beautiful. It was at the foundry belonging to Messrs. Boulton and Watt, at Birmingham, that the first display of gas light was made, in the year 1802, on the occasion of the rejoicings for peace. In 1805, the cotton mills of Messrs. Philips and Lee, at Manchester, were lighted with gas. In the beginning of 1816 it was estimated that, at the three gas-light stations, in Peter street, Westminster, and Worship street and Norton Folgate, London, twenty-five chaldrons of coals were used daily ; and that these were sufficient to supply with gas 125,000 large lamps.

A ton of coal makes between nine and ten thousand feet of gas, and a saleable chaldron of coke. The same quantity loses in the act of carbonizing (if weighed hot) about 30 parts out of a 100 ; so that 70 parts is the quantity of coke left in the retort. Of the 30 parts, 15 are gas, 1 tar, 5 water, and 5 are consumed by purification.

With respect to the illuminating power of ordinary coal gas, it is estimated that five feet are equal to twelve mould candles, of six to the pound weight.

Cannel Coal is of a black colour, with little lustre, is not laminar, but breaks in any direction, like pitch, and does not stain the fingers. It burns with a clear flame resembling a candle. It is rather heavier than water.

This highly inflammable kind of coal is found abundantly in the neighbourhood of Wigan, in Lancashire, where there is an entire stratum of it about four feet in thickness. It is also found near Whitehaven, in some of the pits at Newcastle, and in some parts of Scotland. Doubts have been entertained respecting the name of this coal ; but when it is recollected that in Lancashire, whence it is chiefly brought, the word candle is usually pronounced with the omission of the letter *d*, and that, in many instances, the coal is used by the poor as a substitute for candles, these will be immediately removed. In Scotland it has the name of "parrot coal."

Stone Coal, Kilkenny Coal, Welsh Coal, or *Glance Coal,* is of a dark iron-black colour, with a metallic lustre and foliated texture; and consists almost entirely of charcoal.

Unlike most other kinds of coal, this occurs both in stratified masses, and in lumps, nested in clay. It is found in several countries of the European Continent, in Wales, Scotland, and near Kilkenny in Ireland.

When laid on burning coals, it becomes red hot, emits a blue lambent flame in the same manner as charcoal; and is, at length, slowly consumed, leaving behind a portion of red ashes. No smoke or soot is produced from this coal; but, on the contrary, it whitens the place where the fume is condensed; and the effluvia which it gives out is extremely suffocating. This coal is chiefly used in the drying of malt.

Bovey Coal, *Brown Coal*, or *Bituminous Wood*, is of a brown colour, and in shape exactly resembles the stems and branches of trees, but is usually compressed. It is soft, somewhat flexible, and so light as nearly to float when thrown into water.

The greatest abundance of this coal occurs at Bovey, near Exeter, from which place it derives its name. The lowest stratum is worked at the depth of seventy-five feet beneath the surface of the earth. It is also found in Scotland, Ireland, and Germany.

As fuel, the Bovey coal is used only by the poorest classes, as, notwithstanding its burning with a clear flame, it emits a sweetish but extremely disagreeable sulphurous gas, which is injurious to health. It is principally used for the burning of lime, and for the first baking of earthenware.

Jet, or pitch coal, is a variety of cannel coal, and is a solid, black, and opaque mineral, harder than coal, and found in detached masses from an inch to seven or eight feet in length, having a fine or regular structure, and a grain resembling that of wood. It differs from cannel coal by its superior hardness. Jet cannot without difficulty be scratched with a knife, whilst cannel coal may be marked by the simple pressure of the nail.

The name of jet has been derived from Gages, a river of Lycia, whence the ancients are said to have obtained this substance. It is frequently cast on shore on the eastern coasts of England, together with pieces of amber and curious pebbles, particularly near Lowestoft in Suffolk, and Whitby in Yorkshire, where many persons employ their leisure in searching for it, and forming it into various kinds of trinkets. Jet is found in several countries of the Continent.

Culm is a species of coal frequently used in England and Ireland for lime burning. It contains much earthy matter, will not kindle in an ordinary fireplace, yet produces considerable heat and flame in a furnace to which a strong current of air can be introduced.

Modes of purifying coals are being gradually introduced under patents in England, France, Germany, and elsewhere. In 1851, at the Great Exhibition, Messrs. Berard and Co., in the French Department, produced "small purified coals, and the residue of the same, the produce of a system for purifying coals;" and, at the last English Exhibition, the Americans produced purified coals, made up into light portable fuel. Patent fuel of compressed small coal is now largely made in Wales for steamers. Dried turf, or peat, is extensively used in Ireland for fuel.

In the sandy deserts of the north-east of Africa, the excrement from camels is dried and used as fuel, and other descriptions of excrement might be readily collected and burnt. Before railways became so universally in vogue in England, cottagers in various parts of the country, particularly in Lincolnshire and Leicestershire, were in the habit of saving the refuse from their cow-stalls, laying it from three to three and a-half inches thick upon grass, and in its fresh and moist state cutting it into squares of about six inches, which they left to dry in the sun, and then stored for fuel in the winter. We have ourselves frequently witnessed this, and seen the square or round stacks of the fuel thatched down for domestic use when coals became dear, or winter weather demanded more numerous fires than ordinary. The Chinese have for ages been accustomed to mix the excrement from cows and other refuse vegetable matter, with soft clay and coal-dust, thus forming cakes that, when sun-baked, become a cheap and portable fuel, and they burn with very little smoke. These cakes are, indeed, largely manufactured in the coal districts of Northern China, being widely distributed therefrom over that vast empire by means of junks on the numerous canals. In some parts of Wales, particularly in Pembrokeshire, culm is frequently made into balls with clay, and the poorer classes sit over them for hours in winter, when lighted in the cottage grates.

It will be well for people to bear in mind, that upon the stowage away of large quantities of coals at ordinary temperatures, a slow combustion is going on under the action of the oxygen of the atmosphere, evolving carbonic acid, nitrogen, and inflammable gases, which may lead to explosions, the combustion being the more promoted by high temperature, combined with the presence of moisture. If the coals contain much sulphur or iron pyrites, the chemical action may become so intense as very speedily to fire them. In storing coals, therefore, it is important to keep them dry, and of such a variety as may be the least liable to progressive decomposition.

FORMOSA CAMPHOR.

Camphor is the chief export from Tamsing, but the trade in the drug is still hampered by a monopoly which is not only against the treaty but is clearly unfair to individual merchants. In 1864 the monopoly was apportioned out among there firms, four months to each. The amount incurred by the holder of such monopoly is about 200 dollars a day, 125 of which goes to the Taotæ or superintendent. The current rate of camphor was fifteen dollars a picul, and the rate it was offered at in Taiwan was 13 dollars, so that was quite a losing game with the present holders of the monopoly, though the Taotæ derives his profits therefrom the same as usual. The Taotæ, on behalf of the Government, lays claim to all the timber of the island adapted for naval purposes, or in other words, the camphor wood only; for no steps are taken to prevent the settlers in the bush from cutting down other wood for domestic use or for charring into charcoal. Were the injunctions issued with a view to preserve the wood which is daily being cut away without any attempts to replant it for future use, the measure might be applauded as a beneficial one, and one that ought to have been enforced in many parts of China and India, where the want of firewood is daily making itself more felt; but it refers unquestionably to camphor alone. The fine camphor trees thus destroyed it will take scores of years to replace; and as, from the peculiar character of their large outspreading growth, they only occur at widely scattered intervals, the time may not be distant when the chief source of profit from this locality will be reckoned as one of the things of the past. As it now stands, the Government have doubtless the title over all the jungly land of the Colony, and they may be right in restricting the privilege of demolishing the finest timber to one party for a valuable equivalent. A great deal of secret destruction of timber is always going on, and were it not for the vigilance of the mandarins and of the parties concerned, the annihilation of these trees on the hills would be doubtless brought about in a speedier manner. The tree appears only to flourish in the Tamsing and Komolar Department, it having some time since disappeared from mountains of the southern department accessible to the Chinese settler.

The exports of camphor from Taiwan in 1863 were by

	dollars.
British vessels, 13,670 piculs, val.	205,050
Foreign vessels, 90,482 catties	1,176,266

In 1864, the exports were 10,594 cwt., valued at 26,629*l*., of whic 20,803 cwt. were shipped in British vessels.

THE HISTORY OF COMMERCE.

For thousands of years commerce has spread its blessings over many countries; imperceptible are its beneficent influences on civilisation, nations, and their development; it has brought into advantageous union countries and peoples, founded cities and states, softened men's manners, and conducted them to wealth and education. Commerce has ever been the motive, awakening in every direction life and useful activity, animating production and industry, and stimulating each art to unwearied activity and strife after new discoveries. Without such emulation many discoveries important in their action would never have been made, and distant regions of the earth would have yet remained unknown and uncultivated.

Happy therefore the country where commerce establishes herself. The history of all times gives proofs that States where commerce enters with her attendants, trade, agriculture and mining, quickly raise themselves high above their contemporaries. So shines yet through past ages Phœnicia with her Tyre and Sidon, rich through navigation and industry, and still later the celebrated Carthage, whose opulence and power on the Mediterranean had the same foundation. So rose after them Italy by her great commerce, of which she might well be proud, and Venice and Genoa under the Medici, whose splendours and power have not even yet disappeared. Later still, Great Britain and Holland through commerce have obtained the dominion of the seas and the government of foreign countries; and so by the same stirring commercial activity has arisen a state in the New World, the free Union in North America, which in a wonderfully short time has become a powerful rival in the commercial world, and attained to political importance.

But commerce and industry were not always so flourishing and extensive in the circle of their operations as at present, because not any period of time is so marked as our nineteenth century in varied intellectual development and rapid and common advance in different departments of human knowledge. As it was not always the same country which shone in this respect, it will be interesting to point out in a short sketch the most important phases of commercial life from ancient to recent times.

All commercial intercourse could in the beginning have no other origin than that which we find at the present time among people in the lowest stage of civilisation—viz., an interchange of the raw products of nature; from a want of them on the one side, and an overflow of them on the other. The increase of mankind and their need to buy and sell at certain prices, or by some common medium of barter, must first have led them to settle upon the precious metals or money.

In the East, to whose earliest development as well as to her precious products the most ancient histories point, and from whence at the same time the arts received their foundation, commerce first acquired a wide expansion ; for in the most ancient times valuable oriental goods such as aromatics, spices, perfumes, gold, precious stones, and pearls, ivory, fine wood, cotton, silk, costly fabrics, and gold and silver brocades, were spread from India, Babylonia and Arabia to the western coast of Asia and Egypt, and they were conveyed for security in large companies or by caravans.

The Phœnicians in Tyre and Sidon on the Syrian coast or in the land of Canaan, soon shared this traffic. But they were not content with this circumscribed and difficult land commerce ; for improving their navigation, and incited by rich profits, they were the first bold maritime people to encounter the dangers of the ocean, whilst at the same time they pushed their commerce through caravans to the rich Babylonian markets of Heliopolis or Baalbec, and Palmyra or Tadmor, to India and Arabia Petræ, and traded with those renowned ancient Egyptian cities, Merœ, Thebes, and Memphis in corn, cotton and costly linen. About 1,500 years before Christ, they had already founded commercial settlements at Cyprus, Rhodes, Crete or Candia on the coast of Asia Minor, and Greece, and peopled later, by means of colonies, Sicily, Panormo now called Palermo, and on the northern coast of Africa, Utica, afterwards Carthage, which served them as stations for long voyages. The Phœnician ships also sailed through the pillars of Hercules, the ancient name for the Straits of Gibraltar, and settled their commercial colonies in the south west of Spain, then rich in silver, founded Gades and Hispalis, now called Cadiz and Seville ; even the tin mines of Cornwall appear to have been known to the Tyrian merchants. The Madeiras on the western coast of Africa also received from them colonies.

In the East their navigation extended principally in Solomon's time and in connection with that king, to Palestine, in their neighbourhood, through the ports of Elath and Erion-geber, on the Red Sea, having the gold region of Ophir for its boundaries, which some have placed in Ceylon, others in Arabia Felix, and more recently, on the eastern coast of Africa ; but the part taken by the Israelites, in commerce at sea, ceased soon after the death of their king, Solomon.

The Phœnicians were great and renowned in several trades besides navigation. They discovered the art of making glass and purple colours, weaving and dying splendid stuffs, wrought much brilliant merchandise in ivory, glass, amber, gold, silver, precious stones and pearls. In the ancient times of Homer, and under David and Solomon, people praised the Syrian and Sidonian garments, which were carried to all countries, as articles of luxury for the kings and great. We also owe to them the first money coined.

Contemporaneously flourished through industry, in consequence of her commercial connection with India, proud Babylon on the Euphrates, which not only in architecture, in metallurgy, in steel and curriery, but like Tyre and Sidon, in the manufacture of all wares of oriental luxury, in gold and silver embroidery, in ornamental and jeweller's work, and as at the present day like Bagdad, in costly carpets, and products of wool and silk, was celebrated before all other places.

Greece or Hellas also raised herself in these early times, through Phœnician and Egyptian colonies, favoured by navigation and commerce; and colonies of the Ionian Greeks on the western coast of Asia Minor, especially Milet, the Queen of all Græco-Asiatic cities Ephesus, and Smyrna, renowned as places of trade for the commerce of the Levant, acquired a commercial importance, which the storm that overthrew in the sixth century the Persian rule was not able to destroy, and only had this effect, that from this Ionian coast commercial colonies were settled in several islands in the Archipelago, in the Peloponnesus, on the coast of Italy, Sicily and Galicia itself where Marseilles was founded, and as a result Athens and Corinth, with their many colonies, which in like manner, as important maritime commercial places, afterwards became noted for their manufactures.

But greater than all, after the fourth century before Christ, rose the Phœnician colony of Carthage, on the North coast of Africa (in the neighbourhood of the present Tunis). Not only did she elevate herself to be an important commercial state, but in the spirit of her undertakings, excelled the mother country by improvements in navigation, acquiring the dominion of the seas, and for a long time embracing the commerce of the west. Carthage ruled, as a result, the coasts and islands of the Mediterranean, founding colonies at Syracuse in Sicily, and at Carthagena in Spain. Her fleets went through the pillars of Hercules into the open ocean, to Armoricum and Britannia, and carried a part of her commerce to the West Coast of Africa. The Carthagenians formed caravan roads for commerce, which remain to this day, through Fezzan and Upper Egypt as far as Arabia; so that Carthage became at last so rich and powerful, that it excited the jealousy and fear of the uncultivated Romans, aroused their thirst for conquest, and by them she was conquered 196 years before Christ. Carthage rose like ancient Tyre to greatness by her commercial enterprise, only to share like that city the same sorrowful downfall!

Still later, on the northern coast of the same part of the earth, a new maritime city was founded, which quickly rose to commercial importance,—Alexandria in Egypt, even at this day one of the most flourishing maritime cities of the Mediterranean. This city was first built after the destruction of Tyre and the downfall of the Phœnician commerce 332 years before Christ, by Alexander the Great, and called after the Conqueror of Asia Minor and Egypt. Under the splendid dominion of the Greek regal dynasty, the Ptolomies it at the same time became the seat of Grecian education and activity, and like Athens and Corinth soon absorbed everything to itself, which its magnitude in riches, arts, science, and industry could command. By virtue of its favourable position, Alexandria ruled the coasts of three parts of the earth, and after the fall of Carthage, shared with Rhodes and Corinth the maritime commerce of the Mediterranean. From thence Alexandria pushed her navigation up the Red Sea, and soon embraced the greatest part of the commerce of Arabia and India, for which purpose the harbours of Berenice, Oumas, and Myos were founded by the Ptolomies as places of commerce. From these places merchandise caravans, through the Nile, brought the markets of the commercial world into the harbour of Alexandria, whose riches at length, together with the whole of Egypt, fell into the hands of the insatiable Romans.

Now, although the warlike Romans, after the destruction of Carthage, urged navigation, and for a long time neglected and despised commerce, which they looked upon as business fit only for manumitted slaves and citizens of the lowest class, yet they ultimately began to give it their attention, and after many battles at length also founded a naval power. They obtained the lucrative traffic of the Levant, and under Augustus, A.C. 30, after the conquest of Egypt, seized the Arabian and Indian commerce in Alexandria; but owing to their perpetual wars it could never become a commercial state. Through their conquests almost all known countries brought the Romans treasures, which produced among them a high degree of luxury and love of enjoyment, whereby indeed the fine arts prospered, but at the same time their increasing effeminacy not only ruined commerce but brought the Roman empire itself to an end. Alexandria in Egypt, however, continued to maintain to the last the rank of the first commercial place in the great Roman empire, and remained through all changes the ruler, with only few interruptions, for more than 1,000 years after the fall of Rome, the principal place of trade for the commercial world, and at the same time the chief seat of learning and science.

Next to Alexandria, after the fall of Rome, rose Constantinople, the ancient Byzantium, and the new residence of the Ottoman and Greek emperors, 476 years after Christ. It began to flourish under the dominion of Justinian, who brought the silk-worm from China to Europe about A.D. 555, and by prosperous wars and wise laws raised the splendour of the country of the Greeks to a significant magnitude. After the conquest of Alexandria by the Saracens, A.D. 640, it was desirable for them to obtain the most lucrative commercial connections, and to profit by them. Constantinople was therefore made by the Saracens the principal seat of commerce, and a market not only for the Levant, but also for Asiatic and African merchandise, and whither, therefore, the treasures of many countries flowed. The city itself prepared for commercial diffusion a great number of valuable fabrics in silk, cotton, wool, goats' hair, leather, steel, gold, and silver, and brought besides wax, wine, Indian aromatics, and spices, as well as precious stones and pearls, and much Russian peltry for exportation to the West.

The foundation of a new kingdom in Lesser Asia Minor, and Northern

Africa by Mahomet and his followers, about the middle of the seventh century, must have necessarily shaken the Ostromic, or Greek Kingdom; since the Arabs or Mahommedans, at one time by Islam inspired, and to conquests impelled, like a violent and incessant stream spread themselves over Spain itself, and far into Asia and Africa, and tore away from the Greek Empire, Syria, Asia Minor, and Egypt. Nevertheless, Constantinople yet maintained its political and commercial importance, although for a long time subjected to multifarious battles. But near it, rose towards the end of the eighth century, Bagdad on the Tigris, the seat of oriental luxury, and of the power of the Caliphs. This became the centre of a varied and wide-spread commerce, and a principal seat of art and science, rivalling the city of Damascus in splendour, which had become great through its manufactures in cotton, silk, leather, and steel goods. Aleppo, also in Syria, where the Arabs had spread themselves, at this time had commercial connections with China and Java, and as far as Morocco and Spain; in the ninth century it already trafficked with Canton, and at that time tea, arrack, and porcelain were known to them.

Thus much for the East. After that, Western Europe having recovered herself from the storms and disturbances brought down on the Germanic stem through Rome's decline, had formed herself new states. Then first flourished on the Spanish Peninsula, under the dominion which the Moors or Mahommedan Arabs had forced upon Morocco at the commencement of the eighth century, near the old Punic and Roman colonies, Cadiz, Seville, Malaga, Carthagena, Cordova, Granada, Murcia, Valencia, Tarragona, Barcelona, Saragossa, Toledo; Spanish cities, raised through industrial arts, which the Moors revived, aided by the cultivation of the soil, and the prosperity of commerce.

Already the South of France had established a brisk traffic with the Levant; and the old colony of Marseilles, worthy of her origin, had come to be regarded as the most important mercantile place of Western Europe, next to which Ayles, Narbonne, and Bordeaux, Tours, Soissons, and Paris, distinguished themselves by their manufactures and commerce, and Lyons and St. Denis became renowned through their mercantile fairs. But notwithstanding this apparent happy commencement in Spain and France, the succeeding times (equally also in the Netherlands and Northern Germany, through the repeated Norman invasions, the wars with England, and the endless Moorish battles,) were in the highest degree unfavourable to the prosperity of both States, so that although the wine and salt exportation from both countries, especially to the Netherlands and England had begun to be brisk, yet their commerce up to recent times remained on the whole passive.

About the time of Charlemagne, A.D. 800, Germany began to acquire a flourishing character. Under his rule, rural economy and the industrial trades made for themselves rewards. The people commenced most of the present German products, and worked especially in flax, wool, hides, and metals, for the necessary wants of life. The inhabitants of the coast prosecuted the fisheries successfully, and several places on the Rhine were already famed for wines. But most of the commerce circumscribed itself here to the interior, which was especially carried on in the neighbourhood of monasteries on festive occasions, called their fairs.

Although at this time the cities of Southern Germany came into connection with Constantinople, yet it is more important, especially for Northern Germany and the countries on the Baltic Sea, to point out the commercial roads and the merchandise tracks. These were from Constantinople over the Black Sea, and by means of caravans through Russia, by Kiev on the Dneiper, the central point of this diffused commerce, and Novogorod on the Ilmansee, went to the Baltic, In the ninth century the Sclavonic city Mureta, on the Pomerania Island, Usedom, at that time next to Constantinople, the most important trading place in Europe, and after its decline, Wisby, on the Swedish Island, Gotland, was the place of trade, whither goods from the Levant and India arrived, to be exchanged for northern products, peltry, amber, flax, cordage, wool, hides, leather, iron, copper, tar, blubber, &c.

Since the 10th century the following have become noted as trading places :—On the Baltic, Dantzig; Julin on the Pomeranian Island, Wollin, Schleswig, but especially Lubeck ; on the North Sea, Ripen on the Peninsula of Jutland, Hamburg and Bremen ; on the Rhine, Cologne, Coblentz, Mayence, Worms, Spire, and Strasbourg, particularly Frankfort-on-the-Maine (whose fairs had commenced in A.D. 843) ; whilst in inner Germany, Bardowia in the Launeburg, Brunswick, Magdeburg, Erfurt and Halle ; in Southern Germany, Ulm, Augsburg, Nuremburg, Prague, Salzburg and Vienna flourished by the industrial arts and commerce, as did Belgium, Flanders, and Brabant, Ghent, Bruges, Brussels and Antwerp, pattern states of the industrial arts, and embroidery sought in European markets.

Several cities of upper Italy, enriched by commercial navigation on the Mediterranean and with the East, ascended higher than Germany, and Western Europe, about A.D. 1000, separated from the rule of the German princes, had formed itself in part into powerful Republics.

For many centuries had Italy been oppressed by the hard blows of savage unsettled wars, and after the overthrow of the Roman empire, the rough people from the East and North, the conquerors, crushed her and desolated this beautiful land. Then at last a new and happy life for Italy developed itself through industry and activity in navigation and commerce at several points, and she elevated herself gradually by trade with the Levant—viz., to Constantinople. The maritime cities of Venice, Genoa, Pisa, and Amalfi especially became enriched, whilst contemporaneously through active industry, Florence, Siena, Mailand, Lucca, and Bologna shared this greatness.

The Crusades in the 11th and 12th centuries animated and extended the traffic between Europe and the East to an extraordinary degree; and whilst they continued, Venice and Genoa through their maritime power and enterprising spirit became renowned. They carried in their ships a number of Crusaders to the East, and found it convenient to establish new connections for their traffic, obtaining also permission to preserve for themselves many colonies for their extensive *employés*, so that at length the commerce of the Levant, of India and China, and of all countries at that time known came into their hands.

Venice, for a long time in possession of Constantinople, but dispossessed of this place through its powerful rival the Genoese, embraced the commerce of Syria and Egypt, where its warehouses were at Ptolemais or Acre and Alexandria; Venice had Cyprus, Rhodes, Samos, Chios, Candia, Negropont, several tracts of coast on the Morea, the Ionian Islands, and Dalmatia, and had gained important points in the Archipelago and the Adriatic Sea; whilst Genoa drew to herself the commerce of Constantinople, Asia Minor, and the Black sea; Genoa had taken into her possession the peninsular of Taurus or the Crimea, and had made the seaport Kaffa a magnificent commercial depot, into which, by caravans, Russian, Persian, and Indian merchandise flowed, and the merchandise of the Levant by Constantinople arrived from the West. Each city endeavoured by emulation and persecution to obtain the riches and dominion of the sea, till at length, after many years' fighting, Venice was overpowered by Genoa,—the dominion of Lombardy and the Mediterranean was decided.

Since then, the caravan traffic from the East through Russia to the Baltic has diminished, and Italians carried the Eastern and Indian wares, at the same time with their own products and rich fabrics, in silk, wool, paper, glass, looking-glasses, silver, steel, and many articles of luxury, whose manufacture they had learned in the East, not only to the North West of Europe as far as the Netherlands, where, under the Lombard name, they were seen by the whole of Northern Europe. The Italians also erected large warehouses and fairs at Bruges, Ghent, Brussels and Antwerp; but they sent goods to Southern Germany, and indeed from the Black Sea, along the Danube to Vienna and Ratisbon, as also from Italy to Augsburg, which cities first at this time became noted as depôts for Italian Levantic commerce.

About this period the Italian cities formed for themselves a maritime law, which was confirmed by Rhodes in the South, already in early times renowned for navigation and commerce, by Wisby in the North, and later by Barcelona, Marseilles and Venice, so also in the thirteenth century exchange laws originated at Florence, next to which also for the relief of commercial business in the twelfth century the first Girobank was established at Venice.

Whilst these things were going forward in Italy, through brisk commercial traffic several cities had sprung up in Germany, and this would have been yet more the case, had not in those rough times the attacks of sword-law and of want, rendered commercial travelling unsafe and exposed. Traffic yet wanted the security of later times and these events having occurred, the merchants of a place or country were induced to unite for commercial objects, and travel armed and with armed attendants, this afterwards contributed principally to the expansion of commerce; for these combinations brought about the union of several cities, and also had the effect of laying the foundation of depôts and collecting points, held in common, at home and abroad. And that which had only been a private affair, afterwards became an object of the State, and a means of political importance.

Lubeck was at length made the principal German trading place; in order to give their commerce more expansion, and by defence more security against the constantly occurring attacks on the high roads and rivers, on the part of robbers, and on the Northern and Baltic seas on the part of the Norman pirates. By contract, most of the great cities on the Baltic sea, as well as on the Elbe, Weser, and particularly in Northern Germany, and in part also in the Netherlands, to promote the common interests of commerce, concluded amongst themselves, in the year 1241 with Hamburg and Bremen, an offensive and defensive alliance, against the forcible and rapacious interruptions of their commerce by land and water, forming the celebrated commercial league the *German Hanse.* Thus united, a considerable land-power secured the roads and destroyed several robbers' castles, and its fleet in the Northern waters was as powerful as contemporaneously that of the Italian cities in the Mediterranean.

To extend commercial business, the Hanse erected four great counting-houses and warehouses as places of trade for their commerce, in foreign countries;—viz., for Netherlands, France, and the rest of Southern Europe to connect with the Italian Republics, beginning at Bruges in Flanders, extending to Antwerp; for England at London; for Scandinavia, at Bergen in Norway; for Russia, Livonia, Poland and Prussia, as also to unite with the Black Sea and the East by Kiev; commencing at Novogorod on the Ilmensee, later at Narva, on the Gulf of Finland. The number of confederated cities from the mouths of the Scheldt to Narowa in Russia amounted at last to 85. In this confederation, and united with the three Hanseatic towns Hamburg, Bremen, and Lubeck, were Bergen, Wisby, Revel, Riga, Königsberg, Elbing, Dantzig, Thorn, Cracow, Frankfort, Berlin, Stettin, Cologne, Munster, Minden, Bielfield, Osnabruck, Hildesheim, Launeburg, Goslar, Brunswick, Quedlinbourg, Halberstadt, Magdeburg and Halle.

This league was favoured on all sides by Royal and Princely charters and privileges, and secured lucrative contracts with several neighbouring states for free export and import in their countries; the profit of this common traffic gave it firmness and respectability, but especially the full division of the trade among themselves. At length almost every commercial point in Europe having been drawn within the circle of their influence, procured for them treasure and thereby power, to command for a century in the North of Europe, and till about the end of the sixteenth century to hinder the development of the peculiarly active commerce in the countries on the Baltic and Northern seas, against the interest of their inhabitants.

Besides the exchange of the merchandise of the south, coming from Italy, the Levant and India, owing to the great activity of the Hanse, the products of the North appeared at their principal commercial places in abundance;—viz., corn, flax, hemp, sail-cloth, tar, hides, leather and peltry, iron, copper and amber, salt-fish, blubber, tallow, soap, and timber from Russia and the Baltic; and much wool, tin, lead, and leather from England. For a like object, to animate and secure commerce against the rapacity of the rude nobility on the Rhine and in the Netherlands in the year A.D. 1247, was originated the Rhenish league, by the cities of Mentz, Frankfort, Aschaffenberg, Oppenheim, Worms, Manheim, Heidelberg, Spire, Strasburg, Muhlhausen, Breisach, Basle, Zurich and Freiburg, uniting them with the lower Rhine and the cities in its neighbourhood,—viz., Bonn, Coln, Wesel, and Aix-la-Chapelle and several Westphalian towns, which in the fourteenth century, through the Swabian league, at whose head stood Ausburg, Ulm, Nuremberg and Ratisbon, preserved an advantageous extension. Not only was the commerce on the Danube and its commercial connection with Constantinople advanced, but also the trade of the cities of Southern Germany and the Italian Republics received a considerable impulse. It was at this time that Nuremberg and Augsburg, the principal places between North and South Germany, flourished in an extraordinary degree, and by a varied and notable industrial trade in a thousand different sorts of articles, which are even now carried to all the known countries of the globe, their opulence was established.

About this time, also, through these city unions, many industries were created—as, for instance, mining in several countries—in the Hartz and Ertzgebirge mountains, which already at this period yielded profits in silver, tin, and iron. Next the Netherlands and Germany distinguished themselves by a number of valuable manufactures in linen, woollens, leather, paper, glass, iron and steel goods, as also by a lively interior traffic, which placed its cities in prosperous circumstances; and when Belgium, Flanders, and Brabant reached an eminence in the industrial arts, England gave them the preference before other countries, and they not only supplied its early, flourishing woollen manufactures abundantly with the raw material, but thereby an important commerce was created, for London, with its trade with the Hanseatic towns, was already in the fourteenth century, next to Bruges, a rich and important trading place.

Whilst commerce and the arts thus steadily flourished in Europe, in the East they sensibly declined, in consequence of the long and desolating wars between the Mongolians and the Ottomans, by which the caravan traffic through South-Western Asia (by Cashmir, Lahore Candahar, Cabul, Samarcand, Bokaria, Herat, Teheran, and Taurus, Kasan, Orenburg and Astracan, Tiflis, Erivan, Erzeroum, Mossul, Bagdad and Basra, Mocha, Mecca, Medina, Damascus, Aleppo, Tokat, Brussa, and Smyrna), in several countries for a long time was interrupted, and only Alexandria remained in connection with India, the trade being maintained by Venice for centuries. The rich countries and islands of the south-east of Europe later shared in this misfortune, as the savage Ottomans, in the fourteenth and fifteenth centuries, crossing from Asia, desolated them, and at length the storming of Constantinople, A.D. 1453, made an end of the Greek empire. In consequence of this, the possessions acquired by Genoa and Venice, and the commercial freedom of the Levant, were lost.

In the rest of Europe, commerce remained stationary till after the introduction of the use of the compass at the beginning of the fourteenth century. A new epoch for navigation now commenced. With the help of this simple instrument, sea voyages were performed with rich results, till at length the whole course of trade was revolutionised, and a new period in the commercial world brought about.

Then began a desire for longer sea voyages, in order still further to explore the as yet unknown oceans, and to make fortunate discoveries. In Italy thinking minds were agitated, and the endeavour began to discover a direct way by sea to the East Indies rather than by the circumnavigation of Africa, in order so much the easier to arrive at the spring-head of commerce, and to be able to draw over at first hand the rich productions of that land without the Egyptian Sultan having first to be bought. In Egypt, the traffic was guarded with the most anxious precaution, so that no European could carry down goods to Arabia and India through their land, the Arabian Gulf, or the Red Sea. What the Europeans naturally for profit had brought was consumed by the inter-traders in Indian goods, and that which they carried to Alexandria and Damietta was sold at prices determined and paid by the Venetians.

But it was reserved for Portugal and Spain, instead of Italy, to solve this great problem, alike important for commerce and for science. Portugal, indeed, did much, and had the first triumph, from the circumstance that its King's son, Prince Henry the sailor, broke the path, and discovered Porto Santo and Madeira in 1418, the Azores in 1432, the Cape de Verd Islands in 1444, and Senegambia and the Gold Coast of Guinea in 1452. The circumnavigation of the promontory cf the Cape of Good Hope, and the discovery of the ocean way to the much-prized India, was made by Vasco de Gama in 1498, and thus the long looked for period arrived. But whilst Portugal was occupied in the discovery of land to the far East, the courageous Genoese, Christopher

Columbus, had opened the way over the great ocean to the far West, and made the discovery of the new part of South America.

Portugal and Spain became great through their acquisition of flourishing colonies and rich countries, and by the commerce of the world which now found its seats at Lisbon and Cadiz, whilst the splendour of Venice and Genoa gradually declined with the loss of their commercial monopoly. Portugal and Spain now provided the Italian States and Europe with an abundance of East and West Indian products, and for these there was soon an ever-increasing demand in Europe, which has continued uninterrupted to the present time. Through colonisation, large plantations in fruitful countries were established to supply this commerce, which, under the name of colonial produce (sugar, coffee, cocoa, spices, rice, cotton, indigo, tobacco, &c.), was brought to Europe. To obtain the profits, hundreds of thousands of negro slaves were shipped from Africa to America. This ever-increasing foreign commercial traffic, which soon included China and Japan (which rich countries were discovered by the Portuguese), occasioned a strong exchange of manufactured and woollen goods. This greatly stimulated industry and the industrial arts in Europe (though Italy long retained her pre-eminence), especially France, the Netherlands, England, Germany, and Switzerland, by the development of a variety of manufactures and the sale of a quantity of goods of all kinds for transatlantic commerce, Portugal and Spain, from their small industrial activity, finding it impossible to satisfy the wants of the newly-discovered countries with their own products. Next to Lisbon, Cadiz, Oporto, San Lucas, and Seville, now flourished, also Bordeaux and Havre, and especially Antwerp, which had, since the middle of the fifteenth century, become the chief trading place of commerce between the north and south of Europe. In like manner Amsterdam and London advanced by their maritime commerce, and profited by undertakings which this new direction of commerce suggested; soon, in fact, Holland, England, France, and Denmark endeavoured to take part in the same direction. This commercial activity was at last so extensively diversified, that manufactures rose to the highest degree of development, and Europe may thank these early discoverers for her riches and power.

PROPAGATION OF TROUT IN AMERICA.

Now that fish-breeding by the assistance of art has become a business of great magnitude in different parts of the world, and its pursuit vastly profitable, we have thought that, a description of the simplest and best method for the propagation of brook trout would be both interesting and valuable to our readers.

Of the numerous species and various families of fish being both propagated and improved by artificial culture, there are none so interesting as the genus *Salmo;* and the branch of this family known—apart from the Latin phrases of *farrio* and *fontinalis*—as the brook trout, is one of the most easily and economically propagated of the numerous species of fish in the United States, because it inhabits nearly all the spring streams north of the 40th degree of latitude. In most cases, therefore, in streams where trout are becoming eliminated by the nets, traps, and other cruel devices of the poacher, judicious game-laws should be enacted with suitable penalties for their infringement. This has been done in this State (New York) upon the application of the Sportsmen's Club. In addition to laws for preventing poaching, there should be a law enacted against the erection of dams on streams so constructed as to prevent fish from surmounting them, and the tumbling dam, with steps or stairs on the lower side, should supersede those now erected, so that trout and salmon may reach the heads of the streams to spawn.

Next to the salmon, the brook trout is the best table-fish of our fresh water streams. Indeed, it has the advantage of the "royal salmon" in the sizes necessary for culinary purposes, being small enough to fry or broil, and large enough to boil. Among the reasons why the trout holds so high a rank in the angler's estimation are the facts that he is an intellectual creature and has evidently a will of his own. He looks sagacious and intelligent; he sedulously avoids turbid waters; loves the sparkling stream; displays an ardent ambition to explore streams to their source; is quick, vigorous and elegant in his movements; likes to have the exclusive command of the stream; keeps up a rigid system of order and discipline in the little community of which he is a member; exhibits a remarkable degree of nicety and fastidiousness about his food; is comparatively free from vulgar, low and grovelling habits, though addicted to the crime of cannibalism, and would eat a member of his own family without remorse; but he entices his pursuer into the loveliest scenes of Nature's domains, and calls forth from man the utmost efforts of his ingenuity and skill, and preserves a superior and dignified demeanour unattainable by any other living occupant of the streams. His physical constitution is also incomparably superior, and he boasts a prepossessing figure, moulded in strict conformity with the most refined principles of symmetrical proportion, sparkles in all the gorgeous colours of the rainbow, and occupies a distinguished position in the science of gastronomy.

The brook trout differs in appearance and flavour, according to the waters it inhabits, but its satin surface retains in all waters, a sprinkling of carmine spots, surrounded by a halo of azure, with occasionally spots as round as shot, of brown and yellow or white. Its tail is also nearly square, instead of forked. Its first dorsal fin is formed of soft rays, and its second is merely an adipose protuberance. Its meat ranges in colour from that of the pinky-meated salmon to the mallow-colour, the latter being preferred by epicures, as indicating the condition of creamy succulency between its laminar flakes. By these pen-hints all may know a brook trout, for, though different waters may shade its back from a golden brown tinged with green to sooty black, yet its carmine spots will always be visible and the meat always more or less approximate to that of the salmon in colour. We are thus particular in describing the surface marks of the trout, in order that a chubb shall not be mistaken for one, as is the case in Virginia, or a white bass, as has been the case farther south.

The trout, in disposing of its spawn, follows the the identical rules which govern the salmon in this important process. It thrives best in spring streams, and mates in July or August with one of its same size, and the pair feed and remain together until spawning time, which is September and October, sometimes much later, but these are the principal spawning months for this latitude. As the spawning season approaches, the trout in pairs run up rivers, torrents and brooks, to seek out near the springy sources of the stream the most retired water flowing over gravelly bottoms for their annual operation. There the female digs a trench in the gravel with her nose, and when ready to deposit her spawn she swims round and round with great celerity, the male fish following her, and, as she ejects the ova into the trenches, he discharges the milt which impregnates the ova; and after this process is finished the female covers up the trenches and stands sentry over them to prevent the male trout and other enemies such as eels, roach, &c., from uncovering her nests and eating her eggs.

For the knowledge adequate to enable a person to propagate trout or salmon by artificial means (the manner of propagating trout and salmon are the same), a person should understand the habits of the trout in the natural progress of propagation, and then imitate it as nearly as possible by artificial means.

Fishes of the genus *Salmo* are less prolific than the *Clupia* tribe, the fecundity of which baffles computation, varying from the carp, with its 300,000 eggs—according to Blumenbach, to the sturgeon with its 1,487,500—as recorded by Lowenœck—and who states this to be nothing to the fecundity of the cod, one of which he estimated to contain "upwards of 9,000,000 eggs."

We think it will be ascertained that as animals rise in the scale of entities and mind asserts its power over matter, that fecundity is proportionably lessened. The genus *Salmo*, therefore, as it includes the most intellectual families of all the oviparous tribes, seldom contains more than 25,000 eggs, and some trout not more than as many hundreds, yet the yield of spawn for one year only of a large pair of trout in good condition, would be worth, in a preserve of spring water, several thousand dollars.

There are two general methods for propagating trout, whereas there appears to be but one for salmon, by reason of its migratory nature. It should therefore be propagated from impregnated roe, by artificial means. Cut streams and preserves may be stocked with small trout, or trout of any size required, by transporting them from streams stocked by nature, and that too without injuriously eliminating the serried ranks of speckled beauties, which would flourish and increase faster if the monsters of the pool, which require each a dozen fingerlings for breakfast, were removed for ever from the stream.

Gentlemen who own preserves of trout should cull them occasionally with nets of large meshes and remove the large trout to a separate preserve or employ them to stock preserves with. Unless this course is pursued, the big fish will eat the small ones, and the large ones will become unhealthy and die without any apparent cause. This is frequently the case on parts of streams, where the trout are robbed by insurmountable dams of their spawning beds at the heads of the streams. Too much importance cannot be attached to the necessity for improving all dams so that trout may surmount them. Sawdust, tanbark and poisonous colouring materials, should be kept from trout streams, but the two first are disappearing so fast in the Eastern and Middle States as to create no serious apprehension. They have done their worst, and robbed many streams of more value in trout than the lumber and leather was worth which caused the sacrifice.

From our experience we should think that stocking living spring waters with trout propagated by nature would be the most economical course in this country. It is still a question, which has been the cause of many experiments in France, whether the young trout hatched by artificial means from the ova are as healthy for the first year, and whether they will thrive as well as those propagated by nature in natural trout streams, and afterwards used to stock preserves with.

Much depends upon the extent of a preserve of living spring water and its situation. If it is so extensive as to include several miles of stream above the pond or preserve, or only a fraction of a mile, well protected by a shore shaded with dense shrubbery, then the water may be led by pipes to lateral ponds, so as to keep the trout of different sizes separate, and artificial propagation may be resorted to with great success and profit. But a small pond, fed by only one spring, had best be stocked with trout by Mr. Aaron Vail, of Smithtown, Long Island. He takes all the responsibility of stocking ponds several hundred miles away with Long Island trout, which epicures consider superior to trout of most of the streams in the interior of the State. He has recently stocked extensive preserves in Connecticut and in the interior of the State of Pennsylvania, and from his experience, having been engaged many years at propagating trout and stocking preserves, he is the most competent and reliable person that we know of, unless Mr. Ramsbottom of Islip, would engage to stock a preserve, either artificially or with fingerlings. He is now engaged in propagating salmon, trout, and black bass, in the waters known as the Snedicor Preserve, near Islip. Mr. Ramsbottom has recently been engaged in re-stocking many salmon rivers of Ireland by means of artificial propagation. His father is now engaged at the business on some of the Scottish rivers, and his brother is stocking the streams of Australia with salmon. We anticipate great benefit from the presence of Mr. Ramsbottom, who contemplates stocking with salmon many rivers in this State.

As fish-culture by artificial means has been successfully pursued for several centuries in Christendom, being an invention of the monks, assisted in its discovery by information gathered from Catholic missionaries in China, or on the islands of the Eastern Archipelago, therefore the feasibility of artificial propagation at this late day has become established in every intelligent mind ; but it has been from recent experiments that the commercial world has opened its argus eye to its thousand per cent. profit.

In order to approach a data from which to approximate the profit of propagating trout, we will instance the increase from a pair of salmon—for salmon may be propagated as easily as trout, and as cheaply here as in any other part of the world. It is estimated that after all drawbacks, and an unusual number of disasters, that from a pair of salmon three thousand grilse will return to the river in which they were hatched. It is true that twenty thousand left the spawning-bed, but the host had dwindled to three thousand. Now fifteen hundred per cent. is no mean interest on any stock, and at an average of ten pounds each, this pair of salmon would yield 30,000 dollars. But trout are not liable to the dangers to which the salmon is exposed, and we therefore conclude that, after the work of propagating trout is fairly established, it will yield at least five thousand per cent.

The question should be with those who desire to form trout preserves for profit or recreation, which is the best method of stocking their waters ? Should it be with live trout, or by artificial propagation in hatching from the ova. We incline to the live trout process in this country, because the preserve may be stocked with trout of any size, and at the risk and trouble of stocking your preserves by the propagator, who takes the contract and risk of supplying you at a modest price per thousand fish, the price, of course, depending on the size. By thus stocking your preserve once, your trouble and expense is ended with that investment. You may then draw from your own preserve the means for artificial propagation to an unlimited extent, provided you have a living spring as your sinking fund. In that case an extended business may be sought more successfully by increasing the stock through means of artificial propagation.

A preserve made from living springs was formed two years ago at Maspeth—a suburb only a mile east of Brooklyn—by stocking a pond which was made by leading water through iron pipes from a spring. A club of New York gentlemen hired the exclusive right to fish this pond with a fly from March until July, this year, for the sum of 2,500 dols. The owner is now enlarging the pond, and has let it for fly-fishing for several years, from March 1 to July 1 for 5,000 dols. the season. This sum is not a mean income for a small farmer to receive without the investment of much labour.

Old ponds, even if inhabited by trout, are apt to fill with weeds which grow from all parts of the bottom, except the channel cut by the creek flowing through it ; and if the stream be too small compared with the size of the pond, so that the water is not renewed sufficiently often, then the eels, roach, perch, and pike are apt to accumulate, to the ultimate extermination of the trout. It becomes necessary, therefore, before stocking an old pond, that the water be drawn off and the bottom of the pond thoroughly cleaned. The expense of cleaning a pond is partially paid by the manure thus obtained. Some persons, after cleaning a pond, sow the bottom with lime and salt. The creek should also be cleaned up to its source, by sweeping it with small-meshed nets ; but all its shades on the margin of the stream, and its hiding places of rocks and stones in the stream, should be left, and pegs or piles driven into the bottom, leaving the tops of them a foot or so above the bottom, to prevent poachers from netting the pond or stream. The dam may or may not be constructed so as to permit the trout to follow down the stream to its estuary and return at will. This would depend upon agreement between the different owners of the stream. But when the stream debouches into a bay or river of salt water, a tumbling dam offers an inducement to smelt, herring, &c., to spawn in the pond, and thus stock it with the best feed possible for trout, for those trout which feed on shrimp, smelt, spearing, young herring, and the roe of those fishes, are always superior to such as feed on worms brought down the stream by a freshet. Although one of the principal charms of the trout is that he feeds on the flies which swarm on the surface of the water, thus enlivening and beautifying the water by breaking to the surface and forming numerous wakes of large circles, and sometimes rising above the surface and disclosing miniature rainbows of amber and gold, yet there are times when he prefers something more substantial, and will not touch a fly. In this he imitates humanity, which requires roast beef as well as plum pudding and *omelette soufflèe.* So the trout requires his *piece de resistance* of something more substantial than flies.

Dubravius, Dr. Lebault, and many piscatorial professors, dwell at great length upon preparing fish ponds and taking care of them. We therefore extract the gist of their advice, intermingled with our own, as follows: A pond intended for either profit or pleasure should be cleansed once every three or four years, especially if large compared with the stream by which it is fed, or if sustained by more surface water than of spring water. It should be drained and lie dry six or twelve months, both to kill the water-weeds and the animals which feed on trout and its roe. The letting your pond dry, and sowing oats in the bottom is also good, for it purifies the bottom of the pond.

In reconstructing your pond after draining it, and having made the earth firm where the head of the pond must be, Lebault advises that you drive in two or three rows of oak or elm piles, which should be scorched in the fire or half burned before they be driven in the earth, for being thus used it preserves them much longer from rotting; and having done so, lay faggots or bavins of smaller wood between them, and then earth between and above them; and then, having first well rammed them and the earth, use another pile in like manner as the first were, and note that the second pile is to be of or about the same height that you intend to make your sluice or flood-gate, or the vent that you intend shall convey the overflowings of your pond, or any flood that shall threaten to break the pond-dam. Then he advises the planting of willows and osiers about the dam, and then cast in charred logs not far from the side, as, also, upon the sandy places, in order to protect spawning beds and form hiding places for the small fry. All ponds should contain places of gravel bottom, and places sandy and shallow where trout may disport themselves and burnish their sides. Fish should also have retiring places, such as hollow banks, or shelves, or roots of trees, to keep them from danger and to shade them at times during the day in the extreme heat of Summer, also from the extremity of cold in the Winter. If too many trees be growing about your pond, the leaves thereof, falling into the water, will so impregnate it as to injure the flavor of the fish. Although towering trees form too dense a shade, and the foliage is bad for the stream, while they yield cover to invite winged game and the consequent gunner, and shooting much about a fish preserve is injurious, yet we would advise the planting of willow and alder to partially shade the stream or pond and render firm the shores.

Two trout ponds are more profitable than one of the same area as the two, because they may be cleaned alternately, and the trout turned into one while the other is under cleaning process.

In small ponds, or ponds where the small fry of common fish often form food for trout, Lebault advises the feeding of trout by throwing into the pond chippings of bread, curds, grains, or the entrails of chickens or of any bird or beast you kill to feed yourselves. On the score of feeding trout in preserves our experience is that they are generally fed too much

In ponds where feed is scarce, living bait should be thrown in, such as minnows, mummies, shrimp, and all kind of fish which nature intended for bait, by forbidding them ever to become more than three inches in length. But even this should be done sparingly. We have known several ponds on Long Island where the fish died while they were fed sumptously, and when dead were found to be in excellent condition. We regret to state that some animals endowed with the exterior semblance of humanity keep trout ponds and pretend that they are waters intended for the propagation of trout, wheu in reality, they are pounds, or liquid bastiles, wherein to imprison trout until they command a high price in Fulton Market. When they get orders for them, they at once feed them with a huge meal of mummies (small fish), and when the trout have gorged themselves so, that in some instances, the tails of the fish which the trout vainly endeavoured to swallow are seen protruding from their mouths, these Peter Funks then sweep the pond with a net, send the trout thus stuffed to market, and receive therefor the price which healthy trout command. During the past season one dollar and a half a pound has frequently been paid for trout bought at wholesale. It is said that these Peter Funks rob the trout streams of their neighbourhoods by means of nets during the close season—between the first of September and the first of March—and deposit their stolen gains in liquid pounds, where they feed them until the market opens ; for it is unlawful to catch or sell trout during the close season, except for the purpose of science or the object of propagation.

Having endeavoured to inform the reader about the nature, habits and quality of trout, and the simplest and best methods for propagation by stocking with living fish, we propose in a future Number to give a detailed description (founded on authorities now successfully engaged at fish-culture) of the method for propagating trout and salmon by artificial means.

CLEVELAND WINE.

Cleveland contains 60,000 inhabitants, has a good trade with Ohio and Indiana, and it manufactures pretty largely. Here is the great fruit-preserving house, and it is the centre of the greatest number of vineyards on the American continent.

Mr. George Leick has eighteen acres in vineyard, eight miles east of Cleveland, near Dr. Dunham's. He has three wine presses, one on Kelly's Island, one at Sandusky, and one in Cleveland. He makes some wine from the Isabella. The Clinton grape makes good wine, and is similar to the German red wine ; in fact, Germans cannot tell the difference between it and the old country wine. He values the Clinton ;

no other grape bears better; it likes to run on trees. The Isabella he does not like to mix with other kinds, because it is earliest ripe and ferments soonest. By itself it makes a fair wine. Last year he tried 200 lbs. of the Concord, and does not like it, and yet the Hermann folks value it to mix with Norton's Virginia.

The following is his account of the per-centage of wine in different grapes. He uses the scale of Oéshel which ranges from 4 to 115 degrees. Concord showed from 65 to 70 per cent.; Norton's Virginia, suddenly, 110; Catawba from 80 to 90; Isabella from 60 to 65; Clinton 100, and sometimes 103; of the Delaware he was doubtful.

The amount of acid in the must of different grapes he tests by Geister's acidimeter, ranging from 1 to 20. In addition is a thermometer, which is used in making the trial when the must is at 52 deg. Fahrenheit. In 80 degrees of Catawba saccharine matter there are from 7 to 8 of acid; in Isabella, 9 to 10; Norton's Virginia, 4; Delaware, 5; Concord, 6.

Last year he bought grapes to make from nine to ten thousand gallons of wine; two years ago from eighteen to twenty thousand gallons. He says positively there can be no limit to the market at good prices. Last year most of the grapes were engaged early in August. This year buyers were already around trying to contract.

Mr. Leick has large cellars under his store, where are huge casks, but he has no regular wine-cellar such as at Hermann. Those cellars look like vast railroad culverts walled at one end, and with an entry and two doors in the other. They cost from three to five hundred dollars. If the wine is kept in store during the year it will rapidly ferment, and get what is called age. He can sell all the wine he makes during the year. Should he keep much over, he would require a proper wine-cellar. Still he has some old stocks, so as to have different ages in the business. Mr. Leick makes this statement:—If for five years to come the people of this country plant vineyards as they have for five years past, there will be more wine and grapes here than in the old country.

He says the grapes in Germany have only about half as much acid as those in this country, but the flavour of American wine is three times stronger. The German grapes yield about the same, but the skin is thinner. The acid is in the thick skin of the Catawba. The saccharine matter is about the same. They do not get half as much wine from an acre of grapes there as we do here, for they have a good crop only once in eight years. As regards the comparative quality of the wine he could not decide, so much depends on taste, but the Catawba has only 9½ per cent. of alcohol.

A very great question, however, arises. Is a warm or tropical climate more favourable for producing sugar or saccharine matter than a cold one? It does not follow that in warm climates good wine grapes or other choice fruits will not grow. The truth is, such climates are quite favourable for fruit, but the fruit has more acid.

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PROPAGATION OF TROUT IN AMERICA.

(Concluded from p. 185.)

PISCICULTURISTS of Europe have traced the artificial propagation of fish to the Chinese, thence—moving with empire—the Romans paid signal homage to fish-culture as a pet philosophical pastime for several of the most distinguished epicurean Emperors. Lucullus—the gourmand who dined on peacocks' tongues—expended very large sums in the formation of fish-ponds. Some of them he supplied with sea-water by means of a canal cut from the Mediterranean to his villa at Tusculum. Sergius Orata, in the time of Crassus, stocked the Lucrine Lake with oysters, and derived large revenues therefrom ; while the apparatus used in ostraculture on the Lake of Fusaro formed the base upon which the French have constructed their system of ostraculture of the present day. We saw recently in the Treasury at Naples, among articles exhumed from the ruins of Pompeii, a glass vase of fish eggs in a perfect state of preservation, though having been put up 1,800 years previously. It was supposed to be caviare, but on reflection we have been led to doubt it, because the eggs were as large as those which belong to the *Salmo* genus, and the glass vase was similar in shape to the bottles used in France by fish-culturists to export fecundated roe to all parts of the world, and it is now claimed that it can be preserved for years without addling an egg. We know that the eggs have been shipped first from France to England, and from thence to Australia where they have been hatched—both trout and salmon—and were doing so well that Prof. Ramsbottom, who is the fish artist of the enterprise, recently expressed surprise at the rapidity of their growth—it being much greater than on the British Isles.

From fish-culture in the most refined part of ancient Rome, by the patricians, we next trace it to the Monks of the mountains—those men of science and experiment who invented *eau de vie*, the water of life, commonly known as brandy—where Don Pinchon, a monk of the abbey

Réome, was the inventor of the present plan of hatching fish in boxes. His inventive faculty was doubtless inspired by the necessity of providing for the numerous fasts prescribed by the Church of Rome. After Father Pinchon, much time elapsed before the art of propagating fish travelled far, but it was next discovered on its westward march, when M. Jacobi, a German, in 1763 presented his results of thirty years' application before the Royal Academy of Berlin. The interest thus excited was not suffered to die entirely, though the incredulous retarded its benefits until the success of a few philosophical capitalists became so patent to all who could see and read, that fish by artificial propagation soon became an article of commerce. More recently "the abundant success which attended the institution at Heningen, in which a million of trout have, in a single year, been hatched and reared," so interested the men of science throughout Europe, that a savant of France reported it to the French Minister of Agriculture and Commerce in February 1843, accompanied with the following comments:—"Fish-culture, which had obtained among the ancients so high a degree of perfection, is, in our own days, fallen to such a state of decadence, that it is scarcely reckoned among the least important branches of modern industry, and nevertheless, our social conditions have at no time more imperiously demanded of us again to restore it to a level with the continual increase of our population. There exists not, I safely affirm one single branch of industry or of culture which with less chance of loss, offers to realise more important benefits."

The people of the British Isles were, apparently, first awakened to the subject of propagating trout and salmon by artificial means, through the experiments of Messrs. Shaw and Young, which first resulted in the humourously discussed question in one of the British magazines, about the year 1840 on "The Transmutations of the Salmon," which startled public curiosity with a premonition of those facts which were fully elucidated in France by Messrs. Gehin and Remy in 1847, and divided interest with the continental revolutions of 1848.

Although the French government recognised the importance of the invention of Gehin and Remy by a liberal reward in money and lucrative employment in carrying forward the experiment under government patronage, so that millions of trout and salmon were annually hatched by artificial propagation, yet the people of Britain did not engage in it until after the year 1850, when Messrs. Edmund and Thomas Ashworth are said to have been the first to test it, by stocking some of the rivers on encumbered estates in Ireland, under the superintendence of Mr. Robert Ramsbottom. But in America, up to the present time, only a very few gentlemen have engaged in the enterprize, first among whom is R. L. Pell, Esq., late President of the Agricultural Club of the American Institute in New York, and Mr. Stephen H. Ainsworth, a trout breeder in West Bloomfield, N. Y. To these may be added Solon Robinson and Prof. Maeps as scientific gentlemen and experimenters, the first of whom stated before the American Institute, "That trout can be artificially produced with greater profit to the producer than any kind of meat, no member of the Club entertains a doubt. But to induce people to enter upon the business, the subject needs to be constantly agitated." In addition to these gentlemen, Mr. Aaron Vail and Mr. Ramsbottom (who is son of Robert Ramsbottom, and brother to Mr. Ramsbottom who is now engaged at propagating trout in Australia from fecundated roe transported from England), we know of but few more in this country; but the vital subject is undergoing incubation, and promises a superabundant yield after the people become fully awake to the immense profits and the attractive amusement and luxury of propagating trout by artificial means.

Spring water from 40 deg. to 45 deg. has thus far proven best for propagating trout in this country. Prof. Ramsbottom states that a spring is preferable to a brook, since the latter is liable to sudden inundations which sweep away the ova or destroy them by deposits of mud. In other respects, also, a spring is much more desirable, the temperature of spring water being higher in the winter season, and more equable than that of river water. It is the superior warmth of spring water which renders its employment almost essential to the progress of artificial propagation. When deposited in the bed of a spring the ova are hatched in a much shorter period than in river water. The term of their exposure to the numerous causes of destruction is consequently less, and the probability of their ultimate escape proportionably greater. Instead of being liable to injury for more than one hundred days they are frequently hatched in sixty. River water, indeed, may be of so low a temperature as to render it impossible that the ova shall ever be hatched at all, even when properly impregnated and deposited. In situations where spring water cannot be obtained in sufficient quantities, the river water should pass through a filter of sand and gravel. If the spring is large enough, and the ground suitable, it may be divided into artificial rills with a pipe of two inches run of water to each. Under all circumstances a gentle, equable, and pure current is indispensable.

If you have a trout-pond, tap it at the sluice in the dam, with several pipes of two inches diameter, covering the ends in the pond with fine wire gauze, to exclude young fish, or the eggs of such fish or reptiles as are enemies to the trout. Conduct the water through these pipes to rows of boxes about two feet wide and six feet long, the boxes, from the head one nearest the dam, resting two inches lower than the one which immediately precedes it, so as to produce a current sufficiently swift in this artificial stream formed of a row, or several rows of boxes, and each row formed of a half-dozen boxes. One pipe to supply each row of boxes, and then you may have as many rows of boxes as you have water to supply, always bearing in mind that the water must run continually. The waste water, after it leaves the boxes, may be conducted by a ditch into the brook below the dam, or into a pond prepared to receive the young trout. The bottoms of the boxes are next covered to the depth of a couple of inches with sand and small pebbles, upon which is laid a pavement of stones from three to six inches diameter. The water should be as much as two inches deep above this pavement and fill the boxes two-thirds full. The boxes are open at the top. Then pour the fecundated roe equally over the paved bottom of each box, and it will soon find its way into the crevices of the stony bottom, and within from sixty to seventy-five days the trout will be hatched, and a bag connected to the abdomen by the umbilical cord contains sustenance sufficient for forty days, after which the tiny creature begins to seek food and should be removed to their pond.

The principal object to be aimed at in forming artificial spawning beds with boxes is to imitate Nature as nearly as possible, and improve upon the natural spawning stream by preventing the enemies of the trout and lovers of spawn from gaining access to it. In stocking ponds at first it is well to do it with trout at least two years old, but after the preserve is stocked it is more economical and certain to continue its supply by artificial propagation, for while it is true that young trout have so many enemies in their natural streams that not one in ten matures, and, of ova planted in the natural streams, scarcely one in a hundred is hatched, because of being devoured by roach, eels, and the parent trout, or destroyed by a host of other causes, such as freshets, which either sweep them clean away or leave deposits of mud and other débris so deep as to destroy both eggs and the fish which were lately hatched. While these are the concomitants of the natural procreation of trout, artificial propagation prevents those losses by protecting the eggs until they are hatched, and afterwards by preserving the young trout in shallow ponds by themselves until they become two years old, when they may with safety be turned into the common preserve. If the boxes are to be supplied from a spring direct, pipes in that case will conduct the water as from the pond, bearing in mind that you so place the boxes as to produce fall enough to keep the water always in motion and passing through them regularly. The waste water may then be conducted by a ditch to the main creek, and a dam formed so that the backing water will not interfere with the spawning boxes, and after keeping the trout in the boxes forty days after they were hatched turn them into a shallow compartment of the main pond, when they may be fed with liver, curds, the offal of any animal or fowl you kill, or meal. It is best that they have variety in diet, but after they become a year old they will devour worms, flies, and very small fish. For the trout there is no food more dainty and wholesome than a young shiner, either whole or cut into small pieces. There should be charred wood and stones in the pool for hiding places, and the bottom should be formed of sand and gravel.

Mr. Robert Ramsbottom's Directions for forming Artificial Spawning Beds or Boxes, and procuring Ova from Trout or Salmon and planting it.—A suitable rill, contiguous to the river, and affording a sufficient supply of water, was first selected, and operations commenced at once. Across the stream, which was scarcely thirty inches in width, a rude weir was thrown so as to check the progress of the water, and to form a dam which extended several yards toward the source of the rill, with the average depth of twelve inches. The necessary continuous supply of water was thus obtained, the remainder passing away in an artificial channel cut for the purpose.

The boxes for containing the ova were twenty-four in number, each being six feet long, eighteen inches wide, nine inches deep, and open at the top. The whole were disposed in a double row, parallel with the original course of the rill. Each row consisted of twelve boxes, placed end to end, the beds of the foremost commencing shortly below the lower end of the dam. A piece of three inches in depth and nine in width was cut from each log in order to allow a free passage for the stream through the whole series. At the junction of each box was nailed a sheet of tin with turned-up sides to prevent the escape of the water. A couple of pipes a yard in length and two inches in diameter conveyed the stream to the foremost box in each row, the end of the pipes inserted in the dam being covered with fine wire gauze to prevent the entrance of trout and insects. The whole were arranged on a gentle slope, so as to avoid stagnation, and ensure a tolerably rapid flow of water.

The boxes being arranged, a strata on which to place the ova was then formed. It consisted of a mixture of sand and gravel, of the depth of several inches, upon which were deposited pebbles of the ordinary size of road metal. When properly prepared for the reception of the ova, the stream averaged two inches in depth above the average of the stones.

At a short distance below the dam two ponds were constructed to contain the fry, the one receiving the stream from the double row of boxes, and the other from the bed of the rill. The superficial area of each was 240 yards, being much too small, as finally ascertained, for the hosts of fry with which they were ultimately tenanted.

A spawning bed in the immediate vicinity afforded every facility. In order to obtain the spawn in a perfectly mature state, the fish were taken from the spawning bed in the very act of its deposition. They were caught with nets at night. When taken they were instantly, and without injury, put into an oval tub one-fourth full of water. So soon as a pair of suitable fish were captured, the ova from the female was immediately discharged into the tub by a gentle pressure of the hands from the thorax downward. The milt of the male was ejected in a similar manner, and the contents of the tub gently stirred with the hand. After the lapse of a minute the water was poured off, with the exception of sufficient to keep the ova submerged and fresh supplied in its place. This also was poured off and fresh substituted previously to removing the impregnated spawn to the boxes prepared for its reception.

In discharging the ova from the abdomen of the female, all violence was carefully avoided. If on examination the ova were found to be immature, the fish was immediately returned to the river, and others in a more advanced stage taken. When a sufficient quantity of spawn was collected, it was at once removed to the hatching ground. An amount proportioned to the size of the boxes was carefully poured in at the head of each, the action of the water scattering it pretty equally among the crevices of the stones. A temporary increased flow of the stream easily distributed it wherever it might happen to be too closely crowded together. Out of 24,000 roe deposited in the spawning boxes, 20,000 were successfully hatched.

Mr. John Gillone's Process of Propagating Trout and Salmon.—As owner of the "Longland Fishery," the opinion of Mr. Gillone is received with much confidence and respect throughout England. "In the first place," he states, "we have one mill-dam hecked at top and bottom." (As the word *heck* means "an engine or instrument for catching fish," we suppose that he means a peculiar net or singularly constructed weir, for preventing trout or salmon from passing it, and rendering them liable to capture in the attempt.—Ed.) The upper part of the dam was laid with gravel suitable for salmon or trout to spawn in naturally. There is also a very suitable stream for trout or salmon to deposit their spawn, and so soon as our fishing season is about to close we take the number of fish required to fill our breeding boxes with fecundated ova, and put them into the dam and keep them there until we see them beginning to spawn. (Spawning is continued for several days, and sometimes weeks, by a single pair of fish. The male trout or male salmon sometimes forces the female to the spawning bed before all the ova is sufficiently matured for deposition.—Ed.) We then shut down our upper sluice, catch and examine all the fish, and keep in a large wooden box all the fish ready for manipulation, returning the rest to the dam till we see them beginning to spawn a second time, and so on till we get them all spawned.

We spawn them in a box three feet six inches long, seven inches wide, and nine inches deep, with as much water as will cover the fish. We first take the female fish from a large box filled with water close at hand, lay her in the little box as she swims (that is, her back up), taking her by the tail with the right hand, and with the left gently press from the neck to the vent until you get all the roe excluded. We then pour off about half the water and use the male fish the same way, mixing the milt with the water by the hand. After mixing the ova, we have a large filter that fits the neck of a bottle, water-tight, with a rim of wire gauze two inches deep. We then fill the bottle and filter with water; then, pouring off the greater part of the water in the spawn-box, we empty the roe and water into the filter. The roe, of course, sinks into the bottle, the water runs off through the wire gauze, and prevents any of the ova from being spilled. The bottle is marked off into divisions, each division holding 800 eggs of an average size. By this way we count our roe with little trouble that we deposit in our breeding-boxes. In putting the ova into the breeding-boxes, I have a tin tube that fills the neck of the bottle, tapering to about a half-inch circle at the top. This tube I place below the water in the breeding-box, and gradually empty the roe into glass bars. Our breeding boxes are two in number—or rather a continuation of one. They are laid quite level, so that the water circulates down the one and up the other. The boxes are made of wood four inches deep, one foot wide, and the length of the two boxes combined is 135 feet. These boxes are supplied with frames inside each, three feet long, filled with narrow strips of glass, with the sharp edges ground off to prevent cutting the young fish. The glass is laid across the stream, forming gutters, in which the ova is placed in rows across the run of the water; the glass is supported in the frames three-quarters of an inch from the bottom of the box, the water flowing freely both above and below the ova. These boxes are capable of hatching at a time 15,000 salmon or trout. This season we have 24,000 salmon eggs deposited in them, and the eggs are becoming quite visible. In depositing the ova in the several boxes, I keep each fish's eggs separate, and marked on the boxes 1, 2, 3, &c. I keep corresponding numbers in a book, with a remark on each fish's roe at the time of spawning; and during the time of incubation, if I see anything worthy of notice, I take a note of the number and what has happened. I pick out all the dead ova once or twice a week, and keep account of the number; and when the hatching is finished, I subtract the number of the dead from the number deposited, which will show about the quantity we have hatched.

At the present time, the re-stocking of the Tay with trout and salmon, and stocking with trout and salmon the Tasmanian waters in Australia from ova transported from France and England, are subjects of comment by the most learned pisciculturists, proving that fecundated ova may be carried in glass bottles all over the globe without injury to a single egg. We have just learned that a citizen of Maine has invented a process by which he can preserve roe in a condition for being hatched for many years.

Of the various methods of preparing roe for shipment, MM. Gehin and Remy place the fecundated spawn in a tin box, between layers of pebbles—an undesirable plan, since the shock in transit will certainly crush them. Others have recommended alternate strata of wet sand as suitable for convenient packing. The plan recommended by Professor Ramsbottom, and successfully practised by him for many years, is that of placing the ova in large glass bottles filled with river-water, which is changed as often as convenient. Mr. Francis Francis, a great ichthyological student in London, recommends glass bottles similar to those used by the French government at present for transporting roe. Of course, the fecundated ova can be most safely transported in fall or winter. Salmon roe was imported from Ireland last winter by Mr. Bowman Johnson of Islip, at the instance of Mr. Ramsbottom, whom he has employed to stock the Snedicer Preserves with both salmon and trout; and the roe was hatched at the Artists' Buildings in Tenth street, in Croton water, from whence they were transferred to the Connetquot Preserve below Islip. Although many persons contend that the pair turned into the South Bay will never return to Mr. Johnson's preserve, I doubt them. They perhaps have not taken into account the fact that blue fish, Spanish mackerel, boneta, and sharks, do not inhabit the bay during either spring, fall, or winter, and these are the migratory seasons of the salmon. Of trout, they have been taken in nets in the South Bay several miles from shore. Daniel Webster contended that the trout of Marshfield Creek made regular trips to sea, and improved greatly by their marine voyages. We never doubted it for we know that trout which have access to our bays and inlets from the ocean are fatter and higher flavoured, which is justly attributed to their food in salt water being shrimps, small fish, and the eggs of the numerous tribes of the deep.

It has been proved by experiment that, of salmon, not more than one in a thousand hatched naturally arrive at maturity. Of trout, it is probable that double that proportion mature, for the present experiment of propagating trout and salmon side by side in Australia proves that trout thrive best, and are what Lord Dundreary would call "the most wobust." But the ranks of the speckled beauties in our trout streams and ponds have been decimated, and require filling up. This cannot be done without the assistance of art. Let us suppose that a pond which is supplied by streams suitable for spawning is stocked with five hundred trout, each of which weighs a pound. In the course of one season they will deposit 250,000 ova. Granting that a considerable portion of these are hatched, is it ever found that a fiftieth or a hundredth part of the whole arrive at maturity? Far from this being the case; the number of trout will continue almost the same for years, without any perceptible increase. The reason is plain. As soon as the fry are hatched they are exposed to the attacks of the parent trout. Within the limits of the reservoir there is not the remotest chance of their ultimate escape. It is true, if the fingerlings knew enough, they might ascend the tributaries of the preserve to shoals where the parent trout could not follow; but they do not know, and man being placed over the kingdom of inferior animals should preserve them for his own good. Trout or salmon which spawn in the natural waters, generally go to the heads of the streams during the Fall floods and deposit their spawn: when the waters subside the ova is sometimes destroyed by being left on dry land. Other fish deposit their spawn and cover it on prior beds of spawn. Others spawn in the current of the stream, and a freshet carries it down the current as food for all the inhabitants below. In other cases the female trout makes her spawning-bed, and deposits and covers up the ova, while the male trout is down at the foot of the pool guarding it from the incursions of an army of water-guerillas. Sometimes the place in the stream selected for the spawning-bed is very good while preparing the trenches for the spawn, but by the time the spawn is deposited the stream has become a torrent, and washes away the ova; and yet just like a headstrong specimen of humanity—if the female makes up her mind that she will spawn at a place the rapidity of the flood of water never daunts her, though the swiftness of the current prevents the roe from ever touching bottom. Long Island is formed of a net-work tracery of trout streams, and yet there is but one establishment for the artificial propagation of trout on it. The proprietors and poachers of the island capture trout in Winter to stock ponds which, kept for the commercial advantages of letting them to be fished by amateurs with the fly, or the trout are fed and then netted and taken to market. There is no attention paid to the procreation of the speckled beauties. Many of the best preserves on the island are depleted of trout by sheer neglect. They should divide their ponds, and catch their large trout and use them for stocking subsidiary waters. In a word they should tap their dams with pipes and conduct water into spawning-boxes. Where their dams are near a road or turnpike, they should run the pipes underneath, or place their boxes along the embankment of the dam in such position as to form a rather swift flow of water throughout the line of boxes. Nothing can be more simple or safe. The trout hatched in that way should be placed in small ponds, each brood by itself, thus necessitating three of these small ponds. As each brood arrives at two years of age it should be turned into the main preserve, and that preserve should be swept annually with a large-meshed net, and all the large trout so taken should be transferred to the pond of propagation, which should be watched during spawning-time—in September, October and November—and when found ripe for spawning they should be netted and the roe and milt taken from them and laid in the breeding-boxes.

Whenever practicable, it is desirable to take the trout from the spawning-beds by means of nets, so as to insure the maturity of the ova. It can best be done in the night. So soon as caught, the fish should be placed in a large tub, or other vessel, partially filled with water, till a milter and spawner are taken. In ejecting the ova, the female should first be held over a bucket or large tin can half full of water—the lower end of the abdomen being inserted in the water in order to prevent the exposure of the ova to the air. A gentle pressure of the hand from the thorax down each side of the abdomen will discharge the ova, if mature, without the least injury to the fish. The water in the bucket should then be reduced to three or four quarts previously to ejecting the milt of the male. In expelling the milt the course pursued is precisely the same as that just described, the lower end of the abdomen being in this case also inserted in the water. After stirring the contents of the bucket with the hand, the water should be poured off and fresh supplied several times in succession, until no trace of the milt can be seen, always taking care to keep the ova submerged. the spawn may then be removed to the hatching-ground or boxes ; for the artificial spawning bed may be made in a ditch, dug for the purpose, and paved, and supplied through pipes with water, as well as in boxes ; but experiments have given the preference to boxes, as susceptible of forming thereby a stream more equal in flood, volume and temperature. In the removal of the ova for a short distance it is unimportant in what manner they are conveyed so long as they are not much shaken. In transporting to great distances, requiring much care, it is better to carry them in bottles of water than in layers between sand or moss, because the specific gravity of ova and that of water are so nearly the same as to insure against much oscillation. Another advantage of exporting in bottles of water is found in the less apprehension of their being disturbed or injured by Custom-House officers.

The preparation of the hatching-ground is the same whether it is intended to deposit the ova in boxes or in the natural bed of the spring or stream. The best substratum consists of a mixture of sand and gravel, a couple of inches in depth, upon which stones like the old irregular-sized paving-stones should be laid throughout the entire length, and the stream should flow equally over the whole.

In the deposition of the spawn, a portion is taken into any small vessel and gently poured upon the hatching-ground, care being exercised to distribute it pretty equally. If it should accumulate too thickly in places it may easily be scattered by pouring water upon it, when it will soon disappear among the small interstices of the paving-stones. No further care is then required, except to keep the stream of water constant and pure and protected from injury by frost. The period at which the ova may be expected to come to life will be from sixty to ninety days, owing much to the temperature of the water. Trout have been hatched in this way in less than fifty days, and salmon in less than sixty.

The annual revenue of the Tay is continually increasing since it is being restocked by artificial propagation, and it is now worth 10,000*l.* a year more than it was before its supply was augmented by its thousands annually hatched in fish-boxes.

The experiment of transporting ova to Australia and hatching them there has proved entirely successful.

By a perusal of the foregoing descriptions for propagating trout by the most celebrated and successful fish-culturists, it will be perceived that they do not differ much in the *modus operandi.* Nearly every farmer has a spring on his place yielding surplus water sufficient to hatch trout in boxes. If he does not wish to go to much expense in erecting a dam to form a preserve, he might, at least, hatch the trout in boxes and sell them, for they are as ready sale as any product of a farm. Mr. Ainsworth, of Bloomfield, N. Y., said : "The original stock (of trout) was put in my pond, containing 61 square rods of ground, 14 feet deep, supplied with springs, three years ago, 1,400 in number, age from one to four years. They weigh now from one to three pounds each. They are about as tame as kittens—come at call, and throw themselves clear out of water in their haste for food at the five hundred at a time, and some take it out of a spoon six inches above the water. Think of seeing five hundred trout, all at the same instant, weighing from one to three pounds, and from twelve to eighteen inches long!"

Mr. Ainsworth states that he takes the trout while on their natural spawning-beds and exudes their ova and milt artificially, and then places the spawn in troughs on gravel with pure spring-water running over them. They hatch in seventy-eight days, and commence feeding from forty to fifty days thereafter, during which time they live on the egg attached to them. Last fall I took in this way about 60,000 eggs and hatched say 40,000 of them, which are now from two to four inches long. With all things right, nearly all will hatch in this way. These will grow to a pound in weight in four years, with good water and plenty of food.

A two-pound trout will furnish about 8,000 spawn; smaller ones less in proportion. They commence spawning when one year old.

In this way they can be increased and grown to any extent, and all the ponds and streams in the country stocked to overflowing.

We conclude with the statement of both hope and confidence, that the reader will find fish-breeding in boxes so simple and sure that he will at once prepare to engage in the interesting and profitable occupation of the Propagation of Trout.

ON TORBITE (A NEW PREPARATION OF PEAT) AND ITS USES.*

BY D. K. CLARK, C.E.

The writer had occasion a short time since to inspect professionally the works at Horwich, in Lancashire, to manufacture fuel and charcoal from peat, and was so struck with all that came under his notice, and impressed with the importance of the results obtained, that he feels he cannot bring a more interesting subject before the meeting.

The question of the manufacture of peat into fuel is in reality a question of supplementing the natural supplies of coal with a fuel, which may be made superior to it in every respect, more abundant and more readily accessible. The consumption of coal is so enormous and goes on annually increasing at such a rate that for some time past, serious apprehensions have been entertained that our

* Read before the British Association.

coal measures will be exhausted at no very distant period. Our stock of coal, excluding all that lies at a greater depth than 4,000ft., has been estimated at 83,544,000,000 tons. In 1863 the consumption reached 86,300,000 tons, and the average rate of increase for the last ten years has been two millions of tons a year. Thus, supposing our stock to have been correctly estimated, in less than 100 years our coal will be exhausted. Fortunately, however, nature has not left us dependent on our coal measures alone, but has also given us our bogs.

Peat, it is well known, possesses many most valuable properties as a raw material for fuel, but the attempts hitherto made to utilize peat on a large scale have proved failures, owing to the difficulty of dealing with a substance exceedingly bulky, very loose, and holding from 75 to 85 per cent of water.

To separate the water and to condense and mould the peat into convenient sizes at a cost sufficiently low to render it commercially available as fuel, is a problem which has baffled the efforts of many operators. In most instances, compression has been applied for the purpose of imparting the requisite degree of of solidity, by means of powerful hydraulic presses or other machinery. In the process adopted by Messrs. Gwynne and Mr. C. Hodgson, the peat is first dried and powdered, and then pressed into blocks ; but the action of compression is purely mechanical, and though it imparts great compactness by bringing the particles of the peat into close contiguity, it does not really solidify the substance, since on being exposed to heat, it resumes its original form and crumbles to pieces. Fuel thus prepared is totally incapable of resisting the action of a blast or even of a moderate draft, and though Mr. Hodgson still carries on the manufacture of fuel by his process, the consumption is very limited.

Acccording to Mr. Cobbold's mode of treatment the peat is immersed in water for the purpose of separating the fibre from the more decomposed matter, and the water is afterwards got rid of either by simple evaporation or by means of centrifugal power ; but though by this means a very dense fuel is obtained, the separation of the fibre deprives the fuel of coherency, besides which the process is laborious and costly. Attempts have also been made in Ireland to utilize peat by manufacturing it solely for the sake of its chemical products. Many valuable products have thus been obtained, from which even paraffin candles have been made, but the cost far exceeded the market value.

But such attempts have not been altogether in vain, inasmuch as the experience thus gained in the treatment of peat has proved of great value. To know what will not do is a great step towards knowing what will do ; and the more recent patents show, almost in the order of their dates, the slow but steady progress that has been made until one arrives at the system of manufacture recently inspected by the writer at Horwich : according to this system mechanical compression in any manner is studiously avoided, being not only costly but also ineffectual.

Advantage has, on the contrary, been taken of the natural property of peat, suitably prepared, of contracting as its parts with its moisture and becoming perfectly solid and cohesive. The means of separating the water suspended in the peat have, too, be carefully perfected. The necessity of dealing with, and getting rid of, such a large proportion of water has been a standing difficulty from the first and the cause of excessive expenditure. At Horwich the problem has been carefully studied, and the difficulties appear to have been successfully overcome. Until a mode of artifficially drying peat rapidly and economically had been worked out air drying was necessarily resorted to ; and where limited quantities of fuel—say about 100 tons a-year—only are required to be made air drying may suffice, but for large quantities it would be, in our fickle climate, too uncertain a process to be depended on, and for seven months in the year it would not be available at all.

According to the system matured and established at Horwich, the peat, as it comes from the bog, is thrown into a mill expressly constructed, by which it is reduced to a homogeneous pulpy consistency. The pulp is conveyed, by means of an endless band, to the moulding machine, in which, while it travels, it is formed into a slab and cut into blocks of any required size. The blocks are delivered by a self-acting process on a band, which conveys them into the drying chamber, through which they travel forwards and backwards on a series of endless bands at a fixed rate of speed, exposed all the time to the action of a current of heated air. The travelling bands are so arranged that the blocks of peat are delivered from one to the other consecutively, and are by the same movement turned over in order to expose fresh surfaces at regular intervals to the action of the drying currents, so that they emerge from the chamber dry, hard, and dense. To the peat substance thus treated the name of "torbite" has been given, from the Latin *torbo,* by which name peat is constantly mentioned in ancient charters.

The next stage in the process is the treatment of the torbite in close ovens, when it may either be converted into charcoal for smelting purposes, or may be only partially charred for use as fuel for generating steam, or in the puddling furnace.

The whole of the Horwich system has been planned with a view to the utmost economy of time and labour. The raw peat is nearly altogether automatically treated by steam power—introduced at one end it issues from the other in the form of charcoal, within twenty-four hours after it is excavated from the bog, and the manual labour expended is almost entirely limited to the first operation of digging, consequently the actual outlay in labour and fuel in the production of the charcoal does not exceed from 10s. to 12s. per ton ; but, in addition to the economy thus effected by charring, in close ovens, a considerable quantity of valuable chemical products are yielded, as ammonia, acetic acid, pyroxylic spirit, paraffin oils, the sale of which alone nearly cover the expenses of the whole process.

The fatty matter separated by distillation forms an excellent lubricating grease, the yield of which averages about five per cent. of the weight of charcoal produced; in its crude state it has been sold for 12*l.* per ton at Horwich.

The charcoal made from torbite is extremely dense and pure; its heating and resisting powers have been amply and severely tested, and with the most satisfactory results. At the Horwich works pig iron has been readily melted in a cupola. About eighty tons of superior iron have been made with it in a small blast furnace measuring only six feet in the boshes, and about twenty-six feet high. The ore smelted was partly red hematite, and partly Staffordshire, and the quantity of charcoal consumed was one ton eleven hundredweight to the ton of iron made, but in a larger and better constructed furnace, considerably less charcoal will be required. It has also been tried in puddling and air furnaces with equally good results, considerably improving the quality of the iron melted. For this purpose the fuel was only partially charred, in order not to deprive it of its flame, which is considerably longer than that from coal. Some of the pig iron made at Horwich was then converted into bars, which were afterwards bent completely double when cold without exhibiting a single flaw. Messrs. Brown and Lennox, in testing this iron for chain cables, have reported that its strength was proved to be considerably above the average strength of the best brands.

In Germany, peat mixed with wood charcoal is very extensively used in the production of iron, the peat as prepared there not being sufficiently solid to do the work alone, but it is found that the greater the proportion of peat that can be used, the better is the quality of the iron produced. The gas delivered from the high furnaces has also been satisfactorily employed in the refining of iron and the puddling of steel. The value of peat in the production of iron has long been established. Iron metallurgists are agreed in the opinion that iron so produced is of very superior quality. In every stage of iron manufacture, and in welding, peat charcoal is most valuable. At Messrs. Hick and Son's forge, in Bolton, a large mass of iron, about ten inches square, was heated to a welding heat with peat charcoal made at Horwich. The time occupied was less than the operation would have taken with coal; the whole mass was equally heated through without the slightest trace of burning on the outside, and in hammering out the mass as much was done with one heating as ordinarily required two heatings to effect.

The importance of obtaining an abundant supply, at cheap rates, of peat charcoal cannot, therefore, be too highly estimated.

For the generation of steam the fuel made at Horwich has also been well tested, and its superiority over coal practically demonstrated both in locomotives and stationary engines. On the Northern Counties Railway of Ireland a train was driven with it from Belfast to Portrush, a distance of seventy miles. The result at the end of the journey showed a saving, as regards weight consumed, of twenty-five to thirty per cent. over the average of three months' working with coal on the same journey. There was an excess of steam throughout the run, though the fire-door was constantly open and the damper down. At starting the pressure was 100 lb., but during the trip, and while ascending a steep incline, it rose to 110 lb., and afterwards to 120 lb. with the fire-door open. While running there was no smoke, and very little when standing still.

At the Horwich works the fuel was tested against coal under the boiler there. This was done on two consecutive days, the fire having on each occasion been raked out the night previous.

The following results were obtained :—Coal got up steam to 10 lb. pressure in 2 hours 25 minutes, and to 25 lb. pressure in 3 hours ; peat fuel got up steam to 10 lb in 1 hour 10 minutes, and to 25 lb. in 1 hour 32 minutes; 21 cwt. of coal maintained steam at 30 lb. pressure for 9¾ hours ; 11½ cwt. of peat fuel maintained steam at the same pressure for 8 hours.

But in addition to this a large economy is effected by the use of peat fuel for the generation of steam in the saving of boilers and fire-bars from the destruction caused by the sulphur in coal, from which peat is free. In Bavaria, peat fuel has been used on the railways for several years past, and the economy effected by its use in the wear and tear of the engines is stated by the officials in their reports to be very considerable.

The bogs of Great Britain and Ireland cover an area exceeding five millions of acres, the average depth of which may be taken at twenty feet. Nature has thus supplied us with the means of adding to our stock of fuel some twenty thousand millions of tons.

In Ireland, about a million and a half of acres have been thoroughly surveyed. In the reports of these surveys it is stated that beneath the peat an excellent soil, well situated for drainage, was found fit for arable or pasture land. When it is considered what peat is capable of doing, and all the results involved in the question of utilising peat, it is impossible not to feel impressed with the conviction that in what has been accomplished at Horwich, the foundation has been laid of an undertaking of great national importance and interest.

THE ARMS TRADE OF BELGIUM.

BY MR. BARRON,

HER MAJESTY'S SECRETARY OF LEGATION AT BRUSSELS.

(Concluded from p. 157.)

SECTION III.—*Government Factories.*

THE Belgian artillery possesses four great establishments for manufacturing and repairing arms and ammunition, viz.:—1. The cannon foundry at Liége; 2. The small-arms factory at Liége; 3. The Arsenal de Construction (carriage-factory) at Antwerp; 4. The Ecole de Pyrotechnie (laboratory) at Antwerp. There exists, besides, a shot foundry at Antwerp, intended for use in time of war. The powder is all made by contract, as also some ordnance stores. Nearly everything else pertaining to the armament of the troops and the fortresses is manufactured by the government itself. Trials of cannon are held at the Polygon of Brasschaet, or on the Ostend beach; those of small arms at the camp of Beverloo or on the "champ d'épreuves" at Liege. Since 1859 the Minister of War, Lieutenant-General Baron Chazal, has imparted the greatest activity to this department. Under his energetic impulse, every practical improvement has been introduced into the system of national defences.

Of all the royal factories the Cannon Foundry of Liége stands first in importance and celebrity. It has from time to time supplied most European States with iron and bronze cannon. Thus, from 1840 to 1857 it has executed for foreign governments 2,991 pieces of cannon and 123,000 projectiles, of an aggregate value of 140,000*l.* The government deemed it advisable, in the interests both of science and industry, to keep this establishment constantly at work. The high quality of its productions has become well established by frequent competitive trials, especially that held at Woolwich in 1850. The superb cannon foundries of Truvia, in Spain, and of Vienna, were imitated from that of Liége. The whole strength of the establishment is now employed upon the Belgian artillery. Consequently no orders have been accepted since 1859 for foreign governments. It is not accessible to visitors.

Since the introduction of rifled ordnance the foundry has been kept in extreme activity. Bronze has been entirely discarded, experience having shown that that metal, so superior in tenacity, is deficient in the hardness necessary for rifled guns. In 1861, the new breech-loading rifled gun was adopted, and 14,461,000 francs were voted for "transforming" the whole artillery, *i.e.*, for the manufacture of new and the alteration of old guns. The Belgian cannon is, with slight modifications, that invented by Baron Wahrendorff, and adopted by Prussia. It gives perfect satisfaction. The minister instituted some experiments with steel cannon manufactured of blocks derived from the principal steel-works in England, Germany, and Belgium. The result was so decidedly favourable to Krupp's steel that all the small guns have since been purchased of him. They are supplied by his works at Essen, in Prussia, in the rough state, then rifled and fitted with their breech-closing apparatus in the royal foundry. A 6-pounder of this kind has been fired 5,000 times with full charges, and showed no signs of giving way either in the grooves or at the breech. All the experience of the Belgian Artillery has induced a firm conviction of the incomparable superiority of their gun.

Statement of the number of Cannon and Small-Arms manufactured in the Royal Foundry and Small-Arms Factory during the following Years.

	Cannon.		Small-arms.		
	For Belgian Government.	For Foreign Governments.	Fire-arms.	Lances.	Sabres.
1850 .	31	—	3,795	—	300
1851 .	18	177	3,193	—	215
1852 .	32	336	3,828	621	185
1853 .	119	102	5,101	2,117	901
1854 .	118	136	6,000	1,200	400
1855 .	76	38	6,972	652	1,100
1856 .	63	225	9,441	508	450
1857 .	15	221	6,824	199	772
1858 .	28	226	5,338	200	686
1859 .	85	52	11,440	102	551
1860 .	103	63	10,782	—	636
1861 .	not divulged.	none.	9,440	—	462
1862 .	"	"	14,512	—	400
1863 .	"	"	15,216	—	401
1864 .	"	"	11,201	1,000	400

The new ordnance comprises 4, 6, and 12-pounders of Krupp's steel; 12 and 24-pounders of cast-iron.* The foundry has transformed on a new principle a great number of old iron 12-pounders, and has cast a great number of new ones. The former have proved excellent guns, quite equal to the latter. The different solid and hollow shot required for all these guns are made both in the foundries of Liége and Antwerp, as also by the trade. They are finished and coated with lead in the royal foundries alone. An immense workshop has been newly

* These terms afford only approximative indications of the real diameter of the new Belgium ordnance. These diameters vary somewhat from those of the old guns, and are not made public; I am not therefore at liberty to record them here.

erected for this purpose, as also a great number of new machines for all purposes. The ordinary field and siege artillery will probably be completed in 1865. The vast defences of Antwerp, so far as decreed by the law of 1859, are all but finished, and even partially armed. The eight detached forts are provided with their guns and stores. The enceinte of the town and the future batteries on the Scheldt will require much heavier guns. What guns these are to be is not yet decided, and will depend on some future experiments. The government already possesses an 8-inch steel 100-pounder weighing five tons, and calculated to bear a charge of 40 lbs. of powder, and to throw a projectile of 200 lbs. weight; its cost was 3,400*l*. Another still heavier is ordered.

The following is a brief statement of the antecedents and origin of the present royal manufactory of small-arms. The chief improvements in the fabrication of the old musket were due to the French government. In 1777, King Louis XVI. instituted a Commission in order to lay down fixed principles for the construction of all arms. This Commission caused a pattern musket to be set up on the best principles then known, and drew up a Code of Regulations defining the qualities and tests to be required in receiving the materials; describing minutely the further tests and guages to be applied in verifying every component part as well as the finished musket; finally, depicting in a series of elaborate engravings every separate piece and every instrument used in the process of reception. For fifty years this pattern of 1777 remained, in the eyes of the Liége workman, the standard of perfection. In 1804, the French government established a manufactory of muskets at Liége in the old Dominican Convent, under a private contractor. This establishment only lasted for a year and a-half, but introduced great improvements in the tools, machinery, and processes employed. The new contractor relinquished the factory, and reverted to the old system of home labour, only keeping a few barrel mills and a workshop for making and repairing tools. Still the viewing Commission of that time, being composed of experienced officers and comptrollers, rendered great service in training the workmen. Young men who preferred the profession of making to that of carrying arms, and who could produce a chef d'œuvre in that craft, were dispensed from military service. Thus 40,000 good muskets were made annually at Liége for the Imperial government.

Again, a factory of muskets was established by King William at Liége in 1827, under the management of a contractor, but it was subsequently abandoned. The Belgian Military Department used the building only for the reception of arms, which were all supplied by private makers. An experiment of manufacturing arms for its own account was first tried by this government in 1838, in a hired building, and yielded so much advantage that the government determined to build a factory of its own. To justify this measure, it was held up as intended to assist and instruct the trade. Thus the present factory arose in 1840.

It has produced in the last ten years an average of 10,116 fire-arms per annum. Its workmanship is described by English officers as being of the first class.* All the small and side-arms of the Belgian army are manufactured here, excepting some sabres and swords bought at Solingen. The materials employed are almost exclusively Belgian. It has happened once (in 1859) that some 12,000 muskets of the new pattern wanted as a reserve had to be purchased of the trade. The factory now occupies about 250 men on the premises, and about 300 outside, the latter principally barrel-makers. The whole labour is done by task-work, under the supervision of artillery officers, upon estimates drawn up by them. The workmen earn from 2 to 3 francs per day.

The barrels are forged in the same manner as for the trade, in the rural water-mills. Pure charcoal iron is becoming every year more difficult to obtain; and as the royal factory is obliged to purchase it by adjudication, an inferior material is often substituted. It is likely that steel will soon supersede iron for this purpose. Besides the strong barrel-iron, two other species are used—viz., soft tenacious iron, for the furniture, and tempered iron (by cementation), for several parts of the lock, &c. This latter iron is generally derived from Germany, the Belgian works not having succeeded with it.

The "usinage" of the barrels is all executed at the factory. The first operation included in the above term, that of rough boring, is effected by a series of quadrangular plugs of tempered steel passed through the barrel. It is then annealed—*i.e.*, heated and left to cool gradually in order to restore its tenacity, which is impaired by the boring process. Then follows an external straightening with the hammer; then a succession of internal fine-borings ("alésages"), alternating with seven internal straightenings ("dressages"). The barrel is also compassed, ground, and turned on a lathe. The best straighteners are those trained in a large factory, for the eye being the only guide, great practice is necessary for this work. A polished tube, when pointed towards the light, presents to the eye a certain number of concentric zones perfectly distinct from each other, in each of which any external object will be reflected in a corresponding number of images. If a barrel thoroughly accurate be turned round on its axis, these internal images will remain unaltered and symmetrical. The slightest inequality of the bore will show itself by a distortion of the image at the point, and must, when detected by the workman, be rectified by a blow of the hammer on the faulty point. After the third fine-boring, the outer surface, still rough and uneven, has to be brought down to a true concentrical form by the compasser, who measures the thickness of the barrel, and marks the points where there is an excess of iron to be removed by the mill-stone and the lathe.

Garnishing a barrel includes here the following operations: Forging

* *Vide* "Report of Select Committee on Small Arms, 1854," p. 261, &c.

and screwing on the breech and breech-nose ; brazing and filing the tenon and sight ; cutting, by a machine, the outer surface of the chamber to a perfect octagon ; drilling the touch-hole and lodging the nipple. After garnishing, the barrel is proved twice ; first with 27½ grammes of fine powder, a ball and two wads ; therefore more than three times the ordinary charge, which is 9½ grammes of infantry powder. Finishing the barrel includes the following operations: 1. "Basculage,"—*i.e.*, fashioning and adjusting the break-off and joint ; 2. "Adoucissement,—"*i.e.*, smooth-filing and polishing the barrel, joint, and sight, and adjusting the bayonet ; 3. Exposure in a damp room for a month, in order to test the metal under the effects of rust ; 4. "Systémage," or percussioning,—*i.e.*, fashioning the lump, and fitting the lock firmly to the barrel. This is a peculiarity of the Belgian musket. The break-off joint is different from the English breech-tang, which is screwed into the musket, and by some of our officers considered superior.*

The bayonet is manufactured of two metals welded together,—viz., of soft tenacious iron for the socket, and of hard steel of "two marks" for the blade, which must offer great rigidity. The terms "two marks" or "three marks" are used for steel which, in the process of refining in bars, has been bent two or three times on itself. The blade has, after welding, to be tempered, annealed, ground, polished, smooth-filed, and proved. The socket is bored, turned, jagged, and fitted with its locking-ring. The ramrod is made of the same steel as the bayonet-blade, but receives a softer temper.

The Belgian is a back-action swivel lock, composed of eleven pieces. Two of these, the lock-plate and the cock, are of tempered iron ; nine others of steel. The cock alone is stamped in a ram-block. The other pieces are all forged by hand in common smitheries on a coal-fire ; then filed, adjusted, tempered and polished, and viewed by the comptroller after each of these operations. Two smiths, twelve filers, and six fitters will make ten or twelve locks in ten hours. The steel pieces are tempered *à la volée*, which consists in heating them to cherry heat and then plunging them in cold water, and then annealed. The two iron pieces are tempered *en paquet*, or case-hardened,—*i.e.*, superficially converted to steel by heating in a crucible with a cement of wooden soot, or calcined hoofs, followed by immersion in cold water.

The furniture of the Belgian musket consists of twenty-eight pieces, including the break-off, the trigger, the trigger-guard, the cross, heel-plate, three bands, rings, screws, rammer-springs, sights, &c. The manufacture of all these is conducted like that of the lock-pieces. The whole musket consists of forty-four pieces.

The stocks are made exclusively of walnut-wood, which grows abundantly in Belgium. The desiccation is effected in the factory itself,

* *Vide* "Report on Small Arms," page 268.

by exposure to steam. The master-stocker receives from the store a rough-chiselled stock, a barrel with its bayonet, a ramrod, a lock, and a set of gun furniture. He has then to fashion the wood for lodging accurately the principal parts, and again to put a finishing hand to the stock when it comes back from the setter-up. The duty of the setter-up ("équipeur") is to lodge the trigger-guard, the trigger, the band-springs, and ramrod-springs; to drill the screw-holes; to flush the screw-heads; to temper and polish all the pieces; and, finally, to make the whole weapon act, by adjusting and filing where necessary.

The rifling is effected by machinery, which was mainly created in the factory itself, and once excited the admiration of our mechanists, but has been now surpassed elsewhere. There are twenty rifling benches, each of which can rifle twelve barrels in ten hours. Each barrel passes through the machine twelve times for each of the four grooves—in all, forty-eight times. The grooves have one turn in two mètres, or seventy-nine inches.

The musket is then assembled, and brought by the stocker to the "salle de recette," to be viewed by the first comptroller. After a general view, it is entirely stripped, and every part is again strictly inspected and guaged by four different comptrollers, each having his own part. It is then again assembled, viewed a last time, and marked by the head comptroller, and then put into store.

The estimate of the cost of a rifled musket with its appendages made at the Royal Factory in 1860, was forty-five francs seventy-two centimes, or 1*l.* 16s. 3d. These figures of course only include the cost of materials and labour, not that of the buildings, the machinery, and the staff employed; therefore they cannot be held to represent the real cost of each musket. The price of those supplied by the trade in 1859 was 59 francs, or 2*l.* 6s. 10d. One of these arms is calculated to last thirty years and to stand 25,000 shots.

The armed forces of Belgium may be stated as follows:—

Army.	Effective force—average numbers drawing pay	35,000	
	" " absent on furlough, &c.	65,000	
			100,000
Civic Guard.	Active battalions	25,000	
	Reserve battalions	55,000	
			80,000
	Total		180,000

With the exception of four regiments of lancers, the above troops are all armed with fire-arms provided by the State. The whole muskets of the army, of patterns anterior to 1841, have been put into the hands of the civic guard. Those belonging to the active battalions have been lately rifled on a new principle invented by Mr. Jansen, a gunsmith, which seems to be very suitable for all barrels. About 20,000 have been thus "transformed" by him (rifled with eight shallow grooves) at a contract price of four francs per musket, and now shoot very accurately at a short range.

The small arms now in the hands of the infantry are of three different models,—viz., the musket of 1841, that of 1853, and the stem rifle. The first is the old smooth-bore, made after the regulation laid down at the introduction of the percussion lock, now rifled and fitted with an elevating sight. The second is the present regulation musket and varies little from the former except in a slight increase in strength. It is loaded with five and a half grammes of powder and a hollow cylindro-conical expansive Minié bullet, with an inner core, which serves to preserve the sides of the bullet from being torn by the explosion. This bullet, which originated with Peeters, a workman in the royal factory, has the advantage over the Minié and Enfield bullets of dispensing with a plug. The sight is graduated up to a range of 600 paces, but the real range of the musket is 1,200 paces. One regiment is armed with the stem rifle ("carabine à tige"), which is shorter than the musket, carries a long sword bayonet, and has a steel cylinder or stem screwed to the breech inside the barrel, in order to support the bullet (which is solid) and allow it to expand into the grooves when struck by the ramrod. This is certainly an inferior weapon, being more difficult to load and not more accurate in range than the musket. Consequently the "tige" is to be removed, and the same hollow bullets will be used for all arms.

The calibre of the Belgian fire-arms, seventeen and a half millimètres, like that of the French, is acknowledged to be excessive when applied to the new system. A fire from this bore is certainly more murderous, but is inferior in accuracy and range to that of the Enfield bore. Another serious consideration is the difference of weight between the two systems, especially as to ammunition.

	Belgian musket.	Enfield musket.
Bore in inches	0·688	0·577
Weight of arm with bayonet . lbs.	10·	$9\frac{1}{5}$
Weight of bullet . . ounces	1·740	1·083
Number of grooves	4·	3·
Both have a uniform twist of one turn in inches	79·	78·

The Belgian musket is described as equally sound and serviceable, but is certainly inferior in finish and style. The view at Enfield is more strict. The construction of the Belgian arm, as well as its finish, enables it to be made more cheaply than our own.

The great advantages of the breech-loading system for the musket as well as the cannon have not been lost sight of by the military authorities ; but the problem is not yet considered to be solved. The only infantry now armed with such a weapon is that of Prussia. Opinions are still divided as to the merits of the needle gun, and the balance of the opinion is against it. It is certainly the wisest course for other nations to wait till some more perfect weapon has appeared. In the meantime, inquiries are being conducted with reference to the Westley Richards breech-loader, for the three cavalry regiments armed with carbines. For target practice it is generally believed here that the breech-loading rifle invented and made by M. Ghaye of Liége is the best.

The "Arsénal de Construction" of Antwerp has of late years acquired a development proportionate to that of the royal foundry. All the gun-carriages, caissons, waggons, and appendages of the artillery are here manufactured and repaired. The number of hands employed varies from 700 to 800, including 140 artillery soldiers and sergeants. Yet the new orders have been so heavy that much of the work, especially the rough iron-work, has had to be executed in private workshops. Since 1860 a special workshop has been established here for fabricating the metallic parts of percussion rockets, shot for rifled ordnance, and another for making pointing instruments. Large smiths', saddlers', carpenters', wheelwrights', and other workshops are also in operation here. Steam-power has only been introduced since 1861. The Belgian pontoons manufactured here have been so favourably reported on by Colonel Lovell, R.E. (who was sent on a mission of inquiry through Europe), that a whole pontoon has been supplied by this arsenal to Her Majesty's War Department at a cost of 280*l*.

The Ecole de Pyrotechnie of Antwerp is established in a dependency of the ancient citadel, abutting on the river. The ammunition for the new and old ordnance and small arms is here fabricated, including fulminate, percussion caps, wads, matches, rockets, fuzes, &c. Soldiers are sent here from the artillery to be trained as artificers. They receive a theoretical and practical instruction in this art, and are then sent back to join their batteries. Of late years the processes of manufacture have been notably improved, but they are jealouly guarded from view. Some sixty-four artillerymen and two engineers are employed here. All the workshops are mere wooden sheds at long distances from each other and separated by mounds of earth for safety.

STEEL, AND THE BESSEMER PROCESS.*

BY A. L. HOLLEY.

Although the general composition and nature of steel are well understood, it may not be inappropriate to refer briefly to these subjects, as preliminary to a consideration of the Bessemer process and its results.

It is well known that cast-iron is substantially iron with five per cent. of carbon and one or two per cent. of silex and some other impurities. Steel is iron with one to one-tenth per cent. of carbon and a trace of silicium, and traces of some other substances. Wrought-iron is substantialy iron—iron from which all but a trace of carbon has been eliminated. These are the three commercial forms of iron. Steel is subdivided, first, according to its quality, that is to say, substantially according to the high or low degree of its carbonisation; second, according to its method of manufacture.

First, as to carbonisation. High steel, or hard steel, is that which contains a large amount of carbon and a low specific gravity. Its distinguishing properties are extreme ultimate tenacity, hardness, and capability of extension, without permanent change of figure; but its extensibility beyond the elastic limit is small, and it is therefore brittle under concussion. It will harden when heated and immersed in water; it is with difficulty welded, because it deteriorates under high heat and because its welding heat is very near the melting point, and it is melted at a low temperature as compared with wrought iron on account of its excess of carbon.

Low steel, also called mild steel, soft steel, homogeneous metal, and homogeneous iron, contains less carbon and has a higher specific gravity. It can be welded without difficulty, although it deteriorates by overheating, and it more nearly resembles wrought iron in all its properties, although it has much greater hardness and ultimate tenacity, and a somewhat lower range of ductility, depending on its proportion of carbon. It has less extensibility within the elastic limit than high steel, but greater extensibility beyond it; that is to say, greater ductility.

The grand advantage of low steel over wrought iron, for nearly all purposes, is that it can be made liquid at a practicable heat, and run into solid, homogeneous masses, however large; thus avoiding the great defect of wrought iron—want of soundness due chiefly to welds. It is also harder, more elastic, and more tenacious.

Second, Steel is named according to the processes by which it is manufactured.

What is called "puddled steel" or, by some of its makers "semi-steel," ought not to be called steel at all. The idea of steel involves the idea of casting from a liquid state, and of consequent homogeneity.

* A paper read before the Polytechnic Association of the American Institute, New York, Oct. 12, 1865.

Puddled steel, so called, is high wrought-iron. It is wrought-iron puddled in the ordinary way, except that the process is stopped before the product is quite decarbonised. And the process produces not only the ordinary defects of wrought-iron in the usual degree, but the defect of want of uniformity in a much higher degree. It is not easy to guess at a minute chemical quantity through the flame of a puddling furnace. Puddled steel, however, is stronger than wrought-iron.

Crucible steel or pot steel is made from-cast iron by making cast-iron into wrought-iron—*i. e.*, entirely decarbonising it by the puddling or charcoal refining process, and then melting the wrought-iron with carbon in crucibles, to recarbonise it to the proper degree. Or, wrought-iron bars are covered with charcoal and baked for some days in a converting oven. By this process the bars are somewhat carbonised, but still possess the structural defects of wrought-iron. The product, called blister steel, is used in this state for the cheaper kind of springs, &c.; but its chief value is for remelting in the crucible, with additional carbon, to form cast-steel. Crucible steel is also made from scrap Bessemer steel—the spillings from ladles, &c., and ingot and bar ends ; also from cast-iron decarbonised to the required degree in the Bessemer converting vessel, and then poured into water. The product is fine shot of perfectly uniform steel, which are remelted with or without additional carbon. The Bessemer process, in addition to making ingots, thus furnishes, directly and indirectly, the material for a large quantity of the best tool steel as well as low crucible steel now produced in Sheffield.

A little manganese, or some substitute for that metal, is always put into the crucible with the carbon. Chemists do not agree as to the precise chemical office of the manganese or its substitutes; but the result is to increase the ductility of the steel, in both the heated and the cold state.

Bessemer steel is just as much cast-steel, both structurally and chemically, as steel made in crucibles ; because it is poured from a melted state into masses of any size, and because it is definitely and uniformly carbonised.

By the Bessemer process steel is made in two ways from cast-iron. 1st. As in Sweden, by blowing air through melted cast-iron, the oxygen of the air uniting with the carbon in the cast-iron, and so removing all but the amount required in steel, say one-half to one-tenth of one per cent. The oxygen also removes all but a trace of the silex, and the other impurities are burned out. By this process a certain definite number of cubic feet of air are blown through a certain weight of iron, and the blowing is stopped before the iron is quite decarbonised. 2nd. By the Bessemer process it is more usual and more convenient to blow the air through the melted cast-iron until *all* the carbon and silex are removed, after which a small amount of melted crude cast-iron is mixed with the decarbonised metal, thus giving it the proper quantity of carbon, silex, and manganese ; or, instead of cast-iron, artificial mixtures, containing carbon silex, and manganese, or some substitute for manganese, are poured into the decarbonised iron.

The steel thus produced is cast into ingots, which are then ready for the hammer or the rolls. The apparatus employed is, first, a large melting furnace, to melt the cast-iron to be converted; second, a converting vessel, into which the melted iron is run, and where the air is blown into it to decarbonise it; third, a small melting furnace, where the small quantity of cast-iron or other material for recarbonising is melted; fourth, a ladle, ladle-crane, &c., into which the steel is poured from the converting vessel, and from which it is let out into the ingot moulds.

The melting furnaces used in England and on the Continent are reverberatory furnaces—that is, furnaces in which the flame of the fuel is thrown down upon the iron, instead of the iron being mixed up with the coal. Thus the impurities of the coal do not mix with the iron. The furnaces are similar to common puddling furnaces. They were at first used in this country, but the cupola has now been substituted.

The converting vessel is a cylindrical vessel of plate iron, with rounded or dome ends. It is (for making two tons of steel at a charge) about five feet in diameter and ten feet high. It is mounted on trunnions, so that it may be turned either end upward. On one end is an inclined mouth or spout, and on the other a tuyere box, to which air is admitted from the blowing engine by means of a hollow trunnion and pipes connected with it. The converter is lined with a refractory material about a foot thick—any silicious stone ground fine and rammed in; and the air is carried through this lining, from the tuyere box, by means of six fire-clay tuyeres, each tuyere having a dozen holes about a quarter of an inch in diameter. To the other trunnion is attached gearing and a crank to revolve the converting vessel.

The ladle is a plate-iron vessel some three feet high and three feet in diameter, lined say two inches thick with refractory material, chiefly moulding sand. In the bottom of it is a hole in which is set a fire-clay nozzle. A fire-clay stopper, lifted and lowered by a hand-lever fastened to the outside of the ladle, fits into this nozzle, and thus forms a valve by which the hole in the bottom of the ladle is opened and closed.

The ladle is mounted on a crane, which allows it to move up and down and to swing round in a fixed circle—that is, to swing under the converter to catch the steel, and then to be hoisted and moved over the ingot moulds in succession. The process is as follows:—Two tons of pig-iron are melted in the large furnace; time, one hour and a-half. Meanwhile the converter has a fire made in it, and two or three pounds per square inch pressure of blast let in, to heat the lining red-hot, and the ladle is turned bottom upwards over a little furnace to heat. By means of another crane, the ingot moulds are also arranged in the pit in a half-circle, so that the ladle can swing over them. When the iron in the large furnace is nearly melted, a small quantity of pig-iron or other recarboniser is set to melting in the small furnace. When the iron in the large furnace is melted, the converting vessel is turned on its axis, spout downwards, and the coal emptied out. It is then turned into a horizontal position, and an iron trough lined with loam, suspended on rollers, is swung, one end into the mouth of the vessel and the other under a spout leading to the tap-hole of the furnace. The furnace is then tapped, and the iron runs through the channel thus formed into the converting vessel. The air-blast is then let on, and the vessel turned spout upwards, the tuyeres or air-passages thus being underneath the melted cast-iron. The air is blown up through the cast-iron at about fifteen pounds pressure per square inch. Combustion, first of oxygen and silex, and then of oxygen and carbon, and a violent boiling, at once ensues. In from six to ten minutes, the flame blowing out of the mouth of the converter into the chimney changes from a dull red, full of sparks, to an intense white, with splashes of cinder. After five to ten minutes more the flame gets thinner, shows purple streaks, and finally drops away, not entirely, but very obviously to the practised eye. At this moment the metal is entirely decarbonised. More air blown in would begin to burn the iron itself. At this instant, then, which is so clearly defined that a dozen men tolerably familiar with the process, would cry "stop" at the same second, the converter is turned down into a horizontal position, and the air blast shut off. The recarboniser from the little furnace is then run into the converter by the same means, thus restoring to the metal the exact quantity of carbon, silicium, and manganese or its substitute required, the liquid cast-iron being only the vehicle for conveying these ingredients. The chemical mixture of the recarboniser with the decarbonised iron is complete and almost instantaneous. It causes a momentary boiling of the mass in the converter.

The ladle is then swung under the mouth of the converter, and the latter being lowered, the steel pours out into the ladle. While the ladle is being raised over the ingot moulds, the mouth of the converter is still further lowered to let the slag run out. Some of the slag runs out with the steel and forms a coating over it in the ladle, thus keeping it hot. The slag consists of such impurities of the iron as have not passed off in a gaseous form.

The ladle is then moved over the tops of the moulds successively, and the steel let into them by the stopper and lever above mentioned. When a mould is full, a plate of thin sheet-iron is laid on the top of the steel, then a shovelful of sand, then a thick plate which is wedged down. In ten to sixty minutes, depending upon their weight, the ingots, still red hot, are removed from the moulds, and may be hammered, or rolled into rails, plate, shafting, or other forms, without reheating, except to warm the exterior, chilled by the moulds. Usually, the ingots are allowed to cool before hammering; this cooling changes their crystallisation and improves their ductility. The ingot moulds are usually of cast-iron, from two to three inches thick. Some of them are solid and widest at the bottom, so that the ingot will slip out there. Others are made in two halves, held together by hoops, and are taken apart to let the ingot out.

Ingots are cast in the forms most convenient for hammering or rolling into the desired shapes, and of all weights, from 100 to 5,000 pounds. The loss of iron in the whole process is from twelve to eighteen per cent.

Such are the machinery and the process as put in operation by Messrs. Winslow, Griswold and Holley, at Troy, N. Y., early in the present year, and by which the specimens of steel recently on exhibition by them at the fair of the Institute were produced. The product is ten to twelve tons per twenty-four hours. Early next year this firm will have in operation new works capable of turning out fifty tons of ingots per twenty-four hours. A brief description of these new works, now partially completed, may be of interest. The converting house is a building 110 feet long by seventy feet wide, with walls twenty-two and a half feet high and a ventilated roof. About fifteen feet from one side of the building, and fifteen feet apart, are two converting vessels, fourteen feet high and nine feet in diameter, suspended on trunnions. The outer trunnions, and the frames and standards supporting them, are hollow, and conduct air from the blowing engine to the tuyere boxes. Upon each inner trunnion is a pinion of three feet diameter and twelve-inch face, which is operated by a steel rack that forms the piston-rod of a hydraulic cylinder. The converters are thus rotated and held in any position by simply turning a cock. The hoods and chimneys into which the converters discharge are built with the walls of the house. The weight of the converters, including twelve-inch lining of refractory material, is twenty-five tons each. Their capacity is five to seven tons of steel at a charge.

In front of the converters, and arranged to serve them both, is a fifteen-ton hydraulic crane, with a fourteen-feet jib carrying either a seven-ton or a fifteen-ton ladle, to take the product of one or both converters. This crane is fitted with proper gearing to revolve the ladle in a circle over the ingot moulds, to tip the ladle, and pour from the top in case the fire-clay valve should chill ; and to move the ladle radially, so as to pour into an outer and an inner circle of ingot moulds. On either side and in front of the ingot pit (which is sunk about three feet below the general level) are three eight-ton hydraulic cranes, with twenty-two-feet jibs. These three cranes handle the ingots and moulds, and pass the ladles and vessel bottoms from the places where they are used to the places where they are lined, and the ovens where they are heated. These ovens are in the corners of the building, on the same side with the converters. A railway runs in front of the pit, throughout the building, with branches to the coal and iron-yards.

The melting house is joined to the main building in the rear of the converters, and is large enough to receive four five-ton cupolas and four recarbonising cupolas. A railway runs through the lower story of this building, and the coal and iron cars are lifted from it to the charging floor by another eight-ton hydraulic crane. The melted iron from the cupolas is run into a ladle hung on trunnions, and located on a platform scale, so that it may be exactly weighed and then quickly tipped into a trough which leads it into the converter. The recarbonising furnaces are similary arranged.

The hydraulic machinery is driven by a Worthington duplex pump, specially constructed for this purpose.

The blowing engine consists of two forty-two-inch blowing cylinders and two thirty-six-inch steam cylinders on the same rods, the stroke being four feet. The working air-pressure is twenty-five pounds per square inch, and the working horse-power 350. The valves of the blowing engine are bands of india-rubber, encircling the cylinder and covering and uncovering numerous small holes, thus giving a larger area with little stretching. This kind of valve is durable and noiseless under high pressure. The common flap-valve would obviously be inadequate.

The air is admitted to the converters, and the water to the various hydraulic cylinders and cranes, by cocks and handles situated on an elevated platform, where they may all be worked by a boy. Thus one boy accomplishes the work of *fifty* men.

A pair of vessels of the same size, as arranged in England, will produce only twenty-five to thirty tons per twenty-four hours. It has been the object of the writer, in arranging the new works described, to double the production, with a small addition to the cost of plant, and to economise labour and heat by more rapid working.

The first improvement on the English practice was in facilities for repairing the more perishable parts of the converter. The tuyeres endure but six or eight charges. In England, they are renewed by knocking them out of their seats from the mouth of the converter by a long rod, putting in new ones from the tuyere-box and setting them with lining material, made semi-fluid with water, and poured round them from the mouth of the vessel. These wet bottoms are ten or twelve hours drying, and are not solid when dry. In the works at Troy the system of duplicate bottoms has been adopted. When the tuyeres are worn out, the whole bottom of the vessel is uncottered, lowered by a hydraulic lift, and removed by a crane for repairs. A duplicate bottom, hot from the oven, and in which tuyeres have been set in dry material and rammed, is by the same means attached to the converter. The vessel, still red-hot, is thus made ready for a new succession of charges in less than an hour.

Further improvements have been made in doubling the capacity of the casting-pit, by causing the ladle to travel over two circles of ingot moulds ; in the addition of another ingot crane ; in making more room, within reach of the cranes, for the repairs of ladle linings, stoppers, nozzles, &c., and in more convenient access to ovens and depositories of fire materials.

But the grand American improvement in the Bessemer process is the adaptation of the cupola for melting the iron. In the reverberators a pound of best bituminous coal will melt but two pounds of iron. In the cupola a pound of best anthracite will melt from seven to ten pounds of iron. The sulphur, if any, communicated by melting with best anthracite, has not been discoverable in working some fifty tons of the material into boiler plates, rivets, pistol and rifle steel, and other forms that put its malleability and soundness to the severest tests. The structure and arrangement of the cupola, to better adapt it to this particular service, is the subject of experiments now going on at Troy. It is expected that from nine to twelve charges of steel, of from five to seven tons each, will be made per day. In the old works four charges have been made per twelve hours.

The Bessemer process is, to the casual observer, almost ridiculously simple. It *is*, in fact, very simple; and it is conducted without any risk or difficulty, always providing that the iron used is of good quality, as most American iron is. Indeed, it is almost impossible to make bad steel, or steel that is not uniform, out of good uniform iron, if ordinary attention is paid to the manufacture and the machinery, because the quality of the steel is not in a great degree dependent on the skill or judgment of the operator. The ingredients are mixed by weight. Bessemer steel cannot be economically made, however, without first-rate blowing machinery, good and convenient apparatus, and constant vigilance on the part of two or three skilled operatives who have charge of the tuyeres and linings.

The great commercial advantage of the Bessemer process over all other steel processes, and considering the quality of the product, over puddling, is its cheapness. The only fuel used is that for melting the pigs in a cupola, for heating the converter at the commencement of a series of charges, and the small amount for heating ladles, &c. The fire material costs something more than in iron-making. The pig-iron required is more expensive than the average irons used in puddling. Very little skilled labour is required. Some steel products are produced at about the cost of wrought-iron products of the same shape and weight.

The grand advantage of Bessemer steel over wrought-iron, especially in large masses, is its perfect homogeneity—the absence of welds and consequent imperfections, such as the laminations in rails, blisters in boiler plates, and cold-shuts in heavy forgings. Its tenacity is double that of wrought-iron, considering the above-mentioned and unavoidable defects of wrought-iron in welded masses. In the bar it is one-half greater than that of wrought-iron, or from 90,000 to 120,000 lbs. per square inch, according to the degree of carbonisation required for different purposes. The nature of the Bessemer process renders the product more uniform than wrought-iron can be in all its qualities. The stiffness of this steel, proportionate to its tenacity, adapts it to girder and ship-building, and peculiarly fits it to resist compressive as well as tensile strains, as in piston-rods. While the elasticity, and hence the safe working load, of the lowest steel is much greater than that of wrought-iron, its ductility is equal to that of the best wrought-iron. Two-inch bars may be bent double, when cold, under the steam-hammer. This property insures its safety in the form of axles and tires. The hardness of the material, as well as its homogeneity, increases its durability in the form of rails, guns, and parts subjected to abrasion. It is peculiarly adapted to plates requiring intricate flanging, aud subjected to the immediate contact of fire. For a given strength it may be thinner than wrought-iron; it does not blister, and the carbon in it protects it against corrosion.

The kind of products, now regularly ordered and produced at Troy, are railway axles, marine crank-pins and small shafting, connecting-rods, piston-rods, locomotive crank axles, boiler-plate, machinery steel forgings, such as lathe-spindles, &c., rolled and tilted bars for pistols, rifles, hammers, and agricultural machinery, waggon axles, and bars and rods for miscellaneous purposes. The old works produce ingots up to two tons weight; the new works will produce ingots up to fifteen tons weight.

A few experimental rails and tires without welds have been produced, but the present machinery is not nearly heavy enough for regular service. A heavy plate mill, a heavy mill to roll ingots into blooms, a tire mill requiring 300 horse-power, and several steam-hammers, will be soon added to the works.

This process of making steel was brought out by Mr. Bessemer in 1856. English and European manufacturers began to adopt it in 1859 and 1860, and at the present time not less than 100,000 tons of Bessemer steel are produced per year.

The idea of blowing air into cast-iron is at least three hundred years old. The fusing furnace for partially decarbonising cast-iron, preparatory to puddling, has been worked on this principle for more than one hundred years. Since Mr. Bessemer's patents were issued, and since his practice began, claims have been made by two or three other persons for making steel by the Bessemer process; but not a pound of steel or malleable iron was ever made by either of these processes, and it is physically impossible to make steel or malleable iron by any of them.

Mr. Bessemer spent a large fortune in his effort to carry the process away beyond the highest stage of decarbonisation that could be reached by the fusing or any of its modifications; and I can say, from personal experience, that in his process the use of air as a mechanical agent is quite as indispensable as the use of air as a chemical decarboniser. The attempt to completely decarbonise cast-iron without the use of the apparatus for which Mr. Bessemer has not only one but many distinct patents in England and in the United States, will result in the production of nothing but scrap, unequally decarbonised, and incapable of being either cast, balled, or utilised in any way.

Mr. Bessemer was also the first to suggest and to patent the process of recarbonisation, both by running cast-iron into a decarbonised iron and by other means, and the process of alloying manganese in connection with the pneumatic process. There are now seventeen extensive Bessemer steel works in Great Britain. At the works of the Barrow Steel Company, 1,200 tons per week of finished steel can be turned out, and when their new converting-house, containing twelve more five-ton converters is completed, these magnificent works will be capable of producing weekly from 2,000 to 2,400 tons of cast-steel. There are at present erected and in course of erection in England no less than sixty converting vessels, each capable of producing from three to ten tons at a single charge. When in regular operation, these vessels are capable of producing fully 6,000 tons of steel weekly, or equal to fifteen times the entire production of cast steel in Great Britain before the introduction of the Bessemer process. The average selling price of this steel is at least 20*l.* per ton below the average price at which cast-steel was sold at the period mentioned. With the present means of production, therefore, a saving of no less than 6,240,000*l.* per annum may be effected in Great Britain alone, even in this infant state of the Bessemer steel manufacture.

FOOD PRODUCTS AND CHEMICALS AT THE DUBLIN INTERNATIONAL EXHIBITION, 1865.

From the Reports of the Jurors submitted to the Executive Committee we extract reports on two sections, one by Dr. Charles A. Cameron on "Substances Used as Food," and the other on "Chemical and Pharmaceutical Processes and Products Generally," by C. R. C. Tichborne, F.C.S., F.R.G.S., Chemist to the Apothecaries Hall of Ireland.

I.—Substances used as Food.

Although, from an æsthetical point of view, the "Substances Used as Food" do not form a very attractive feature of the Exhibition, they nevertheless constitute one of the most important—in one sense *the* most important—collection of articles shown therein. If the great object of the Exhibition be to render facile, pleasurable, and popular a knowledge of the resources of foreign and colonial countries—to exhibit the condition of their agriculture, arts, and manufactures in comparison with that of our own industries—then the "food substances" shown in the Exhibition acquire a high degree of interest, because they afford one of the best means by which such a comparison may be made. It is true that the civilisation and material prosperity of a country cannot be solely measured by the quantity and quality of the food produced in it—that is but one of several indices; but it is certain that a knowledge of the acreable produce of a country, and of the variety and comparative excellence of its manufactured goods and beverages, enables one to form a tolerable accurate estimate of the social condition of its inhabitants.

In this large and varied collection, the produce of every variety of climate and soil is exemplified; and even those denizens of the air and inhabitants of the deep that minister to man's wants are here represented. In most of the colonial departments, reports and pamphlets give valuable statistics and other information relative to the food substances sent from those countries. From these documents and the articles exhibited the visitor may correctly inform himself on the subject of the products of each of our respective colonial dependencies.

Many of the food substances are rather curious. In the Chinese department may be seen specimens of the esculent nests of swallows, an article greatly prized by the inhabitants of the "Flowery Land." The articles from Siam embrace the "edible flying bat," which is regarded as a most delectable food by the natives of that empire. Preserved *fresh* fish is shown in the Nova Scotian department. Australia sends salted mess-beef, of such good quality that it might easily be palmed off as of home preparation. The Kingdom of Italy exhibits goat's-milk cheese, hams "fit to be eaten raw or cooked," and vinegar 104 years old. Finally, the Indian collection includes no fewer than eighty different specimens of tea.

The number of exhibitors in this section is no less than 381, exclusive of Mr. P. L. Simmonds, whose extensive contributions to the Exhibition include a great variety of food substances from China, Siam, Japan, and several of the colonies. The valuable collection of similar products from India is chiefly due to the exertions of Dr. Forbes Watson. The whole collection embraces so many thousand specimens, that it would be impossible to particularise more than a few articles or classes of substances which appear to possess more than usual merit or interest.

None of the articles shown in this section possess greater interest than the seeds. The specimens contributed from the colony of Victoria embrace wheat, oats, barley, Indian corn, flax, tares, beans, peas, and prairie grass. Of these the leguminous seeds are of excellent quality; the oats and barley are, on the whole, only of mediocre quality; but the wheat is particularly good. Of a fine colour, with smooth skin, and on the average weighing sixty-eight pounds per bushel, this Australian wheat will some day become a favourite with the British miller and public. The flour prepared from this wheat is of good quality, and is particularly rich in gluten; it consequently would prove a goo "muscle-forming" food. The millers of Victoria appear to be very skilful in their business, for this flour is exceedingly fine, and the "sharps" have been deprived of every trace of farina. The foods and beverages contributed by this colony include arrow-root, groats, bread, biscuits, maizena, maccaroni, semolina, vermicelli, pickles, sauces, butter, cheese, bacon, beef, confectionery, porter, ale, whiskey, wine, white spirit, rum, treacle, and sugar. One of the most interesting articles in the Victorian collection is the "mess-beef." It has been simply well-salted and carefully packed in casks. After two days' steep it retains but a small proportion of salt, and possesses an excellent flavour, as well as being tender. This meat is a far more palatable food than the jerked beef which has hitherto been imported from South America; and if it were imported in sufficient quantity and offered at a moderate price—say fourpence per pound—it would be certain to command a large sale. The colony of Victoria is one of the most distant dependencies of the British crown, and when beef can be conveyed without deterioration from a region so remote to this country, it seems strange that colonies nearer home should not supply the mother country with this prized commodity. Canada, Nova Scotia, and New Brunswick have extensive pastures, on which vast quantities of animal food could be cheaply produced. As the sea passage between these countries and our own occupies less than a fortnight, beef and mutton could be imported from them in a fresh state, or but slightly pickled. At present the demand for animal food is very great; and as the supplies of it are likely to be seriously diminished by the ravages of the cattle plague, a useful hint might be taken from the fact that good corned beef can be obtained from Australia. In the matter of wines there is a manifest improvement since 1862, both in character, variety, and manufacture. The malt liquors and whiskey are also on a par with the British.

The other colonies are not nearly so well represented in this section as Victoria. From Nova Scotia the contributions are chiefly excellent collections of cereals and garden seeds, and some splendid samples of maple sugar. The preserved fish shown in this department were adjudged a medal, as were also some cordials, of novel taste, being flavoured with the essence of native wild fruits. The agriculture of Canada is fairly represented by three illustrative collections, contributed by official bodies. A sample of tobacco, shown by Mr. M'Collum, is of extremely good quality, and is interesting inasmuch as this plant has only recently been cultivated in Canada. From the Mauritius there are numerous samples of refined sugar, all of the best quality.

Amongst foreign countries Italy occupies the most prominent position as a contributor of food substances. Hams, Bologna sausages, and other kinds of preserved meat are largely exhibited in this department. Of these a large proportion has, unfortunately, been spoiled by the action of the sun, to which these articles were much exposed, but the portion which escaped is of very good quality, though, perhaps, not, in some respects, suited for the British palate. The ham, "fit to be eaten raw or cooked," is highly flavoured, and has a garlic odour; and, though much liked in Italy, would not be generally appreciated here. The maccaroni paste for soup, and other farinaceous articles shown here, are superior to anything of the kind made out of Italy. One of the best articles in this department is the Parmesan cheese, the flavour of which is particularly fine. The liquors are, in general, very pleasant in flavour and well made. There is also a large collection of wines of a more varied character perhaps than any similar collection in the building; but, owing to some extent, to imperfection of manufacture, but more particularly to the action of the sun to which they have been mercilessly exposed, they have suffered so much as to make a fair opinion of their merits impossible.

France contributes excellent coffee, chocolate, and preserved fruits. The chocolate of Menier is particularly good; and the same may be said of Gy's coffee. Gy was the first who "torrified" coffee by means of heated air instead of the application of heated iron; a plan by which the aromatic qualities of the seed were much improved. The wine in this department is, as might be expected, of excellent quality, so far as it is represented. It is, however, much to be regretted that the collection is so small and imperfect. Indeed, with the exception of some most excellent Burgundy, and one or two exhibitors of Champagne, there is nothing to mark the high position of France in these productions, and no data wherefrom to make a comparative estimate of its progress. The brandies, however, are better represented, and are of the first quality.

In the Netherlands department there are excellent specimens of wheat and rye flour, ship-bread, and biscuits. Amsterdam, famous for its sugar refineries, is represented by splendid samples of crystallized white sugar. The hops and seeds contributed by Belgium are of good quality. The high position of the Netherlands as a producer of exquisite liqueurs and Schiedam is fully maintained.

In the Zollverein department some samples of flour from the Stettin Steam Mills Company are deserving of notice. The best flour imported into Ireland is that kind of French termed Gruaux. A comparison of a sample of the Stettin flour with the Gruaux showed that the former was a shade better in colour, whilst being equally good in "strength." When baked the Stettin flour produces extremely white bread. It is to be hoped that this flour will be imported before long into these countries, where the taste for very white bread so generally prevails. A specimen of hops grown in Pomerania was awarded a medal. It appears that this plant is largely cultivated in Pomerania and Prussian Poland, and that the growers are anxious to do an export trade. Hops are, occasionally, a scarce crop in England; and their consequently high price seriously diminished the profits of the brewer. Should Posen and Pomeranian hops ever find their way into the British market they would, by competition, check the tendency to high prices to which the British grown article is liable.

The Zollverein wines are very inadequately represented; some of the Rhine and Moselle wines are, however, excellent. The wines from Austria and Hungary are deserving of especial notice. There is a very fair collection both of red and white wines, still and sparkling, of kinds but little and imperfectly known in this kingdom. Their excellence in quality and manufacture, added to their cheapness of production, bid fair to make them dangerous rivals to French light wines. They are most agreeable, fragrant, and pure, with the further recommendations of novelty and cheapness.

The food substances of the British Isles are rather inadequately represented by thirty contributors. Messrs. J. H. Gamble of Cork, exhibit several cases of preserved fish, meat, and soup. The preparations of this firm have long been held in great repute by travellers; and a careful examination of those in the Exhibition fully proved that the meat and fish had really been preserved, and were very well flavoured. The biscuits shown by Messrs. Jacob and Co., Messrs. Baker, Simpson, and Co., and Messrs. Peak, Frean, and Co., present a striking contrast to the biscuits made twenty years ago; they are beautifully white, and very fine in texture. The gelatine shown by Messrs. Cox, of Edinburgh, is one of the finest samples ever exhibited. The chocolate of Messrs. Fry and Sons is a very pure substance; and the collection of articles illustrating the manufacture of chocolate is deserving of notice. The groats and barley shown by Messrs. Keen, Robinson, and Belleville are particularly good. Messrs. J. and J. Colman's mustard possesses a very fine colour, aroma, and flavour, and is evidently the product of a most carefully conducted manufacture. The British wines of Messrs. Egan and Cottle, and of Bewley and Draper, of Dublin, are deserving of the highest commendation, as are also the liqueurs of the former firm.

II.—Chemical and Pharmaceutical Products.

In chemistry proper, the reporter has not much to note as novel. This may be accounted for from the fact that so short a time has elapsed since the last London Exhibition, and also, that there are few of the principal leading products of applied chemistry,—viz., sulphuric acid, alkalies, bleaching powder, &c., exhibited. Commercial acids and bleaching powders are shown in the British and Italian departments; but the only exhibitors of soda ash and sodium products are J. Hutchinson and Co., Widnes (United Kingdom, 56), who give specimens of crystals of carbonate and bicarbonate of sodium (the latter pseudomorphs); two specimens of caustic soda fused. These contain sixty and seventy per cent. of soda. The latter may be viewed as nearly pure hydrate, the theoretical quantity being 77·5. Caustic soda may be looked upon as one of those articles but lately introduced into commerce, and yet it bids fair to become one of the most important of the sodium products. The specimens shown by the above firm are examples of the perfection to which any individual article of industry may rise in a short time if there is a demand. Independently of the use of this product by the soap and other manufacturers, there can be no doubt that the late American war, from the restriction it put upon the potassium compounds, gave an impetus to the caustic soda trade. This soda is now largely exported to America and Australia Messrs. Hutchinson and Co. also show a specimen of precipitated sulphur, procured from the sulphide of calcium, of the alkali waste. If they can successfully carry this out, they have solved one of the most difficult problems of the alkali manufacturers. The great weight of the material that has to be handled, combined with the nuisance arising from the working has been so far a prohibition to the adoption of many of the numerous processes introduced.

In connection with this class of manufactures we may notice a fine case of platinum stills, syphons, and other apparatus, exhibited by Messrs. Johnson, Matthey, and Co., London (United Kingdom, 21). These articles are all soldered by fusing the seams together, instead of using gold—a more perfect joint is by this means procured, at a less expense. This case raised, some time since, a friendly discussion* between Messrs. Johnson and Co. and the reporter, in reference to the substitution of glass for platinum in the concentration of sulphuric acid. The real position, in the opinion of the reporter, as regards this important point is, that the advantages and disadvantages are so nearly balanced, that in England, where fuel is not of so much importance, the manufacturers are reverting back to the glass; but that on the Continent, fuel being of greater consideration, the platinum still holds its ground, and is likely to do so, from its greater economy in this respect. This firm also shows some specimens of the refractory metals and rare metals, which could hardly have been produced in such quantities had it not been for the experiments of Deville, Debray, and others. Products of the Magnesium Company (Sonstadt's patent) are exhibited by this firm; and as we owe the production of this metal, in a commercial aspect, entirely to the latter gentleman's perseverance, a special medal would have been awarded, but that the rules of the Exhibition Committee prohibit any but exhibitors from receiving medals. Messrs. Johnson and Sons, London (United Kingdom, 22), show a case, perhaps less pretentious, but containing products equally good. Gold, silver, and uranium salts, are also well shown in both these cases.

In iodine and bromine products, Messrs. Tissier and Son (France, 7) show some fine specimens, the iodide of mercury being crystals got by sublimation instead of the ordinary process of precipitation. The French and German firms had almost entirely the supplying of the British

* 'Chemical News,' June 16 and July 7, 1865.

market with bromine until lately, but we find that Mr. Edward Stanford includes this element amongst his products. Mr. Stanford's process for working seaweed is illustrated by a series of specimens exhibited by the British Seaweed Company (United Kingdom, 13). This process, although of modern date, is well known to the chemical public. The systems generally used in working kelp are still of the old crude and primitive style. In most of the methods, about one-half of the iodine contained in the seaweed is volatilised. We look upon Mr. Stanford's method as the first one which has been at all successfully worked with a view to prevent this. He incinerates the seaweed enclosed in iron retorts, and by this means saves a large number of bye-products, the result of the destructive distillation of the organic matter. But he also aims at a further yield of the iodine. A glance at the semi-fused lump of kelp in the French department will bring forcibly before us the advantages of this process. Another company, the Marine Salts Company of Ireland (United Kingdom, 28), lately started, also exhibits a series illustrative of a new method of making iodine.

There are not many general collections of chemicals; but one that requires special mention is that of Henner and Co. (Switzerland, 1). This comprises technical products, photographic and rare organic chemicals. Some of the latter were examined by one of the jury (Dr. Maxwell Simpson), and found to be what might be termed very fair commercial specimens. As he remarks, it offers great facilities to original research, that such substances can be procured in quantities and at reasonable prices. Amylene (C_5H_{10}) was one of the products examined. "Almost the entire quantity I took," says Dr. Simpson, "distilled over between 35° to 45° cent. The distillate, on being agitated with a solution of chloride of iodine, yielded chlor-iodide of amylene (C_5H_{10} ClI.), a new body, an account of which has not yet been published. The iodide of allyle (C_3H_5I) is also a good product, the greater part distilled over between 100° to 106° cent.; on being agitated with metallic mercury, it became a mass of yellow crystals, the mercuro-iodide of allyle [(C_3H_5) Hg^2I]. The butylic alcohol distilled over between 104° to 120° cent., and treated with iodine and phosphorus yielded iodide of butyle, the boiling point of which was about 121° cent." Another case of great interest is that of Dr. Schuchardt, Silesia (Zollverein, 16). This collection is of a more special character. The contents consist of chemicals used in glass-staining. He also exhibits a siccative, specimens of which will also be found exhibited by Candiani and Co., Milan (Italy, 26). This is borate of manganese, two ounces of which are said to render drying one cwt. of oil. The last two cases are, in the reporter's opinion, especially worthy of note. In connection with the Zollverein department, the watch oils have been individualised by a medal to each exhibitor. Some examined by the reporter were found to consist of pure and very neutral olein. Submitted to a long and continuous temperature of 0 cent., these oils became viscid, but not the slightest solidification was observed. Lubricating oils for fine machinery procured from the glycerides will always be open to the objection that they become rancid upon exposure to air and light, and the reporter is of opinion that the best oil for these purposes is to be procured from some of the less volatile hydrocarbons, which are the products of distillation of mineral oils.

In the Canadian department, we get a speeimen of the oil from the mineral springs exhibited by D. Bogart, Gaspé (Canada, 5); also a specimen marked cedar oil, which was examined by Professor Jellett, who gives the following account of it:—The specific gravity is ·9235. Rotates the plane of polarisation of a transmitted ray to the left. Taking the rotary power of American oil of turpentine (which is in an opposite direction) as unity, the rotary power of oil of cedar is 1·2479. In this department chrome yellows are exhibited, procured from the native chrome iron, considerable quantities of which are found among the mineral riches of Canada.

In the collection of colours, Hare and Co., Bristol (United Kingdom, 19), carry off the palm by their fine display, in all the gradations of the chromatic scale—viz., shades known under the names of Brunswick green, chrome yellow, Prussian blue, Chinese blue, Pure blue, Brunswick and celestial blue, purple, browns, Indian red, and lakes. The specimens of white lead are numerous, and both those of Messrs. Walker, Parker, and Co., Chester (United Kingdom, 837) and Messrs. S. and W. Tudor, London, (United Kingdom, 35) are excellent. Good specimens will also be found in the Belgian department. There are several second qualities of this article scattered through the building; but according to the analyses made by Professor Galloway in every case the deteriorations are produced by the admixture of sulphate of barium. In pigments for metal work there is one in the Belgian department which requires a short notice from the fact that the ferruginous pigments are becoming very general. The objection to the old "priming" colour, red lead, is, that for iron work it seems to produce some oxidising influence upon the surface of the metal. This objection also holds good in connetion with precipitated oxides of irons unless they are very carefully washed. There is a class of ferruginous oxides which consist of burnt ochres, containing a considerable amount of clay, which would interfere very much with the body and protective power of the pigment. The specimen exhibited by De Cartier, Auderghem (Belgium 15), nnder the name of "Minium de fer d'Auderghem," seem to posses advantages over the ordinary preparations, as they consist of roasted hematite finely levigated with water.

The candle and soap-making trades are well represented in this Exhibition. The British and Irish exhibitors are on the whole very superior to Foreign and Colonial both in candles and soaps, and it is perhap the only branch in this section where any marked superiority is observed. It is evinced doth in the appearance anp quality, most of the foreign soaps presenting an amount of causticity very undesirable. There are certain names which have become household words, and although so intimately connected with these branches of industry, they seem to the reporter's mind to embody much more than the name of a successful traderr If such names were merely printed and placed in an industrial exhibition, they would be entitled to the highest honours a jury could give. The reporter refers to firms that have opened up discoveries and branches of industry entirely new, and after innumerable difficulties have brought the art of their discoveries to the highest state of perfection. We have not a few such exhibitors in this section. First, the firm that trades under the name of "Price's Patent Candle Co." (United Kingdom, 31). To this firm we owe the great perfection to which the distillation of glycerides or saponifiable fats is carried, *i.e.*, so as to procure intact the glycerine. Indeed with them, we may say, arose the birth of chemically pure glycerine.

To Mr. Young (United Kingdom, 41) we owe the greater part of the supply of the paraffine used in this country, procured by the patentee from the Bog Head Coal.

The next important exhibitor amongst this class is Mr. Gossage United Kingdom, 830), to whom, independently of the articles he exhibits, we owe many improvements in technical chemistry. His soaps are silicated soaps, namely, soaps containing a certain amount of soluble glass. They are coloured with the aniline dyes. Most of the soaps, British and foreign, were examined in Dr. Apjohn's laboratory.

The following names may be especially mentioned as affording fine speciments of candle manufacturing :—Messrs. J. C. and J. Field, London United Kingdom, 17), J. G. Rathborne, Dublin (United Kingdom, 831); and Messrs. Taylor and Co., Leith (United Kingdom, 34). Also good specimens of naturally bleached wax, and candles made therefrom, are shown by Petricioli, of Dalmatia.

In perfumery, very good articles will be found in the stands of Lewis, Dublin, (United Kingdom, 24); Piesse and Lubin, London (United Kingdom, 29); and Rimmel, London (United Kingdom, 38).

Perhaps there is no section that embraces such a mixture of different classes of exhibitors as Section II. One of them is a photographic firm, and as there is a special section for photography, it at first sight might appear strange that they compete in Section II., but they appear as manufacturers of photographic collodions and other chemicals, also as the inventors of a new photographic chemical process. It is with much pleasure that the reporter is enabled to treat in a few words of the inventions of such importance as are here exhibited by Messrs. Mawson and Swan (United Kingdom, 27). There have been two *desiderata* in connection with photography, each of which has been from time to time, the *summum bonum* of photographic ambition. One was the printing in carbon so that the picture might be permanent, and the other the fixing of the natural tints in the picture. The first we may consider as accomplished by

Mr. Swan—not only accomplished, but worked out with such results that the most fastidious cannot cavil. This process is based upon the fact that gelatine, containing a small quantity of bichromate of potassium, is rendered insoluble when submitted to the chemical action of the sun's rays. All attempts in this direction had hitherto failed, as no half tones were produced. The specimens shown are beautiful in the extreme. The liability of photographs to fade has tended more than anything else to narrow photography as an industrial art. Messrs. Mawson and Swan also show collodion remarkable for extreme sensitiveness, and yet having been more than six months iodized. They also show collodion for glazing pictures, and also for fixing crayon drawings (a new idea). Also a new application of Mr. Wharton Simpson's "collodio chloride of silver" for glass printing. Mr. Simpson's original preparation would not do for this purpose, and we believe the preparation shown contains nitric acid.

Messrs. Dubosc and Co. (France, 6) exhibit some solid extracts evidently prepared with great care. They were found by the Reporter to be perfectly soluble, and to give transparent solutions. These extracts are made for dyeing purposes, and are said by the exhibitors to be used in preference to the woods by many of the Manchester houses.

In Victoria there are exhibited some gums and essential oils, many of them new to British commerce. The peppermint oil, distilled from the plant grown in the colonies, is excellent. The oil of amygdalina odorata (*Eucalyptus amygdalina*), from its price, might be used in perfuming cheap soaps; whilst the kino-like gums from *Eucalyptus rostrata* and *E. Amygdaina*, might be used for medical or tanning purposes. The essential oils have been examined, as regards their physical properties, by Dr. Gladstone, *vide* 'Journal of the Chemical Society', Vol. XVII., p. 1.

In the Italian department we meet some things of great interest. The mannite, or sugar of mushrooms, exhibited by Prof. de Luca, University of Naples (Italy, 32), is procured from the olive tree; also bicarbonate of potassium and sodium, exhibited by Giuseppe Ciaranfi (Italy, 28), and obtained by submitting crude soda and potash to the action of the carbonic anhydride evolved from the mineral springs of Cinciano. The carbonate of iron shown, as might be imagined, only contained about ten per cent. of that substance when examined by the Reporter; but the other products are very good. The legitimate application of such carbonic anhydride streams would be to carbonate the liquors in making soda ash, and thus to prevent that source of trouble—the formation of sulphide of sodium by the presence of caustic soda. M. Scheurer Kestner expresses the formation of sulphide of sodium in the black ash residue by the following series of equations:—

$$(Ca_2O)^a + (Na_2CO_3)^a = (Ca_2CO_3)^a + (Na_2O)^a.$$
$$(Na_2O)^a + (Ca_2S)^a = (Na_2S)^a + (Ca_2O)^b.$$
$$(Ca_2O)^b + (Na_2CO_3)^b = (Ca_2CO_3)^b + (Na_2O)^b.$$
$$(Na_2O)^b + (Ca_2S)^b = (Na_2S)^b + (Ca_2O)^c.$$

The finest starch is exhibited by Messrs. J. and J. Colman (United Kingdom, 39), who also introduce a novelty suggested by the Society of Arts, viz., "coloured starches." They consist of rice starch tinted with the aniline colours. Muslins starched with these preparations become temporarily dyed, and we believe that the colours are quickly and effectually removed by washing.

The specimens of ethers shown bv Messrs. Boileau and Boyd (United Kingdom, 42), are very good.

Scientific Notes.

FRENCH WIRE NAILS.—Nails made of wire of various sizes, from ¼ of an inch down to 1·32d, are still used in France. The points are conical, about 60 deg. They may be driven without splitting the wood. A common pin when driven into the edge of a thin piece of wood splits it; but if the tapered point be cut off, and a conical point made, it may be driven without splitting. In making small models of soft wood, we have used steel pins with conical points, made of pieces of knitting needles. They drive well, and hold fully as well as brads. We believe that tapered nails are not so good, for some uses, as prismatic nails with pyramidal points would be; or perhaps wedge ends, for convenience of manufacture, would be better. They would not split the wood; the wedge point, if about 60 deg., would crush a little at a time, and make a hole for itself, whereas a long wedge or tapered point in its effort to crush a greater amount at a time, splits it; that is, the power required to crush so much is more than is required to split the piece. Let any one file the ends of parallel nails that he finds among common nails, and try them, and he will find that they will be safer to drive where there is danger of splitting. The French wire nail is expensive; but it is worth using for some purposes. For delicate work such nails, made of brass wire, with heads like screw heads without nicks, would be good. If a good machine could be invented to make nails of this kind cheaply, we think it might be worked with profit. But parallel cut nails with wedge points can be made cheaply, and we think a few should be tried.

BLEACHING.—Perhaps there is more prejudice than taste in the preference of pure white to a tint such as that of unbleached cotton, or linen, that has been prepared by a process that does not darken it. During the siege of Granada, Queen Isabella, to insure the success of an assault, vowed that she would not change her linen until the city should be taken. The assault failed, and many weeks elapsed before the queen changed her linen. All her ladies, of course, followed suit, and before the city was taken the linen had acquired a warm Titianesquê tone that was greatly admired by the cavaliers ; and continued to be admired and imitated long after the incident that gave it a chance to be appreciated. We have been told that ladies tint their lace with coffee, to give it an agreeable tone. Others put blue into their starch to neutralize the warm tone of cottons that have been long shut up, and, perhaps, not properly cleansed from soap. Altogether the evidence by no means proves that pure white is the best foil for flesh of any and every hue, from the sickliest grown young or old lady, down to the healthy brunette who delights in sunshine. And artists incline to warmer hues—whether because Titian and Reynolds were so inclined, or because they are really more beautiful, is a question that may as well be considered before we rot more cloth by bleaching, For some observation and inquiry, we believe that bleaching takes half the durability out of cotton and linen ; and that it is more a matter of fashion and prejudice than of good taste.

Boards, Pipes, &c., of Paper.—Colonel Szerelmey is best known in this country as being the most successful among the many competitors for the treatment of the stone decay in the new Houses of Parliament. But he has made it the study of his life, during many years of foreign travel and research, to attain a knowledge of what the zopissa of the ancient Greeks was composed of. But our main business just now is with the products from his paper pulp, treated and manufactured in a way peculiarly his own. They were shown at the Exhibition of 1862; but, like many other things, they did not then attract the attention they now apparently deserve. If half of what the Colonel and his friends say turns out to be true, his will rank high among the most important inventions or discoveries of this generation. He professes to make zopissa paper boards stronger and cheaper by fifty per cent. than oak, indestructible, and perfectly waterproof. They can be made of any length and thickness, and may be cut to any shape like wood, with a common saw. They will resist a pressure of 250lb. to the square inch, or more if required. They are said to be suitable for shipbuilding, the construction of portable houses, roofing, flooring, coach panels, boxes, piano and packing cases, &c. The paper pipes, for water, gas, liquid manure, &c., are produced from the same substances as the boards, and have the same properties. They can be made of any length, diameter, and thickness required, and can be constructed to bear almost any pressure to the square inch. They are said to be fifty per cent. cheaper than iron pipes ; they are not affected by gas or water ; not being porous, no leakage can take place from them, and the material being a non-conductor of heat or electricity they possess many advantages over all other pipes, besides keeping the passing water cool in summer and unfrozen in winter. Rocket tubes, cartridge cases, large guns, and even houses are to be manufactured of this paper. Its power of resisting shot is said to be ten to one greater than that of oak. It can be easily moulded to any form desired. It is capable of being used in mass, without waste, like fusible metal. It is entirely free from moisture ; and while any ordinary paper would corrode iron, this can be made to adhere to and form a covering impervious to water over it. It is said that it must eventually be generally used as a covering for boilers, steam tubes, funnels, &c. The raw material, we are informed, is much cheaper than any now in use, and its manufacture simple. But what strikes us most at the present time—just after a second failure to establish telegraphic communication with America—is the confident assertion of Colonel Szerelmey's friends well known in several circles, that by this zopissa paper alone, of all the materials at present known, can a perfect electric cable be formed. We were shown a rope of less than an inch in diameter, with an ordinary copper wire projecting at each end through its centre. This rope was formed neither of hemp, india-rubber, gutta-percha, cork shavings, nor any ordinarily recommended covering—but simply of zopissa paper. It is almost impossible that it can break ; it will not stretch, and thus throw the strain on the copper wire, although it is perfectly flexible. Lastly, it has been reported by some of the most skilled electricians of the day as being perfect in insulation and other respects. Now, if anything like what we have heard as to the practicability of this discovery and its application to so many of the purposes of life, its cheapness, its durability, its comparative safety from fire, and so forth, be feasible—it is high time that the public took pains to be thoroughly informed on the subject. Colonel Szerelmey has been many years among us, as an Hungarian exile. He has earned the right to have the merits of his inventions fairly tested —'Times.'

THE TECHNOLOGIST.

RESEARCHES ON THE JUICE OF THE SUGAR CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

BY DR. ICERY.

President of the Chamber of Agriculture.

Translated by JAMES MORRIS, Esq., Representative of the Chamber of Agriculture of Mauritius.

I TRANSLATE this memoir because it is the most complete and exhaustive analysis since the time when M. Pelignot published his remarkable contribution on a similar subject some years ago, and which was so valuable an addition to the then scanty literature of the sugar cane. But M. Pelignot had to work on incomplete and inadequate materials, and at the time of his researches was distant from the countries where the sugar cane is cultivated for commercial purposes. Dr. Icery, the pupil of Dumas and Boussingault, is not only an able and experienced chemist, but is also one of the most influential sugar proprietors of sugar estates in Mauritius. The means of analysis at his command were, therefore, ample and continuous ; while, as President of the Chamber of Agriculture in the colony, this important contribution to the chemistry of the sugar cane was a graceful memorial of his year of office, which has been fully appreciated, not only by his colleagues, who are so capable of judging it, but also by the scientific men of Europe who have made this speciality their study. When read in connection with the marvellous triumphs of science in regard to beet-root sugar, and with the anomalies of our fiscal system of sugar duties, and the antagonistic opinions of eminent statesmen on this question, this memoir will have an additional value for all those interested in the development of the sugar industry of our colonies and in the rectification of errors of all kinds, which, up to the present time, surrounded this important subject, and materially tended to impede the march of its improvement.

Introduction.

During the last two years, having sought to keep an exact account of the different modifications which the juice of the cane undergoes during the process for the extraction of sugar as practised in this colony, we have insensibly been led to extend our researches to the plant itself, and have step by step investigated all those questions relative to its history. We propose then, in a brief sketch, to reproduce the notes we have collected on those points which most deserve the notice of the planter. But before specifying the results of our observations we do not think that a few words on the early development of sugar industry will be out of place.

The sugar cane, originally from those regions now named India and Indo-China, has there been exclusively cultivated from the highest antiquity to the middle of the thirteenth century, at which period the Asiatic merchants trading in sugar began to penetrate into those countries situated beyond the Ganges, whence was brought this precious plant, which from that time was not long in spreading into Arabia, Syria, and Egypt. It was introduced into Cyprus and Sicily at the end of the following century; from thence it was spread to Madeira and the Canaries, and, at a later period, became in Spain, and even in the South of France, the object of especial culture. Imported into the islands of St. Thomas and St. Domingo, at the beginning of the sixteenth century, it grew there so rapidly, and produced such results, that in a few years a considerable number of sugar plantations were established in these colonies.

It was about two centuries and a half after these first and successful efforts, that is about 1750, the sugar cane was first introduced into Mauritius. The cultivation of this plant was at first limited to some few estates, and carried out on a small scale, and made but indifferent progress, remaining for a long time nearly stationary. But sixty years later, its cultivation being better appreciated, became greatly developed, and by degrees was substituted for most of those crops formerly cultivated. It is now the only one which is carried out on large estates, of which it constitutes, under present circumstances, the surest and most remunerative resource.

It is generally thought that the first cane planted in Mauritius was that commonly called the white cane, and which is indigenous to the islands of the Pacific. This cane is one of the most juicy and saccharine that we possess, formed for a long time the greater part of the plantations established in the different localities of Mauritius but the disease which attacked it about twenty years ago, compelled the planters to restrict its use. Numerous varieties of cane have since been introduced into the island, they have been cultivated and propagated with every care, but they have not all offered the same chances of success.

The most productive having been constantly renewed, but are those which now are threatened with those alterations from which certain estates have already suffered so much loss. Of the twenty varieties of cane which have been introduced at different periods, and which have had more or less prominent cultivation in this colony, we will speak of six, because they are those generally met with, and also because they have been exclusively the object of our researches.

1st. The white, or Otaheite cane.

2nd. The bamboo, or Batavian cane.

3rd. The Guingan, or violet-striped cane.

4th. The Belloguet, or purple Java cane.

5th. The Penang cane.

6th. The Diard cane, with which the white Bellognet is generally confounded.

Before the cultivation of the cane had taken that extension which of late years it has acquired, and had become the principal, if not the sole source of the productions of this colony, it increased with a marvellous rapidity, and without the aid of manure; it formed on the surface of a rich and virgin soil into which its roots penetrated deeply, a layer of long thick matted stalks, whose thickness reached to five or six feet above the soil. But the imperfection of the means employed in sugar manufacture did not allow the planter to gain from this luxuriant vegetation all the profit that it appeared to offer. The method employed for extracting the sugar is principally to be blamed, for it was simply that copied from the Arabs, and was hardly modified until the end of the last century, and, in fact, did not undergo any real amelioration until the latent heat of steam, and the vacuum apparatus permitted the planter to obtain nearly the same qualities of sugar, whatever might be the soil or climate in which the cane had grown. To speak only on what takes place in this colony, do we not know, for instance, that the planters situated near the sea-coast have had for a length of time, thanks to the nature of the soil and to the climatal conditions of the locality, the opportunity of manufacturing easily a very fine looking sugar, whilst those whose plantations were situated in the high and moist parts of the island, notwithstanding their most intelligent efforts and repeated trials never succeeded either in extracting the same quantity, and, above all, the same quality of sugar. We shall see in the course of this memoir the causes which influenced in so peculiar a manner such marked differences of production, and which as yet have remained without any sufficient explanation. The advantages which the colony derived from a manufacture better understood and directed have been nevertheless diminished by the drawbacks inseparable from the too great prominence given to the cultivation of the same crop on the same soil.

I do not wish to agitate this question here, the importance of which is too great to be treated in a casual manner. I only wish to draw notice to a fact which must be closely connected with a certain modification attributed to the juice of the sugar cane. I shall have, in fact, to seek further if the alterations and diseases which are said to belong to the cane, in developing themselves in this plant, and in modifying more or less its organisation and its appearances, act equally on the nature and proportion of the various substances from which its juice is formed.

The sugar industry of the colonies has been, and is still, blamed with a kind of complacency, because planters allow themselves to be guided by blind practice, and disdain the ameliorations which science would not delay in introducing into the process of sugar extraction, were they less influenced by routine and preconceived notions, and were they willing to acquire a more perfect knowledge of those primal products which they manipulate, and were they also willing to profit by that example which a rival industry in Europe offers them, the intelligent efforts of which have been crowned with the most complete success. Generally speaking, such reproaches are unjust, and arise only from an unexact appreciation of the colonial practice. If it has been said with reason that about thirty years ago more than two-thirds of the sugar contained in the cane were lost by the methods then in use, may it not be said at the present time with equal certainty that six-tenths, at least, of this sugar is easily obtained by the machines at present in use, thanks to the progress which has been realised and the initiative of which has not been always foreign to the industry of the colony. Such progress is mainly the simple result of the perfection and the complete modification which the evaporating apparatus has undergone, which in this colony may now be found on nearly every estate of any importance.

The method which comprehends particularly the care necessary to be given to the cane juice during the process of evaporation, has not unfortunately experienced all the improvements of which it was susceptible; this method still is what it was at the beginning of the present century, notwithstanding the experiments of which it has been the object, and which have all failed in presence of those obstacles which have not been sufficiently taken into consideration.

If, as the results of analyses made under circumstances not very favourable, there was at first an excessive exaggeration of the importance of those elements which concurred with the saccharine matter forming the juice of the cane; at a later period, the importance of some of those substances during the manufacture of sugar has been too much neglected.

The predominating scientific idea of the present time with regard to the nature of the cane juice, which is considered as almost pure saccharine water, does not appear to us proper to be henceforth accepted without limitation. This juice presents in its normal condition, in special circumstances, which we shall shortly explain, certain modifications which must be thoroughly considered if we wish to arrive at a full explanation of the different results often obtained from the same processes of manufacture. This very simple composition attributed to the cane juice is not only opposed to the daily practice of the sugar manufactories, it is also opposed to an attentive and continuous study of the cane at different periods of its development. From this source arise difficulties and obstacles in the manufacture of sugar which have been attributed to the inexperience of the planter, and to his pretended desire not to depart from the routine path marked out for him by his predecessors.

Chance, that providence in all rising industries, has from the very commencement of colonial sugar enterprise, revealed the chief indications to which the cane juice was subordinated during the process of evaporation, in order to produce a sugar of good quality in sufficient quantity. Thus, whatever apparatus may be used, that ancient method has not been departed from, which will continue to be a necessity so long as our present legislation will not allow us, by the employment of animal charcoal, to manufacture a refined sugar at the first essay.

In the present condition of our market, and in presence of all those conflicting eventualities which so heavily press upon the productions of Mauritius, so complete a reform cannot be realised. The colonial planters cannot then, like the manufacturers of beet sugar, determine beforehand the progress of their manufacture, and fix, in an absolute degree, the quality which, in accordance with the processes at their disposal, was to furnish the greatest amount of realisable production. Limited in their action, and bound down by necessities unknown to the European manufacturers, the colonial planters have to calculate, not the greatest product of a determinate volume of cane juice, but the most remunerative price which such quantity of cane juice will bring, according to those shades of difference recognised by the colonial markets, and which are far from having any relation to the saccharine richness of the product obtained. In such a condition of things, we must be prepared to recognise notable differences in the results furnished by the examination of those secondary syrups which come from a manufactory, according to those more or less important types which such manufactory produces. For, as I shall hereafter show, the first qualities obtained by our modern processes cannot be realised except by sacrificing a quantity of sugar far more considerable than is generally thought. This loss will be also the more apparent in proportion as the cane juice employed will be in one of these conditions to which I shall allude at the conclusion of this memoir.

I shall begin by examining the degree of pressure which can be obtained by the means in use at the present time in Mauritius; that is, by determining the returns obtained at the sugar-mill from the different species of canes, as well as the influence produced on the external qualities and the minute composition of the juice by the force, more or less greatly employed to produce such pressure.

I shall then specify the chief physical characteristics which distinguish the cane juice freshly pressed out by the mill, indicating those particularities furnished by microscopical examination, and which have been considered worthy to engage the future attention of the planter.

In the second part of this memoir, I shall examine the chemical properties of the cane juice, insisting, at the same time, particularly on certain substances, the nature and mode of action of which have not, perhaps, up to the present time been sufficiently determined. In the third part I shall endeavour to determine the causes of the principal change which this liquid undergoes during the process of evaporation by the ordinary method adopted in this colony.

(To be contiuued.)

ON THE CULTIVATION OF INDIGENOUS OPIUM.

BY ALPHONSE ODEPH.

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1. *On the possibility of obtaining in France a greater quantity of indigenous Opium than that of foreign, which is imported each year for the consumption of the country.*

Opium is the white milky juice which flows from the capsules or heads of the poppy whilst green, by making slight incisions of the surface.

Since the time of Belon, who was the first to advise the preparation of it in France, there have been a succession of names connected with this oriental culture under whose shadow I scarcely dare place myself. Messrs. Dubne at Rouen in 1779-1800; Britanneau at Chenoncon, near Tours, in 1805; Loiseleur de Longchamps in 1807, near Paris; Pelletier, Mérat-Guillot at Auxerre, in 1818; Petit at Corbeil, in 1826; General Lamargne at Eyeres, in Landes, in 1828; Hardy and Simon in Algeria, in 1843 and 1844; Professor Aubergier at Clermont-Ferrand from 1841 to 1854; Decharme, Professor Bénard and Dechamps at Amiens in 1854 and 1856; Professor Roux at Rochefort in 1851-1856, 1857 and 1858; Lepage in Gisons in 1857, 1858 to 1859. These have all made very valuable experiments, and published excellent works on the possibility of this culture in France; but not one of them have distinctly stated what remains to be done in order that we may finally dispense with foreign opium. To know this we must first ascertain the quantity of opium imported into France each year. To the kindness of Monsieur Barbier, conseiller d'état, director-general of customs and of *contributions indirectes,* I owe the knowledge of these quantities during the years 1859, 1860 and 1861, and this statistical information now enables me to solve the important problem, as follows :—

The quantity of opium imported each year for the consumption of France being ascertained, what are, at an average per *commune*, the surface of ground, and the amount of hand-labour necessary to be employed in the annual production of the same quantity of opium from the soil of our own beautiful country ?

Many think that this object could never be attained on account of the slowness of the harvest process. They look upon this question as an immense work, and practically impossible in France, because not knowing the real figure to be reached, they exaggerate the quantity of opium imported each year for our consumption, and consequently the quantity required to be produced from our territory in order that we may dispense with that of oriental nations.

But the experiments that I made in 1860, 1861, 1862, 1863 and 1864, and the satisfactory results obtained from my course of public and gratuitous lectures on agriculture tell me on the contrary that nothing is more simple, or more easy than the solution of this practical question. To prove this, I shall confine myself to taking for example my own small cultivation of one year. It will suffice to show what can be done by a willing and persevering mind.

The duties of my official capacity, and the lectures that I gave throughout the country, having absorbed almost all my time, I could only cultivate thirty square yards of ground. This was very little, and yet five times this quantity cultivated by the inhabitants would give a reply to the grand problem of the home production of opium.

I sowed in February, as I shall hereafter indicate, about six grammes of the seed of the carnation poppy. I occupied four hours at the sowing and digging of this, and two hours during five days in collecting eighty grammes of milky juice which gave me forty grammes of dry opium, containing 19·4 per cent. of morphine, and lastly one hour in gathering four litres ninety centilitres of seed.

Such is the account of my small culture. And here is now an extract from the quantities of opium imported for consumption into France : during the years 1859, 4,916 kilogr., 1860, 5,661 kilogr., 1861, 6,653 kilogr.

Let us take the last number, as it is the largest. The Post Office Directory of the year 1835 gives for the eighty-six departments of which France was then composed 37,153 communes. Admitting this to be so, if one workman for each commune operating only on thirty square yards of ground were to collect, as I have done in ten hours of work, forty grammes of dry opium, there could be collected in 37,153 communes 1,486 kilogr. 120 grammes.*

* A cultivator more accustomed than I am to bear the heat of the sun in July, could work more rapidly, and produce consequently more opium in the same time.

But if one workman per commune can furnish 1,486 kilogrammes 120 grammes of opium, then, for 37,153 communes, as many times as these 1,486 kilogr. 120 grammes are contained in the total quantity of opium imported into France or in 6,653, so many workers would be necessary from each commune to arrive at the same quantity of indigenous opium. We should have then $\frac{6,653}{1,486\text{--}120} = 4{\cdot}40$, say in round numbers five.

Thus, the great practical problem of the production of opium in France solves itself thus: Five cultivators on a average per commune, working only during *ten* hours on thirty square yards of ground each, will produce from the whole of France, not counting Savoy or Algeria and the colonies, a number much higher than 6,653, which was the number of kilogrammes of opium imported in 1861.

I do not speak here of the expenses of cultivation, I shall show in another place that they are covered by the seed, which is used in the manufacture of poppy oil. Furthermore, if we compare carnation opium, which contains fifteen to twenty per cent. of morphine, with the oriental opiums which only contain from three to ten per cent. of morphine, we shall see that our country, released from the tribute which she pays to the nations of the east, could draw from her own territory a national and pure production of a commercial value very superior to that of the exotic product which comes to us almost always adulterated.

If, then, our government in its solicitude for us, and in union with the agricultural societies, would take the initiative and patronise this new culture, there would easily be found in every commune five cultivators, able each to dispose of thirty square yards of ground, and of ten hours of work each year to endow France with a precious substance.

2. *The Necessity of obtaining Opium in France.*

Opium is justly considered as one of the drugs most valuable and most employed in materia medica.

"To recount the encomiums and to retrace the species of worship of which opium has been the object," says M. Cazin of Boulogne-sur-Mer, in his treatise on indigenous medicinal plants, "to explain the theories which have caused it to be considered sometimes as a universal panacea, sometimes as a dangerous medicine; to point out the numerous cases in which it has been employed with success, and those in which it has proved hurtful, would be at once to give the history of medicine, and to take a review of the whole of pathology."

"Amongst all the remedies which an omnipotent God has presented to man, there are none" says Sydenham, "more universal or more efficacious than opium. It is so necessary in medicine that it cannot possibly be dispensed with, and a physician who knows how to administer it with skill may perform wonders." It acts then a most important part, and forms the basis of a great number of officinal preparations on the activity of which the physician should always be able to rely. It is the only means which can arrest the rapid and frightful progress of tetanus, that dreadful malady. It is the well-known specific for all essentially nervous complaints, so that it is employed in a great variety of diseases.

A small dose (two to five centigrammes), says M. A. Richard in his Medical Botany, calms excitement, allays pain, and produces sweet and refreshing sleep. As the last resource of art, it soothes that anguish, the source of which cannot be stopped, and renders the last moments of existence tranquil when it is no longer possible to prolong them.

But the demand for opium being always on the increase, owing to the increasing avidity with which it is used, as M. Aubergier justly observes, often leaves the cultivators without a supply, and fraud then takes upon itself to provide for the insufficiency of the crop.

Monsieur Chevallier, the eminent professor of the school of pharmacy in Paris, in his remarkable *Dictionnaire des Falsifications*, devotes fifteen pages to the adulteration of opium. He says that opium has been adulterated in gathering it from vegetable substances and forming a basis of from six to seven milimetres deep ; that it has been adulterated with the extract of celadine or chelidonium, of the *lactuca virosa* (lettuce) ; of liquorice, of cashew nut, with oil of linseed, gum arabic and gum tragacanth, with sand, with *bouche de vâche*, with earth, with lead, and with sediment, with extract of poppy leaves procured by boiling, with crushed grapes, and salep powder, &c. According to M. Aubergier, a great number of cases have been seized at Havre, containing a production which had only the name and appearance of opium, and not containing the smallest particle of morphine.

M. E. Barruil was employed in 1851 to examine, at Marseilles, opiums not containing morphine. M. de Smedt, chemist at Borgerhort, received in 1846 an opium which had also the appearance of an excellent product, but which however, like the preceding ones, did not contain an atom of morphine.

M. Batka, of Prague, has also described an opium manufactured, at all points, not containing either opium or alcaloid.

A great number of chemists have occupied themselves on this grand question of opium : Derosne, Sertuerner, Séguin, Robiquet, Vauquelin, Pelletier. M.M. Payen, Cavantow, Conerhe, Deiblane, Chevallier, Bussy, Guibourt, Barruil, Ganthier, de Claubry, O. Réveil, Olivier d'Angers, Aubergier, Guillermond, Mialhe, Labarragne, Thiboumerg, Merck, Berthemot, Decharme, Biltz, Robertson, Thomson, Herpin, de Vrey, Legriss, &c., have thrown a light upon the composition of this powerful and precious narcotic. The result of their labour proves that the proportion of morphine is very variable, even in opiums reputed to be of good quality. There have also been found in commerce, opiums presenting every degree of strength, from 1·50 to from 12 to 13 per cent. of morphine. These deviations of opiums in the quantity of morphine they contain, are comprised in limits too extensive for the physician or apothecary not to occupy themselves with seriously. The therapeutist finding himself fatally under the absolute necessity of employing an active production which unfortunately is too variable in its composition, and consequently in its action on the human frame. So that a physician, who prescribes a dose of opium, may expose himself to the risk of giving too weak a dose of morphine, and then he fails to stop the progress of certain mortal maladies which carry off the patient in a few days, perhaps in a few hours before his eyes; or, on the other hand, he may expose himself to the opposite risk of administering a dose of morphine ten or fifteen times too strong, which will not fail to produce the train of frightful symptoms of poisoning by opium.

Is this not a question interesting in the highest degree to public life and health, and one in which both are concerned? Have we not here the most powerful argument, supported by the views of M. Aubergier, when he states in his work already quoted, "we think that measures ought to be taken," that opium, except that which is employed as the extract of the alkaloids, should not be permitted to be sold without being titled *titré*.

We cannot do otherwise than applaud the proposition of the eminent professor, who has already done so much in unveiling to all eyes the subtleties of adulteration. We cannot but approve the project of our learned brother and co-disciple, M. Andrien, of preparing opiums *titré*, stamped—titled—labelled—at ten per cent. of morphine, and giving them up to the apothecary under the guarantee of this seal, as M. Aubergier has besides already done. The opium of Smyrna, which is considered the best opium in the trade, according to M. Andrien, arrives in cakes always very moist, containing a certain quantity of water, the proportion of which rises from five to twenty per cent., its richness in morphine varies from three to 9·50 per cent., and it is but seldom that it attains the latter rank.

After having chosen an opium of good quality, I malaxate or soften it, to produce uniformity throughout of all its parts. It is only after this indispensable operation that I proceed to the *d'osage* of the morphine.

This analysis being ended, and the exact value of the opium known, nothing is more simple than to bring it by the drying process to contain exactly the required title of ten per cent. of morphine. But we must not disguise the fact that the consumption of morphine increases everywhere each year in frightful proportions, and a day must come, if a remedy be not provided, when the oriental production will not be sufficient for the wants of all populations, and when falsifiers will no longer fear to exercise openly their culpable industry by giving to unfortunate invalids a frightful imitation of opium which cannot then be replaced by the natural and pure production of the poppy, because too rare. Indeed, from the information furnished by M. Barbier, conseiller d'état, director-general of excise, it appears that French consumption increases by a thousand kilogrammes of opium yearly; thus, whilst in 1859 it was 4,916 kilogr. it has successively risen to 5,661 kilogr. in 1860, and to 6,653 in 1861.

In England, and above all in China, the increasing progress of annual consumption has attained an incredible figure, and is almost fabulous.

Let us see what M. Chevallier says of it:—

"The importation of opium in the United Kingdom continues every year to increase, particularly in the manufacturing counties, where the use of it is so immoderate that some temperance societies are accused of replacing brandy and Geneva by opium.

"In 1848 there were imported 96,835 English pounds weight of opium, of which 31,204 lbs. were consumed in England, the remainder served for commercial export.

"In 1849 there were imported 196,246 lbs. weight, of which 41,671 were consumed. This makes in a single year an increase of 100,411 lbs. imported, and of 10,467 lbs. consumed.

"In 1850 the consumption was 42,324 lbs., and in 1851 it was 50,368 lbs."

Besides this, M. Dorvault, the learned author of the *Officinal* in the 'Pharmaceutical Review' of 1857, at the end of a note of Professor O. Réveil, gives a table of the quantities and the total value of Indian opium, consumed in China during the years 1827 to 1833:—

	Total number of cases of 133½ lbs. each.	Value in dollars.
1827—28 . . .	9,535	10,429,079
1828—29 . . .	13,152	12,533,215
1829—30 . . .	14,000	12,657,157
1830—31 . . .	18,760	12,904,263
1831—32 . . .	14,225	11,501,584
1832—33 . . .	23,693½	15,350,720

The dollar is 5 frs. 40 cents. in value, making for six years a total of 303,701,088 frs., and an average of 50,616,838 frs. per annum; but the figures are still very far from the truth.*

Meyen affirms that the quantity consumed by the Malays of the Indian Archipelago, in Cochin China, Siam, as well as in India and Persia is so great that if the true figures could be given it would appear perfectly incredible.

* [The following figures will show the imports and consumption of this drug in the United Kingdom:—

	Imports.	Consumption.
1845 . . .	259,644 lbs.	38,229 lbs.
1850 . . .	126,318 "	42,324 "
1855 . . .	50,143 "	34,473 "
1858 . . .	82,085 "	77,639 "
1863 . . .	254,314 "	144,213 "

In 1846-47, 22,468 chests of opium (each containing about 140 lbs.) were exported to China by the East India Company, and which yielded an income of 2,886,201*l*. In 1857-58, the exports had increased to 68,004 chests, yielding 5,918,375*l*. revenue.—*Ed. Technol.*]

The opium commerce gives to the Indian government an annual revenue of 87,000,000 frs., and in this computation is not included the opium which China receives from the countries which bound it on the west or which it produces itself; so that the price of opium consumed by the Chinese annually amounts to 125 millions of francs.

M. le Professeur Guibourt says that in 1827-28, the exportation of opium from India to China was from 550,765 kilogr.; in 1853 it was from 1,395,887 kilogr., it must now be considerable more.

It appears, too, that the use of opium spreads itself also over the New World, and that the consumption of this narcotic everywhere increases in proportions that are alarming, for this reason that the production does not increase to the same extent.

The day will come, I repeat again, if this state of things continues, when European doctors will not be able to obtain pure oriental opium even at a high price, and the medical world is well aware, as Sydenham, the eminent English physician, declares, there is scarcely a medicine without opium. Then opium must be grown in France.

Let us next see what would be the price of French opium, and compare it with that of the exotic opiums.

And first, M. Aubergier, in practising incisions of the poppy head with an instrument with *four* blades,* and taking away the opium juice as soon as it appears. M. Aubergier, I say, has succeeded after several and praiseworthy attempts, in obtaining from each day's work 450 grs. of the milky juice from white poppies, and 300 grammes from the purple.

Monsieur Chevallier, whose name is sufficient authority in science, gives an account of an experiment made under his eyes on the purple poppy in the plantation of the professor at Clermont. He thus expresses himself:—

"Two workers, in the space of forty-five minutes, collected thirty grammes of poppy juice, which comes to forty grammes of juice in an hour, and consequently 400 grammes in ten hours work. These 400 grammes of poppy juice lose by drying in a stove (we made the experiment) 264 grammes of water, and leave 136 grammes of an opium more dry than that which is given in trade.

"We see that with two workers, to whom we pay 60 cents. or 1 fr. 20 cents., we obtain more than 125 grammes of opium of from 4 to 5 frs. value, which leaves a profit of 2 frs. 75 cents.; still we have only brought opium to 32 frs., whilst in trade opium of good quality sells for from 32 to 40 frs. the kilogramme."

In another experiment, the results of which are in the same way

* M. Guibourt, the learned professor of the Parisian school, says that the idea adopted by M. Aubergier of employing an instrument with *four* blades is not new; it is in reality surpassed by that of *five* blades, already described by Kampfer and mentioned by Geoffrey, and by M. Guibourt himself in his 'Natural History of Simple Drugs.'

given by M. Chevallier, and recorded in the same report, the return amounts to seventy-two grammes per hour, and consequently to 720 grammes a day; but M. Aubergier admits himself, that this result, obtained under the most extraordinary circumstances, cannot be considered as possible to be realised in the regular course of events in the manufacture.

It would also be difficult at present to find women who would work, as then, for sixty cents. I think, however, with M. Bénard, that there might be obtained from schools or orphanages, children of from twelve to fourteen years of age, who would give themselves readily to this kind of work which does not require masculine strength, and children of that age are generally nimble and dexterous.

M. Bénard, at Amiens, had extracted opium from reed seed, sown *broadcast* at the rate of from 28 frs. 58 cents. the kilogr., and in another case, the red having been planted in lines, obtained only 23 frs. 95 cents. M. Bénard, cultivator at Pucheville, in Somme, collected at the rate of from 26 frs. 65 cents. the kilogramme; but to arrive at that there must be workers, paid at 75 cents. to 1 fr. per day, also favourable weather and skilled hands. Let us now examine the result of our personal observations, and calculate the cost by the hectare of ground.

	frs.	cents.
In our country a hectare of ground is rented at .	90	0
Interest of this sum	4	50
Farm manure, thirty cubic yards at 5 frs. each .	150	0
Two labourers at 20 frs. each	40	0
For harrowing twice	10	0
Seed, five quarts at 32 cents.	1	60
Digging ground, 56 days of women at 1 fr. 25 cts.	70	0
Gathering of seed, 28 days	36	0
Gathering of opium, 200 days	250	0
Total of the cost for cultivation and the crop per hectare	627	10

I have purposely omitted the price of carriage from the plantation to the habitation; the stems, or straw, and the compost in reserve more than covers that expense.

RECEIPTS.

The hectare gives in general :—	frs.	cents.
1st. 20 hectolitres of seed at 30 frs. each . . .	600	0
2nd. 9 to 10 kilogrs. of dry opium, containing from 15 to 20 per cent. of morphine at 80 frs. the kilogr.	800	0
Total receipt	1400	0
Receipt exceeding the outlay or net profit on the hectare	772	90

In quoting opium only at 60 frs. the kilogr. would give a net profit of 572 frs. 90 cents. the *hectare*.

By operating with care the opium harvest may be augmented; for in a plantation which I shall hereinafter point out, counting 429,000 poppy heads, and one head by a single incision, almost circular, furnishes on an average five centigrammes of dry opium, as I have already several times demonstrated.

In using the instrument which I shall describe further on, and which permits the action of the blades to be regulated at will, the incisions can be made with such rapidity that generally on an average 100 grammes of opium juice per day may be obtained, which diminished one-half in drying, gives 50 grammes of dry opium, making the price of this opium come to 25 or 30 frs. the kilogr. on an average.

It is the quantity per cent. of morphine that an opium contains which gives it commercial value. Now, we know that the best exotic opims rarely contain 9·50 per cent. of morphine, that they are quoted at 40 and 50 frs. the kilogr.; and that that endorsed 10 per cent by M. Aubergier is sold at 70 frs. the kilogr.

Then the indigenous poppy, so rich as to contain from fifteen to twenty per cent. of morphine, and the extraction of which costs but 30 frs. the kilogr. can easily be tariffed at 60 and even at 80 frs. the kilogr.

It is then perfectly certain that indigenous opium can be obtained at a price very much lower than that of exotic opiums. But it may asked, Is the opium gathered from poppies cultivated under our own sky, identically the same as exotic opium in a double point of view; both in its chemical composition and in its therapeutic or medicinal effect?

M. Aubergier, in a remarkable memoir presented to the Academy of Medicine in 1852, has solved the first part of this important question.

His experiments, full of interest, were tried on the three varieties of poppy known under the names of white poppy, purple poppy, and red poppy.

The opium of the first variety (white poppy) gave to the professor of Clermont a maximum title of 6·630 per cent. of morphine; that of the purple poppy furnished pretty regularly 10 per cent. of morphine; and lastly, the red poppy presented an opium so rich as 17·833 per cent. of alkaloid.

Further, our learned brother has proved the growth of morphine and of narcotine during the ripening of the capsule.

This difference established between the richness of the above-named opiums; M. Aubergier has sought in these opiums for the other immediate principles. He has singled out codéine* thébaïne, narcéine, méconine, méconic acid, oily matter, and resinous already proved by the illustrious Pelletier, Caoutchouc, &c.

He has found that the proportion of narcotine is stronger in the

* M. M. Bénard and Deschamps d'Amiens have proved the presence of this alkaloid in opium furnished from the red poppy of the North.

opium of the white poppy than in that of the purple, and that in the latter it diminishes rapidly by the ripening of the capsule. It can be easily understood, with our *confrère* of L'Auvergne that this may have escaped Pelletier in the analysis which he made of a specimen of opium collected by General Lamarque.

With regard to the therapeutic effect of indigenous opium, it is reserved for the eminent professors of the Faculty of Medicine in Paris to make it know to the medical world. Clinical experiments have taken place in the attendance of MM. Rayer and Grisolle upon the hospitals of charity and pity ; and it was the extract of opium from the purple poppy which was tried comparatively with the extract of exotic opium used in the hospitals of Paris. This latter extract, it is known, is always supplied by opiums containing at least 9 per cent. of morphine, the strength required by the 'Pharmacie Centrale.'

Here are some passages from the report given at the Academy of Medicine the 28th December, 1852, by MM. Rayer, Orfila, Beullay, Chevallier, Grisolle, and Bouchardet, the reporters. These few lines will show that indigenous opium has not only an identity of component parts, as we have already seen, but also an identity of action. "That which is certain," says the report, "is that in an hundred cases it has been proved that the sedative effects of indigenous odium have never been below the effects of exotic opium in habitual use."

Further on, we read, "Constantly indigenous opium given in the ordinary dose of exotic opium, has produced ease and sleep." Again, "There are few diseases in which indigenous opium may not be employed either to calm pain or to produce refreshing sleep, and check morbidly increased secretions.

"Your 'commission' could not have extended their comparative researches to all cases. But it has been demonstrated for them and proved that the indigenous opium remitted to them by M. Aubergier, possesses all the therapeutic properties of exotic opium to a degree at least equal to that of opium of good quality employed in our hospitals."

We have now no longer any reason for preferring to the rich production of our own soil, that opium so frequently adulterated even on the spot of its growth, and which, at the price of gold, we ask from oriental nations.

It was in order not any longer to remain tributary to strangers, that at different periods men, jealous for the future of France, watched over the public health and attempted the culture of this rich substance. Their great and arduous labours which led the way to this new conquest over the East, must not be left neglected and forgotten in the recessses of a library, they ought, on the contrary, to serve as a polar star to the sailors of progress, to direct their frail barque towards the desired haven, and to enable others to avoid the many rocks which they have encountered.

In the present day the cultivation of opium may be accomplished under conditions really industrial and commercial, thanks to the many discoveries which have been made either in the manner of proceeding or in the apparatus for making incisions in the poppy heads.

This harvest, the possibility and the importance of which has been completely proved cannot spread too rapidly over every territory of the empire; it will free us from the enormous tribute which we each year pay to the Levant. Let the pharmaceutist, whose zeal in general, and energy in every good cause are well known, encourage in each of their localities this oriental culture, and very soon by degrees and imitation, and the force of example, it will spread over all France.

Let each agriculturist devote a corner of his soul to this new tillage, which will be to him a lucrative and agreeable amusement.

This culture is still more profitable in that it can be carried on by children of from twelve to fifteen years of age, who are but of secondary use in rough agricultural work.

The agriculturist, without neglecting his ordinary employment, can have the gratification of seeing his young children occupy themselves in a foreign cultivation, lucrative and easy. And more, this culture will augment agricultural wealth in furnishing a produce which, from its purity and high name, will be appreciated by, and certainly preferred in, all the markets of the world to those exotic mixtures of a composition so variable.

Finally, it can be given a fixed strength, 10 per cent. of morphine, thus securing a medicinal opium, rare and notable, *par excellence,* in following the method already pointed out by M. Adrien.

After some time, the number of productors becoming greater, the excess of French consumption may become an object of important export, at the same time procuring for the agriculturist solid advantages.

It will even be possible, as Professor Roux de Rochefort says, to exchange upon favourable terms our indigenous opium for other productions, which we draw at a high price from the extremity of the East, such as tea, rhubarb, &c., &c. The passage by Suez enabling us more easily to forward it to the Celestial Empire, where, unhappily, the sad habit in China of smoking and masticating this substance is so widely spread.

(To be continued.)

THE METALS IN CANADA.*

BY MESSRS. WILTON AND ROBB.

LEAD.—The Geological Survey report the occurrence of lead in many localities in Canada. The following extracts from Sir William Logan's Reports of Progress will conclusively show to any one at all acquainted with the subject, that rich and persistent deposits of lead may be looked for in the townships of Bedford and Lansdowne, counties of Frontenac and Leeds.

In the Report for 1858, pp. 48—50, he says under the head:—"*Galena.* —This ore of lead is another of the minerals that are to be looked for in connection with the limestones of the Laurentian series, but it is not yet determined whether it specially characterises one or more of the bands. None of it was met with in the calcareous exposures in the district of the Rouge; but I have been informed that several veins holding galena have recently been discovered in the township of Bedford, not very far removed from the lodes which have already been discovered by Mr. Murray, in the twenty-first lot; and near the line between the eighteen and nineteen lots of the eighth range of the township."

In the Report for 1851-52, Mr. Murray makes mention of the occurrence, in the second lot of the eighth range of Lansdowne, of a vein of heavy-spar and calc-spar cutting rocks of the Laurentian series, and holding disseminated crystals of galena, which had been unsuccessfully tried as a lead mine. Subsequently to his visit to the locality, a lode was discovered on the third lot of the same range, from which specimens were obtained in 1855 for the Paris Exhibition.

A trial shaft was sunk on it to the depth, it was said, of fifty feet, and a sufficient quantity of ore obtained to pay the expenses of sinking. The specimens showed a thickness of between two and three inches of pure galena, associated with calc-spar. It was said that other lodes existed in the neighbourhood, but their position was kept secret.

"The bearings given by Mr. Murray to the three lodes examined by him in Bedford are N. 15 W., N. 32 W., and N. 85 W., the last being the course of the lode traced and tested farthest. The distance between the Bedford and Lansdowne lodes is not much over twenty miles; and considering the differences that may be allowed for the gentle windings which usually exist in the courses of metalliferous veins, it appears not at all improbable that the lodes of the two localities may be identical or belong to one group, the bearing of the two positions being about N. 68 W. and S. 68 E. of one another. If a line from the Bedford to the Lansdowne lodes were continued twenty-five miles farther, it would cross the St. Lawrence and strike Rossie in Lawrence County, New York: where a group of well known veins of lead ore exists, some of

* Report of Progress for 1858, page 51.

which, though just now abandoned, are not supposed to be exhausted, and two of which are known at one period to have yielded a great quantity of ore.

"The rock cut by the lodes at Rossie is of the Laurentian series; but a line between Rossie and Lansdowne would intersect the outcrop of the Potsdam sandstone, which lies between Rossie and the St. Lawrence. It has been ascertained that a vein of lead ore cuts through this sandstone at Redwood, which would not be far from the position of the line to Lansdowne. It is thus not improbable that there is a group of lead ores running from Rossie to Bedford, and this metalliferous line appears well worthy the attention of explorers in search of lead ores. The dislocations in which the lodes exist are of course thus proved to be of more recent age than the Potsdam sandstone, but this by no means establishes that the older rock may not be the source of the metal."

Ramsay Lead Mine.—In 1853, Mr. Richardson ascertained the existence of a vein of galena on the third lot of the sixth range of Ramsay, in the county of Lanark. The rock which the vein intersects is an arenaceous limestone, the fossils of which prove it to belong to that division of the Lower Silurian series known as the calciferous sand-rock. Mining operations have been prosecuted with some success, and have established beyond a doubt the important facts that the galena occurs in true veins which may be depended on for persistence in depth, and that its quality is most excellent, producing eighty per cent. of metallic lead. "There appear," says Sir William Logan, "to be indications of other lodes with nearly the same bearing as the one opened at Ramsay, not far removed from it, and it may belong to a group which, running parallel with the Bedford and Rossie group, would be about forty miles from it to the north-east."

Sir William in 1848 discovered traces of galena at Bay St. Paul, on the north bank of the St. Lawrence, about ninety miles below Quebec. Although in unworkable quantity, the mode of occurrence of the ore gave unmistakeable evidence of its being in a true vein; and, from the well known valuable characteristics of such deposits, this circumstance invests the discovery with some importance.

Galena of an excellent quality is known to exist at several points in the Quebec group of rocks, stretching from Lake Champlain to Gaspé, but the facts have not yet been accurately ascertained by the compilers.

Gold.—Discoveries of gold have been made at several localities, and in fair quantity in Eastern Canada, chiefly in the valleys of the rivers Chaudiere and Du Loup, and their tributaries, and on the St. Francis, all in the Eastern townships. In all cases it has been obtained by a laborious process of washing or *stream-work*, the material subjected to this process consisting of drift clay and gravel, the debris of the rocks, on which they repose. These rocks consist of clay-slates, and interstratified grey sandstones associated with conglomerates, talcose slate and serpentine, and with various ores of iron; and it seems probable from recent observations, that the gold producing regions will have the same geographical limits as those assigned to the Quebec group of rocks.* The gold has nowhere been found in place, with the exception of a mere trace discovered in a quartz vein near Sherbrooke. The size of the largest nuggets varies from two to four ounces.

The result of the washings on the Du Loup and Chaudière in 1851-52, when the process was vigorously and systematically pursued during a whole season, was about 1,900 dwts.; and the proceeds showed a yield of about double wages. The quantity obtained was not so great, nor the results, as far as regards profitable working, so satisfactory as to give much encouragement to the gold seeker in Canada; but it is fair to infer that since the rocks of the country are *now* ascertained to be identical with those which, in the neighbouring States, have yielded a considerable amount of the precious metal, explorations will be undertaken and prosecuted with greater vigour and greater prospects of success. On the whole, however, it may not be considered out of place to repeat the caution given by Sir William Logan, that in all probability, "the deposit will not in general remunerate *unskilled* labour, and that agriculturalists and others engaged in the ordinary occupations of the country, would lose their labour, by turning gold hunters."

Silver.—With reference to the occurrence of this metal in Canada we are not aware of the existence of any silver ores proper; and the lead ores which have been hitherto discovered are for the most part exceedingly poor in silver. Mr. Hunt however, in the Report for 1853, page 370, gives details of assays made by him upon samples of galena from Meredith's location (Maimanse) on Lake Superior, and from the Rapids of the Chaudière in Lower Canada, the former yielding thirty ounces, and the latter twenty-five ounces per ton of metallic lead. This result affords the strongest encouragement to the prosecution of the search for argentiferous lead ores in these districts, which although widely separated geographically, have been lately ascertained to belong to the same geological epoch.

On the north shore of Lake Superior, and in Michipicoten Island, considerable amounts of native silver have been obtained associated with copper veins and native copper.

At Prince's location, towards the western extremity of the Lake, fifteen miles west of Sturgeon bay, a bunch of four cwt. of ore containing about

* The Quebec group consisting of altered and highly dislocated and disturbed limestone and sandstone strata, belonging to the Lower Silurian system; and extends in a belt varying from twenty to sixty miles wide, from the borders of Lake Champlaine eastward to nearly the extreme point of Gaspé. This band of rock is pronounced by Sir Wm. Logan, J. D. Whitney and other eminent geologists, to be a portion of the great metalliferous formation of North America; to which belongs not only the rich ores of Lake Superior, but the gold, silver, lead, zinc, copper, cobalt, nickel, chrome and titanium, found along the Appallachian chain from Canada to Georgia, as also in Missouri and Tennesee.

four per cent. of silver, with traces of gold, has been found. On the south shore in Michigan, which is considered to be in the same geological formation, a considerable amount of native silver is frequently met with, in workings for copper ; but in most instances it is stolen, or deemed a perquisite by the miners ; one nugget is mentioned by Whitney which weighed 96·8 oz.

COPPER.—Although iron ores are most extensively distributed, and lead veins have been detected in the Laurentian rocks, we are not aware of any discoveries of copper in the region occupied by the great mass of this formation. This region has, however, been so little explored that it would be altogether premature to assert the absence of this metal. At various points along the lines of junction or contact between the Laurentian and the next succeeding formations, namely, the Huronian in the west and Lower Silurian in the east, important discoveries of copper have been made.

Lake Region.—In the Lake region the disturbances are so great and the amount of exploration hitherto accomplished so limited, that it is impossible to indicate accurately the geographical boundaries of the formations ; but the recent observations of Mr. Murray seem to point to this geological horizon as a promising field. In his Report for 1856, he says, referring to districts overlying this point in the series, "The existence of the ores of copper and iron, which are known to be more or less characteristic of the Huronian series of rocks, invests the geographical distributiou of the formation with much economic importance. These ores were repeatedly observed in the region explored last season, and although nowhere seen in large amount or to a great extent, the indications were sufficient to establish their pretty general distribution. Small specks and patches of the yellow sulphuret of copper was frequently found in the blackish and dark grey slates on the lower lakes of the Maskinongi ; and at the southern turn of these lakes there is a quartz vein of from six to eight feet wide, with copper pyrites cutting slate conglomerates, and an intrusive mast of compact flesh-red feldspar. In the felspathic dyke, small narrow veins of peculiar iron ore occur, which appear to run parallel with the dyke or slightly oblique to it, and the quartz veins and its subordinate *droppers* cut across both. Were this vein as conveniently situated as those of somewhat similar character on Lake Huron, it is fully as well worthy of trial as many that were selected by explorers there some years ago upon which to found claims for mining locations."

In the Report for 1857, he says, "Copper pyrites is very generally disseminated through masses of greenstone wherever they were examined, and it occasionally appears in quartz veins in sufficient abundance to constitute metalliferous lodes. The most favourable indication known of this description is the area on the south side of Echo lake, and in the hills north of the mouth of Root river, both of which localities have been taken up for the purpose of mining, but have not hitherto been worked to advantage."

Again, in the Report for 1858, Mr. Murray gives a list of all the localities where copper ores were found on the river Mississagui ; and in reference to it states that, " though the quantity of the ore does not in the case of any of the veins appear very encouraging, they may become the means leading to the discovery of veins of a more promising character in the neighbourhood." A useful hint to the explorer will be found embodied in a further statement made by Mr. Murray in reference to the same locality, " The examination of the area connected with the Mississagui has not yet been sufficiently extended to determine the relations between the copper-bearing veins of the Grand Portage and the physical form to which they are subordinate. The veins of the lower part of the river are evidently related to the anti-clinal existing there. Those of the south part of Echo lake also belong to an anticlinal ; so do those of the Bruce and Wellington mines ; and it would almost appear as if the importance of the metalliferous indications rose with the sharpness of the fold. But, whatever be the cause of the dislocations in which metalliferous minerals are secreted, it would seem to be a probable supposition that in a metalliferous district the greater the dislocations, the greater the chances of valuable metalliferous lodes."

The Huronian system itself occupies the whole northern flank of Lake Huron and parts of Lake Superior, and constitutes the lower copper-bearing rocks of the lake region,—consisting of white and often vitreous sandstone or quartzite, passing into a jasper conglomerate and intestratified with heavy masses of trap. The deposits exist in the form of true veins, although it is said that some of the lodes have become rather poor and thin on penetrating to a comparatively small depth. The ores are entirely sulphurets,—yellow, variegated, and vitreous—no native copper being found in this region. The Wallace, Bruce, and Wellington mines have been worked in this formation for many years : of these the Bruce mines are the most important, and have been worked by the Montreal Mining Company with tolerable success ; and had proper skill and discretion been exercised from the first in their management, they would undoubtedly have proved an excellent investment. These are truly valuable mines, and should produce largely.

The important copper deposits at Miamanse, Michipicoten Island, and the more western localities of the north shore of Lake Superior, in all probability belong to the upper copper-bearing rocks ; being the same as are exposed on the south shore, and have produced such extraordinary results.

The promontory of Miamanse consists of thick masses of quartzoes, sandstone and conglomerate, associated with amygdaloid trap and volcanic ash or tufa. The copper occurs in the amygdaloid trap both in the native state and as ore, the vein-stones being principally calc-spar and quartz ; the deposits seem to partake of the character of segregated veins, and are both very thin and do not hold out in depth, though exceedingly rich in some places. In 1855, at the depth of eighteen feet a mass of native copper weighing 630 lbs. was extracted, and the whole yield of a shaft twenty-seven feet deep and without galleries was about three tons of metallic copper.

On Michipicoten Island, where copper mining has been carried on for many years, the metal is deposited in the native state in beds of amygdaloid trap and volcanic ash, overlaid by compact trap and underlaid by a coarse red quartzose sandstone; the cupriferous bed proper being from one to two feet thick, and sufficiently rich to pay for working. The metal also pervades to some extent the rocks lying above and below the copper-bearing belt, being distributed through the former in bunches, and through the latter disseminated in grains. It occurs also in veins traversing the beds at nearly right angles. It seems that when a metalliferous belt has been broken up by the intrusion of igneous rocks and rearranged under metamorphic action, rich deposits of ore may be expected.

At the western locations on Lake Superior, the rocks consist of argillaceous shales or slates overlaid by a flow of trap; both formations being cut by numerous parallel trap dykes, and by transverse veins of quartz, barytes, and calc-spar, carrying ores of copper and native copper. We are not aware of the extent to which these veins have proved productive. The amazing development reached by the copper workings on the south shore, situated in corresponding positions, will be best judged by the fact that in 1850 the aggregate value of exports was 266,000 dols., while in 1860 it had attained the sum of 3,000,000 dols. Masses of nearly pure native copper have been there discovered weighing from 300 to 400 tons.

Copper in Lower Canada.—We have already remarked that the Quebec group of rocks are the equivalents of the upper copper-bearing rocks of Lake Superior; and accordingly we find them characterised by similar features, as regards their metallic contents. Towards the line of junction between the Laurentian rocks and the Quebec group of the Lower Silurian system a few discoveries of copper ore have been made and recorded by the Provincial geologists. In the Report for 1852-53, Sir William Logan states, that in the seignoiry of La-Norraye, in the county of Berthier, on the north side of the St. Lawrence, a point situated in the above geological horizon, a vein of calc-spar and pearl-spar occurs carrying copper pyrites, though in small quantity. He remarks that "though the vein does not appear by any means a promising one, it yet bears too many of the characteristics of a regular lode to be passed over without notice." Recently, a report which, however, wants confirmation, has been made of an important discovery of copper ore at St. Irenée Malbaie, which, as will be seen by reference to the Report for 1849-50, is also situated at this point in the geological series.

In this connection also we have shortly to notice the discovery as related by Mr. Murray (Report 1851-52), of a small quantity of copper pyrites occurring in a vein of calc-spar which is found penetrating the Laurentian limestone and Potsdam sandstone, in the township of Bastard, county of Leeds. The vein was tried by sinking a shaft to the depth of twenty feet on it, but the amount of ore found was not sufficient to justify the expectation of a favourable result. The trial seems to have been made in consequence of the previous discovery, on Gananoque Lake near the same locality, of some loose masses of very fine and rich copper pyrites of considerable size, and containing upwards of thirty per cent. of copper. The source of these masses has not yet been discovered.

In the same neighbourhood in the township of Escott, and still upon the borders of the Laurentain rocks, there occurs a *bed* of magnetic oxide of iron, holding a considerable quantity of copper pyrites so strongly resembling the detached masses found on Gananoque Lake as to induce the belief that they have originated in similar deposits.* The cupriferous portion of the bed varied from six to ten inches in thickness over a length of about twelve feet extending in the direction of the stratification. Sir William remarks : I understand that between eighteen and twenty tons of the copper ore were obtained, but after this bunch became exhausted I believe no excavation was made through the dead ground in search of a further quantity. On testing the iron pyrites, Mr. Hunt has detected in it traces of cobalt, and as cobalt and nickel very generally accompany one another, the latter may very reasonably be expected in this deposit.

Copper in the Eastern Townships.—But the copper region of Eastern Canada, *par excellence*, will be found to be on the south side of the St. Lawrence in the Quebec group of rocks. So far as hitherto discovered, the deposits occur most abundantly and in greatest richness, as might be expected, in the highly altered and disturbed strata constituting the mountainous and picturesque region of the eastern townships. Throughout this region and extending as far as the extremity of Gaspé, the rocks are distributed in long narrow synclinal forms, with many sharp plications or folds, and in some cases overturn dips. The ores, consisting of the pyritous and variegated sulphurets of copper, are found usually in the vicinity of certain bands of dolomite, serpentine, soapstone, and other magnesian rocks ; and the deposits, in every instance yet discovered, preserve a direction coinciding with the stratification.

Upton.—In a trial excavation in the township of Upton, Drummond county, the ore, consisting of pure pyrites, in a matrix of calc-spar, occurred in the form of reticulating veins of from a quarter of an inch to an inch in thickness, enclosed in a partially crystalline limestone, the veins constituting bunches, several of which could be traced in the strike of the limestone. Sir William Logan regards them as veins of

* See Report of Progress for 1858, p. 52.

segregation, filling up fissures which do not pass beyond the limits of the limestone.

The same calcareous band, is traceable through several townships in a north-easterly direction parallel with the mountain ranges; and transversely to this course, a series of ridges nearly parallel to the first, are produced by repeated folding of the strata into synclinal and anticlinal forms; at many points in this series copper ore has been found under the same circumstances as at Upton. "The ore is very irregularly distributed in bunches, some of which might produce five, and others two to three hundred weight of between twenty and thirty per cent. to a fathom of ground; but the irregularities appear to be so great as to make it questionable if the ore is capable of being profitably mined."

Acton.—A very remarkable exception, however, occurs in the rich deposit forming the well known "*Acton Mine*" in Bagot county, an admirable description of which will be found in Sir William Logan's Report for 1858, to which we must refer our readers; as well as to an interesting and lively sketch of the same locality in the "Canadian Naturalist and Geologist," Vol. V.

In this case the greater proportion of the ore is deposited in brecciated masses or conglomerate beds, the pebbles being limestone, partly angular and partly rounded, and the paste consisting of the variegated and vitreous sulphurets of copper; the beds in question being subordinate to the stratification of the limestone rocks of the country. Many examples of similar brecciated bunches occur in the true veins of Cornwall and Devonshire, in England, as related by De La Beche,* and Sir William Logan states that the whole conditions of the case bear a striking resemblance to those of the copper deposits of the Ural Mountains, as described by Sir Roderick Murchison.

Referring to the Acton deposits, Sir William Logan says: "There is no doubt the mass of ore is a very important one; already after but nine weeks working not far from 300 tons have been housed, supposed to contain about thirty per cent. of pure metal. The value of this quantity would be about 45,000 dols.; while inclusive of lordship, the mining expenses and those necessary to carry the ore to a market will be comparatively small. The quantity of ore excavated seems to have produced but a moderate impression on the total mass in sight." Since the above was written additional masses of ore are said to have been discovered at the same locality, and the working has been equally successful.

Leeds, &c.—In the townships of Inverness and Leeds, Megantic county, copper ore has been discovered at several points, in a different form from any we have hitherto noticed, and mining operations are there carried on with much vigour and skill. The ore occurs in rocks

* Report on the Geology of Cornwall, Devon, &c., page 323.

of an aluminous and micaceous nature, most appropriately named by Mr. Hunt "nacreous" (or pearly) slates; it is of the same description as that found at Acton, but is distributed in a succession of slate bed coinciding with the stratification, and also in quartz courses or veins crossing the strata at various angles. "The mode," says Sir William Logan, "in which the copper ore is distributed in the nacreous slates of Leeds precisely resembles that in which it occurs in the bituminous slates of Germany; and it is only the circumstance that the facts known in connection with the Canadian deposits are yet too few to give entire confidence in the persistence of similar conditions over a great area, which should moderate expectation of an important result."

Sir William estimates the average yield of metallic copper from the Leeds beds at about four per cent. The copper-bearing slates of Mansfeldt in Germany, above referred to, are profitably worked on a yield of only two per cent.; and the following remarks by Mr. Whitney in reference to somewhat similar circumstances are deserving of attention. Speaking of one of the workings on Keewanaw Point, Lake Superior, he says, "Here a bed of sandstone has been lately examined, carrying enough copper to be excellent stamp-work. By some it is believed that it carries *one per cent.* of copper, but by others it is thought to be richer. It is perfectly clear from what can now be seen of it that many thousand tons of mixed rock and copper will be taken up from it in opening the mines. It will require no calcining to stamp and wash easily, and can be cheaply excavated. So little has been done in testing the value of the bed in question, that great caution should be observed in giving an opinion in regard to it; but metalliferous beds have been and are now mined in the Ontonagon districts with some success, and on Portage Lake with prospects decidedly flattering."

MANUFACTURE OF PAPIER MACHE.

THE origin of the manufacture of useful and ornamental articles from paper, is still a matter of doubt, although it is generally believed that the Japanese were the first inventors. From the name given to it, we would naturally infer that it had been introduced by the French; a recent French writer, however, ascribes the merit of producing paper ornaments to the English.

When the art of moulding and casting in plaster was first introduced into England, the art of preparing the pulp of paper was improved and extended, and ultimately rendered practicable the adoption of papier maché in the formation of architectural decorations. The handsome ceilings of Chesterfield that adorned many of the fine old ceilings in deep relief of the Elizabethian era, are of this material.

The following is a description of the various processes practised in the manufacture of papier maché, at the works of Messrs Loveridge and Shoolbred, at Wolverhampton.

There are at present five principal varieties of *papier maché* known in the trade, viz., 1, sheets of paper pasted together upon models ; 2, thick sheets or boards produced by pressing ordinary paper pulp between dies ; 3, *fibrous slab*, which is made of the coarse varieties of fibre only, mixed with some earthy matter, and certain chemical agents introduced for the purpose of rendering the mass incombustible (a cementing size is added, and the whole well kneaded together with the aid of steam. The kneaded mass is passed repeatedly through iron rollers, which squeeze it out to a perfectly uniform thickness ; it is then dried at a proper temperature) ; 4, *Carton pierre*, which is made of pulp or paper mixed with whiting and glue, pressed into plaster piece-moulds, baked with paper, and, when sufficiently set, hardened by drying in a hot room ; 5, *Martin's Ceramic papier maché*, a new composition, patented in 1858, which consists of paper pulp, rosin, glue, drying oil and sugar of lead, mixed in certain fixed proportions, and kneaded together ; this composition is extremely plastic, and may be worked, pressed, or moulded into any required form. It may be preserved in this plastic condition for several months, by keeping the air away and occasionally kneading the mass.

The first mentioned variety of *papier maché* alone engages our attention here. A special kind of paper, of a porous texture, is manufactured for this purpose. An iron mould of somewhat smaller size than the object required, is greased with Russian tallow, a sheet of the paper is laid on to the greased surface of the mould, and covered over with a coat of paste made of the best biscuit flour and glue, which is spread evenly all over the sheet with the hands ; another sheet is then laid on, and rubbed down evenly, so that the two sheets are closely pasted together at all points. After this the mould is taken to the drying chamber, where it is exposed to a temperature of about 120 deg. ; when quite dry, which it takes several hours to accomplish, it is carried back to the pasting-room, and another sheet laid on with another coat of paste, after which it is returned to the drying chamber, and the same operation is repeated over and over again until sufficient thickness is attained, which, for superior articles, such as are manufactured at these works, requires from thirty to forty sheets of paper, and of course as many coats of paste between. The shell is then removed from the mould, and planed to shape with a carpenter's plane, after which it is dipped in linseed oil and spirits of tar to harden it ; this changes the colour from a grey to a dingy yellowish-brown tint. The article is then stoved, and seven or eight coats of varnish are laid on (with a stoving after each), which are cleared off each time, any inequalities of surface being finally removed with pumice-stone. The number of drying processes the articles have to go through consume so much time that it takes three or four weeks to fit them for ornamentation, which is applied in bronze-powder, gold or colour, and for many articles also in mother-of-pearl. The ornamentation of these articles is sometimes effected in the highest style of the painter's art. It was in Wolverhampton that Bird, R.A., worked as a "japanner," the technical name given to an "ornamentor;" and we believe some other of our great artists have sprung from the pursuit of this occupation.

The gold-leaf is laid on with a solution of isinglass in water, the design then pencilled on with asphaltum, the superfluous gold removed with a dossil of cotton dipped in water, which leaves intact the parts touched with asphaltum, and the latter finally removed with essence of turpentine. The cotton pledgets used are, of course, carefully collected to recover the gold removed by them.

After the application of every coat of colour or varnish, the object so coloured or varnished is dried in an oven or chamber, called a stove, and heated by flues to as high a temperature as can safely be employed without injuring the articles or causing the varnish to blister. All articles so japanned, or to use the technical term, "stoved," are more durable than they would be if simply left to dry in the air.

For black grounds, drop ivory-black mixed with dark coloured animé varnish is used; for coloured grounds the ordinary painter's colours, ground with linseed oil or turpentine, and mixed with animé varnish. The colours most in use are white lead, cobalt blue, yellow, vermillion (used more particularly to imitate tortoise shell), Indian red, verdigris, umber, and the intermediate tints produced by mixing two or several of them together. The varnishes most used are animé and copal. The grounds and varnishes are generally laid on with painting brushes, or flat brushes, made of fine soft bristles. Tin-plate articles intended for japanning, are first thoroughly cleansed from every trace of grease that may adhere to them, with turpentine or spirits of tar, then rubbed with sand-paper. They are then ready to receive the first coat, after which they are thoroughly dried in the stove.

For black japanned works, the ground is prepared with a coating of black made just as now stated, by mixing drop ivory-black with dark-coloured animé varnish, which gives a blacker surface than would be produced by the japan alone; and the object is then dried in the stove; from three to six coats of japan are afterwards successively applied, the work being always thoroughly dried again in the stove ovens between the laying on of every fresh coat.

For brown japanned works, umber is mixed with the japan, to give the required tint; the process in all other respects being the same as for black japanned works.

The colours are protected against atmospheric influences, and made to shine with greater brilliancy by two or three coats of copal or animé varnish. Superior articles receive as many as five or six coats of varnish, and are finally polished.

The ornamentation of all such articles as come under the head of toilet wares, is effected by the ordinary mode of painting with a camel's hair pencil, or some fitting substitute; when imitations of woods or marble is intended, the ordinary grainer's tools are used. Many patterns are produced upon the various articles by "transfer printing,"

"HOMES WITHOUT HANDS."

NOTWITHSTANDING the recent and very interesting volume on this subject, it is not yet exhausted. Fresh facts may be gathered about what has already been done, and result in the contemplation of animal life in the highest phases of its intellectual or instinctive development. The infinite variety of means by which one end is to be attained is marvellous. To multiply its kind, and provide a home and shelter for its future offspring, is the great idea which pervades all forms of life. This is more or less elaborated in different individuals, but in all the same object is paramount. Two or three instances may be given here, which possess in themselves another interest, of an economic character.

TREHALA.—A singular substance has long been known in the East under the name of *Trehala* or *Tricula*. It consists of oval cases from half to three-quarters of an inch in length, found attached by one side to twigs of a species of Syrian *Echinops*. The external surface is rough and irregular, nearly of the colour of Sicilian manna, hard, brittle, and with a sweetish taste. These cases are constructed by a little beetle

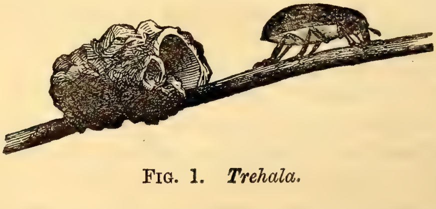

FIG. 1. *Trehala.*

(*Larinus subrugosus*, Chevr.), of which a figure is given (Fig. 1). "It appears that the larva of the *Larinus* collects a considerable quantity of saccharine and amylaceous matter, which it procures from the *Echinops*, and that it constructs its dwelling by disgorging this matter and moulding it with its rostrum." Each case contains only one individual, and when this has assumed its perfect form it emerges from the orifice at the upper end. There is much in the history and economy of this little insect which is still a mystery to us, but enough is known to make us wish for more. Analysis of these curious nests has shown that they contain gum, starch, and sugar in their composition, and when thrown into water, at the ordinary temperature, they swell, partly dissolve, and become converted into a pasty mass. In Turkey and Syria they are collected and employed as food, many being sent to Constantinople and other Turkish cities, where they are regularly offered for sale. Some of this substance was exhibited in the Turkish department of the Great Exhibition of 1851. The insect itself is of an oblong form and black, about three-fifths of an inch in length. Its snout is projecting, with the antennæ attached on either side about half-way down. The elytra or wing-cases are marked on the surface by ten punctured lines, which commence at the upper edge and unite before reaching the opposite extremity.

SHUKHUR-OOL-ASHUR, or *Shukhur treghal*, is a very similar substance, and consists of the nests of just such another little beetle. In

FIG. 2. *Shukhur-ool-Ashur.*

this instance the country of production is India, where the cases are known by the Arabic names already given ; they are far from common, but are collected by the natives and employed as a kind of manna. The plant on which they are found is the Mudar or Ashur (*Calotropis gigantea*, and probably allied species), whence the name "Sugar of the Ashur" is derived. Dr. Royle, in his "Himalayan Botany," says of it: "This is a sweetish exudation formed on the plant, in consequence of the puncture of an insect called *Gultigal.*" With but little modification this paragraph has been repeated by subsequent authors, and is almost the whole knowledge we have possessed of this substance or its fabricator. Having obtained specimens of the *Shukhur* from India, I succeeded in discovering one of the beetles still enclosed in its case, all the other cases being empty. This insect, with its nidus, I submitted to Mr. Smith, of the British Museum, for identification, and he has declared it to be the species known as *Larinus ursus* of Fabricius. It may now, therefore, be affirmed with confidence that the sweetish cases, or "sugar" of the *Calotropis* is the nidus of a small beetle known in Arabic as *Gultigal* (which, being interpreted, appears to mean "flower-nest"), and to entomologists as *Larinus ursus.* It is very much like the insect that produces the *Trehala,* as also is its nidus (see fig. 2); although I am not prepared to affirm that both are in reality the same species, under different names, but should rather be disposed to regard them as distinct.

POONYET.—Whilst upon the subject of "Insect-homes," I cannot resist adverting to the substance, which is found in Burmah, and called *Pwai-ngnet* or *Poonyet.* It is a blackish resin, channelled with little chambers or cells, by some species of Dammar-bee. and is found in holes in the ground, and in hollow trees. This resin, or wax, is employed by the Burmese for caulking boats, and is constantly on sale in the bazaars. The resin which I have seen under this name is slightly fragrant, and apparently identical with that of *Canarium strictum,* the honey-combed structure alone excepted. The latter resin is common in Travancore, in Southern India, and Mr. J. Brown, of Trevandrum, says that it exudes from cuts in the trunk of the tree, and seems to be a great favourite of several species of insect, especially of one resembling a bee, called by the Hillmen *Kulliada,* which live in pairs in holes in the ground. It is singular that the same tree is common in Malacca, where it yields a black resin, and there also is found a honey-combed resin, which the natives call "Dammar Klotee," and which is said to resemble the *Pwai-ngyet,* although the cells are larger, and the resin blacker and harder. This substance I do not remember to have seen. Dr. Mason, of Rangoon, states that he forwarded some specimens of the insect which produces the Burmese *Pwai-ngyet,* to Mr. F. Smith, and that he identified them with *Trigone Lœviceps,* which had been first received from Signapore. The conclusion, therefore, at which I have arrived, is to the effect that the "honey-combed resin," of Pegu and Burmah is the natural resin which exudes from the bark of the Black Dammar tree (*Canarium strictum*), channelled and perforated by the insect known in southern India as *Kulliada,* and which is also found at Singapore, as well as in Pegu and Burmah, and recognised by entomologists as *Trigona Lœviceps,* but whether the resin is perforated in its soft state, soon after it issues from the tree, or, if after it becomes hard, how the feat is accomplished is more than I am at present able to affirm. Perhaps some correspondent who resides near one of the localities indicated will institute inquiries, render our information more complete respecting the economy of the Dammar Bee.—M. C. COOKE in 'Science Gossip.'

VEGETABLE FOOD.

Food yielding fat and oil is supplied by both the vegetable and animal kingdoms. The distinguishing feature of the following articles of food is the oil they contain :

OLEAGINOUS FOOD.

Under the names of oil, butter, fat, lard, suet, grease, a substance is used largely as an article of food, which differs chemically from starch and sugar in the small quantities of oxygen gas it contains. The composition of these oleaginous substances may be represented generally as follows :—Carbon eleven parts, hydrogen ten parts, oxygen one part.

Oil differs from the other carbonaceous substances in food in not only supplying materials for maintaining animal heat, but in forming a part of the tissues of the body called fat.

Its action as a heat-giver is greater than starch or sugar, as it supplies hydrogen as well as carbon for burning in contact with oxygen. Its power as a heat-giver compared with these is as two-and-a-half to one. It is very generally present in both animal and vegetable food. The action of oil on the system is not, however, confined to its heat-giving powers. It seems essential to the development of the fleshy part of the body. Hence it is found present in the eggs of animals. Fish-oil is given in those diseases where a wasting of the flesh is present, as in consumption.

The animal system has the power of converting starch and sugar into fat. All ruminant and hybernating animals become fat in the summer and autumn. The fat thus accumulated is consumed during the winter in maintaining the heat of the body. Man to some extent obeys the same law, and weighs more during the summer than the winter months.

Oils vary in their chemical composition and physical properties. Many vegetable oils, as cocoa-nut and olive oil, contain two principles one of which is liquid, and remains so at all ordinary temperatures ; the other is solid when the temperature falls below 40 degrees. The former is called *Oleine*, and the latter *Stearine*. Fats, lards, and butters are composed of the latter, or of principles having the same property.

Oleine, stearine, and other fatty principles consist of acids combined with a base. This base is called *Glycerine*, and is separated from oils in the process of soap-making.

The principal source of oil used as food from the vegetable kingdom is the olive (*Olea Europea*). The seeds of most plants contain oil in addition to starch and other matters. The seeds of the palm tribe contain much oil as the cocoa-nut palm (*Cocus nucifera*). So also do the seeds of the cocoa or chocolate plant (*Theobroma cacao*).

The following table gives the quantities of oil or fat in one hundred pounds of the more common articles of food :—

VEGETABLE FOOD.

Potatoes	0·2
Wheat flour	1·2
Barley Meal	0·3
Oatmeal	5·7
Indian Meal	7·7
Rye	1·0
Peas	2·0
Rice	0·7
Beans	2·0
Cocoa	50·0
Lentils	2·0
Buckwheat	1·0
Tea	4·0
Coffee	12·0

ANIMAL FOOD.

Milk	3·5
Pork	50·0
Veal	16·0
Beef	30·0
Mutton	40·0
Fish	7·0
Cheese	25·0

The olive (*Olea Europea*) is cultivated in the south of Europe. The part of the plant which contains the oil is the fruit. The berries of the olives are pressed, and yield the oil which is so extensively employed on the continent of Europe, and known in this country under the name of salad oil. In countries where little butter or fat meat is employed as food, this oil is a most important ingredient in diet.

The seeds of most plants contain oil in addition to starch and other principles. Many seeds are used for obtaining oil for various purposes in the arts, as the poppy, rape, mustard, hemp, and flax seeds. The following seeds, eaten as food, contain oil :—

Almonds	(*Amygdalis communis*).
Chesnuts	(*Castania vesca*).
Walnuts	(*Juglans regia* et *Juglans nigra*).
Peccan nuts	(*Juglans olivæ formis*).
Brazil nuts	(*Bertholletia excelsa*).
Spanish and hazel nuts	(*Carylus avellana*).
Hickory nuts	(*Carya alba*).
Beech nuts	(*Fagus sylvatica*).

Pistacia nuts	. . .	(*Pistacia vera*).
Cashew nuts	. . .	(*Anacardium occidentale*).
Chicha nuts	. . .	(*Sterculia Chicha*).
Pine seeds	. . .	(*Pinus Pinea*).

The seeds of many other species of plants are eaten, and the oil they contain is probably their chief recommendation.

Amongst them may be mentioned the various forms of acorns which are eaten in Portugal, Greece, Asia Minor, and other parts of the world. The sacred bean of Egypt (*Nelumbium speciosum*), and the lotos (*Nymphœa lotos*) of the same region, the water-nuts (*Trapa natans*) of China and Cashmir, and the souari, or butter nuts (*Caryocar buiryosum*) of Demerara.

A bread is made at Gaboon, in Africa, from the seeds of the *Mangifera gabonensis*, called dica or odika bread. By simply boiling in water, from 70 to 80 per cent. of fat can be extracted from this bread. In this respect these seeds resemble chocolate, and it is not impossible that they might be used in Europe in the same way. They are exceedingly abundant in Gaboon.

The seeds of many of the palms yield large quantities of oil, especially the oil palm (*Elaïs guineensis*) of Africa. The seed of the cocoa-nut palm (*Cocos nucifera*) is used as a substantive article of diet in Ceylon and many parts of the East Indies. It is imported into this country for the sake of the oil it contains. The milk in the interior of the seed is a blank fluid, and when the nut is fresh gathered, is a cool and pleasant drink. In the young state the seeds of most palms are filled with a cool fluid consisting mostly of water. This fluid is drunk by the inhabitants of the countries in which they grow. The double cocoa-nut of the Seychelles Islands (*Loidicea Seychellarum*) contains sometimes as much as fourteen pints of water, and is drunk by sailors touching on these islands with great relish. Even the hard ivory-nut (*Phytelephas macrocarpa*) contains when young a fluid which is drunk by the natives of the countries in which it grows.

Amongst vegetable foods yielding oil the cocoa or chocolate plant (*Theobromo cacao*) is one of the most remarkable. The seeds of this plant contain 50 per cent. of a hard oil or butter.

Food is sometimes preserved in oil which, on account of the small quantity of oxygen it contains, prevents animal or vegetable substances from putrefying. A familiar instance is known in this country in the case of the fish called sardines, which are thus preserved. Oil is used for this purpose in China.

Acids.—Many of the organic acids resemble closely in their composition starch and sugar, and may to a certain extent act on the system in the same way. They are therefore referred to the carbonaceous group, but there is no reason to suppose that in any system of diet they could be substituted for any of the other substances in the group. The following paragraphs explain their action ;

Organic Acids enter extensively into the composition of various kinds of food. The acids most commonly used in diet are—Acetic acid, citric acid, tartaric acid, malic acic, oxalic acid.

As articles of diet they probably all act in the same manner on the system. They all exert a solvent power over mineral substances, and assist in carrying the alkalies and alkaline earths into the blood. There is also reason to believe that in certain states of the system they favour the development of the gastric juice in the stomach, and assist, by their decomposition, in oxidising the materials of the blood. In all cases they act medicinally, or as auxiliaries, to the first class of foods.

Acetic Acid, or *Vinegar*, is obtained either from the oxidation of alcohol in fermented liquors, or from the distillation of wood. Common vinegar is obtained from the oxidation of the fermented wort of malt. Vinegar is added to sauces and food to give them a flavour. It also preserves vegetable substances from decomposition, and is used in the manufacture of what are called "Pickles."

Citric Acid is contained in many fruits, but it exists in greatest abundance and purity in the fruits of the Orange tribe (*Aurantiaceæ*). Citric acid is separated from the fruits of these plants in a crystalline form.

Tartaric Acid is found in the juice of the fruits of the vine tribe (*Vitaceæ*), more especially of the common vine (*Vitis vinifera*). This acid gives the acidity to the fruit of the grape, and is the acid present in wines. It forms with potass an insoluble salt, known by the name of cream of tartar.

Malic Acid is contained in the fruits of the rose tribe (*Rosaceæ*). It has the same general properties as the other acids, and is contained alone in apples and pears, whilst in cherries, plums, &c., it is mixed with other acids.

Oxalic Acid is contained in the wood sorrel (*Oxalis acetosella*, also in the common sorrel (*Rumex acetosa*), and various species of rhubarb (*Rheum*). Species of the latter genus are extensively cultivated in this country, and the petioles of their large leaves cut up and made into pies, puddings, &c.

The basis of vinegar consists of acetic acid, which is composed of carbon, hydrogen, and oxygen ; the same elements that enter into the composition of alcohol. This compound is also procured from the distillation of wood. The acetic acid thus procured is called pyroligneous acid. The quantity of acetic acid in vinegar is from four to five per cent. Malt vinegar contains, besides acetic acid, water, dextrin, and frequently sulphuric acid. Wine vinegar contains besides acetic acid, the constituents of the wine from which it is made, as tartaric acid, &c. Pure vinegar is transparent, but burnt sugar is added to give it a colour, on account of a popular prejudice in favour of coloured vinegar.

Various kinds of fruits, leaves, and parts of plants are preserved in vinegar and added to food. Some things are used in this way which are not otherwise employed. This is the case with the caper, which is the fruit of the *Capparis spinosa;* and the stertion, the fruit of the Indian cress (*Tropæolum majus*). A collection of fruits and plants preserved in vinegar will be found on the shelves devoted to the exhibition of "acids."

Sugar may be converted into vinegar by the aid of vegetation. The so-called "Vinegar Plant," of which a specimen is exhibited in the Museum, is the *mycelium* of a fungus, which, during its growth in sugar and water, decomposes the sugar, and the result is the formation of the vegetable matter of the plant, and the development of acetic acid.

The natural order Aurantiaceæ embraces the orange, the lemon, the citron, the shaddock, the pomelot, the lime, and other fruits. All of them contain citric acid, and varying proportions of sugar.

The flowers of the orange yield a delicious perfume known as oil of Neroli.

The juice of these fruits is employed in the Navy for the purpose of preventing scurvy amongst sailors. This effect has been attributed solely to the citric acid, but it has been found that the acid alone does not act so efficaciously as when contained in the juice of the fruit. Hence some writers have attributed the effect to a chemical compound of the acid with other ingredients of the jnice.

Citric acid is also found in many fruits, but mixed with other acids, as in the berberry, strawberry, &c.

Tartaric Acid forms with potass an insoluble salt, known by the name of argol, and, when purified, cream of tartar. This salt is found in the lees of wine. By burning it the tartaric acid is converted into carbonic acid, and the salt of tartar (carbonate of potash) is made from the tartar of wine. Hence also the name tartaric acid. The dried fruits of the grape (*Vitis vinifera*) are known by the name of "raisins" and "currants."

The tomato is the fruit of the *Lycopersicum esculentum,* and on account of its acid flavour is used as a sauce.

The edible products of the natural order Rosaceæ, comprising the fruits of the apple, pear, apricot, nectarine, peach, cherry, plum, raspberry, strawberry, contain malic acid. They are mostly preserved in sugar. Many forms of plums called prunes contain a sufficient quantity of sugar to be dried and preserved without further preparation.—'Guide to the Food Collection in the South Kensington Museum.'

BORDEN'S EXTRACT OF BEEF.

At a recent meeting of the American Institute Farmers Club, held at New York, some interesting information was furnished, of a product which Mr. Borden is about introducing to the public, for it is of great interest to producer and consumer. To the farmers who live remote from market, it is of great interest for him to know that all the most valuable portion of a bullock can be extracted near its home on the great Western pastures, and put into such a form that it will save all the waste and nearly all the weight of transportation to market. To the city consumer, and above all the sick, this extract is of the utmost importance, for it insures the finest nutriment in the world, in the most healthy condition, and concentrated form. The extract is not gelatine, in the form of glue, for it is more like soft leather. Yet in a little hot water, it dissolves into an almost clear liquid, which is palatable to all tastes, when seasoned to suit, and nutritious, stimulating and refreshing to any person, faint for want of sustenance.

This little cake, weighing only two ounces, represents two and a half pounds of the very best quality, for the bullock fresh from the pasture was killed and put into the great chemical retort before any process of deterioration could have possibly begun. In short, then, this is nothing more nor less than the juices of choice beef cooked in the most perfect manner, concentrated by evaporation in vacuo (without addition of salt or any condiments) into the smallest possible bulk, and comprises the nutritive value of twenty times its weight of fresh beef of the first quality.

Without the cattle fed upon the Western prairies (observed the chairman), this city, New York, could not enjoy its roast beef, steaks and soups. Without railroads how should we get the vast numbers received? —last year over 267,000 head. If they came on foot they might be healthy, but the fine rich juices of the meat would be nearly all wasted upon the long march over plains and mountains. Upon railroads, do they reach the city in a healthy condition fit for human food? Sometimes, and sometimes far from it. I have known droves arrive which have been five days upon the cars, *without food or drink.* Think of giving such food as such meat would make to a sick friend. Thanks to the inventive genius of Mr. Borden, we are not now obliged to go to the butcher and risk the purchase of what would tend to kill, sooner than cure, when we need something peculiarly nourishing to the convalescent. Here it is. It comes from a great manufactory which Mr. Borden has established at Elgin, Ill., forty miles north-west of Chicago, where the extract is made from mature, healthy, grass and corn fed bullocks.

It may not be as well known to you, as it is to me, that beef fresh from prairie grass is the most delicious of any in the world, yet such a bullock transported to New York loses largely in weight, and almost inconceivably in quality. The fine aroma and the delicious nutritive juices obtained from the sweet prairie grass are all gone. You will find them all concentrated in this extract, which is not to be confounded with, nor mistaken for, any preparations of gelatine, made in Europe or this country, for there is nothing else like it. This is an American discovery, and a pure genuine American article.

Gelatine was formerly thought to be nutritious. This is an error. It has been ascertained that it is not capable of contributing to any of the requirements of the organism, but is excreted mainly by the kidneys very soon after its absorption into the blood.

By protracted boiling in water, the tendons, membranes, and cartilages, are converted into gelatine, and the same substance may be obtained in large quantities from bones, skin, hoofs, horns, &c.

Soups, *properly made*, consist of the *juices* of meat extracted by maceration with hot water. If bones, cartilages and tendons, in large proportion, as is sometimes done, be added to the meat, and the boiling long continued, a soup is obtained, which, though it may *appear substantial*, is really, in a great measure, devoid of nutritious qualities, consisting, as it must, chiefly of a solution of gelatine, which, alone, is incapable of supporting life.

Preeminent among stimulating, supporting and reconstructive aliments are the juices of good beef; and this for the simple reason that they embrace those indispensable constituents of an animal organization which are, as it were, the fuel and the forces needful to keep up healthy vital action; and so they are able to contribute to the well-being of another animal organism to which the powers of life are more or less prostrated, by reason of the abstraction from it of these very elements in consequence of disease.

This extract is a great improvement upon "meat biscuit," as originally made by Mr. Borden in Texas, which "received the commendation of scientific and practical men, both in America and Europe, and to which, after full investigation by a committee consisting of Dr. Lyon Playfair, Professor Solly, and other celebrated men, was awarded the Great Council Medal (the highest award made in any case) at the International Exhibition at London in 1851—an honour shared only by three other contributors from the United States. The meat biscuit was used and commended by Dr. Kane, in his Arctic Expedition, as well as by many others upon various expeditions, long voyages, overland journeys across the continent, and in hospital and household use."

Dr. J. V. C. Smith, former Mayor of Boston, now Professor of Anatomy in New York, gave his experience at some length in the soldiers' hospitals at the South with preparations of condensed food, made by various parties in the country who are anxious to introduce it into hospital use. He found generally that the patients relished the soups prepared from it once or twice, but soon tired, and none that he tried gave full satisfaction. For many purposes, such as travelling over deserts, condensed food is a necessity. He had found it so at one time, when for thirty days he was on camel back, but he became so tired of it that he thought he should prefer a soup made of bones which we throw away. He hopes this article will prove more valuable than anything which has preceded it, even Borden's meat biscuit, of which mention has been made, and which he is aware has been so serviceable to travellers.

Mr. Goodale said this article differed materially from anything which has preceded it. Mr. Borden has been for twenty years earnestly endeavouring to produce something which would be highly valuable for hospital purposes. He at length succeeded in producing the article about a year ago, and so far it has met the universal approbation of physicians. Beside the higher degree of concentration, this extract differs from the meat biscuit, as it contains no farinaceous constituent, and the flavour and essential qualities of the meat are more fully preserved.

Professor S. R. Percy gave two cases in his practice where this extract used as a medicine produced the most beneficial results. A gentlemen who had been two weeks suffering with typhoid fever, had become very much reduced, when Dr. Percy was called in consultation. He found the patient in a very prostrate condition, with a very rapid and feeble pulse, and a stomach so irritable that it rejected almost everything that was taken. At the first visit a perfect change in the diet was ordered. Borden's beef extract alone was given in teaspoonful doses. Within four hours from the change of diet the pulse had become more quiet and fuller, the vomiting entirely ceased, and he slept quietly. No medicine was given for several days, but the beef extract was alone used. He recovered quickly. The second case was that of an officer in the army, who had served in the West and contracted miasmatic fever and dysentery of the very worst form. When Dr. Percy first saw him, he had been suffering with this dysentery for about seven months, and was now given over as incurable. A quantity of Mr. Borden's beef extract was obtained and fed to him in teaspoonful doses every half hour. The *Collinsonia canodensis* was alone used as a medicine. A marked improvement was quickly seen, and on the 16th day he was able to be carried out of doors and up and down in the sunshine. For two weeks no food of any description was given to him but this beef extract. There is one peculiarity about the use of this extract with debilitated persons—its effects are always recognizable by the pulse, making it fuller and stronger; and this may be noticed within half an hour of its administration. He could say much on the use of this beef extract in cases of sickness: the article was so good that it needed only to be used to recommend itself.

A SUBSTITUTE FOR GLUE—VEGETABLE ALBUMEN.

An improved process has been invented by E. Hanon, of Paris, by which he obtains vegetable albumen from gluten, for the purpose of applying it as a cheap agent for fixing printed colours on textile fabrics, and also for uniting pieces of wood, leather, &c. The following is the substance of the specification, as published in 'Newton's London Journal of Arts':—

Gluten is obtained by kneading wheat flour paste with water. During the operation of kneading, the feculent part of the paste is carried off with the water, and the glutinous parts unite and form an elastic substance called gluten, which contains about twice its weight of water; the gluten, in this state, is converted into albumen, by the process of fermentation.

In carrying out the invention, gluten of the best quality, free from fecula, and after having been well washed in warm water, is placed in vessels, in which it is left to ferment until it is completely soft, and has lost its elasticity, and until the greater portion of the water which it has taken up during the operation of kneading is combined with it; when the gluten has undergone the regular fermentation or modification, it offers no resistance to the finger, or to any article which may be passed through the mass, and the modified gluten should also adhere to the object with which it is brought in contact. The gluten, so modified, is then ready for use; but as it has been brought, by the process of fermentation, into a very thin paste, it is necessary to place it in moulds for drying.

The process of fermentation may be performed, either with or without the aid of artificial heat; when artificial heat is applied, the process is considerably expedited, and the heat found most beneficial is about 20° to 30° Fah., above the temperature of the surrounding atmosphere. During the fermentation, it is requisite to stir the gluten frequently, and to remove the water which rises to the surface. With the above temperature, and in operating upon about fifty or sixty pounds of gluten, placed in a vessel, the fermentation will be sufficiently advanced in three or four days, and the fermented gluten or vegetable albumen, will then be in the proper state for being made into thin plates and dried. The greatest care must be taken that the fermentation is stopped at the proper point, for if it is allowed to proceed too far, the gluten is converted into a noxious mass.

When the gluten is converted into vegetable albumen it is divided, and formed into plates of about one quarter to three-eighths of an inch in thickness; this is effected by spreading the albumen in metal or other moulds by means of a spatula; it is then left to dry, either in the open air, or by the aid of a gentle heat, and the plates, when dry, are about one-eighth of an inch in thickness.

The process of converting gluten into vegetable albumen may be accelerated in the following manner :—The gluten is put into a vessel or boiler, and heated by steam, or in a water bath, but the heat must only be sufficient to soften the gluten, and should vary from 105° to 140° Fah. The gluten combines and unites with the water which became incorporated with it in the operation of kneading ; part of the water is, however, evaporated during the process of fermentation, and that the time required for drying the modified gluten, in the manner before described is reduced. The water and gluten, when united, form a perfectly homogeneous mass of a thin pasty consistency, which is removed from the vessel, and dried, as before described ; or the drying chamber may be heated by steam, care being taken that the heat is very moderate. When dry, the vegetable albumen takes up the greater part of the water which it has lost through evaporation during the process of desiccation. In order to dissolve it, it is put to steep, for about forty-eight hours, in cold water, and, by preference, in soft water ; during this time it should be frequently stirred. Before being used the liquid should be diluted with water, and well stirred and shaken up, so that the whole mass of solution is perfectly homogeneous. The quantity of water for dilution must be regulated according to the purpose for which the solution is required. One pound of the so-called vegetable albumen to one pound and a half of water will give a solution which may be used as a substitute for the strongest glue or gelatine, and which resists moisture to a great extent, and is not influenced by heat.

The solution may be used cold, and will retain its properties from ten to fifteen days in summer, and twice as long in winter ; that is to say, if it is kept cool, and, if possible, in a current of air.

This vegetable albumen is applicable, first, for uniting pieces of wood, in lieu of glue or gelatine ; secondly, for uniting pieces of porcelain, earthenware, glass, enamel, and other similar articles ; thirdly, for uniting pieces of leather, skin, linen, paper, pasteboard, and other similar substances ; fourthly, for rectifying, clarifying, strengthening, preserving, and generally improving malt liquors ; fifthly, for sizing paper and warps ; sixthly, for sizing, dressing, stiffening, and thickening every description of woven fabrics and silks, instead of, or combined with, animal gelatine, gum, dextrine, fecula, or other substances ; seventhly, for fixing all colours, except ultramarine blue, in printing fabrics ; it is requisite to add from ten to twenty-five per cent. of acetic acid, of the strength of seven or eight degrees of Beaume's hydrometer, to the vegetable albumen, which is then thickened in the ordinary manner with fine wheat flour, starch, fecula, or dextrine of wheat, care being taken to boil the same from ten to thirty minutes, according to the degree of concentration, and the consistence of the colour required. Before use, the mixture should be allowed to cool sufficiently to avoid coagulation. For ultramarine blue, a little ammonia is used, instead of the acetic acid ; the vegetable albumen must then be dissolved in, or combined with, a solution of slacked lime or phosphate of lime or magnesia. Eighthly, as a mordant for fixing colours in dyeing ; ninthly, as a means of fixing gold or other metal leaf on to fabrics, leather, or other materials. In this case, the vegetable albumen, in the form of a dry powder, is rubbed or spread on the surface of the fabric or other material ; the gold or other metal leaf is then placed over the part to be figured, and it is fixed thereon by the pressure of a heated die or roller, on which the design is made in relief. The metal may be applied in any other form, instead of in leaf.

THE SUGAR TRADE.

We Englishmen, in our national pride, are too apt to pre-suppose that we can beat all foreigners in machinery and its applications to our own particular province. But this over-confidence in our own merit has lately had some severe shocks in the inability of English to compete with foreign machinists in supplying locomotive engines and other machines. Presumptuous persons have even ventured to hint that we are far inferior to the French, and even to the Scotch, in everything connected with sugar-making ; but the chilling reception given to their insinuations has discouraged a repetition of the attempt to shake the confidence of Londoners in the skill of their countrymen. The foreigners certainly use a far better class of sugar for refining, and it would be worth while to find out why they do so. Is it because the continental consumption of brown sugar is limited, and that in consequence of this fact the refiners buy a strong and fine sugar in order to leave as little pieces as possible ? If this explanation be correct, it is evident that the reason of the foreigners making cheaper sugar is found ; for in order to enable the pieces and bastards left after extracting the loaves to compete with raw sugar, the London refiners have been obliged to sell the lower products at little or no profit, and to get their profit from the stoved sugar. The English public use brown sugar in very large quantities, and there is thus some apparent justification for the practice of buying comparatively low qualities at a cheap rate, with the view of supplying the consumption of brown as well as of white sugar ; and the system, though wrong in theory, answered very well while an extra protection duty was levied on the foreign refined. Since the imposition of the 12s. 10d. instead of the 18s. 4d. rate, the practice has to some extent been abandoned by our refiners, to enable them to keep the Dutch and French goods out of the market, but we might surely with profit use a stronger sugar for refining. Some light has recently been thrown on the kinds most suited to the refiner by examinations carried on with polarized light by M. Emile Monier, into the constitution of sugar, and published in his work, "Guide pour l'Essai et l'Analyse des Sucres." (Paris : E. Lacroix.) This book contains a perfect mine of information for refiners, and it would seem that the polariscope, or optical saccharometer, by which the results given are arrived at, is not nearly so well known among us as it ought to be. By the use of this delicate instrument, the saccharine richness of sugar can be shown to the minutest fraction, and the system of classification by shades of colour, or of types, is shown to be delusive. A yellow sugar, of which the crystals are clear and good, is often richer than a white sugar, of which the crystals are hardly formed or badly defined. The richness also varies in samples of sugar of the same shade of colour. Thus, No. 12 of French beetroot sugar contains from 92 to 97 per cent. of crystallisable sugar—a difference of four per cent. in richness, and a margin of four francs in the buying price. At the same time this sugar (No. 12), when good, contains 97 per cent., or the same saccharine richness as some samples of Nos. 18 and 19, worth 4s. or 5s. per cwt. more in the market. M. Monier states that beetroot sugar, as presented in the market, is richer than any other kind of saccharine matter, and gives the greatest yield when refined. The principal distinction between cane and beetroot sugar is, that the former contains from ten to fifteen times as much glucose or incrystallisable sugar. Independent testimony to the superiority of the beetroot to the cane sugar is given by Mr. Barron, in his report upon the Belgian sugar industry ("Reports of the Secretaries of Legation," No. 6, page 208):—"Beetroot sugar is preferred by the refiners for the volume and whiteness of its yield. In refining it gives a much larger yield in loaves than Havana or Jamaica sugar." After the beetroot, M. Monier places the sugars of Java, Cuba, Mauritius, and Bourbon ; and last, those of Martinique, Gaudaloupe, and Porto Rico. We should be curious to know where M. Monier would place the lower class of British West India sugars, on which he has apparently made no experiments. We fear they would end his list. These analyses throw considerable light on the question of why the foreign refiner can produce loaf sugar more cheaply than the English—it is by the use of beetroot, Java, Cuba, and Mauritius sugars, instead of inferior kinds. The interest taken by the trade in the imports of beetroot will be added to as the refiner makes more loaf sugar from it. With some approach to free trade in sugar, English refiners must be ready to make changes in their manufacture, or they will continue to lose ground. In the revenue returns for the year 1864-5, a charge appears for British native sugar, and this item has led to some speculation on the part of those interested in the subject, as to whether beetroot had again been tried in England. That starch sugar was made in this city was certainly not generally known, as it was thought that the manufacture was prohibited by the excise. The following extract from the 'Times,' however, shows that a general misapprehension existed on the subject : — "British made sugar has long held a merely nominal place in our list of exciseable articles, but in the past year two manufactories of glucose, or starch sugar, have been established in London. The quantity brought to charge in the financial year 1864-65 was 1,064 cwt. The materials from which this sugar are made is chiefly sago and potato starch. It has but little resemblance to cane sugar, and less sweetness than the lowest class of colonial sugar. The rate of duty with which it has been charged is 9s. 4d. per cwt., being that on yellow Muscavado or brown clayed sugar. It is stated that it is intended to be used in brewing. The imposition of the 9s. 4d. rate on sugar possessing so little saccharine matter gives a new instance of the injustice of the scale of duties.

Scientific Notes.

New Paper Material.—M. Caminade has taken out a patent in France for manufacturing paper from the roots of the lucerne plant. When dried and beaten, these show thousands of very white fibres, which form an excellent pulp for paper-makers, and may be substituted with great advantage for rags. The three species of lucerne, *Medicago media*, *M. falcata*, and *M. maculata*, produce equally good roots for paper-makers' use. M. Rabourdin, an experienced agriculturist, states that the month of December is the best time for taking up the roots of the plant. The earth is then moist, and a great part of the root can be easily drawn. In the months of January or February following, a harrow may be drawn over the land, and the remainder will then come to the surface. The roots are then to be well washed and delivered to the paper-makers. The pulp produced is said to be equal to that of ordinary rags. The roots are to be first pressed between two rollers to open them, and when sufficiently crushed and dried, they are left to soak in running water for fifteen days or three weeks. The pulp, besides the fibre for paper, produces salt of soda and a colouring matter, called by the inventor "luzerine." It is calculated that France produces annually seventy-five million kilogrammes of paper, of which one-seventh is exported, leaving not more than two kilogrammes for each inhabitant. It is consequently inferred that the production of paper would increase considerably, were it not for the scarcity of the raw material. It requires one pound and a quarter of rags to make one pound of paper. Rags are eagerly sought for by every nation where paper is manufactured, hence this warm competition makes rags scarce and dear. M. Lafon, of Candeval, considers that the *Arundo festucoides*, or wild hemp, which grows abundantly in vast tracts of land in Algeria, might be much more utilised than it is for paper material. At least twenty or thirty millions of hectares are covered with this plant. While rags cost from 270 to 300 francs the ton, the pulp made with this wild plant might be sold with advantage at one-third of this price. Dr. O'Rorke, after alluding to the employment of this plant by the ancients, thinks that paper made with this pulp would want consistence, but M. Lafon refutes this objection by furnishing paper made of it, which is tough, and offers great resistance.

ANTI-CORROSIVE BROWN PAPER.—An entirely new description of brown paper has been introduced by Mr. John Gladwin, paper manufacturer of Ecclesfield near Sheffield. This paper is made of materials peculiarly adapted for giving strong and resisting properties, and by the introduction of a powerful anti-corrosive element, a high standard of quality is obtained for cutlery and steel goods, the extinct moisture being totally excluded. Goods requiring the moisture to be retained, may also be folded in it advantageously. A stouter make of this paper is also adapted to the same purpose as the usual make of waterproof paper. To test its quality, a paper vessel may be made of, and filled with water, which will remain until it is exhausted by absorption from the surface ; when empty, the sediment may be cleaned out from the bottom and the vessel refilled as often as may be desired. A more severe test of quality may be made by suspending a vessel filled with water over a flame ; it then exhibites fire-proof properties the water in the vessel becoming heated. Under the process of glazing, it attains a higher degree of finish. There is no difference in appearance between this and the ordinary brown paper no surface covering to render it waterproof, its own inherent properties suffice for this purpose. The inventor says there is no necessity for holding paper in stock to season for years as is now the custom of cutlery manufacturers ; and that if this is used in a few months it will answer every purpose, thereby saving the cost of keeping large stocks. By rolling, this paper takes a highly glossy appearance.

THE TECHNOLOGIST.

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ON THE MANUFACTURE OF GOBELINS TAPESTRY AND OF SAVONNERIE CARPETS.

BY A. L. LACORDAIRE,
Director of that Establishment.

The Imperial manufactory of Gobelins includes two distinct works: that of historical tapestries or mural hangings, and that of carpets in fine wool called Savonnerie, from the name of the house where they were first made. ("*La Savonnière.*")

These two textures appear to have been in use from the most remote period of time; they are mentioned in the most ancient documents transmitted to us by history and by monuments; the art of manufacturing them was imported from the East into Europe at a period difficult to determine, but which for France does not appear to be further back than the ninth century. Saint Angelure de Norvége, Bishop of Auxerre, who died in 840, had a great number of carpets executed for his church;(*a*) about 985, the Monks of the Abbey of Saint-Florent de Saumur manufactured themselves in their enclosures, tapestries and different stuffs,(*b*) Matthew de Loudun, Abbot of this Monastery, nominated in 1133, had an entire suite of hangings executed by them for his church; on one of the pieces which ornamented the choir was represented the four and twenty elders of the Apocalypse; on another piece a subject taken from the same book, and on that of the nave, the hunting of wild deer.(*c*) Towards the year 1060, Gervin, Abbot of Saint-Riqrier, was remarkable for his liberality in the purchase of

(*a*) Le Bœuf, Histoire d'Auxerre, tom. 1, page 173. Le Père Labbe, Histoire de l'Eglise d'Auxerre, chap. xxxv.

(*b*) DD Martenue et Durand, Historia Monasterii Sancti Florenti Salmuriensis Ampl. col., tom. v.

(*c*) *Ibid.*

hangings and for the *carpets* which he ordered.(*a*) At Poitiers, in 1025, there was a manufactory of tapestry and of carpets on which were represented figures of animals, portraits of emperors, and subjects taken from sacred history ;(*b*) the towns of Reims, Troyes, Beauvais, Aubusson, Felletin, Tours, and Arras, had seen this industry naturalised amongst them at an early date.(*c*)

In the considerable development and progress which these distant epochs present, not only in France, but also in different parts of Europe and above all in Flanders, the East can only claim the primitive elements, and the fact of a simple initiation ; the coarse images and rude figures with insipid colouring traced on some of the ancient Persian or Byzantine tissues, are very different from the personages and scenes represented on the tapestries of the West.

The history of this branch of the arts in France since the ninth century appears to divide itself into three distinct epochs :—

In the first, the tapestry worker only makes use of a simple and expeditious process ; he has his invariable tone composed of a few tame colours fixed on the wool or silk by the dyer, and for models simple designs, superficially tinged, of which he makes, with regard to colouring, but an inaccurate imitation and purely conventional ; all is combined for expeditious work. The tapestries that result from this system present, and only can present (whatever may have been at first the quality of the models employed), a uniform tone in all their similar details, and an absolute want of harmony. This was the era of *industrial tapestry*, an epoch which seems to embrace the whole of the productions of this art, from its origin in France to the foundation in 1662, of the manufacture of regal furniture by Louis XIV.

The second epoch is that where by taking a new direction, the worker gradually abandons his own colouring, and where the models, too, are modified. Simple designs lightly touched give way to paintings more and more finished. Such changes cannot be effected without difficulty ; they gave rise to a struggle between the industrial and artistic principles, a struggle which was personified in the Gobelins manufacture, from 1662 until towards the end of the eighteenth century.

In the third and last epoch, industrial tradition and conventional colouring disappear as much as the nature of the tissue and the resources of the dyer permitted with the employment of wool and silk

(*a*) In palliis adquirendis, in tapetibus faciendis. Vit. S. Gerv., c. vii. ; apud d'Ach. et Mab., Ibid., tom. ix., p. 322.

(*b*) Hist. Episc. Antissiod, cap. liii., apud Labbe, Nov. Bibl. Manuscr., tom. i., p. 457 ; Le Bœuf, Mém. Concern. l'hist. d'Aux., tom. i., part 1, p. 258 ; Chron. Gaufredi, cap. ix, apud Labbe, Ibid., tom. ii., p. 283 ; Episc. Carnut. elogia—apud Mabill. Analecta vet. monum., tom ii., 598.

(*c*) In this enumeration of towns, *Arras* is comprised as having been a part of France for two centuries ; but, in reality, it is to Flanders that the celebrity belongs of this town in its industry in carpets and hangings.

instead of fluid colouring. The last efforts of the artist in tapestry result not in a copy but in the transfer of character, where the different qualities of the model are rendered with a harmony and skill unknown in preceding centuries. These productions surpass the ancient tapestries as much as modern engraving upon box-wood, executed by the most skilful artist, surpasses the engraving upon pear-tree wood of the fifteenth and sixteenth centuries. This perfection, the only reason for the existence of the actual art of tapestries, does not prevent some lingering remnant of the industrial element, though become totally subordinate. But it is difficult to go back upon the course of ages; we can no more reproduce the tapestries of the early eras than we can restore the Byzantine School of Painting.(*a*)

The most ancient manufacturers of tapestry in France, named in the registry of trades and merchandize in the city of Paris, bore the name of Sarrazinois. From the twelfth century, under the reign of Philippe-Auguste, they formed in Paris an important corporation, amongst other privileges due to Royal protection, they enjoyed gratuitously an exemption from watching, and from paying to the king tribute of what they bought or sold in their trade. They had also permission to dye their *stuffs*.(*b*)

These privileges of a certain importance at that time, were justified by the peculiar conditions of the industrial work, or, more correctly speaking, the art of tapestry, an art requiring a long apprenticeship, a variety of learning and information, and considerable expense, all circumstances perfectly appreciated, even at the epoch when workers in tapestry were classed amongst simple artizans. An exact notion is not given of the work executed by the *Sarrazinois* artisans, which appears to have consisted chiefly in a sort of embroidery. This much may be affirmed that they did not work in tapestry, and that other artizans called "*haute liciers*" (*high warp* weavers) established a long time after them in Paris, entering into competition, it became necessary, towards the end of the fourteenth century, to terminate their differences by an union of the two industries in one and the same company.

This incorporation, commenced in 1301, was finally established by the formation of public statutes transcribed in the records of the castle, the Saturday after the disputes of the following year.

The Sarrazinois artists and the artists in tapestry formed separate bodies until 1625, when they were united to other bodies of trade having very little affinity; makers of bed coveri g in serges, coverlets woven in squares, ticking makers, counterpanes, &c. But already the Sarra-

(*a*) These general remarks, it must be understood, only apply to the manufacture of Historical Tapestry, of which the manufacture of Gobelins is, in the entire world, the only representative, and has been for a great length of time.

(*b*) Thus were named the first materials entering into the tapestry work, silk, wo ol, wire-drawn gold or silver.

zinois had experienced so many transformations, that their primitive industry, almost forgotten, became an object of the most vague conjecture. On this subject, about 1632, Peter Dupont, Master of Tapestry to Henri Quatre, expresses himself:—

It is to be presumed that after the entire ruin of the Saracens by Charles Martel, in the year 726, some of those who knew how to make these carpets, fugitives and vagrants, or, possibly, escaped from the defeat and settled in France, to gain a livelihood there, began to establish this manufacture of Sarrazinois carpets. To know of what fabric, or by what method or stuff, these carpets were made one could not judge, save that it is seen by the sentence of 1302 that these Sarrazinois carpets were instituted long before the tapestry hangings, had been long in possession, but were on the decline, and that tapestry hangings began to appear and bury in oblivion and set aside the Sarrazinois carpeting as they have done.

This manufacture, if the same, having failed in France or remained among the Turks, had been lost since that time, we see it, notwithstanding being raised up and re-established in greater perfection than it ever was before, or even than it is in Turkey.(*a*)

These vicissitudes and modifications in the art of Sarrazinois tapestry did not prevent the name from perpetuating itself until the period when freemen's rights and wardens were abolished, and from figuring in all the rules of the corporation of mitre tapissiers, or tapestry makers.

The first royal manufacture of tapestry was not established in France until about the middle of the sixteenth century. Francis I., in the latter years of his reign collected at Fontainbleau some workers in *haute lice* (high warp) (*b*) under the direction of Philibert Babon, Master of the Bourdaizière, Superintendent of Royal buildings, and of Sebastien Serlio, (*c*) Painter and Decorator to his Majesty. He confided the execution of patterns to several French painters and foreigners who worked at the decoration of this royal residence.

Henri II. whilst preserving the manufacture at Fontainbleau, the directing of which he gave to Philibert de Lorme, his architect in ordi-

(*a*) Extract of chapter ii, of "Stromatourgie, or the excellence of the manufacture of carpets, called Turkey, lately established in France, under the direction of the nobleman Pierre du Pont, tapestry maker in ordinary to the King, and called Works — *mieux faire que bien dire* at Paris in the gallery of the Louvre, at the house of the author, 1632.

(*b*) This denomination (*haute lice*) has its origin in the disposition of the loom on which these tapestries are made. In the "*haute lice*" loom the chain of the tissue is vertically disposed; in the—*basse lice* (low warp),—it is disposed horizontally; hence the essential difference in the method of working and in the products. The "*haute lice*" is at present reserved for great suites of hangings, the "*basse lice*," for tapestry of lesser importance.

(*c*) Named by warrant of 27th Dec., 1541.

nary, established another at Trinity Hospital in Paris,(*a*) which rapidly reached a high degree of prosperity.

Henri IV. in 1597, gave additional impetus to this industry, by creating a new manufactory in the house of the Jesuits, at the Faubourg Saint-Antoine, vacant since the expulsion of those monks. Laurent, an excellent worker in tapestry,(*b*) had the management of it, and Dubreuil, a famous painter (*c*) was entrusted with the furnishing of patterns. The Jesuits having been re-established, one party of the tapestry workers, received towards the end of the year 1603, accommodation in the galleries of the Louvre ; another party, probably the most important, were removed to the house of the Gobelins, and augmented by a number of Flemish workers.

Marc de Comans and François de la Planche, both natives of the Low Countries, were entrusted with the enterprise, and to them was committed the special care and direction of this new manufacture of Flanders tapestry.(*d*) Henri IV. ennobled them and conferred on them, by letters patent (January 1607), the freedom, not only of Paris, but of every city in the kingdom where they wished to establish themselves.

The house of *Gobelins* had then enjoyed more than a century of industrial celebrity ; Jehan Gobelin, first of the name, dyer in scarlet, established himself, about 1450, on the banks of the river de Bièvre, the water of which was at the time considered of a superior quality for dyeing. (*e*) According to a very uncertain tradition he was a native of Reims. Growing prosperity was, in this family, the result of the persevering efforts of several generations, and very soon we find the name of Gobelin allied to that of ancient and noble families, the magistracy, the army, finance, and government. There were still in the middle of the seventeenth century dyers of this name ; but they disappeared towards the year 1650, about the period when the Dutchman, Jean Gluck, brought into France a new process for dyeing scarlet. The

(*a*) Founded in the eleventh century, and suppressed at the commencement of the Revolution, This Hospital occupied the greater part of the small Island comprised between the streets Saint Denis, Grenétat and Guérin-Boisseau ; the opening of the Boulevard of Sébastopol has caused the last traces of it to disappear.

(*b*) Sauval, "Antiquities of Paris," t. xi. (*c*) *Ibid.*

(*d*) This name seems only to have been given on account of the essential difference of the Paris tapestry makers, and that of their Flanders *confrères ;* the former generally employed the *haute lice* loom, the latter worked only in *basse lice.*

(*e*) A reputation very much lowered in the present day ; the waters of this river, infected for more than a mile of their course towards the city of Paris, by the deposits of innumerable bleach-greens and other industrial establishments, are no longer fit for dyeing ; they blacken silver, and destroy by their putrid emanations, the colours of the patterns employed in Gobelins, For a great number of years, there has not been used, even for washing, or in the workshop of this establishment, for dyeing, any but filtered Seine water.

actual works of the manufacture of Gobelins are only united to the industry of these celebrated dyers from having the same workshop for dyeing, common to the two manufacturers of crown tapestry.

Henri IV. also established, about 1604, in the galleries of the Louvre, a workshop of carpets called "à la façon de Perse et de Turquie" (Persian and Turkey carpets), under the direction of Pierre du Pont, a skilful tapestry maker, and this was the beginning of the celebrated manufacture "*de la Savonnerie,*" founded by Louis XIII. in the house of this name, on the Quai de la Conférence, in the place actually occupied by the military.

The house of Savonnerie was originally a soap manufactory. The Queen, Marie de Médicis established there, in 1614, by royal patent the seventh day of May, "poor children, to be lodged, fed, and instructed in the fear of God, and in making several works in linen, cloth and others. . . ." Simon Lourdet, pupil of Pierre du Pont, afterwards his partner, opened there, at an epoch which we cannot determine, but which is anterior to the year 1626, a workshop for carpets, "façon du Perse et du Levant," (Persian and Levant make). Pierre du Pont never lived there, as we are assured by different acts.(*a*)

The 17th April, 1627, both of them received from Louis XIII., the conclusive right to this industry, a pension of 1,500 livres and letters of nobility for themselves and their children, born or to be born, in legitimate marriage, who might follow and maintain the said art and manufacture.

The manufacture of tapestries *façons de Flanders,* left to itself, after the death of Henri IV., appears to have suddenly experienced the fate of the greater number of the establishments founded by this sovereign. In the year 1612 there only remained the manufactures of silks at Lyons, at Tours, and in the South of France.

Marc de Comans and his partner François de la Planché solicited from Louis XIII. the confirmation of their privileges, and obtained, the 8th April, 1625, new letters patent for ". . . the continuance of the fabric and manufacture of tapestries '*façon de Flandres,*' for eighteen years, to commence at the expiration of the term granted by the late king." In 1629, they resigned the direction of this establishment in favour of their sons, Charles de Comans and Raphael de la Planché, but these not being able to agree, solicited and obtained authority to exercise their industry separately ; Charles de Comans remained with the Gobelins, Raphael de la Planché established himself *au faubourg* Saint Germain, in a place which has since been united to the *hospice de Ménages.* This separation took place in 1633.

Charles de Comans died in December, 1634, and was replaced by his brother Alexander de Comans ; Raphael de la Planché, treasurer to the

(*a*) A patent of the last day of September, 1637 exempts P. du Pont from the obligation of residing in the house of Savonnerie. The register of his death proves that he continued to inhabit the galleries of the Louvre.

buildings of the king under Louis XIII. and Louis the XIV. only kept the direction of his manufacture in tapestry until 1667, the period when the work of this establishment ended.

Under the name of "Manufacture des meubles de la Couronne," (court furniture) Louis XIV. in 1662, established a truly artistic and industrial Gobelins school, inhabited by artists and workmen chosen from amongst the most skilful. The edict however, relative to this establishment did not appear until November, 1667 ; in it we read that "the manufactures and dependencies hereof shall be regulated according to the orders of the Master Colbert, superintendent of the building, and the particular direction of the Master Le Brun, chief painter to the king, in conformity with letters granted to him 2nd March, 1663. That the superintendent of the buildings, and the overseer under him shall keep the manufactory full of good painters, masters of tapestry *de haute lice*, goldsmiths, founders, engravers, lapidaries, &c.; that the workmen employed in the aforesaid manufactures shall be exempt from all *logements de guerre* (billeting of soldiers in time of war or siege). That apprentices, to the number of sixty, chosen by the superintendent shall be maintained and employed in the school of the director ; that very express inhibitions and prohibitions be given to all merchants and other persons to prevent their purchasing or causing to be imported the tapestries of foreign countries, &c."

L'hostel des Gobelins, which, since the year 1603, had only been held in tenancy for the use of the Crown, was in 1662 purchased by Colbert, in the name of the king, as well as eight other estates near it, all for the sum of 90,242 livres, 10 sols. The area of the manufactory, comprising the public walks, gardens, meadows, and different sorts of tillage extending between the two branches of the Bièvre as far as the Crouleborbe mill, amounts to 12,266 square *toises* (*a*) about 46,610 square mètres (a *toise* is six feet, English).

The workshops for tapestry in the Louvre (still there), and those of the *Faubourg* Saint-Germain, were at that time successively incorporated with those of Gobelins.

Like Henri IV. his grandfather, Louis XIV. induced a great number of tapestry makers in *haute* and *basse lice* to come over from Flanders ; he placed them at Gobelins, as well as in the manufactory of Beauvais, founded in 1664.

Flanders continued thus to be the principal seat of this manufacture, its prosperous condition in that country being traced to a remote period. So far back as the twelfth century, the Flemish manufacturers were flourishing ; in the sixteenth, the emperor Charles-Quint had given

(*a*) This is still the superficies of the Gobelins manufactory. Out of the space exceeding the wants of the service, somewhat more than a hundred small allotments are distributed to the housekeepers of the establishment, all cultivated as gardens.

them a definite constitution (Statute of 16th May, 1544, on the style and trade in tapestry of the Pays-Bas, divided into ninety heads).

They were empowered to supply with this precious material all the sovereign and princely houses of Europe. The 'Garde Meuble' in France contained a considerable quantity of hangings in Flemish tapestry, dating back to the reign of François I. ; but when Louis XIV. had given to the production of French tapestries a new and powerful impulse, more especially in developing their artistic character, too much neglected until then, the condition of affairs changed ; the manufacture of Flemish tapestries was eclipsed by degrees, and, about 1787, disappeared entirely.(*a*)

The multitude of *chefs d'œuvre* in painting, tapestry, sculpture, goldsmith's ware, engraving, mosaic, cabinet making in ebony, &c., which resulted from the manufacture of crown furniture, exercised a very marked influence upon the general taste and industry of the nation. This influence extended even abroad, and very soon placed in the first rank, the productions, arts, and manufactures of France. The workshops of tapestry formed always the most important part of this establishment, the only one which has resisted the efforts of time and of revolutions.

The arts, excepting those which tended directly to the manufacture of tapestry, ceased to be represented at Gobelins in the latter years of the eighteenth century ; more than two hundred workers in *haute* and *basse lice* were employed there from 1662 to 1690, under the direction of Charles le Brun ; Jans, father and son, master workers in *haute lice*, had themselves alone the direction of sixty. A second workshop in *haute lice* was under the management of Lefebvre ; Jean-Baptiste Mosin and Jean de Lacroix conducted each a workshop of *basse lice*. A Flemish dyer, a native of the town of Oudenarde, Vander Kerchove, was placed at the head of the dye-house. With regard to the productions of these different workshops, we must confine ourselves to citing. The Acts of the Apostles, in ten pieces, raised with gold, in imitation of the celebrated tapestries of Raphael. The suite of hangings, said to be of the Vatican, in imitation of the frescos of the same master, in eight pieces ; the Elements, raised in gold, in eight pieces, from Charles le Brun ; History of the King (Louis XIV.), in fourteen pieces, also in imitation of Le Brun, and Vander Meulen ; History of Alexander, from Le Brun, in eleven pieces ; the Seasons, in eight pieces, raised in gold ; the Months, in imitation of Le Brun ; the History of Moses, in ten pieces, in imitation of Nicolas Poussin and Le Brun ; the History of Méléagre, in eight pieces, in imitation of Le Brun ; the Fruits of War, in eight pieces, in imitation of the ancient tapestries executed from the

(*a*) At Oudenarde, the last representative of this industry, Jean-Baptiste Brandt, addressed to the commercial authorities of that town, the 9th May, 1787, an account of the business and liabilities of the corporation of tapestry makers, and soon after closed his own workshops.

drawings of Lucas de Leyde ; the Battles of Scipio, in ten pieces ; the History of Constantine, in eight pieces, &c., A specimen of this latter hanging, in five pieces only, was issued from a manufactory founded at Mincy by the Superintendent Fouquet, but which was closed at the time of the disgrace of this minister ; the Gobelin workers in tapestry having been commanded to place upon this hanging the arms of the king instead of those of the superintendent, and to add bordures (in heraldry) to them.

We do not purpose speaking of the well-known works of the celebrated engravers Audran, Rousselet, Sebastien Leclerc, nor of those of the sculptors Tuby and Coisevoix, who all resided at Gobelins, nor of the fine works of chased gold, the artistic value of which far surpassed that of the material, yet could not preserve them from complete destruction, for Louis XIV., in 1690, in consequence of the penury of the royal treasury, thought that he ought to convert them into money ; they had been in part executed at Gobelins by the goldsmiths Alexis, Loir, du Tel, Claude de Villers and his sons.

The manufactory of the Savonnerie executed, at the same time, in imitation of models of the most skilful masters, works which, from their multiplicity and being of a character exclusively decorative, have escaped almost any description ; a carpet for Versailles and the Louvre, seats of every form, folding screens, *portieres* (pieces of tapestry hung before a door to keep out the wind), &c. The carpet of the great gallery uniting the Louvre to the Tuileries, and that of the little gallery of the Louvre, called d'Apollon, were finished at this period.

The first, commenced in the reign of Henry IV., contained ninety-two compartments, seven yards and a half in length uniformly, by from four to five yards in breadth, and of a varied composition, where were represented landscapes, military trophies, different symbolical figures, War, Peace, Music, Astronomy, &c. The second carpet, that of the small gallery of the Louvre, was composed of thirteen pieces in designs appropriate to the place ; that is to say, all the characters produced upon it were connected in some measure with the god of day.

To Ch. Le Brun succeeded P. Mignard as governor of the Gobelins manufactory ; but this illustrious painter, already aged, did not leave many traces of his rule. It was besides partly under his direction that the only total interruption of the works took place which that establishment experienced since its foundation.

In 1694, a ruinous war obliged Louis XIV. to dismiss the greater part of the workmen assembled at Gobelins. Some of them entered the French army, others returned to Flanders, their native country ; the greater number were collected by the Master Béhayle, one of the most skilful directors and master tapestry-makers which the manufactory of Beauvais ever had.

The peace of Ryswick restored work to its former activity. Robert de Cotte, an architect, superintendent of buildings to the King, directed in his turn the Gobelins manufacture. After him, Jules Robert de Cotte, his son, who was also architect and governor of the buildings to the King in the department of Paris.

The twenty-five last years of the reign of Louis XIV., less productive, perhaps, in great compositions in tapestry than the first period of the reign of this sovereign, furnish, notwithstanding some fine suites of hangings, amongst which we may name the Triomphe des Dieux, from Noël Coypel, in eight pieees; the suite of hangings called de L'Ancien Testament, in eight pieces from Jouvenet.(*a*) The hangings called des Judes, in eight pieces, in imitation of the models originally painted in India ; and a great many *portieres*, the greater number of them representing gods and goddesses, the elements, the seasons, &c.

It is much less by the number of the hangings that we must estimate the importance of the works of which we have given a rapid notice, than by the real progress accomplished in the composition and construction of tapestry. In our opinion no epoch surpassed that of Louis XIV. in the choice and composition of models ; but this branch of the art is solely the office of the governors and of the painters who superintend the execution of the work. Simple copyists or translators, the master *tapissiers* and their workmen, do not appear even in this period to have raised themselves above their predecessors. The traditions and methods then in use being only at that time permitted to them in a very limited measure. We find even long and sharp disputes relative to this latter question occupying a part of the following reign, disputes upon which it will be necessary for us to say a few words.

The ancient tapestry makers only reproduced the models placed before them in a manner purely conventional, that is to say, by contract; they were neither colourists in the modern sense, nor designers. The school of design founded at Gobelins under Louis XIV., and directed by four professors of the Academy of Painting and Sculpture, was not precisely instituted for them, but for the painters, sculptors, engravers, and other artists assembled in this house. The workmen who commenced work at break of day and did not leave off until nightfall, had not certainly time to give to the study of drawing, or to anything but the *broche* (*b*) in their hand and the working of the tapestry.

The pallet placed by the dyer in the hand of the tapestry maker was at that time composed of but a few plain colours, having little to do with transitions, without which all harmony in colouring is impossible. But as soon as an influence more or less marked was attributed to painters in the fabrication, convention (from which could only result tapestries

(*a*) In the reign of Louis XV. these hangings were augmented by four pieces, in imitation of Jouxenet and Restout.

(*b*) *Broche*, the instrument on which is rolled the coloured wool destined to form the woof of the tapestry, and which to the artist in tapestry supplies the place of the weaver's shuttle.

of a general and not agreeable tone, discordant colours (always the same), gave place to an imitation more and more rigorous and correct; it then became necessary to increase the number of shades—light shades in particular, and to employ a greater number of subdued colours, otherwise weakened and rendered dim by a certain quantity of black; the primitive simplicity of the work disappears, difficulties augment, and the hand of the workman acquires a proportionate value. Such changes could not be effected without opposition on the part of the manager and of the operatives, opposition the sharper as the latter worked by *piece* or *task work*, the quantity made being to them their daily bread, and which they must each day defend against the growing demands of their immediate chiefs, and of the painters who superintended the artistic part of the work.

We need not be astonished, then, at the complaints which resounded through this manufactory during a great part of the eighteenth century, nor at the ardour of the workmen, in 1790, to conquer a different administration, that of free work and by the day. Contemporaneously with these disputes, persevering efforts, crowned with success, were made by one of the master tapestry-makers to the King, Jacques Neilson, to improve the *basse lice* work, fallen into complete decay before his nomination as head of the department (1449), the trade of *basse lice* was brought to perfection by Vaucanson (1757), and very important works carried out by a skilful dyer named Quemiset (1773—1779), under the conduct of J. Neilson, to raise the dyeing of wool and silk to the level of the new requirements of the fabrication. This movement, seconded by the architect Soufflot, then manager of the Royal Manufactures of Tapestry (1775—1780), did not last long enough to bring about really useful results. It was put an end to in consequence of the death almost simultaneously of Quemiset, of the sons of Neilson, and of Soufflot.

But these early efforts determined the superior administration, then in the hands of M. Le Comte d'Angivillers, to establish for this manufacture a scientific element, which until then had been unknown. The chemists Cornette and Darcet were called upon to take charge of the dyeing; the latter, named as inspector of this department in the workshops (the 15th August, 1786), took up the work commenced some years before; but it was not long before he himself was stopped in his researches by the sudden reforms which followed the fall of the monarchy (1792). Much about the same time the inspector of dyeing, the chief dyer, and the three painters attached to the manufactory, were dismissed as useless; the school of design was closed; one of the master tapestry-makers, the master Audran, secret promoter of all these changes, took the place of the architect Guillaumot, who had directed the royal manufactories of tapestry since the decease of M. Pierre, first painter to the King, Louis XVI. (1789). Audran re-established taskwork, suppressed two years before, at the suggestion of his predecessor. This return to an order of things precipitated his fall; after less than a year he was accused of want of patriotism, arrested, and sentenced to six months' imprisonment at Sainte-Pelagie. A painter, Augustin Belle, son of the superintendent of Gobelins, replaced him.

A warm republican, the new director, caused to be burned in the court of the manufactory, at the foot of the tree of Liberty, all the precious hangings decorated with the insignia of royalty. This act of Vandalism, authorised by the Minister of the Interior, was accomplished on the 30th November, 1793, "in honour of the martyrs of Liberty, Marat, Lepelletier, Beauvais, Préan, Pierre Bayle, and Chalier." But very soon the fall of Robespierre permitted the return of the Director Audran (14th April, 1796). He, however, died at the end of three months (26th June). These disturbances and perpetual changes paralysed work and stopped all progress. In vain was a commission of painters, sculptors, and men of letters instituted under the name of "Jury des Arts" (17th July, 1794) by the Committee of Public Welfare. After having reformed almost all the patterns employed at Gobelins and at Savonnerie, they determined the conditions for a meeting for the creation of patterns fit to regenerate the art in these establishments.

No one replied to this appeal; the moment was not favourable for these pacific modes of arriving at perfection. A tapestry-maker in *haute lice* of Gobelins, named Mangelschott, officer of the National Guard, and a zealous patriot, tried for himself the sad experiment; he was decapitated (the 14th July, 1794), merely for having at a club interrupted by a simple observation the discourse of a member of the Convention. Two years before the manufacture had paid for the first time its tribute of blood to the Revolution, in the person of its chaplain, M. de la Frenée, imprisoned and massacred with a great number of priests. It was now no longer a question of perfection, but of existence. The Republic besides did not want tapestry; it sold them for next to nothing, gave them in payment to army contractors, burnt the hangings raised in gold of the royal wardrobe, to get from them those portions of the precious metal which obstinately remained in the fabric. The workmen only existed by taking oaths, and by exercising different professions strangers to their art. Some became soldiers. From the commencement of the war more than twenty Gobelins tapestry-makers and of Savonnerie thus furnished a respectable contingent for the defence of the territory.

The 18th August, 1794, the Committee of Public Welfare re-established a workshop for dyeing; the Master Galley, a skilful workman and patriot, was named chief dyer (8th November). The 25th September the Master Duvivier, manufacturer of Savonnerie, was named as director.

The 3rd December, 1800, the pupils and apprentices, suppressed in 1792, were again set to work. Eight sons of master tapestry-makers, six in *haute lice*, and two in *basse lice*, took their place in the workshops.

The 6th May, 1803, at the proposition of the Cardinal Archbishop of Paris, the First Consul established worship in the chapel of the Gobelins, and named as chaplain to this house M. Pioret, formerly prior-dean of Saint Jean de Dijon.

On the 27th September of the same year, M. Roard, professor of medicine and of chemistry to the central school of the department of Oise, was named director of dyeing in the national manufacture of tapestry.

Scarcely installed in these functions, M. Roard asked and obtained, by the influence of MM. Chaptal and Berthollet, the creation of a practical school of dyeing, of which the Minister of the Interior bore the expense. Frenchmen and foreigners were admitted without distinction. Amongst the former six received from the Minister an annual stipend of a thousand francs.

In a short time a number of distinguished artists (*a*) left this school, and founded at Paris, at Lyons, at Tours, at Mulhouse, at Avignon, and at Turin, workshops for dyeing, renowned for the beauty, the solidity and perfection of their work.(*b*)

Under the imperial era, the art of tapestry recovered again. The French school of painting contributed to the production of patterns destined for the manufacture of Gobelins. The Emperor had an account furnished him of the most minute details connected with this establishment and that of Savonnerie. By his orders, the greater part of the compositions representing facts from contemporaneous history were transformed to tapestry. The events of 1814 and of 1815 do not admit of the entire accomplishment of these works; but from the numerous fragments that figure in one of the exhibition halls of the manufacture of Gobelins, one may judge of their importance; their execution leaves little to be desired, notwithstanding the relative inferiority of the process still employed at this epoch. The artist in tapestry, no longer enslaved by the system of taskwork definitively replaced by free labour, seeks now, without intermission, the means of remedying the difficulties always existing. Notwithstanding the improvements accomplished in the art of dyeing, certain delicate colours fade some time after the execution of the piece of tapestry; others, on the contrary, become more intensified or turn brown, thus producing shocking differences and destroying all harmony in the most perfect pieces in appearance at the moment they were finished.

(*a*) MM. Brauvisage at Paris, Renard at Lyons, Perdreau at Tours, Gonfreville, at Rouen, &c.

(*b*) The bounds which with regret we impose on ourselves do not permit us to follow M. Roard in his honourable career at Gobelins from 1803 to the 4th May, 1816, the epoch of the momentary suppression of the office of director of dyeing. Numerous experiments are due to him in the use of indigo, of Prussian blue, of madder, the results of which are recorded in the reports of the Society of Encouragement, and in other scientific works. Memoirs, first, on alum, and the influence of the different states of wool in dyeing; second, on the washing of silk preparatory to dyeing; third, on the mordants; fourth, on the influence of Roman alum compared with that of French, which have been approved of by the Institute, and published in the collection of *Savants Etrangers.*

The chemist and the dyer having in vain exhausted the resources of their art, whatever may be in effect, the shades employed and the process in preparing them, they cannot arrive, in the light part of the shades, "*gammes*" (*a*) at the same solidity as in the deep tones. Vainly too, in the composition of patterns for tapestry, have they exerted themselves not to leave the limits of the pallet of the dyer in solid colours. About the year 1812, the head of a workshop in *basse lice*, M. Gilbert Degrolle,(*b*) solved the problem by a new combination of colours, in the tissue even of the tapestry, replacing the old system of monochrome or cross hatching, in one shade, by hatchings in two shades.(*c*) He applied this process, however, only in a restricted degree; and many years must pass before it arrives at perfection, and is generally adopted in workshops.

He is at present almost the only one who uses it. It is, in fact, the sole way of forming a combination of colours in wool or in silk, which admits of obtaining in the highest degree, exactness in the translation of the colours of the pattern, durable harmony of the shades employed, and transparency.

This invention, which to be perfectly explained would require to be fully unravelled, constitutes a true revolution in the working of the Gobelins manufactory. The remarks made at different times, on the absence of durability and harmony in the colouring of some tapestries of ancient date, are now inapplicable, as attested by the number of suites of hangings sent forth from this establishment during the last twenty years.

After the hundred days, M. Lemonniere, historical painter, director of this manufacture from 1810, was obliged to retire, as well as MM. Roard and Augustine Belle; the latter having entered it in 1802 as inspector and professor of the school of design.

M. le Baron des Rotours, formerly an officer of artillery, was named manager, and filled the duties of that office until 1833.

M. le Comte de la Boulaye-Marillac, named director of the dyeing department the 10th October, 1816, was besides required to give a course of lectures on chemistry applicable to dyeing. The salary of the professor was deducted from the fund of 6,000 francs, annually granted by the Minister of the Interior for the school of Painting, which reduced from six to three, the number of pupils in this school From this reduction to a total suppression the descent was rapid ; so that, as appeared a few years later, at the period for the nomination of the actual titular

(*a*) At Gobelins are expressed by "*gammes*," the whole of the regular gradations, from brown to bright of a shade ; generally the number of these gradations is from twenty to twenty-four in the workshop of Savonnerie, and from twenty to thirty for tapestry.

(*b*) Died in 1814.

(*c*) *Hachures* are employed in graduating tints and to avoid the mosaic effect which results from a simple juxtaposition of colours ; they constitute one of the greatest difficulties in tapestry work.

(September 9, 1824), the fund of 6,000 francs ceased to be paid, and the institution fell. M. Chevreul, however, did not cease giving each year his course of chemical lectures upon dyeing, and to instruct pupils.

Under the able direction of M. des Rotours, important improvements were produced, viz. :—

The creation of a special school of tapestry, a tardy realisation of the school ordered by the edict of 1667.(*a*)

The suppression, by decision of May 4, 1826, of the fabric in *basse lice* which hereditary prepossession had preserved on an equality with the fabric in *haute lice.*

The suppressed looms were removed to the manufacture at Beauvais, and this species of work is applied exclusively to a secondary order of tapestry for furniture.

The union of the manufacture of Savonniere with that of Gobelins was taken advantage of to suppress in the manufacture of carpets the system of *task* work, which had been re-established there in 1805.

These different measures have at this day the complete sanction of time and experience ; the governments that follow have especially to encourage with all their interest the development of the elements of prosperity and of progress united long since in these manufactures. Proficiency, it is true, is slow, but sure, in its accomplishment. By drawing and the study of colours, more and more diffused amongst young artists in tapestry ; by the spread and general employment of work *à deux nuances* (a shadowing with light colours upon dark of the same kind, or, with dark colours upon lighter), by the complete application of such perfect order as will enable each artist to find at the moment any colour required in the execution of his work ; and, lastly, by the dyeing department being constantly directed in a manner to secure the beauty and solidity of the shades, it may be truly said that this art is transformed, and no longer recognises any obstacle.

This account would be incomplete if it did not notice some of the finest of the suites of hangings executed in Gobelins tapestry since the reign of Louis XIV., the administrators or directors of this manufacture since the year 1662, the ancient masters of tapestry in *haute* and *basse lice* to the King, from 1662 to 1792, the period of their suppression ; and, lastly, the process of the fabrication of tapestry in *haute lice* and Savonnerie carpets.

To the reign of Louis XV. belong the following hangings :—

Sequel to the History of Louis XIV., after Hallé, Vernansal, Antoine Dieu, Dulin, in six pieces.

The suite of hangings from Don Quixotte, in twenty-eight pieces, after Charles Coypel.

(*a*) We must observe, however, that this school had not at that period been granted the conditions necessary for permanency, and that it was necessary to create it anew in 1848.

Field Sports of Louis XV., after Oudry, in eight pieces.

The History of Esther, in seven pieces, after De Troy.

The History of Jason and of Medea, after the same painter, in seven pieces.

The Loves of the Gods, after F. Boucher.

The Story of Daphne and Chloe, after Jeaurat, in seven pieces.

Village Fêtes, after the same painter, in four pieces.

Under the reign of Louis XVI. were executed :—

The Sequel to the Loves of the Gods, after Pierre and Vien.

The History of France, in five pieces, after Vincent.

The second hanging of the History of France, in eight pieces, from the paintings of Berthélemy, Suvée, Brenet, Du Rameau, Menageot.

Under the Empire :—

A succession of compositions relative to the History of Napoleon I. (The greater part of these tapestries remain unfinished.)

Under Louis XVIII. and Charles X. :—

A third hanging of the History of France, after Rouget.

A hanging cf the History of Marie de Médicis, after Rubens. in twelve pieces. (This hanging was only finished in the reign of Louis-Philippe.)

A hanging of the History of Saint Bruno, in seven pieces, after Lesueur.

The Acts of the Apostles, after Raphaël, and ancient copies of hangings of the Vatican of the period of Louis XIV. (This hanging was only finished under the reign of Louis-Philippe.) And a great number of isolated pieces, after L. Boullongue, Callet, M. de Le Brun, Robert Lefèvre, Gérard, Gros, Horace Vernet, Guérin, and Delaroche.

In the reign of Louis-Philippe two hangings were finished which had been commenced under the preceding reign.

The Acts of the Apostles. The History of Marie de Médicis. Another hanging, called the Castles, in five pieces, after MM. Alaux and Couder, was commenced; and lastly, some isolated pieces executed, after Le Brun, François Despartes, and Horace Vernet.

The Directors, or Governors, from 1662 to the present time were :—

Ch. Le Brun, chief painter to the King (*a*).	1663—1690
P. Mignard, chief painter to the King .	1690—1695
Robert de Cotte, architect	1699—1709
Jules Robert de Cotte, son of the preceding, architect	1709—1747
D'Isle, architect	1747—1755
Soufflot, architect	1755—1780
Pierre, chief painter to the King . .	1781—1789
Guillamout, architect	1789—1792
The same	1795—1807

(*a*) The two dates are those of entering into office, and of the retiring or death of each director.

Joseph Audran, former head of workshop	1792—1793
The same	1795—
Augustin Belle, painter	1793—1795
Chanal, chef de division au ministère de la maison de L'Empereur, intérim director	1807—1810
Lemonnier, painter	1810—1816
Des Rotours (Le Baron), former officer of artillery	1816—1833
Lavocat	1833—1848
Badin, painter	1348—1850
Lacordaire, architect and engineer	1850—

The master tapestry-makers to the King, managers of *haute* and *basse lisse*, at the manufactory of Gobelins, from 1662 to 1692, the period of their suppression, were—

Jean Jans (*Haute lice*)	1662—1668
Henri Laurent (*Haute lice*)	1663—1670
Lefebvre, father (*Haute lice*)	1663—1700
Jean de la Croix (*Basse lice*)	1663—1712
Jean Baptiste Mosin (*Basse lice*)	1663—1693
Jean Jans, fils (*Haute lice*)	1668—1623
Dominique de la Croix, fils (*Basse lice*)	1693—1737
Souette (*Basse lice*)	1693—1724
Jean de la Fraye (*Basse lice*)	1693—1729
Lefebvre, fils (*Haute lice*)	1697—1736
Etienne le Blond (*Basse lice*)	1701—1727
Mathieu Monmerqué (In *basse lice* 1730 to 1736 ; In *haute lice* from 1749 to 1792.	1736—1792
Michel Andran (*Haute lice*)	1733—1771
Pierre Francois Cozette (In *basse lice* from 1736 to 1749 ; in *haute lice* from 1749 to 1792	1736—1792
Jacques Neilson (*Basse lice*)	1749—1788
Daniel-Marie Neilson, fils (*a*) (*Basse lice*)	1775—1779
Joseph Audran (*b*) (*Haute lice*)	1772—1792
Michel-Henri Cozette (*c*) (*Basse lice*)	1788—1792

All the tapestries formerly bore on the selvage, or on the ground of the composition, the name of the chief of the workshop where they had been executed. Being thus given the names and the duration of active life of all the managers who have directed the Gobelins workshops, it will always be possible to determine the origin of any piece that has been executed in this manufactory, and the approximate epoch of its fabrication.

(*a*) Partner with his father in 1775.

(*b*) Named director the 4th September, 1792.

(*c*) Retained, as also his father, as chief of the workshop in 1792.

Method of Weaving Tapestry.

The Gobelins tapestries and Savonnerie carpets are both made in high warp looms. Tapestries present, like all interwoven cloths, a warp and a woof, but the woof alone appears both on the right side and on the wrong; the warp is wool, it may also be cotton or even silk, or other fibres used in tapestry; it is vertically held on two rollers called beams; the threads parallel to each other, and on the same level, are passed alternately over a staff called the *croisure* (cross-web), so that one-half of the threads are, relatively to the worker, forward, and the other half backward. But the backward thread may be drawn forward by means of rings of pack-thread called *lices* which surround them, and are held at the opposite side, on a fixed rod placed below the cross-web staff, at a little distance from the plane of the warp.

For Gobelins the cross-web staff is a glass tube from two to three inches in diameter, which is called *baton d'entre deux* (inter-medium staff).

The woof is rolled on a little instrument, made of wood, called a *broche*, terminating in a point at one end, and which, in tapestry, is used instead of a shuttle.

To form the tissue, the worker takes a broche filled with wool or silk of the proper colour, fastens the extremity of the thread of the woof on the thread of the warp at the left of the space where the shades are to be placed, then, passing the left hand between the threads in front and back, removes those that cover again that same shade; the right hand passing between the same threads takes from the left the broche to bring it back to the right; the left hand then seizing the warp, brings to the front the back threads, and the right hand darts the broche to the point from whence it came. This working of the broche, backward and forward in two opposite directions, forms what is technically called two *passages* or one row.

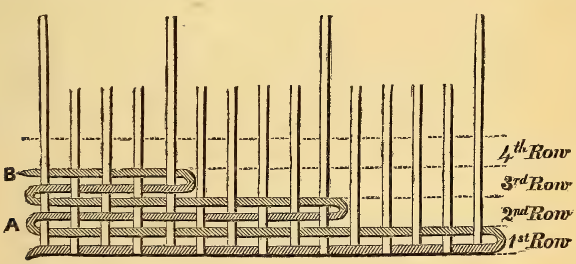
The worker repeats, successively, these rows one over the other, according to the extent and outline of the space which the shades are to occupy with which the broche is filled, taking a new broche for every new shade; he cuts, stops, and loses at the wrong side of the tapestry, that is to say, the side on which he works, the thread of the preceding broche, *if* he is not to begin using it again near the same place.

At each row, he draws together, with the pointed end of the broche, the threads of the woof of the portion of the tissue already made; this first pressing together is not sufficient either to regulate the tissue, or to cover the warp exactly. The worker, after he has placed some rows one above the other, completes the compression by beating the woof with a heavy ivory comb, the teeth of which penetrate between the threads of the warp, the latter are thus completely hidden and brought to the same level.

The extent that a shade occupies determines the number of threads of warp in a passage or row; in a horizontal or even part, the passage is stretched as much as possible to accelerate the work ; it often happens that one passage contains only two or three threads of warp : the outlines of the design to be produced, the divers accidents of colouring, the greater or less extent of light, of mezzotint, &c., indicate the space to be given to the rows, as well as their number one above the other. They pass from light to brown, and from one tone to another, by colours softening gradually the one into the other, and disposed in *hachures.*

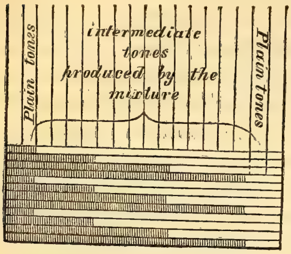
The outlines obliquely inclined in the construction of the threads of the warp, by the different lengths of the rows, are not in the greater number of cases, and if considered in a small part of their development, either right lines or curved, but always indented. This disposition, considering the fineness of the threads of the woof, does not in any way injure the general effect of the objects represented ; it disappears in the details of shadow and light of the extreme outlines, and by the work of the *hachure.* The *hachures* are employed to graduate the shades and to prevent the mosaic effect that would result from a simple juxtaposition of colours.

If we suppose that, in a given space, of fifteen threads, for example, a colour **A** forms a row from one end to the other, then, on ten threads,



a second row, and lastly, on five threads, a third row, there will be a gradation in the colour employed, and the greater the number of rows the more intense the colour will be. If, now, we imagine a second colour coming from the point **B** traversing equally the fine threads and filling the spaces, that is to say, making three rows, where the first colour made one ; two, where the other made two rows, and one where it made three, there will be the same number of rows, four on fifteen threads, and these two colours thus employed will produce intermediate tints, so much the more resembling either of the two, as it has more rows in the composition of the *hachure.*

The accompanying figure represents the effect of the superposition of the *hachures,* and how it is possible with two colours to produce two and three intermediate tones. This disposition constitutes in its simplicity the ancient system of *hachures* called "of one tone," or of one shade, a system very little used in the present day, and which is reis replaced by the work of hachures called, of two tones, or of two shades crossing each other continually and giving as result a lightness of tone, transparency, and solidity, to which it is impossible to arrive by any other combination.



The tapestry-maker, for the design of the objects to be represented by the passage from one shade to another, is guided by a pattern traced in black on the warp, by the intervention of tracing paper on which he has previously chalked the drawing of the pattern.

This sketch appears equally before and behind the warp, and consequently the worker can always see it whether he occupies his habitual place, or whether he goes round to the back to judge of the general effect.

The Savonnerie carpets differ essentially, both in the process of weaving, and in the result, from the Gobelin tapestries; they belong to the class of velvets. The threads of wool, at their juxtaposition from the surface are each stopped by a double knot on two threads of the warp, this latter is in wool and double, the warp combines itself both with the threads of the velvet surface, and with a woof and a *duite* (*a*) of which no part appears outside; the carpet maker sees the right side of the carpet and not the wrong, as in Gobelin tapestry. The warp is held vertically, as in the high warp looms for tapestry, and the loom is of the same form, but much larger. The carpet is begun by a selvage, the web of which is the same as that of tapestry.

To commence the velvet groundwork, or otherwise to make a *stitch*, the worker having chosen a broche filled with wool of the shade required by the pattern, takes with the fingers of the left hand the thread of the warp on which he is to begin; he draws it a little towards him and with his right hand passes the broche of woollen thread behind it. He then draws to his side the thread of the next warp placed a little behind the first, and makes a sliding or running knot on this thread which he fastens. Between these two *passages* (this is the technical term) the wool forms, in front of the warp, a ring, the amplitude of which answers to the height of the velvet pile. An iron instrument called *tranche-fil*, and formed of a round bar, four to five inches in diameter, terminating in a knife blade, is passed through the ring of wool of which we have been speaking; it occupies a horizontal position on the web or groundwork, and is filled successively by woollen rings produced by the repetition of the stitches.

When the whole of the cylindrical part of the *tranche-fil* is covered with rings of wool, it is drawn from left to right to cut the rings; they

(*a*) This denomination "*duite*" common to the two fabrics, carpet and apestry, is applied, however, in each to an object of a totally different nature.

are thus divided into two threads, implanted perpendicularly on the warp; immediately a new series of knots is begun, and the rings of wool are cut; this produces a continuous and horizontal line of threads each knotted on two threads of the warp. This row of stitches is afterwards strengthened, 1st, with a very strong thread of hemp, called *duite*, which is added to the knots between the two rows of the warp threads, throughout the breadth of the carpet; 2nd, by a thread of woof which envelops each of the threads of the warp and is added to the *duite*. To place the woof in the groundwork or web by means of the warp, the worker brings forward the back thread, passes the woof between the two rows of threads, then lets those of the back return to their place, taking care to hold that woof loose enough, that it may follow the contour of each of the threads of the warp. In this manner the stitches are fixed.

The worker then heaps up with a very heavy iron comb, the stitches, the *duite*, and the woof; the threads of the hemp composing the two latter elements in the web remain there perfectly invisible.

This series of operations being terminated, the threads of the wool forming the velvet are sheared with a peculiar kind of scissors. In large carpets these threads are left about one centimetre long; in carpets of small dimensions, such as hearth-rugs, banquettes, &c., the threads are only left the length of from seven to eight millimetres, thus diminishing the velvet pile. It is by the shearing process that the interior of the woollen threads is exposed to view and that the visible surface of the carpet is put in its proper place. That the effect may be satisfactory, the most perfect regularity is necessary, and each partial shearing should be made in such a manner as to present the effect of a single cut bringing all to an even surface.

The mode of tracing employed for tapestries has been used for some time in the fabrication of the carpets of the Savonniere; but for the latter, patterns are designed in squares of voluntary dimensions, these squares are marked on the warp; 1st, by coloured threads; 2nd, by horizontal lines traced in ink or chalk. The partial outlines bearing the same divisions are adjusted to the general design with mathematical precision. No part of the design is previously traced on the warp of carpet, this model is copied in squares of twenty-five millimetres each side; the method is infinitely preferable, because it gives to the worker the possibility of transferring his pattern without head work, and in some degree without fatigue.

The wool employed in the velvet is composed generally of six threads of different shades but of nearly equal value all harmonising together. In certain cases these threads amount to nine in number. The combination of these shades requires on the part of the worker a peculiar aptitude for colours; he draws with these threads of wool as the painter does, with his brush and palette, but in proceeding by stitches of which the greatest surface does not exceed nine square millimetres, he arrives, according to the nature of the pattern, at very remarkable results ; this cannot be better compared than to mosaic. What is possible to the artist in mosaic, with regard to the design, the pattern, and the colouring, is equally so to the artist in tapestry, with this difference to the advantage of the latter, that the threads of wool, of which the surface of the velvet is composed, are not singly perceptible to the eye, like each of the cubes of marble or of enamel of which Mosaic is composed.

The dyed wools and the silks belonging to the two Gobelins fabrics, are stored in proximity with each other :—1st. In a general warehouse, where they are arranged in skeins ; 2nd. In a retail shop where they are on broches, ready for use ; further, to each loom is appropriated a press, containing wools assorted by the artizan for his work, and those he has already used, that may again be of use in the execution of the tapestry in the loom.

The workers independently of the weaving of the tapestries and carpets, mount the warp, chalk the pattern, and assort the wools of the colour they require.

The heads of the workshop constantly superintend the work, (*a*) the sub-chiefs replace them when they are obliged to be absent, (*b*) all are chosen from amongst the oldest and most skilful artists in tapestry. An historical painter, bearing the title of Inspector of Works of Arts, visits the workshops at least once a week. (*c*)

The tapestries actually occupy forty artists in tapestry, comprising in that number two chiefs, two sub-chiefs, and four pupils. The carpets occupy thirty-seven, comprising one chief, two sub-chiefs, and four pupils. The highest of the payments does not exceed 2,000 francs. Emulation is preserved much more by the rewards accorded to perfection, than by the quantity of tapestry or of carpets produced. The latter may be estimated, in both fabrics, on an average, at from thirty-four square centimetres (*d*) each person.

The service of the storehouses for the two workshops employ eight persons, generally chosen from amongst the old artist workers. The manufactory contains, besides a workshop for dyeing, a laboratory for chemistry, schools of design and tapestry, a workshop for fine-drawing,

(*a*) M. Limosin, dit Laforest, chief of the workshop, directs that of tapestry since 1828; M. Gilbert, artist in tapestry, has been associated with him since March 1, 1858, under the title of Chief of the 2nd class workshop. M. Legrand, chief of carpets, filled this office from 1853, after having exercised that of sub-chief for twenty-one years.

(*b*) In the tapestry workshops, the sub-chiefs are MM. Duruy and Buffit ; in the carpet workshop, MM. François and Bordot exercise the same functions.

(*c*) M. Muller (Charles Louis), has been Inspector of the Works of Arts in the manufacture of Gobelins, since 1st June, 1851.

(*d*) Or thirty squares of one centimetre the side.

galleries of exhibition. The workshop for dyeing, independently of a director (a) and a sub-director, (b) occupies a chief dyer, (c) two journeymen, a pupil and two labourers. The wools and silks used in the manufactory of Beauvais are dyed there. The director of dyeing, gives each year a course of chemistry applicable to dyeing. The schools of design and of tapestry, are directed by two professors, (d) of whom one bears the title of assistant professor. Free pupils from without are admitted, in tolerable numbers, to follow the course of the school of design, which comprises elementary drawing, study of the antique and living models (e).

The school of tapestry, opened in 1848, with five or six pupils, now contains twenty-two. These pupils taken generally at the age of twelve or thirteen years, and by ministerial authority, after two years trial, belong indifferently to the families of tapestry workers, or outside; it is very rarely that they are admitted to the workshops of tapestry or of carpets before the age of nineteen or twenty years. In entering them they are still looked upon and directed as pupils for several years.

The workshop for fine-drawing or darning occupies five persons; a first fine-drawer, two old tapestry fine drawers, and two workers.

The business of this workshop, consists in reuniting or fine-drawing the parts of the carpets or tapestries made separately in the loom, in mending torn parts, holes, or pieces moth-eaten. The fine-drawer does with the needle what the maker does with the broche; he reëstablishes in the first place the portions of the warp injured or destroyed, then the woof, with the wools of colours assorted for tapestry to be repaired.

The exhibition galleries contain a suite of choice tapestries, belonging to the different periods of fabrication, and from which a judgment may be formed of the modifications and progress of the art from the foundation of the manufacture of the Gobelins to the present day.

(a) M. Chevreuil, Member of the Institute, has directed, since 1824, the chemical laboratory and workshop for dyeing.

(b) These functions are filled by M. Decaux, appointed October 18, 1843.

(c) M. Perrey has filled this office since 1858, in the place of M. le Bois, who died the 15th July, 1857.

(d) M. Abel Lucas, painter and artist in tapestry making, pupil of the School of Fine Arts in the manufactory of the Gobelins, is professor of the School of Design since 1848, period of the retiring of M. Mulard, ancient inspector of the manufacture, and professor of that school. He unites to these functions, since 1850, that of professor of the school of tapestry. M. Hippolyte Lucas, his brother also a painter, pupil of the Fine Arts and of the Gobelin manufactory, is assistant professor at the schools of design and of tapestry since 1857.

(e) The study of living models, suppressed in 1848 was re-established in 1850.

RESEARCHES ON THE JUICE OF THE SUGAR CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

BY DR. ICERY.
President of the Chamber of Agriculture.
Translated by JAMES MORRIS, Esq., Representative of the Chamber of Agriculture of Mauritius.

(Continued from page 236.)

PART I.—EXTRACTION OF THE JUICE.

THE cause of the greater part of the loss experienced for a length of time, in the Colony, in sugar manufacture has, without doubt, been the insufficient action of the machinery used to crush the cane. The first mills which were employed, consisted of three cast iron cylinders placed vertically, to which mules communicated motion by means of toothed wheels. The first improvement introduced into this system, as rude as it was defective, was the application of a power both more effective and regular, supplied by the action of wind or water. Shortly afterwards this, steam was applied to cane mills, and these machines in the meantime became more perfect, which necessarily allowed them to work with a precision and power hitherto unknown. Yet these first mills left much to be desired ; the irregularity and the too rapid movement of the machinery, as well as the insufficient resistance of the chief parts, did not allow a pressure to be exerted so as to obtain more cane juice than 45 to 50 per cent. of the weight of cane.

In recent times machinery more perfect, and moved by a force equal to the resistance to be overcome, introduced a real progress. Thanks to the employment of these improved mills, the yield of cane juice ha increased about 25 per cent.

Numerous experiments have been made elsewhere to determine the quantity of juice which could, on the average, be extracted from the cane by the different mills usually employed in sugar manufacture. It appears to me interesting to repeat these experiments, for too much importance cannot be given to the results furnished by this first part of the labour of our machines.

Under this head might be predicted very notable differences, resulting not only from the greater or less perfection of the machinery employed, but also in the manner these are directed and the nature as well as the age of the canes which are used.

Mills of large size, in order to produce an adequate pressure, require the cylinders fed with a considerable quantity of canes. They ought also to be the object of especial care, not always easy to attain. I have seen these powerful machines moved by a nominal force of sixty to eighty horse power, produce no more effect than a mill three or four times less powerful, and yield only in juice 55 per cent. of the weight of the canes. The return obtained, whatever may be the force employed, depends essentially on the manner the pressure is exerted, and as often as the pressure is not regularly applied, the most powerful machines in present use, fail in one of their advantages, namely, to crush daily a greater quantity of cane.

We may seem perhaps rather indisposed to admit that machines otherwise perfectly regulated do not sometimes produce, even with the aid of strong and expensive apparatus, a return equal, or at least hardly superior, to what is produced by mills of far less power. Every attentive observer who has visited the sugar manufactories of this colony, will allow the justice of such an observation; he will be astonished to see how little care is bestowed on this part of the work, and on merely examining the *bagasse* (*a*) escaping from the cylinders, he will find that it is frequently impregnated with a quantity of sugar liquid equal to the half of that of the juice extracted. We must, however, add that a contrary practice exists in some establishments, and where the pressure is always suited to the power of the machinery employed.

Averaged generally, the yield which is usually furnished by the best mills on the largest estates, is about 75 per cent. of the juice contained in the cane, or three-fourths of the liquid to be extracted. The quality of the canes experimented on, and the degree of resistance they offer naturally influence this estimate, the extreme limits of which, from my own experience, are 84 per cent., and 69 per cent.

Of all canes, the Bellognet or purple Java cane, is the most easily crushed, and gives the greatest quantity of juice; after it, comes the Diard cane, the Otaheite cane, the Penang, the Guinghan, and the Bamboo.

The method employed to test what a mill can yield, consists in first weighing the canes to be crushed, and then in estimating the juice obtained from them, or determining the weight of the bagasse remaining. This method entails considerable trouble in weighing, on account of the enormous quantity of the substance employed, and does not present those conditions of exactness, which should accompany every experiment. For this reason we find considerable difference of estimation in those authors who have treated this question.

I have adopted a much simpler method which allows us to undertake such researches without having occasion to keep an exact account of such large weights, and without being troubled with the quantity of canes employed.

It will be sufficient to know by a preliminary experiment the quantity per cent. of ligneous substance contained in the canes submitted to the mill, the yield of which is required to be ascertained. This being once determined, we take a certain quantity of wet bagasse from the

(*a*) The Creole corruption for an old Spanish term, implying the cane residuum after passing through the mill.

mill, about 250 grammes, taking care to select it in a state of compression which represents on the average the result of the ordinary action of the cylinders. This bagasse is then weighed, and after having placed it in a little bag of strong cloth so as to preclude all after loss, it is submitted to a rapid washing in luke-warm water, then to a complete drying in the stove, and the weight is again ascertained; the difference between these weights gives the quantity of juice remaining in the bagasse and which had necessarily escaped the crushing power of the mill.

Let B = the weight of the damp bagasse.

B′ = the weight of the dry bagasse.

C = the weight of the woody substance contained in 100 parts of the canes passed through the mill. We shall then have $\frac{100\ B'}{C} - B = X$, or the quantity of the juice extracted corresponding to B of bagasse furnished by the mill. The quantity of canes corresponding to the same weight of B of bagasse being represented by $\frac{100\ B'}{C}$, we see that the yield of any kind of mill can be easily calculated by the plan of two successive weighings of a small quantity of the bagasse produced; for, strictly speaking, we can dispense with determining the value of C by a special proof, this quantity not presenting great variations, and being generally of the average of ten for the finest kinds of Bellognet and Diard and 11·5 for the other kinds.

In order to facilitate this operation, I shall give the following example:—

A mill of forty horse power acting on Guingham cane stalks which contain 11·5 per cent. of woody fibre, gives a bagasse of which a portion perfectly similar in appearance by its state of compression to the total of the bagasse produced, weighed when damp, 207·63 grammes, and when dry, 87·30 grammes. To find according to the above formula the quantity of juice extracted from 207·63 grammes of moist bagasse, 87·30 must be multiplied by 100, and the product divided by 11·7, from the quotient 759·1 grammes, 207·63 are to be subtracted, which leaves 551·5 grammes. As the above quotient of 759·1 grammes is simply the equivalent of the quantity of canes producing the bagasse submitted to experiment, it is clear that the yield of the mill will be definitely given by the proportion: 759·1 : 551.5 :: 1 : X = 72.6 per cent.

It is at the same time clear that the absolute quantity of juice being 100—11·5, there has been left in the bagasse 15·90; (*a*) it therefore results that, in round figures, for every 100 parts of juice contained in those

	Grammes.		Grammes.
(*a*) Juice extracted	551.5	...	72·6
Juice remaining in the Bagasse	120.33	...	15.9
Woody fibre	87.3	...	11.5
	759.13	...	100.00

Guinghan canes, eighty-two parts have been extracted, and eighteen have escaped the action of the mill.

It must now be asked whether we really extract by this augmentation of pressure a quantity of sugar always proportioned to the quantity of juice obtained; in other words, if for all degrees of pressure the juice possesses the same qualities, and if the elements of which it is composed are found in the same respective proportions. It might happen in the case where this proportion is broken, that the advantage gained from an increase of juice would be weakened by newly acquired properties, which interrupted the after operations, and in fact, rendered the extraction of sugar a more expensive and a more difficult operation. This is, indeed, a question which deserves to be seriously examined, and which has never yet been studied. It is generally thought that the last portions of the juice extracted from the cane, are similar to what flows from it at the first pressure; and all those who in the various colonies have occupied themselves in increasing the compressive force of the sugar mills, have never doubted of its similarity. Some persons seemed to attribute even a richer, saccharine principle to the juice which flows at the last pressure. The researches I have made clear up this hitherto unnoticed point, and force me to adopt a totally different opinion. The quantity of sugar, after a certain degree of pressure, diminishes in the ratio of the augmentation of the pressure; and other substances, such as the azotised principles and the mineral salts, proceed in an inverse ratio, increasing with the pressure. This result is one of the most manifest, and is explained by the differences of weight which one is far from expecting.

But what are the causes of such modifications? You will seek it in vain except in the constitution of the plant itself and the unequal resistance of its various parts. The medullary portions being really supplied with a juice more saccharine, offering less obstacle to the action of the press or cylinders, allow the juice to flow more freely, whilst the bark and the concentric tissues, less rich in sugar, have far more resisting power, and thus much longer retain the juices with which they are impregnated.

Here are some results which strengthen this argument and which give the measure of the differences observed under these circumstances, whatever portion of the canes be examined, whether the knots of the cane, or the intervening parts be crushed or not. A certain quantity of cane has at first been subjected to a pressure equal to that obtained from a mill which yields 60 per cent., and then to a second pressure of a mill capable of yielding 78 per cent.

The juice obtained in the first instance was clear and limpid; in the second, its clearness was thickened because it contained a greater quantity of organic remains. After being filtered with care, an analysis was made under exactly similar conditions.

	Juice			
	Of White Bellognet Cane.		Of Penang Cane.	
	1st Pressure.	2nd Pressure.	1st Pressure.	2nd Pressure.
Density . . .	1084	1079	1080	1078
Quantity of sugar .	19·8	18·9	19·6	18.5 p. cent.
Albuminous matters .	0·18	0·27	0·16	0.20 p. cent.
Weight of ashes . .	0·20	0·22	0·13	0.23 p. cent.

The difference is more marked with the Penang cane, than with the white Bellognet, resulting from the former being harder, and offering more resistance to the pressure of the cylinders.

After what has been said, an account may easily be given of the numerous specialities which take place in sugar manufacture, and which have been explained in various ways. It is evident at once that the juice extracted from canes slightly crushed being relatively richer in saccharine and poorer in organic and mineral substances, is of easier labour, and yields for the same weight or volume, a greater proportion of sugar. Such a result is not solely due to a superior saccharine richness of juice, but rather to a less quantity of albumenoid and saline principles; for by our usual process of manufacture, evaporation cannot be prolonged without producing a very perceptible interversion of crystallisable sugar, and this transformation is also subordinate to the quantity of organic matter held in the juice.

It seems to me incontestable that it is still more in this difference of qualities presented by the juice, according to the pressure to which the cane has been subjected, that we ought to seek for a rational explanation of the general belief that with the same means of evaporation, the extraction of sugar was easier formerly than now. If it be remembered that the first advance realised was due to the use of more perfect mills, and that the evaporating apparatus now employed was only adopted long after, it will be difficult, unless we deny the results of exact experiments, and these too within the reach of all, not to attribute to the more efficacious pressure of our mills, what in my opinion, has been most erroneously considered as the result of degeneration of the cane.

I shall show further on in continuing these researches, that this idea is contrary to the facts which come under our daily notice, and shall complete my remarks on the part which this assumed degeneration plays in the production of sugar.

(To be continued.)

ON PEPSINE.

BY FRANK VINCER.

PEPSINE was introduced into medicine by Dr. Lucien Corvisart. The daily increasing importance of pepsine, which has now been in use during the last fourteen years, demands a short history—1. Of its extraction ; 2. Its employ ; 3. Its pharmaceutical preparations, including the principle formulæ in use.

1. This substance, which is the active principle of the gastric juice, is found in those glands of the stomach called peptic of vertebrate animals ; but the isolation and preparation, so as to preserve to this agent its physiological properties, are extremely delicate operations.

A. Certain pharmaciens have lately found no means more profitable and economic than that of simply drying the mucous membrance of the stomach of animals (pigs, &c.), and selling it under the name of pepsine. Nothing is more simple, but nothing more deplorable in every respect ; the name of this product is at once a falsification, as the pepsine is as impure as it is possible for it to be, none of the detritus of the dead membrane or of the putrid matter being removed. For example, if this powder is mixed with water and maintained for twenty-four hours at a temperature of 40° C., it is decomposed, and exhales an insupportable and fetid odour. This in Germany has been designated "Pepsine de Lamatch." These products are easily recognized under the microscope, which discloses the organic cellular *débris.*

B. Other manufacturers have at least eliminated those putrefiable portions of the gastric membrane which are solid. Heidenham directs the maceration of frogs' stomachs and the liquid portion only is desiccated. Some, to disguise the putrid matter (after the example of Dr. Aschentreumer), have added to this product, before evaporation, 2 to 5 per cent. of salt. The preparation sold at Berlin under the name of "Pepsine de Simon" contains salt; this is easily recognized, as, when exposed to the air, it becomes viscid and attracts moisture rapidly, an inconvenience which causes the weight of the pepsine to vary with the closing of the bottles and the changes of the atmosphere.

These preparations are simply the liquid or solid rennet, in which, at the end of a few days. the digestive property is lost; that of Aschentreumer has been named Chymosum Muriaticum dilutum. None of these can be called pepsine, and ought to be studiously interdicted, as they are merely falsifications.

We will now consider pepsine isolated from all foreign matters—that is to say, chemically pure. Schwann was the first (1834) who extracted (and named) pepsine from the gastric juice in a state of purity ; to this end he made use of bichloride of mercury, which precipitates pepsine ; the precipitate was dissolved in hydrochloric acid, through which he then passed a current of sulphuretted hydrogen to throw down any excess of mercury, and leave the pepsine in solution. Wasman employed acetate of lead. These facts were little known in France when this substance was extracted from the rennet by Deschamps, by means of ammonia, by Payen from the gastric juice by alcohol; other processes are given by George Wood and Franklin Bache, authors of the United States Dispensatory, &c., &c.

After extraction, pepsine, freshly prepared and dissolved in acidulated water, is precipitated from its solution by protosulphate of iron, acetate of lead, sulphate of copper, bichloride of mercury, tannin, alcohol, &c., it combines with certain acids, and it is in this state that it exists in the gastric juice, but we do not think it is able to form definite salts, so that the names of acetate and hydrochlorate of pepsine are wrongfully employed; without any trace of acid, and neutral to litmus, it is little or not at all soluble in water. Experience has shown the physiological action of pepsine, to which the gastric juice owes its digestive powers, as it produces the operations of digestion exactly identical.

2. *Its Employ.*—It should be a medicine acceptable to the taste, and the digestive power, naturally variable, should be brought by science to a uniform standard; and, finally, that a chemical determination should be made as to the doses in which it should be administered. It was in 1851 that the first chemical observations were made by Corvisart, and towards the end of 1852 this doctor communicated his opinions to the Academy of Sciences; some refused to admit the idea of assisting human digestion by the digestive agent of animals, or that this, once extracted, could retain the properties it possessed as gastric juice; but others, more advanced in modern science, saw in this a radical progress in an entire branch of therapeutics. In 1854, Corvisart determined the form, the mode of administration, the doses, and the cases which required the application of this new physiological medicine; the detailed observations of a great number of physicians depose to the correctness of the result stated. Thirty-two cases were reported, in a third the contra test recommended by Corvisart had been tried with the best success, viz. *with the cessation* of the pepsine at meals the *indigestion reappeared.* The same year, Silliet (Geneva) stated the good effects of its use, and recommended that it should be tried in all cases of disordered stomach. In 1855, L. Fleury reported many successful cases. Desmartes (Bordeaux) advocated its employ in chlorosis and choleraic diarrhœa of infants. Dechambie also published the happy results from its use; and Debout, from his experience, particularly recommended it in the diarrhœa of young children. In 1856, Corvisart was rewarded by the Institute. In 1857, Ballard, physician to St. George's Hospital, having employed Boudault's pepsine, stated, "he thought that he ought to acquaint the profession with the results he had obtained, as they promised henceforth to largely diminish the mortality from many diseases;" at the same period, another English physician, Nelson, confirmed the good effects of liquid pepsine (liquor pepticus). Finally, T. K. Chambers, Dr. Todd, Dr. Protheroe Smith, James Ross, William Moore (Dublin), strengthened

the facts already advanced. In 1858, L. Gross employed pepsine with success in the sickness incidental to pregnancy; Barthez has administered it to children suffering with apepsia, in which the food passes through the stomach and bowels undigested; after the exhibition of the pepsine, digestion took place, and the stools presented a natural appearance.

Pepsine is indicated in cases were the secretions of the stomach, being disordered, the digestion is laborious, imperfect, or almost impossible—that is to say, in gastralgia, dyspepsia, debility, convalescence from acute diseases, &c., when the food produces vomiting, nausea, diarrhœa, &c. &c. We may add, that the rapidity of its action in appropriate cases is so great that it forms an excellent means of diagnosis; employed at hazard in an affection of this sort, if it succeeds, in three or four days the cure commences; if it fails, this short space of time is sufficient to show that it is not in the gastric juice that the physician ought to search for the cause of the malady, an advantage which spare much loss of valuable time and useless treatment. This was especially remarked by Rilliet in his practice.

3. *Its Pharmaceutical Preparation.*—It is solely perfectly pure pepsine that is capable of being employed therapeutically. When pure, after being extracted and dried at 40°, it has the form of laminæ or scales of a lemon colour, very similar to dried albumen; taste slightly styptic, and generally a slight odour of cheese when rubbed. It is extremely delicate, and a temperature higher than 45° C. completely destroys its digestive property without altering its chemical composition. It is impossible to employ pepsine in a state of extract for many reasons.

First. It has been remarked that pepsine (a product of fermentation rather than a simple chemical body) varies extremely in energy according to the species of animal from which it is procured, and in the same animal whether taken at the time of eating or fasting, whether young or old, change of seasons, &c., &c., so that any two preparations do not resemble each other. Sometimes it is necessary to use twenty centigrammes to produce a given effect, another time seventy; but it is important to the physician to be able to administer an equal digestive power in the same weight, it is necessary to add to the pepsine a variable quantity of inert matter, so that a given weight contains always an equal amount of digestive power.

Secondly. When the extract is desiccated without any additional substance it does not retain its original form; being hygrometric in the highest degree, it readily absorbs humidity from the atmosphere becomes viscid, soon liquefies, and consequently returns into the category of nitrogenous bodies, which in the presence of water and a slightly elevated temperature, enter into putrid decomposition. In this state pepsine loses all its digestive properties, and is variable from the augmentation of weight due to water, the medicinal properties diminisning accordingly.

How is the hygrometricity to be remedied? The inert powder already mentioned solves this problem, since, as soon as it is intimately incorporated with the extract, this ceases to attract humidity, and preserves a granular pulverulent form. Starch is the substance which best preserves pepsine from decomposition without injury to its therapeutic action; most other vegetable powders, either from the tannin they contain or from some catalytic force arising from their porosity, destroy rather than preserve it.

The admixture of starch gives to pepsine the most convenient form. Corvisart has noted all the conditions that it ought to present in practice, viz. :—

First. The action of the gastric juice is the dissemination of its active principle amongst the food, so the pepsine in powder imitates the natural action by the dissemination of its granules; on the contrary, the pills, &c., of pepsine have an opposite effect and frequently pass into the intestines without action.

Secondly. The gastric secretion does not pass into the stomach by the mouth before action; so, the pepsine powder taken in wafer paper, commences to act in the stomach, and thus fulfils the physiological design; whilst the *dragées* or pepsine lozenges, which dissolve in the mouth, are little in accordance with it.

Thirdly. The gastric juice is secreted drop by drop, slowly and successively; so each granule of starchy pepsine evolves, in dissolving, its active principle, thus imitating the formation of the natural fluid. This is not the case with the solutions of pepsine. When administered, in cases where the stomach is irritable, under the form of wines and syrups, it is sometimes borne with difficulty.

These conditions, which demand a preparation pure, unalterable, possessing always an invariable digestive power, are fulfilled by the "Pepsine Amylacée," or medicinal pepsine, which imitates the formation of the gastric juice, its gradual secretion, and its slow and continual dissemination amongst the food.

Mode of Extraction.—A certain number of calves' or sheep's rennets are taken from the animals as soon as killed, thorougly washed with water; the mucuous membrane, which contains the peptic glands, is scraped, macerated in water, at 10° to 15° C. for twelve hours; the pepsine in the solution is then precipitated by acetate of lead, allowed to settle, and the supernatant liquid poured off; a current of sulphuretted hydrogen is passed through the semi-liquid deposit, which precipitates the lead in the form of sulphide; the pure pepsine remains in solution with the free acetic acid; it is then filtered, and finally evaporated to dryness at a uniform temperature of 40° C.

The next operation is the trial and determination of the dose of the pepsine. To determine the quantity of digestive power contained in a given weight, three samples are taken from the mass, the first of 25 centigrammes, the second 50 centigrammes, and the third 75 centigrammes. Each is placed in a separate vessel, with the addition of, first, 25 grammes of water , secondly, acid, (lactic or other acid), a sufficient quantity to saturate 17 centigrammes of pure caustic potass (equivalent to the acidity of the gastric juice) ; thirdly, fibrine obtained from calves' blood, washed and strongly pressed in a cloth. The three vessels are then placed in a stove, and maintained at a uniform temperature of 45° C. for twelve hours. The sample in which the fibrine has been dissolved and converted into pure peptone (albuminose), not precipitable by nitric acid, is the normal and therapeutic dose of the pepsine.

But as the weight of pepsine necessary to obtain this regular power varies incessantly, sometimes 25, sometimes 50, or 75 centigrammes, whichever it may be, at each operation, sufficient starch is added to make the weight one gramme, so that each gramme contains invariably a uniorm digestive power, the quantitity of starch alone varying. No physical or chemical characteristics distinguish active pepsine from that which is inert, nor from other nitrogeneous bodies more or less allied; the only important quality being its digestive power, the test with fibrine is the only method of determining their value, all preparations, whatever may be their aspect and chemical reactions, are not pepsine if they do not answer to it. The digestive characteristic consists in that pepsine, in twelve hours, dissolves fibrine, and converts it into peptone, not precipitating from its solution by heat, alkalies or acids; sometimes the dilute acids (hydrochloric, &c.) dissolve fibrine, causing it at first to swell enormously, which is characteristic of their action. Besides this, after twelve hours peptone is not formed ; as the liquid gives a large precipitate with nitric acid, this test is conclusive. The modes of administration proposed for pepsine are very numerous, but, in Corvisart's opinion, the pepsine in powder, the syrups, the elixirs, and wine answer every exigency. The most preferable forms are those that are most miscible with the food. Finally, besides the addition of codeia, nitrate of bismuth, strychnine, lactate of iron, and reduced iron (in small doses), which are without any injurious action on pepsine, many formulæ have been proposed in which it is combined with a large number of other remedies ; but these preparations are better avoided. So the combination of pepsine with alkalies or alkaline lactates is not physiological ; the alkalies very certainly produce good results in some dyspepsias, but they have an action very distinct from that of pepsine. We think that the alkaline salts and the gastric secretion may be mutually injurious when meeting in the stomach, especially when the stomach does not sufficiently renew the peptic fluid, for it is necessary to remember that the acidity is the essential ingredient in it, and it is therefore necessary to employ pepsine and the alkaline lactates separately.

The solution remains perfectly transparent on the addition of four drops of nitric acid=pure pepsine.

PAPER-MAKING MATERIALS IN RUSSIA.

Inquiry having been made on the subject of the available raw materials for paper (especially from the flax plant), through the Foreign Office, some interesting information is furnished thereon in several of the recent Consular reports.

Mr. Stevens, the British Vice-Consul at Kherson, writes in the inclosed despatch that he made inquiries as to the possibility of selecting flax-stems for exportation so far back as 1859, but found that the expense of conveyance to a port for shipment would be too costly. He adds that, although there are more than 200,000 acres of land under flax in the government of Kherson, very little is grown in the immediate neighbourhood of the Black Sea; and, as it is only sown on virgin soil, its cultivation is annually falling back farther into the interior. A great deal of flax is grown on the banks of the Dnieper, between Nicopol and Ekaterinoslav, but the means of river-transport are insufficient, and freights are too high to make it worth the attention of commerce. The plants are not burned, but the best stems are pulled and selected for making a coarse kind of linen. It is only the refuse of the crop that is either burnt or employed in thatching. There is a kind of rush, he states, very plentiful near Kherson which might be worthy the attention of the paper manufacturer.

One of the largest landowners in Southern Russia, says that the flax-plant is extensively cultivated in New Russia, Bessarabia, Kherson, and Ekaterinoslav. Odessa alone annually exports more than 140,000 quarters of linseed.

While these provinces continue to be thinly populated, he thinks that the cultivation of flax will increase, as it is less troublesome and expensive to produce than cereals; but, if the population increases, the land under flax must decrease, as it requires virgin soil, which will become scarce.

The plant is now cultivated chiefly for the seed. No care is taken to grow good stems; and this country being subject to drought four years out of five, the want of moisture renders the stems of little value, though it does not affect the seed. When a season, however, has been wet, the peasants convert the stem into flax for linen. It is only when the stalk is worthless for manufacturing purposes that it is burnt. If the person desirous of employing the stem in paper-making could pay from 3s. 6d. to 4s. 6d. per Russian poud—say 36 lbs. English, delivered at a seaport ready for shipment, the landowner is of opinion that they could be supplied with a large quantity from this country; and, if encouragement of a ready market were offered, the cultivation of the plant for the stem would immediately occupy the attention of growers.

The chief of an eminent commercial firm, which may be considered at the head of the trade of Southern Russia, considers the exportation of the flax-plant from that country could not be made profitable. The expense of bringing stalks to Odessa would be nearly 9*l.* sterling per ton, without counting their cost price, while the charges of shipping them to England would be from 6*l.* to 7*l.* sterling more, thus making the total cost of the article in England between 15*l.* and 16*l.* sterling per ton, while the best rags in London are worth only from 12*l.* to 13*l.* sterling per ton.

Flax is very extensively grown in Southern Russia for the seed alone. After the seed is collected the plants are either burned or are used for thatching. The idea that flax might be profitably employed as an article of commerce has been entertained for some years by merchants residing here, and attempts have been made to export it, but without success. The expense of carting it to a seaport, and the heavy freight charged for its conveyance to England or France, have proved obstacles which rendered its sale impossible, and no further trials appear necessary to confirm a fact which has been already established at heavy cost. It is clear that flax cannot be usefully exported from here without previous preparation, to reduce its bulk, and lessen very materially the cost of transport.

A process appears to have been discovered by which the useful portion of the flax plant could be easily extracted, and profitably exported. M. Pitancier, an experimental chemist, is the inventor. He is a gentleman of some local importance, who gained a medal at the London Exhibition in 1851, and two medals in the Exhibition of 1862, for chemical products of his manufacture. During several years he has given his attention to the subject of employing flax in the manufacture of paper. He found that the stems could not be profitably exported in their crude state, for the following reasons:—Firstly, because the plant is too light and too bulky. Secondly, because it cannot be easily reduced by pressure. Thirdly, because the material applicable to the purposes of the manufacturer is small in proportion to the refuse matter, amounting, indeed, only to sixteen per cent.

Appreciating the value of flax to papermakers, M. Pitancier studied the possibility of separating the fibre from the woody matter, and then exporting the fibre. To do this cheaply, however, in a country where good workmen are rare, and water is scarce, was the great difficulty. At length he discovered a method which did all he desired without water, and he now finds that he can reduce the expense of freight and carriage on flax by eighty-four per cent., or five-sixths, through this process.

M. Pitancier further advocates the reduction of the fibre into pulp previous to its exportation. This can be done by another process of his own in less than seven hours, and at a very small cost. He calculates that the pulp so produced could be sold to papermakers in England or France at about half the price now paid for raw material.

M. Pitancier has obtained a patent from the Russian government for his method of treating paper-producing plants, and he is now constructing a paper manufactory in Odessa, to supply local demands, which are considerable. As, however, an export trade would be more lucrative, he proposes to enter into engagements with any firms in England desirous of utilizing the materials for paper now wasted in this country.

M. Pitancier states that there are other vegetable productions here of far greater value to the papermaker than flax, and especially calls attention to straw of various kinds, and the leaves of maize. The reeds growing on the banks of rivers he has also ascertained by experiment yield nearly fifty per cent. of their bulk as material for paper. The rush is almost as rich; and the paper produced from these plants is strong, lustrous, and smooth.

M. Pitancier has drawn up a report on these plants, and has annexed samples of the materials he uses, and of the various qualities of paper he can produce.

My inquiries, observes Mr. Consul-General Murray, tend to show that Southern Russia grows an immense quantity of flax, which could be usefully employed in paper-making. But all my informants combine in declaring that it cannot be exported in its natural state; for it is evident that an article must be of great value to admit of its being sent thousands of miles, when only one-sixth part of it is of any use. The same argument applies with more or less force to all vegetable productions of like nature. These are very plentiful in Southern Russia, but under scientific treatment only could they be exported with advantage both to producer and to the consumer.

Mr. Bernstein, one of the most eminent brokers at Odessa, who has previously, on several occasions, rendered important services to Her Majesty's Government, in similar inquiries to the present, after stating the exact quantity of land under flax in the province of Kherson, gives some information as to the mode of cultivation of the kind of flax grown there, as well as the quantity produced. Mr. Bernstein gives his opinion that the flax fibre could be pressed in the same manner as wool and cotton, so as to be exported in a small compass; but I am not inclined to attach the same weight to his opinion on the subject as to that of M. Pitancier, although it is just possible that an inventor may be a little misled by his own theories. Mr. Bernstein thinks, as is natural, looking at the question from his point of view, that British capital might be profitably employed to purchase the raw material here, without reference to M. Pitancier's inventions; and he adds that it could be bought for little more than the cost of transport. He also thinks that the erection of a paper-mill here would be a good speculation. I have the honour, likewise, to inclose a translation from the German newspaper published here, trusting that it may be read with interest.

In conclusion, I am bound to observe that a reliable estimate of the quantity and quality of the fibre which Southern Russia could annually export can only be made by an actual survey of the lands under flax, and other plants useful to the papermaker. Doubtless, if a sound conclusion were arrived at on this subject, and the result should, as appears probable, be satisfactory, the price of many useful kinds of paper might be materially lowered.

Mr. M. Bernstein, of Odessa, states that in the government of Kherson, about 80,000 dessiatines (or French hectares) of land, after lying seven or eight years fallow, are annually cultivated with flax. No kind of manure whatever is employed in this culture. Operations are limited to a simple autumn ploughing, sixteen or eighteen centimetres deep, and followed by two harrowings in the following spring. No hoeing or weeding are ever resorted to. The expense of cultivation for one dessiatine (seed included) does not exceed six or seven roubles. Coarse flax is the only kind cultivated in this country, and solely for the sake of obtaining the seed. The inconvenience of our dry temperature, want of water for retting the flax, scarcity of lands, &c., prevent us from cultivating the other kinds for the fibre.

Taking for basis the average of two years' crop, one dessiatine gives us about four tchetwerts linseed which produces an annual total of 320,000 tchetwerts of seed and about 45,000 kilogrammes weight of stem, containing excellent fibre. This refuse material is generally employed as fuel, or is left to rot, in consequence of the considerable distance it is from the linen and paper mills.

Flax in this country is generally mowed in the manner wheat and other cereals are, so that the stem is detached from the root, the totally useless part.

Having separated the seed from the stalk, and exposed this latter to the action of dew or rain, to dissolve the resinous gum, and after getting it trampled or beaten asunder by horses on a threshing floor, one may obtain the fibre almost entirely deprived of its ligneous particles. This experiment has already been made by one of my acquaintances in a neighbouring farming establishment. The fibre could be compressed in the same manner as wool and cotton, so as to be exported in the smallest possible volume. It is more than probable that, an English company furnished with necessary capital and establishing at Odessa an office for the purchase of the material (which could be obtained for little more than the cost of transport), and erecting a paper mill, would reap very large advantages on the capital employed for this purpose.

In the *Journal of Odessa* of Jan. 18, 1865 we find the following remarks :—Recently we had a conversation with a large landed proprietor who cultivates flax on a grand scale, and we asked him what he did with the stems of the plant which contain so much useful fibre. They serve for fuel, he replied.

The want of labour prevents the cutting or pulling up the stems, and it has to be mown and is then passed through a mill to separate the seed. Hence, the fibre is not fit for textile purposes. But this material is nevertheless, too valuable to be wasted as fuel, a papermaker could derive great profit from the use of this substance which would be equal to the best linen rags.

There are few branches of industry which offer greater prospects of success than papermaking in this country, seeing that the raw materials are to be obtained in such great abundance.

Other suitable materials could be furnished by Odessa in larger quantities, than other towns of similar population from the number of sacks used for grain annually. The stalk and leaves of the maize plant could furnish here as in Austria, most useful paper stuff. The reeds of the rivers Dnieper and Dniester would serve admirably for manufacturing paper. We have seen white writing paper of an excellent quality made of this substance by Mr. G. Pitancier, chemist of this town, in his laboratory. The Customs tariff accord to papermakers here considerable protection over foreign makers. The duty on foreign made paper being from 5½ to 10 roubles the poud. Notwithstanding this heavy duty, Odessa receives annually 3,300 pouds of foreign made paper, hence it may easily be calculated what profit a local paper mill would deserve.

The town of Odessa, which at present receives its supplies from Moscow and foreign ports, would take a large part of the quantity made. All the other towns on the coast of the Black Sea are in the same position as this seaport. It might also be possible to supply some foreign wants, especially Constantinople. Why has no person yet entered on this profitable field of enterprise. ?

IRISH MANUFACTURES.

The linen manufacture of Ireland which was substituted for the woollen, after flourishing for many years, chiefly in Ulster, has greatly revived in consequence of the application of machinery to the spinning of yarn, and of the introduction of the power-loom in weaving.

The exports of linen yarns and linen manufactures from Ireland to Great Britain and foreign countries, was, in 1862, 6,292,000*l.*; in 1863, 8,084,000*l.*; and, in 1864, 10,327,000*l.* The number of spindles in operation for spinning flax, in Ireland, in 1864, was 761,060; 200,000 persons are altogether employed in connection with the trade, and the amount invested in buildings, machinery, and the requisite floating capital, is estimated at 3,000,000*l.* In 1864, there were 42 factories, with 8,187 power-looms, nearly the whole of which were employed.

The estimated quantity of flax grown in Ireland in the seven years ending 1864 was 216,897 tons, or on an average 30,985 tons per annum. The number of acres sown in 1863 was 214,099, and in 1864, 301,693 acres, an increase of 87,594 acres, chiefly in Ulster. The produce of the two years in dressed material ready for spinning was 139,712 tons. The import of foreign flax into the United Kingdom in those years was 164,416 tons, so that the quantity consumed in the manufacture of linen cloth exceeded the entire produce of the whole of Ireland. There will, therefore, be a ready market for twice the quantity of flax grown last year, supposing the machinery then existing to remain the same. But in fact the manufacture of linen is progressing with unexampled rapidity. Mr. Baker gives the number of spindles working in Ireland in May, 1864, as 665,442, but, at the close of 1864, this number had increased to 761,060. These, with the English and Scotch mills, would demand 152,550 tons of dressed flax, or a quantity fully equal to the home production and imports from abroad in 1864. In foreign countries, too, flax spinning has increased 426 per cent. in ten years, and is still more rapidly progressing. It is evident from the figures that if Ireland produced three times the quantity of flax grown in 1864 there would be a ready sale for it for home consumption and exportation.

The English inspectors of factories believe that a less extent of land will be sown with flax in the present year than in 1864. The produce of the last flax crop was, in general, abundant in quantity but deficient in quality. The Irish inspectors attribute this to "late sowing," "insufficient preparation of the soil, and want of care in weeding the crop." The English inspectors to monetary difficulties and an unfavourable season.

The Government have determined, to continue the grant for Government instructors. From the report on the statistics of flax culture in Connaught and Munster in 1865, by W. Neilson Hancock, LL.D., it is proved that the decline which took place in the production of flax in Ulster, in 1865, compared with 1864 is not peculiar to that year. In the last sixteen years there was a decrease in acreage in seven years at different times, and an increase in nine years, but, on the whole, the growth of flax increased from 60,314 acres in 1849 to 251, 534 in 1865, being an increase of over 300 per cent. in sixteen years.

The increase in the growth of flax in Connaught, from 1861 to 1863, when no Government aid was granted, was only 986 acres, but in 1864 with Government aid the increase was 6,110 acres. There was a decrease of thirteen per cent. in 1865, but this year's crop if compared with that of 1861 shows an increase of 254 per cent. Similarly, in Munster, from 1861 to 1863, when no Government aid was given, the whole increase was only 908 acres, but with Government aid in 1864 the increase was 2,398 acres. Although there was a diminution of flax culture in 1865 as compared with 1864, the statistics prove that the Government encouragement has worked most successfully, and that its assistance may be expected to be advantageous.

The greatest exertions are being made to extend the cultivation of flax in England, but the Irish farmer has only to sow early, to prepare his ground carefully, and to give the crop ordinary care, to secure ample remuneration. The farmer whose expectations were not fully answered last year should hope for a more favourable result next year. He does not abandon the culture of any other crop because it may not have fulfilled his hopes in one year. In general all the flax grown in Ireland has been sold at prices which yielded to the farmer a larger profit than he could have obtained from any other crop, and this ought to be a sufficient encouragement for the cultivation of the crop.

The flax plant and the linen manufacture are two sources of almost unlimited prosperity. Ireland has an opportunity of becoming the great flax market of Europe. With plain ordinary care the crop may be grown and pulled in excellent condition. Mills, for dressing flax and preparing it for the mill, have been erected in many counties which last year produced flax on an extensive scale for the first time. There is no true reason for supposing that cotton will ever again be so cheap as to render the culture of flax in Ireland unremunerative.

The cotton trade in Ireland is found in six counties only ; it has entirely disappeared from six. In 1862, there were 1,412 persons employed in this trade in the county of Waterford, 639 in the county of Antrim, and 492 in the county of Dublin. There is not in any county a single instance of the number of cotton mills increasing since 1839. In Londonderry and Tyrone, however, it is new. In 1862, the total number of mills was nine, and the persons employed 2,734. A new factory has been lately erected in Drogheda.

Sewed Muslins.—A great source of employment for females has of late years sprung up in the North of Ireland, in the working of patterns on muslin with the needle. Belfast is the centre of this manufacture, which employs about 300,000 persons, chiefly females, scattered through all the counties of Ulster, and some localities of the other provinces. About forty firms are engaged in the trade, some being Irish houses and others agents for Scotch firms, and the gross value of the manufactured goods amounts to about 1,400,000*l.*

The woollen manufacture, which was nearly extinguished at the Revolution, revived for some time after, but is now confined to Dublin, Cork, King's County, Waterford, Kilkenny, and Queen's County. There appears to have been a positive decrease of factories in use between 1839 and 1850, no doubt owing to a decline in the trade, which has revived since, and the discontinued factories have been reoccupied. The total number of counties manufacturing is ten, and in these there are only four in which there are 100 persons employed in the aggregate—viz., Dublin, Cork, Westmeath, and Kilkenny. The trade has entirely left Kildare and Wicklow, and has been established in Fermanagh, Limerick, Meath, and Westmeath since 1839, and a great improvement has been made in the machinery.

Silk manufactures since their introduction by French emigrants in the beginning of the last century, have been confined to Dublin ; its chief branch is tabinets or Irish poplins, which still flourishes.

Paper Manufacture.—In 1860, the year before the repeal of the duty on paper, 9,314,985 lbs. were manufactured in Ireland, being an increase of 1,022,524 lbs. on the previous year. The quantity made in 1847 was only 5,711,546 lbs.

COMPARATIVE VALUE OF WOOD.

THE following seasonable advice is from an American paper:—

Wood that is intended for fuel should be cut in the winter, as it contains less sap than in the spring, and will season quicker. The sooner it is converted into stove wood after being cut from the stump the less work will be required, for it is well known that seasoned timber is harder to saw and split than green. The best way to store it for seasoning is to pile it under cover; it will do very well to cord it out of doors and if merely thrown together in a large pile it will wet in but little, though from the greater amount exposed on the ground and outside this is more wasteful than the other methods. It does not seem a good plan for farmers to cut more wood into cord length than in the course of the winter and spring they can convert into a size fit for the stove.

And the time has come when it pays to cull the forest. Save the timber. Use up first the dead and fallen trees; cut the crooked, worthless saplings; thin out where too thick, and by this treatment the timber lot will improve in value. Be careful, also, in felling large trees, not to injure the valuable undergrowth beneath and near them. Many of our most useful kinds of timber throw up numerous thrifty sprouts from the stump after being cut—chestnut for example. These should be cared for—thinned—and in a remarkably short time several trees, large enough for stakes or posts, will replace the parent.

Nearly all the work that pertains to preparing wood for fuel is laborious. It takes strong muscle to swing the axe and fell the king of the forest; but it requires more endurance to work steadily the buck-saw. It pays to work the wood into suitable size for handling readily, and then saw it with horse-power. One machine will answer for a neighbourhood, and can be moved easily. When large trees are to be cut up, two men with a cross-cut saw can take off lengths for a stove rapidly, and these can be easily split with an axe.

Although it will not be good economy for a farmer to *pick* his fuel from his wood lot, merely with regard to its good qualities *as* fuel, yet it may be interesting to know the relative value of different kinds of American wood for burning purposes. We subjoin a table from the best authorities:—

	1.	2.
Shellbark or Hickory	1·000	1·00
White-Ash	·772	·97
Apple	·697	·70
White Beech	·724	·65
Chestnut	·522	·52
Pignut Hickory	·949	·95
Red Heart Hickory	·829	·81
Hard Maple	·644	·60
Soft Maple	·597	·54

	1.	2.
White Oak	·855	·81
Scrub Black Oak	·728	·71
Red Oak	·728	·69
Yellow Oak	·653	·60
Yellow Pine	·551	·54
Pitch Pine	·426	·43
White Pine	·418	·42
Sassafras	·618	·59
White Elm	·580	·58
Red Cedar	·565	·56
Black Walnut	·681	·65

The column marked 1 gives the specific gravity of dried samples of the different kinds, and that marked 2 the relative value of specified quantities compared with shellbark hickory as a standard, which is marked at ·100. Shellbark hickory is considered the best wood in market for fuel. Next, hard maple and beech are held in highest estimation. But it will be noticed in the table that several woods are placed in advance of the latter. White oak stands near to hickory, and white ash next. Yet who, in our markets, would think of paying as much for a cord of these as for sound, hard maple? But we apprehend the table is right in regard to the value of the different woods for fuel. With white and red oak we have had some experience, and know, if *well seasoned*, it will *equal* any hard maple we ever burned.

But in a green state it is almost worthless. It contains more water than maple or beech, and requires much more seasoning to become fit for burning. Undoubtedly the prejudice in favour of beech and maple arose from this cause. It was generally more plentiful than oak, and as it would burn quite readily without much seasoning, and is easier to kindle when dry, it was taken into favour. Oak and ash being more valuable as timber for manufacturing purposes, naturally would not be thrown into market for fuel to so great an extent as beech and maple. But as ash, and especially oak contain, more water when green, and require a longer time to season thoroughly, they are apt to be used before they are perfectly dry, or else become slightly decayed from long exposure to the weather.

Scientific Notes.

Alvaro Reynoso's Cold Process of Making Sugar.—Messrs Travers and Co. call attention to this process as follows :—" Certainly no one can say that sugar manufacture is not advancing, when we have to chronicle in one year, Fryer's Concretor, the Alcoholic Process (of which we hope to give details shortly), and the Cold Process of M. Reynoso. True, neither of these inventions have as yet had any effect upon sugar-making in general, but they have also not been tried. Without them, however, a point has been reached, when, with vacuum pans, centrifugal machines, *appareils à triple effet*, and other old inventions and new applications, white sugar can be as cheaply made as brown, and when, were it not for the scale of duties, we should receive all our sugar in a fit state for immediate use. With regard to M. Reynoso's process, the following particulars are extracted from a paper read by that gentleman before the French Académie des Sciences, and reported in the 'Comptes Rendus' of that body. M. A. Reynoso commences by saying :—'The process for the treatment of saccharine juices, which I have the honour to submit to the Académie is divided into two parts. 1st. Defecation. Chemists have long been occupied with the advantages that would result were aluminous substances used in sugar manufactures. Alum, sulphate of alumina, and alumina itself, in a more or less pure state have been tried with variable success in sugar manufactories. Evans has described in detail the way in which alum and the sulphate of alumina were used, and speaks of the good results that had been obtained in the English colonies. I myself have employed sulphate of alumina under different circumstances, but have seen that, side by side with considerable advantages, the use of this substance leads to serious inconveniences. Acid phosphate of lime has been used in Cuba since 1860, and particularly in 1863, in M. D'Aldama's works, by Mr. Swift, a distinguished American refiner, and I about that time described his process. I believe that I can now use alumina in a way to produce a defecation, perfect in a commercial point of view, and that I at the same time succeed in eliminating hurtful substances. The substance I use is acid phosphate of alumina. After having put it directly into the cane juice, the mixture is treated with lime ; free alumina and phosphate of lime are thus formed. The reactions resulting from acid phosphate of alumina, from alumina, from phosphate of lime, and from lime added in slight excess, do away with the colouring matters, azotized bodies, &c., in such a way that only a few of the salts are left that originally existed in the juice. This defecation may be compared to that produced by sub-acetate of lead, but it has not its inconveniences. 2ndly. Separation of the water. To evaporate the water contained in the purified juice, I employ *cold instead of heat.* I prevent in this way the numerous and complex reactions which, under the simultaneous influence of air and water, and heat coming between the different matters of which the juice is formed, cause the change in the colour of the sugar. By means of a rapid cooling, produced in suitable machines, I change the juice into a Magma—formed of a mixture of water reduced to the state of small pieces of ice, and of a syrup more or less dense, according to the conditions of the operation. To separate this mixture I have recourse to centrifugal machines, and I end the process by evaporating the syrup in vacuo. The details of the process will be found in my memoir.' This memoir has not yet been made public, and we shall await further particulars with some impatience. To give an opinion as to the value of the chemical part of the defecation, would be premature, and it is only in practice that its value can be determined. With regard to the separation of the greater part of the water by freezing, the idea is so simple, and yet so beautiful, that it cannot but excite admiration. It is well known that water when frozen rejects almost all alien substances, and that the ice even of a muddy puddle is pure, while the salt is driven out of frozen sea water. Whether the cold process will pay we cannot say, but M. Reynoso deserves credit for the application of a well-known principle to sugar-making, and we may conclude by wishing him the success to which his efforts entitle him."

FISH-FLOUR AND FISH-GUANO.—The simplest form in which cod fish is prepared for market in Norway, is to cure and hang the fish on long spears till it is dried and has become as hard as a piece of wood; in this form it is shipped to Spain and Italy under the name of stockfish. When this dried fish has to be prepared for eating, it must be well beaten to get it soft, and laid in water several days. Before you get it on the table, the preparing process, soaking and cooking, will take the most essential of the nourishment, especially all the phosphates or lime in the bones that is a very essential support for the frames and brain will be lost. To make what may be termed fish-flour, the best dried stockfish is ground-up, bones, skin and all, to a dust or flour, in which form it may easily be used for all sorts of dishes, and gives a cheap and substantial food. It may be mixed with potatoes or other substances, according to taste, or made into cakes or biscuits. It is to be observed that in this way the fish is more fit for transport and can be packed in barrels, without causing any inconvenience from the particular fishy smell. Fish guano is manufactured at Lofoten, in Norway, of cod-heads and backbones collected during the great cod fishery season in the winter, chiefly by poor and infirm people, and children or women who cannot take part in the fisheries. The heads and backbones are hung in bundles for drying on long spears, or laid on the bare rock. In the month of June and July this raw material is brought to the mills where it is cut in pieces, dried artificially, and ground on millstones. It is shipped in bags, each containing 250 lb. Norwegian weight (about 2½ cwt.), and delivered in Hamburg at the price of about 9*l.* per ton. An analysis of this manure by the celebrated German Professor Stöckhardt in 1860, inserted in Chem. Ann., gave the following proportions:—Water, 12·2; organic, matter, 53·7; phosphates of lime, 30·5; alkaline salts, 3·1; sand, 0·5; nitrogen, 10·15; ammonia, 9·9. The Norwegian Fish-guano Company has been established since 1856. It has been a great benefit for the fisheries in Lofoten to get rid of this manure that formerly spoiled the bottom of the fishing banks and infected the harbours where it in some places was laying knee-deep on the beach.

THE TECHNOLOGIST.

ON THE CULTIVATION OF INDIGENOUS OPIUM.

BY ALPHONSE ODEPH.

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(Continued from page 246.)

1st. *Choice of the Plant.*

THE poppy is an herbaceous annual belonging to the genus *Papaver* of that family known to botanists as Papaveraceal.

There are a great many varieties of this plant all furnishing opium; but the quantity which they yield and the richness of the product varies according to the species employed, as has been proved by Professor Cavantou of the School of Pharmacy in Paris, and according to the degree of advancement in ripening of the capsule as M. Aubergier has observed.

Let us examine these varieties, taking some of the results of M. Aubergier, and see if this distinguished writer has been correct in fixing his choice upon the purple poppy, *having regard to the cost of extraction; the returns in opium; and above all in seed*; for the latter must be taken into consideration as a great, and very important portion of the products of the crop. It is the seed, in fact, which in covering the expense of culture, ought to enable us on French soil with a changeable climate; —labour, and rent of suitable ground being also high, to permit us to compete successfully with oriental production.

Professor Clermont, in his treatise has confined his attention to three varieties of poppy; the white somniferous poppy with white seeds; (*Papaver Somniferum*) the purple poppy, and the carnation poppy of the North.

I name them in the order of their greatest value for the quantity of opium they yield, and for the thickness of the sides of the capsules; but, unfortunately every medal has its reverse, and we find these poppies placed in an inverse order when we come to examine the richness of the product, and the abundance of seed. The thick sides of the white poppy head so favourable to incisions give a very poor opium, and but a small quantity of seed, although the seed yields an oil of a superior quality.

According to the multiplied experiments of MM. Aubergier, Decharmes, Bénard, O. Reveil, Mialhe, Lepage, &c., it appears.

That the opium of the carnation contains from 14 to 23 per cent. of morphia; that of the purple poppy from 10 to 12 per cent. whilst the white poppy affords an amount of morphia which varies from 3·27 to 7 and rarely reaches 8 per cent.

For these reasons the last variety should be rejected as giving but little seed, and an opium the weakness of which in alkaloid seems to increase with the progress of ripening.

M. Aubergier who has not only collected the opium juice of each variety, but the product of each day's work separately and submitted them to a comparative analysis, has remarked that, the opium of the white poppy gathered by him before the complete development of the capsules, the 9th of July, 1845, gave on analysis 6·63 per cent. of morphia; that collected in the same plantation the 28th of the same month, the capsules still green having arrived at their full growth, only furnished 5·53 per cent. of alkaloid, and lastly, the juice obtained the 13th August from poppy heads already arrived at the colour of dead leaves gave but 3·27 per cent of morphia.

He also found in the carnation poppy the same stages of decrease in morphia during the ripening of the fruit.

The carnation poppy, at the gathering of the 29th to the 31st July, 1845 would have given to the Professor 17·833 per cent. of morphia; and the opium gathered the 21st August would have furnished about 14·780 per cent of alkaloid.

M. Aubergier has observed that the variations in the quantity of morphia in the purple poppy are confined within very narrow limits (1 per cent.), and that it gives pretty regularly a rich opium of 10 per cent. strength

Buchner, however, in his experiments has arrived at opposite results, for according to that experimentalist, the morphia increases with the progress of ripening in the capsule.

But, have these two chemists studied the products in the same condition and under the same circumstances?

It is in fact, difficult to follow separately the capsules in their development, those which bud in the morning arriving sometimes at maturity much sooner than those of the evening before, as I have often proved by neighbouring plants. Moreover, it is necessary to give an account of the variable produce which may compose each day's harvest, before deducing scientific results from them, for in my opinion they must make the value of the opium vary in quality.

In effect, whilst the opium of the first day is usually gathered from the first capsules which appear on each stalk (those at the top of the plant), that of the second day must be obtained from the first capsules already incised, or from those capsules which did not appear upon the stalk until after the first, and finally on the third day of work, none but heads already exhausted are left to be operated on, or those newly come. Now, observation has clearly proved to me that the first fruits which appear on the stalks acquire a development much more considerable than the fruits of a later growth, which are always more or less stunted in size, and the juice of the former also appears to be more abundant and more laden with active principles than in the latter. Therefore, the produce of even one day's work may differ essentially, according as it is composed exclusively of juice taken from capsules of the same age, or a mixture of juice taken from the heads of young poppies and of capsules that have been incised several times.

Hence it is impossible, scientifically speaking, to admit or to reject this or that opinion, and new researches and fresh experiments become necessary. But to make them profitably we must first put the question clearly so that it may not have two solutions. And the question is either scientific or practical. If of a scientific character, we must operate on capsules of the same age and follow them in their development to maturity. Here is in my opinion the mode of operation for making important experiments, from which it will be possible to deduce scientific results. At the time of blossoming, to recognise afterwards the capsules of the same age, the peduncle should be decorated with a ribbon or some mark to point out the flowers which fade the same day. The capsules thus ornamented, that is to say those which are grown the same day must be divided into three series.

All the heads of the first series are to be incised before they arrive at their full growth.

Those of the second series are not to be operated on until they are fully grown, although still green ; and lastly, the incisions of the third series are not to be made until the capsules have become the colour of a dead leaf. Then by analysing separately the produce obtained, we can be certain of what takes place during maturation,

I have never had time to try these experiments which I purpose making this year.

But if the question is merely of a practical nature there no longer remains the shadow of a doubt, for every one knows that the opium resulting from a first incision made at the proper time is richer than the juice gathered in at two operations, only because of operating on the first and consequently on the finest capsules in the plantation. This is so true, that the last incisions do not pay by their product for the time they take

I shall show further on the most favourable moment for making incisions of the carnation poppy so as to obtain the richest product.

This long digression was necessary to establish one reason for the preference that I accord to the carnation poppy for the extraction of opium.

In first making choice of the purple poppy, it was deemed expedient to sacrifice the question of economy, and consequently the commercial question, to uniformity in the quality of the opium, which could, however, be obtained more easily and more exactly in another way.

By a singular chance, the opium of the purple poppy, obtained by M. Aubergier during five successive years, gave pretty regularly 10 per cent. of morphia; and this coincidence of strength which could not fail to excite a lively enthusiasm amongst men who, up to the present moment, have desired regularity in the composition and uniformity in the strength of the opium employed in medicine.

But what has resulted from the preference given to the purple poppy? This—that the commercial question has ended there.

It is, however, possible, I think, to obtain with certainty a constant and regular yield of 10 per cent. of morphia without depending entirely on the caprices of nature. I believe that it must be with the culture of the purple poppy as with other cultures, and the opium of this variety, cannot any more than the other products of the soil, give regularly the same results.

Everyone knows, in effect, that the same kinds of wheat, of vines, &c., do not give every year produce of the same quality.

To admit a similar principle we must suppose an identity of circumstances which we do not always meet, and above all, a permanence of the same atmospheric conditions which are to be met with still more rarely.

It is true that the carnation poppy has been reproached with the thinness of its walls, but this objection disappears in using the instrument which I have invented for making incisions in the poppy head, and which only allows the flexible blades of this apparatus to make superficial cuts.

Admitting this, let us now examine seriously the economical, and consequently the commercial side of the question of *indigenous opium.*

What is the most powerful cause which has hitherto been an obstacle to the extraction of opium in an industrial point of view?

It is evidently the slow process of incising the heads, the length of time that the collecting of the produce requires. But this inconvenience is the same for the purple as for the carnation variety, and the incisions cannot be made with greater rapidity on one variety than on the other. Moreover, the purple poppy scarcely gives as much opium as the carnation. That being so, the richness of the carnation opium allows us to reduce the price at least one-half per kilogramme of medicinal opium containing 10 per cent. of morphia.

Let me explain myself. We know that the opium of the purple poppy gives approximately 10 per cent. of morphia, and that of the carnation never descends lower than 15 per cent., and sometimes reaches 23 per cent. This variableness of the carnation poppy need not perplex us; the height to which its strength ascends will enable us to manage the produce as we desire. "Abondance de biens ne nuit pas."

It will be easy for us, to buy at a low price *the poorest* exotic opium, and by mixing it with the extract of the juice of the plant, to obtain a medicinal opium with a fixed 10 per cent. of morphia by following the process recently pointed out by Mr. Adrien.

An example is necessary to understand these facts.

Let us take for instance :—

1 kilog. 500 grammes of carnation opium at 19·40 per cent. of morphia.
2 kilog. of exotic opium at 3 per cent.

Let us mix exactly these products, having previously analysed them, and calculate the sum of kilogrammes and that of morphia, and we have—

3 kilog. 500 grammes on one side, and multiplied by 10 351 of morphia on the other.

Whence we have $\frac{351 \text{ (morphia)}}{3{,}500 \text{ (weight)}} = 102$ of morphia per kilog.

or in round numbers 100, and consequently 10 per cent. So, that if 1 kilog. 500 grammes of carnation poppy has cost forty-five francs in the extraction—the kilogramme of opium at 10 per cent. will only come to fifteen francs, or what is the same, instead of 1 kilog. 500 grammes of opium, you obtain 3 kilog. 500 grammes for the same price.

One word more. Why then substitute for this carnation poppy, already acclimatised and so well known in parts of France for its fruitfulness and for its culture ?—a variety which both in opium and in seed gives produce of an inferior quality.* The oil of the purple poppy is well known to be more highly coloured than that of the carnation. And when have we ever seen France, that nation of progressive improvement, prefer an inferior product to one of superior quality ?

Let us, then, with MM. Bénard of Amiens, and Roux of Rochefort, give the preference to the carnation poppy, which will produce a double harvest, give a richer opium, and abundance of seed afterwards.

What I have said of the culture of this plant, and of the manner of collecting the opium juice and seed, applies to every other variety of the poppy.

2. *Description of the Plant.*

The carnation poppy is a variety of the *Papaver somniferum,* or rather of the *Papaver nigrum,* the capsule being dehiscent. It has an

* It was impossible for me to find purple poppy seed in any of the seed shops in Paris.

annual root which is white and fusiform; stem from 3 to 3½ feet high, cylindrical, glaucous and glabrous, straight at the base and ramified at the top. The leaves are alternate, amplexicaul, oblong, and deeply cut.

The flower bud grows at the extremity of the branch, and is provided with an oval calyx, having two sepals and very perishable.

The corolla has four entire petals, but crumpled before the blowing of the flowers. They are generally of a roseate white, with a deep violet eye at the base. In some instances, however, they are perfectly white.

The stamens are very numerous. I have counted from 300 to 340 of them in one flower.

The capsules, either oblong or flat, are at first of a very delicate green, which becomes by degrees deeper, then glaucous and succulent, afterwards greyish, and when ripe, dry.

The oblong capsules when fully grown are in general from 48 to 65 millimètres high by 111 to 117 in circumference.

The depressed or flattened capsules are from 34 to 50 millimètres high, and from 120 to 130 in circumference. They have all from 13 to 14 stigmas (sometimes 16) standing in rows upon a starred disk crowning the ovary.

The carnation poppy produces from seven to forty heads according to the nature of the soil and the distance between the plants.

The capsules of the poppy contain a great number of very small seeds, reniform and reticulated at the surface. These seeds are attached to false partitions known under the name of parietal trophosperms.

At maturity, the disk and stigmas separating themselves from the capsule, small openings are made which correspond with the inner partitions, and by these openings the seeds escape to spread over the soil, if the stems are left to themselves.

3. *Nature of Soil and Choice of Ground.*

The vegetable basis of earth is in part composed of triturations from the sub-soil. It generally contains alumina, carbonate of lime, silica, and *humus* (a matter arising from the decomposition of any substance) in diverse proportions, which cause an infinite variety in the nature and fertility of our soils.

Sometimes, however, ground contains also magnesia, oxide of iron, and sulphates, which are far from rendering soil productive. I shall only point out how these various mineral products are to be known, as it is not necessary to enter into chemical considerations in a work intended to be *essentially practical.*

I need only say that earths are designated from the mineral strata on which they lie. Thus, earths are called clayey, calcareous, ferruginous, marly, siliceous, according as they cover beds of clay, lime, iron, marl, or rock containing quartz, in their composition.

But cultivators in general here being in a great measure ignorant of chemistry, recognise only four sorts of earth, which they call by the names of *cold* earth, *warm* earth, light earth, and hard or stony earth. They comprehend under the name of *warm* earths all those which are easily penetrated by rain water, and do not retain it long; that become hot by the prolonged action of the sun, and retain heat a considerable time.

They give the name of *cold* earths to those which are slowly warmed by the action of the sun on account of the presence of water which they hold for a long time. Under this class may be ranged marly and clayey earths.

I purpose speaking in another place of *light* earths and *hard* earths.

But there is another classification of soil, much more rational, established by the learned and distinguished geologist, M. Thirria.

He divides them into five classes, according to their mineralogical constitution—viz.:

1st. Hard earths.

2nd. Light earths.

3rd. Poor earths.

4th. Ferruginous earths.

5th. Magnesian earths.

Hard or stony earths, he says, are compact, difficult to work, and are not easily penetrated by water. They are either yellowish, red, or of a greyish black. These earths, which are marly or clayey, are fertile when alumina is not in too great a proportion, but when it predominates the earth is too long in a damp state, the water not being able to escape easily, and the roots of vegetables decay.

Light earths are friable and easily worked; their colour is generally greyish or yellowish. They are sandy, calcareous, or marly. They owe their friability either to the silica or to the lime which predominates in their constituent parts when they are sandy or calcareous, or to the heaps of small calcareous stones which divide them when marly.

They are very productive when the proportions of silica or of lime are not so strong as to prevent their absorbing a sufficient quantity of water for vegetation, or when the amount is abundant of small calcareous stones, in which case these stones have the advantage of admitting the introduction of water to the soil, and of warming it by transmitting atmospheric heat better than the surrounding earth.

The earths called poor are those which, being sandy or calcareous, contain a great deal of silica or lime. Their colour is generally whitish or yellowish grey; they are unfruitful, because they cannot retain enough water to transmit to vegetables the quantity necessary for their growth.

Ferruginous earths are of a red colour, more or less deep, and are always clayey. They are in general barren, because the oxide of iron with which they are charged contains often a small quantity of protoxide of iron, which experience has proved to be very injurious to vegetation.

Lastly, magnesian earths are rather grey or black and marly. They are all sterile, on account of the magnesia, which exercises over vegetables a pernicious action.—*E. Thirria's Statistics of Hte. Saône.*

So much being granted, let us now see what soils are suitable for the carnation poppy.

After the numerous experiments that I have made on the various soils of three departments of France between 1860 and 1864, the result is,

1st. That we must employ for this culture, as far as possible, choice lands with rich soil.

2nd. We must reject strong earths or poor soils without depth or too arid; as on these the poppy will not thrive nor yield much opium.

3rd. The carnation poppy seems to like ferruginous earths.

4th. It flourishes best of all in *light* or sandy soils which have a little depth; in a word, it requires ground not too dry, and soil not too compact, for the root of this plant being pivoted it must perish in an unpenetrable or arid soil.

5th. The nature of the ground must be chosen according to the aspect or situation of the sun. Therefore, in places exposed to the north we must reject cold earths; poppies there give little opium, and the opium yields little morphia (8 per cent.)

On the contrary, in places exposed to the south or on a plain, we must give the preference to cold earths, for then the water retained in the sub-soil furnishes a useful humidity which constantly tempers the heat of the sun. Poppies growing there furnish in abundance an opium rich in morphia (15 to 20 per cent.) I have had the best results at Grandchamp (Haute Marne), in sandy ground exposed to the south, belonging to the ferruginous class, and reposing on the marls of that degree.

The carnation poppy there, acquired prodigious dimensions, and furnished abundantly a rich opium with 20 per cent. of morphia.

I found it grow equally well in the plains of Haute Saône, on a reddish soil reposing on a clay containing iron.

It also gave me equally good results, at Luxeuil, in a soil of motley grey, the superstructure of a clayey subsoil.

From the preceding observations, and from analogy, it is easy to point out the land most suited to the cultivation of the carnation poppy in different climates.

Thus, in the northern departments, with land situated in the plains, or on hilly ground facing the south, cold earths must be rejected.

On the contrary, in the southern departments the preference should be given to land having a subsoil impermeable to water, and in still hotter regions land must be chosen upon rising ground exposed to the north, in order that the plants may be protected from the rays of a burning sun. In the latter climates in particular the seed must be sown in autumn.

M. Aubergier thinks that land reposing on volcanic formations is very favourable to the culture of poppies ; and it is to this kind of soil that he attributes, in a great degree, the success of his culture in Auvergne.

4. *Analysis of Soils.*

The analysis of soils, as its name indicates, is an operation the object of which is to determine the nature and proportion of the different substances that compose a given soil, so that the agriculturist may arrange it in one of the preceding classes.

To make this analysis we purpose following the simple and easy process pointed out by Professor Lassaigne of the Imperial School at Alfort.

First find the proportion of moisture contained in the earth. Then separate the matters soluble in water from those not so, and finally determine, successively, the nature of the bodies which compose the watery solution, and the residue.

The proportion of *humidity* may be estimated by drying a given weight of earth for analysation, and taking care not to decompose the organic substances found in it.

After this determination, separate the gravel and stones, weigh them and ascertain their nature by means of hydrocloric or nitric acid ; they will be dissolved by effervescence if they are formed of chalk (carbonate of lime), but will remain insoluble if silica forms the base.

Soils, besides the gravel and stones which mix with them in variable quantities, contain a greater or less proportion of fine sand, which can be separated by stirring the earth in water.

The sand, being heavier, is precipitated in less than a minute ; it is then collected in a vase by decanting, and when dry is to be weighed, its nature is as easily known by an acid as that of the gravel.

The finer parts of earth, and the animal and vegetable matter, less heavy than the sand, remain for a longer time suspended in the water. The liquid is to be filtered through paper to separate them.

As the water which served for this operation contains the saline and soluble organic matters, if any existed, in the earth, it is to be evaporated to dryness in a crucible or small saucer of clay for roasting samples of ore, so as to weigh the residue and examine it separately.

The disunited matter of the soil, separated by filtration is the most important to determine ; it contains generally the remains of organic matter, of silica, of alumina, bi-oxide of iron, carbonate of lime, and sometimes carbonate of magnesia.

A portion is to be calcined in a crucible to a red heat, to ascertain the weight of the organic matter by the loss of weight sustained. But as this part of the loss is due also to the carbonic acid, which proceeds from the calcareous carbonate, the quantity of this must be estimated by the loss another weight of earth sustains by dissolving it in a given quantity of weak hydrochloric acid; subtracting then the latter weight from that which the calcined residue expresses, the remainder is the weight of organic matter. The residue of the calcination is treated by hydrochloric acid in a little test tube; all the oxides are dissolved, with the exception of the silica, which is collected by a filter, and which, after having been well washed in hot distilled water, should be calcined before its true weight can be taken.

The hydrochloric separation is precipitated by a solution of bicarbonate of potash. The bi-oxide of iron, the alumina, and the lime are separated, whilst the magnesia remains in the filtered solution and may be extracted from it by boiling.

The precipitate formed by the bi-carbonate of potash is collected by decanting or filtering; whilst damp it is put into a solution of caustic potash and boiled to collect the alumina, which is afterwards separated from this alkaline solution by hydrochlorate of ammonia.

The insoluble portion of the precipitate in the potash only contains the bi-oxide of iron and the carbonate of lime; these are to be dissolved again in hydrochloric acid, and in adding afterwards ammonia the bi-oxide of iron is isolated from the lime which floats upon the liquor, and in its turn is precipitated by a solution of carbonate of potash.

Each principle thus separated should be strongly calcined and then weighed, that the properties may be known as they existed in the specimen of earth submitted to analysis.

The name of humus has been given to the residue formed by the decomposition, more or less advanced, of organic substances exposed to contact with the air. This black residue, in consequence of its earthy appearance, is known also by the name of vegetable or animal earth, according as it proceeds from vegetable or animal substances. It supplies agriculture with an excellent manure, and appears to act on the process of vegetation, not only by the soluble saline principles which it contains, but by the property it possesses (as observed by de Saussure and Humboldt), of absorbing by its carbon a certain quantity of oxygen from the air and producing carbonic acid gas, which decomposed by the plants, becomes to them one of their principal elements.

The enterprising researches of M. Theodore de Saussure have proved that vegetable earth contains a very small quantity of extractive matter soluble in water and alcohol; but that it is almost entirely formed of a brownish-black matter, soluble alkaline solutions, and having the characteristics of *ulmine;* and that in equal weights of each, it contains more of carbon and nitrogen, and less of hydrogen and oxygen, than the vegetables which have furnished it.

Though the composition of earths comes very near in general to those which we have described, they vary according to the nature of the organic substances which produce them.

5. *Preparation of the Soil, Sowing, and Care of the Young Plant.*

Soon after the harvest of cereals (wheat, barley, &c.), it is good to till the soil, and leave it to rest until October or November.

At this period the ground should be well manured (about thirty cubic metres to the hectare), this should be followed by deep trenching the poppy being an exhausting plant.

In the month of January or February, if the weather permit, or in autumn in warmer countries, it is harrowed twice and in dry weather the seed is sown in lines (about five litres to the hectare), and a light roller is passed over them.

But it must be borne in mind that the month of April and the end of March being almost always very dry, germination could not take place and the seed would experience an irreparable delay, if the last sowing in our country (France) were not terminated by the 15th of March.

It may, however, be delayed in land where the subsoil is marly or clayey, or on hillocks facing the north, and hastened, on the contrary in dry land, in plains, and in aspects exposed to the south.

The carnation poppy may also be sown in autumn in still warmer climates, Professor Aubergier having proved that the sowing of this season gives the best results, and better than those of spring, but in Haute Saône the sowings in autumn have never succeeded, the soil freezes there easily.

This shows that the sowing must depend upon climate and the aspect of the soil.

With regard to the disposal of the plants, I cannot do better than reproduce here the mode of planting indicated by M. Decharme, in his treatise upon indigenous opium in 1855.

"Two rows of poppies are to be planted," he says, "so that the plants may be at a distance of twenty centimètres, one from the other, then, besides that of those two rows, an interval is to be left of sixty centimètres, according to the length of the field, so that the circle of the field may be easily taken to incise the capsules right and left of the plants that border the same walk."

I think, however, that I must in some degree modify this practice; for the plants not being distant enough become less vigorous in growth, the capsules not so large or so numerous as when at a greater distance.

I think it useful to place the poppies so that the rows may be at a distance of forty centimetres from each other, at the same time leaving sixty centimetres in breadth for the walks.

In this way, 71,500 plants of poppy per hectare may be counted, and the plants will acquire enormous dimensions. It is thus that in the plantation of M. Arbeltier, at Grand champs (Haute Marne), I counted in 1862, as many as forty heads on one stalk. It would be possible by leaving a sufficient interval between the rows (say, 0m. 50c.), to substitute for digging, which is always very slow and expensive, the employment of the horse hoe, which, by abridging the work, and permitting the diggings between the lines to be multiplied, would carry with it a very perceptible economy.

In the latter case, however, it would be necessary to dig with the hand the intervals left between each poppy in the rows.

To make these seed plats regular I use a kind of large rake, furnished with a long handle firmly fixed. This rake has only three teeth of a harrow, flattened like a lance, being each fifteen centimètres in length by four in breadth. The teeth are fastened in a piece of oak six centimètres square and one metre twenty in length; two of them are placed at ten centimètres from each of the extremities of the wood, and the third between the two others, 40 centimètres from the one and 60 from the other. It is sufficient to drag this instrument over the soil, previously harrowed, to obtain three furrows, the first destined for the poppies, leaving an interval of 40 centimètres, and the third, distant from the second 60, will show on the ground the breadth of a walk, and serves as a guide in the next operation, the first tooth of the instrument having to go over the third furrow made by the third tooth in the preceding operation. So that in each new operation, the first tooth of the instrument ought to follow exactly the third furrow made by the preceding operation.

Besides this, I arrange the sowing of the plant in such a manner that the lines may be as much as possible in a direction from north to south, so that the rays of the sun may more easily penetrate between the rows of plants.

When the whole of the intended plantation is thus traced the seed is then to be sown, having previously mixed it with fine sand or dry earth in order to obtain a thin and regular sowing, and afterwards a light roller is to be passed over the field.

The seed remains in the ground a fortnight before the plant appears, and develops itself so slowly, that at the end of twenty days the stem is scarcely half a millimetre thick, and only five millimetres high, with six small leaves of from four to five millimetres in length.

As soon as the plant has grown to five centimètres high, which happens about forty days after its first appearance, it will be necessary to dig very lightly in thinning them. It may, however, be as well to retard a little this first digging if the frosts of spring are still to be feared. M. Lepage of Gisors does away with them altogether, and confines himself to simply passing the *parior* between the lines.

Twelve days after the first digging, it will be necessary, without injuring the roots of the delicate plant, to practice a second digging, the object of which is to raise the surplus plants, and to make a distance between those that remain of about thirty centimètres in the direction of the lines. If required, another digging may be made, which, by destroying extraneous vegetables hurtful to the plantation, and facilitating the penetration of rain, will augment the fertility of the soil, seeing that the same surface of ground will preserve this portion of nourishment which would otherwise be spent in pure loss by parasitical plants.

All the diggings must terminate twenty or twenty-two days after the first, for about this time the stem of the plant begins to rise, the radical leaves entirely covering the soil ; and the shade and coolness of these large and beautiful leaves, smother the weeds which may have grown after the last digging.

The poppy, as I have already stated, has a tap root, and requires, consequently, deepness of earth ; the depth may be augmented by banking up the plants at the second digging. After this, the poppy becomes strong, grows rapidly, and very soon attains a mètre in height.

The blossoming takes place about three months after the sowing, and commences by the top buds ; afterwards this continues slowly, hence there are found at the same time on one plant flowers scarcely come to light—capsules still green—and heads perfectly ripe.

The poppy has a very short existence, altogether ephemeral ; those which open in the morning seldom live to see the next day's sun, and give place to a little capsule of a very delicate green, about six centimètres in circumference.

Seven days later, the capsule already begins to whiten underneath the stigmas, then at the base of the fruit, and finally, four days after, the surface of the head of the poppy is covered over with a powder of an opaque white colour.

The capsule remains in this state during eight or nine days, during which the wall of the poppy head, becoming hard, gives more and more opposition to the pressure of the finger.

About twenty or twenty-two days after the blooming of the flower, the head of the poppy softens, and the longitudinal depressions, beginning at the point where the stamens are inserted, turn yellow at their lower extremity, whilst the rest of the surface of the capsule offers a tint of pale green over the white bed of down, become translucent.

Dehiscence commences towards the thirtieth day after the fall of the petals, and complete maturity takes place about the fortieth day.

In this manner, from the time of sowing to the gathering of the seed, a period elapses of about for months and a half.

6. *Apparatus for Incising the Poppy Heads.*

In giving a description of my instrument for incising poppy heads, I do not pretend to assume as new, the idea that I have had of making an apparatus containing several parallel blades. This invention, as is known already, is of old date. But what I have invented—never having seen this sort of instrument—is the form, arrangement of the apparatus, and in particular, the method of rendering the blades either movable or fixed at will, so as to regulate easily their force, and to enable the operator to make superficial incisions on the capsules.

This instrument, which has been on my part the object of two successive improvements, obtained a bronze medal at the Concours Régional of Vesoul in 1863, and the bronze medal at that of Epinal in 1864. But if it prove useful to the planters of opium, and to the country, this will be my best recompense.

It is composed first, of a frame of iron, furnished with a handle of wood, and into which frame, there slides, like the iron of a plane, three lancet blades, at a distance from each other, and held afterwards in their position by the help of a vice *de pression.* The blades of the instrument may be regulated at will. If the incisions are very superficial, the vice being fastened, the operation can be continued. If, on the contrary, it is perceived they run through the wall of the capsule, the length of the blades must be gradually diminished, until they are short enough to make superficial incisions ; for every *pierced* capsule is a capsule lost, the seed never coming to maturity. If the instrument does not wound sufficiently more blade can be exposed, and try again.

Such was originally my instrument. In a first improvement upon it, I changed the shape of the blades, substituting for lancets the blade of a penknife ; the point of the latter giving greater facility for commencing the incisions. In my second, the vice for holding the lancet has been changed in position, and placed at the back of the instrument ; by the fraction of a turn, it causes the frame of the three blades to move either backwards or forwards in an infinitely small degree.

This instrument, by its construction, enables even the most unskilful workman to give to the cutting blades the exact projection necessary for producing superficial incisions, and which, not penetrating the wall of the capsule, does not injure the growth of the plant, or, consequently, the maturity of the seed.

The instrument with bent teeth spoken of by Messrs. Benard and Collas, is little used. It pierces and destroys the wall of the poppy head. I tried it in 1860.

7. *Gathering of the Opium.*

When the capsules, or poppy heads, still green, have attained their full size (fifteen to twenty days after the falling of the leaves), incisions, horizontal and very superficial, are to be made with the little instrument I have just described.*

The milky juice then appears, and is collected some minutes after, for later it will not fail to become thick, solid, and dry; and then the gathering of it becomes more tedious and expensive: besides, in our country, it might be fatally carried away and lost by storm showers.

It is sufficient to hold the head of the poppy between the thumb and index finger of the left hand, and to pass horizontally over the surface

* M. Bonafous, of Turin (Italy), has proved that transverse incisions give a quantity of opium juice double that furnished by longitudinal incisions.

the instrument, which the operator holds in his right hand, leaning a little on it, taking care to regulate first the projecting of the cutting blades.

When rapidity is wished, this is how we must proceed :

In the morning, after the disappearance of the dew, the operator, running all down one passage, incises on the right and left of him all the poppy heads to be found there, without troubling himself about the gathering.

When he has arrived at fifty or sixty steps from where he set out, a second person, who is to collect the opium, commences his walk and follows at this distance the operator, who goes successively through all the passages.

This walk is nearly that pointed out by M. Decharme. But the time that passes between the incision and the gathering of the opium is more or less long ;* it ought to be the inverse of the temperature, for the milky juice thickens more rapidly as the heat is more intense. This juice, when gathered, ought to have about the consistence of the casein in curdled milk.

The gathering is very simple ; a child might do it, it is only necessary to take each incised head between the thumb and index finger of the left hand, and after to pass the index finger of the right hand along the incisions to take up the opiate juice, already a little thick, which is to be deposited in a vase of tin, which is fixed to the waist of the operator, this is done simply by wiping off the pulp from the finger on the sharp edges of the vase.

When the operator is alone, it will be enough for him, in gathering the opium, to come back upon his steps after having incised all the capsules of the same passage, and not to commence the incisions of the next until all the product of the first has been collected.

This operation for the extraction of opium may continue every day, as long as the capsules are still *green*, hard, resistant to the touch, and covered with white opaque dust. As soon, however, as the heads begin to turn yellow, and to soften, the work must be suspended, as they will no longer furnish any product, and it will be injurious to the seed. But in order that the culture of opium may finally take root amongst us, it must yield to the agriculturist real advantages. And that the extraction of the opiate juice may increase agricultural wealth, a just application of the practical observations which follow must be made—they are the result of five years of serious experiments.

1st. It will be necessary to choose the moment for incising the capsule.

After the falling of the petals, the heads of poppy, at first very small,

* The time that may pass between the incision and the gathering of the opium juice, ought to be in an inverse ratio to the temperature, for the gummy sap dries more rapidly in hot weather ; but the time fixed by M. Lepage, of one hour appears to me to be more than exaggerated.

are of a delicate green, which they preserve for about eight days : the wall of the capsules, then very thin, is elastic; yields under the pressure of the instrument for incising, is difficult to cut, or else may be pierced through, in this case, nothing is obtained but a milky juice, so thin that it falls almost immediately over the leaves of the plant, where it is impossible to gather it.

Later still, the capsules become of a deep green tint, grow hard, resistant, and their surface is covered with a kind of whitish dust, easily removed by the finger. The longitudinal depressions corresponding with the false partitions of the interior, become very apparent ; the capsule, then under the incising instrument, makes a slight noise, analogous to that which the cutting of an apple produces.

The sap, slightly yellowish, which comes in abundance from it, concretes rapidly and gives an opium very rich in morphia. It is then, at this stage of vegetation, that it is necessary to practice light incisions of the poppy head to obtain the best results. Later in their growth, the capsules become yellowish and yield little opium.

However, some travellers say that it is only at this moment that the gathering of the opium takes place in Oriental countries. But the trials made in France have all proved that it is then too late to take the juice.

2. It must not be forgotten that a *too* superficial incision gives less milky juice than that which penetrates half through the thickness of the wall of the capsule; but the contrary extreme must not take place, and the capsule be pierced, which would let part of the opiate juice into the interior of the head, and finally destroy the seed.

3. When it is intended to incise, for example, the same heads three times, the length of each horizontal incision must be less than the third of the circumference of the head, and the cuttings must not cross each other.

4. It must be remembered that the first incisions made of the capsules *in an opportune time*, furnish opium the richest in morphia; that the second gives a production less abundant, and not so rich as the first; and the third less rich still than the second, and so on, until in the end the last incisions do not pay in produce for the time they take.

5. The first incision made at the right moment, as already remarked, gives a product more abundant and richer than any other. I think, therefore, to economise time and labour, it would be better to use a greater quantity of ground, and only to practice a single incision on all the plantation, thus leaving aside the late capsules. In this way it would be always possible to hire labourers by the day, and to pursue the operation from the disappearance of morning dew until four or five in the evening.

It would even be possible, in certain localities, to sow poppies for the seed in preference to rape, which gives an oil of a quality very inferior to the poppy, and only to incise the whole plantation once, observing always that this one incision of each head must be circular and almost complete, and to practice it in a direction perpendicular with the axis, and about a third of the height of the capsule from the base.

In this way, much opium may be obtained in a short time, and the agriculturist who generally rejects minute work, and dislikes returning to go over the same work for hours, will not hesitate to sacrifice each year, one whole day that he may double the amount of his harvest.

It was thus that in 1862, and under my direction M. Née, Nicolas de Leffond (Haute Sâone) collected in one day and a quarter of work, 150 grammes of dry opium, containing 20 per cent. of morphia.

From the appearance of the first to the last flower I have remarked that there are generally twenty-two days; which shows that all the capsules of one plantation are not equally advanced at the same time. It is necessary then, when only one incision is to be made, to seize the moment in which the greatest number of heads have arrived at the development fit for the operation; this is generally twenty-five days, or so, after the appearance of the first flower in the plantation.

6. MM. Decharme and Bénard say, that the circumstances most favourable to the harvest, in giving an abundant produce, are:—The warmth of the afternoon, the damp air from the south, south-west, and west, as well as slight atmospheric pressure.

However, M. Aubergier, on his part, maintains that the permanence of a high temperature tends rather as an obstacle to the gathering of the opium than an advantage, and he adds that in hot countries, the gathering of the juice always takes place, before the time of great heat; he recommends only to make incisions in the morning and in the evening; for he adds, the harvest is little or nothing under a burning sun.

If the harvest is considered only with regard to *abundance*, I should not hesitate to join in opinion with Professor de Clermont. But I maintain an opposite position when the *richness* of the opium is considered.

In 1860, a very rainy year, the carnation opium contained here 15 per cent. of morphia, and in 1861, a very dry year, it furnished 20 per cent. It seems then that these numbers fifteen and twenty are the extreme limits of the ordinary strength of the carnation opium, although MM. Decharme and Bénard have obtained 23 per cent. in the department of Somme. It appears then that these two years 1860 and 1861 of diametrically opposite atmospheric conditions, fortunately succeeded each other, so as to enable me to establish an average strength for other years, and to prove that the quality of an opium rises with the temperature that produces it.

Furthermore, I have always remarked that incisions made after five or six o'clock in the evening, do not give good results, the coolness of the night is opposed to the coagulation of the opiate juice in the capsules, they do not close, and the opium continues to flow in waste until morning over the leaves of the plant.

This loss, necessarily impoverishes the gathering of the next day, which gives but a small amount of morphia, the opiate juice not having had time to concentrate itself in the capsule and to acquire from it the necessary amount of morphia, for it is principally in this part of the vegetable that the alkaloid is formed, and the milky juice which constantly arrives there, contains little alkaloid if it is not allowed to remain in the capsule a certain time.

To prove this, I refer to the experiments made by M. Aubergier, and repeated several times by myself.

In effect, whilst the Professor de Clermont, in July 1844, gathered by incisions of a mixture of somniferous poppies with long and round heads, an opium containing 8·57 per cent. of morphia and 9·48 of water, he only obtained by squeezing in his hands the poppy heads, *not* detached from the stalk (the crown of the stigma only being raised), he obtained I say, a product, only giving 1·52 per cent. of morphia and 7·67 of water.

It must be admitted that in this case the juices of the plant are mixed with opium.

8. *The Drying of Opiums for Sale.*

When the collection of the opiate juice has terminated it is to be placed in vases, such as a deep plate that may be covered with a leaf to keep the substance from water and from dust. It is then exposed to the sun, taking care to turn it occasionally to hasten the dessicating process; for according to MM. Décharme and Bénard, opium when slowly dried undergoes a change injurious to the morphia, which then suffers a sort of fermentation or oxygenation which transforms by degrees the alkaloid into a less valuable product.

The opiate juice, which was of a milky white, becomes of a blackish brown in solidifying. As soon as it is dry, it is made into balls of a hundred grains weight, and then rolled up in a sheet of oiled paper; they are then fit to be taken to the apothecary, who purchases them according to their richness in morphia, so that the price may vary from sixty to one hundred and twenty francs the kilogramme.

Before ending the subject of the extraction of opium, it may be useful to tell the planters, that the opiate juice applied to the sting of bees, causes the pain to cease immediately; and we know that in practising the incisions on poppy heads, we are not free from the attacks of these insects.

9. *Collecting of the Seed.*

The culture of carnation poppy being made on so large a scale in the department of Somme where more than twelve thousand *hectares* are given up to this oil plant, with a view to the extraction of the white oil, called carnation, I think I ought to reproduce here the valuable experiments given by MM. Bénard and Collis, on the method of collecting the seed in the north of France.

"Towards the end of July, the moment the capsules begin to open, the stalks are pulled up always holding them straight. Bundles are then formed of about a hundred in each and tied together, making what is called a sheaf.

"Ten or twelve days after the pulling up, whilst all the capsules are open and well dried, when the grain is hard upon agitating the heads, they are rested on a large cloth, and beaten with a little stick, then the labourers take each a bunch of poppy stems under each arm, knocking the heads against each other, the seed is thus made to fall out on the *bâche*. These bundles are then put standing up in a line to undergo a second beating, in a week after the first, when it is perceived that a good many capsules still contain seed.

"The seed passed through a sieve and well cleaned, is ready for market, where it sells at a price varying from twenty-eight to thirty-five francs the hectolitre, on an average, of thirty-one francs fifty cents for Amiens."

To these details, I shall add some information resulting from my own experience :—

1. A carnation poppy capsule gives on an average three grammes and a half to four grammes of dry seed.

2. To produce a *litre*, requires from a hundred and fifty to two hundred heads.

3. The litre of seed weighs 600 grammes, and consequently the *hectolitre* 60 kilogrammess.

From the poppy seed there is extracted by pressure an oil, which next to olive oil holds the highest rank for alimentary use. It gives 28 litres per hectolitre.

This oil is white, siccative, of a very agreeable sweet odour, something like that of the hazel nut, its density is from 0·9253 taken by the oleometest of M. Lefebvre of Amiens and marks 55° 25′ the centesimal alcoometer ; it is soluble in twenty-five parts of alcohol (cold), and six of boiling alcohol, and remains liquid at ten, and even fifteen degrees below zero—it never turns rancid.

Notwithstanding the prejudices which exist, I ought to say that neither this oil, nor the seed which furnishes it, have any unwholesome property.*

It does not contain any narcotic principle, children eat poppy seed without being indisposed, and birds as well as poultry are very fond of it. M. Emile Mouchon, pharmacien at Lyons, in his Dictionary on "*Bromatologie vegetale exotique*," relates the daily use that has been made of it from time immemorial by the different nations of Europe.

The Egyptians, the Greeks, and the ancient Romans kneaded it with honey and with flour to make cakes that were much esteemed. The

* It was Rosier, who first, at the end of the last century, proved them to be innocuous.

Orientals, we are told by Thevenot, covered their bread with it. The ladies of Gênes eat it covered over with sugar. The Tuscans, with this seed and wheaten paste made hard cakes called *paverata.* The inhabitants of Hungary and Poland, of Germany, of Alsace, and of Picardy, feed upon it habitually.

The oil and seed then of the carnation poppy may, with perfect safety be applied to alimentary purposes.

France produces annually poppy seed in value from twenty-five to three millions of francs. The department of Somme alone, according to M. Bénard, furnished in 1857, 140 thousand hectolitres of seed, valued at 4,480,000 francs.

Why then not combine in these plantations, the gathering of opium with that of seed ? The value of the harvest might then be doubled.

The agriculturist, I know, fears to compromise by this extraction of opium, the seed harvest. To satisfy him, I say with Messrs. Hardy, Bénard, and Collas, that incised capsules, give seed, which, when sown, produces in its turn, poppies furnishing opium as rich, and a seed as abundant, and giving as much oil, as poppies that had not been incised.

But, for this, it is necessary that the incising instrument, be the same as mine, that it may not penetrate the wall of the capsule, for then, as M. Hardy has proved, a portion of the opiate juice will overflow the interior, injure the seed, and prevent its coming to maturity.

It was also M. Hardy who first proved that the incisions which do not go through the endocarp of the poppy head do not prevent the seed from ripening.

Test of Opiums.

It is to the percentage of morphia an opium contains that it owes its value in commerce. The greater the quantity of morphia the higher the value of the opium rises, and consequently the higher the price of the kilogramme. To know then the value of an opium the morphia must be estimated, and the process which seems to me the best for determining the richness of an opium is that of Guillermond. Fifteen grammes of opium are to be examined. Let it be pounded in a mortar with sixty grammes of alcohol, at 71° and thrown on a cloth and squeezed ; the cake is then taken with forty grammes of fresh alcohol, the tinctures are reunited in a bottle with four grammes of ammonia, twelve hours afterwards the result is obtained. The morphia is eliminated at the same time with a quantity greater or less of narcotine ; the former hanging on the sides of the bottle in crystals, coloured, and of a tolerable size, the latter in spiral crystals, very light. The crystals are to be placed together on a cloth, and well washed in several waters, to get rid of the meconate of ammonia which soils them, these crystals are to be plunged in a little flask of water. The narcotine remains suspended in this vehicle, and by decanting, it will be separated from the morphia, which remaining at the bottom, can be collected, dried, and weighed.

M. Mialhe has modified this mode of separation, he prefers employing five or six washings, with four or five grammes of ether, performed by trituration of the crystals previously pulverised, the morphia being thus set at liberty it is easy enough to dry and weigh it.

M. Aubergier states that, the separation of the narcotine by washing, and by decanting, gives much quicker results, and in the greater number of cases, quite as certain and as exact as the treatment by ether. And he adds, that in case of adopting the latter method, the operator must not content himself with seven or eight washings by four grammes of ether as there is a risk very often of leaving a considerable portion of the narcotine undissolved. In this case, the washings with ether must not cease until the insoluble residue no longer diminishes in weight, a gramme of ether will only dissolve about five milligrammes of narcotine.

M. Aubergier says he has repeated the washing sixty times, and employed 230 grammes of ether in the analysis of an opium which contained 19·153 of narcotine for fifteen grammes.

It appears then, he says, that morphia, instead of depositing itself in voluminous crystals, is granulous, gives a pulverulent precipitate, although crystalline, which is easily held in suspension in water, and carried away by washing. The mixture of morphia and narcotine may be treated by a solution of caustic potash, containing a decigramme of alcohol per gramme of water. I have ascertained, he says, that four grammes of potash are sufficient to dissolve one gramme of morphia. The weight can be calculated by the deficiency, after having washed, dried, and weighed the residue of the narcotine.

Independently of the morphia and of the narcotine, M. Aubergier has found in indigenous opium, codéine, thébaine, narcéine, meconine, meconic acid, caoutchouc, and oily and resinous matters, already enumerated by Pelletier. But narcotine, according to Professor de Clermont, exists in greater quantity in the white poppy than in the purple poppy.

PHOTOGRAPHY.

Photography is an affair of the present century. Its annals cover scarcely sixty years, and may be divided into three distinct periods:—The first extending from the time when science partially revealed the fascinating secret of light-printing, till the independent and valuable discoveries of Mr. Fox Talbot gave the world an art of sterling utility, where it had before possessed only a few curious experiments; the second comprising the years when, protected by Mr. Talbot's care, and in a great degree popularized by the restrictive powers of his patent, the art made slow advances to maturity; the third reaching down to the present time, from the date when the art somewhat ungraciously burst away from the control of its practical originator. As early as 1802, Sir Humphry Davy and Mr. Wedgwood hit upon a process by which they were able to render paper so sensitive of light that they could produce upon it negative images of objects brought directly in contact with it. They even directed attention to the probable results to be obtained through this sensitive paper and the co-operation of a camera obscura. The pictures, however, produced by Sir Humphry and his coadjutor were transient, and they expressly avowed their ignorance of any means by which the semblances could be rendered permanent. From 1802 till 1834 Sir Humphry's experiments remained, at least as far as the public knew, without being in any way developed or improved upon. In the latter year however, Mr. Fox Talbot, by independent investigation and perfectly original experiments, went far beyond the distinguished philosopher, He achieved, like Sir Humphry, pictures, but he also contrived to render them permanent. Mr. Talbot's next step was to discover a process by which he obtained "positives" *from* his "negatives," On the 8th of February, 1841, William Henry Fox Talbot, of Lacock Abbey in the County of Wilts, Esquire, obtained letters patent for his famous calotype process. A gentleman of position and wealth, Mr. Talbot made no ungenerous use of his patent. Reserving to himself, as he was well entitled to do, the commercial advantages that might accrue to the parent of so remarkable an invention, he gracefully waived his patent rights in favour of amateur photographers, permiting them without let or hindrance to derive all possible enjoyment from the practice of his discovery, so long as they did not employ it for pecuniary gain. At this date it would he nothing short of repulsive injustice to detract from Mr. Talbot's services. He was indeed the father of the photographic profession, as well as the inventor of the photographic art. From his own funds, as well as by his influence with men of science, he created a new field of industry. At a considerable expense he erected worshops and employed assistants. Before, however, he could reap a reward from his outlay, or even reimburse to himself the large sums absorbed by his operations, the invention of the collodion process by Mr. Archer in 1850, gave the death blow to his undertakings. In the memorable trial of Talbot *v.* Laroche in the Common Pleas, December, 1854, it was attempted to establish that the unlicensed practitioners of the collodion process were guilty of infringing Mr. Talbot's rights. The jury, however, declined to adopt that view of the case; and passing over the Rev. Mr. Reade's discoveries prior to 1841, they gave Mr. Talbot the merit of being, within the meaning of the patent laws, the first and true inventor of the calotype process; but at the same time they found that in producing pictures by the collodion process M. Laroche had in no way been guilty of violating Mr. Talbot's patent. The decision was most important to photographers. It was given just as the term of Mr. Talbot's patent was at the point of expiration, and was the cause why that gentleman failed to obtain a renewal of his rights. From that time photography has been free from the fetters of letters patent. If that feeedom has been beneficial to the artists, it is no less certain that it has been injurious to the originator of their art. The public can, however, console themselves for this unhappy consequence of a useful decision, by reflecting that to a man in Mr. Talbot's circumstances, the position of a victim for the public good is a comparatively easy lot, and Mr. Talbot has reason at the same time to congratulate himself that he has not like some inventors, lost the credit of his invention, although like some inventors, he has acquired but little substantial gain from his ingenuity.—'Photographic Journal.'

RESEARCHES ON THE JUICE OF THE SUGAR CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

BY DR. ICERY.
President of the Chamber of Agriculture.
Translated by JAMES MORRIS, Esq., Representative of the Chamber of Agriculture of Mauritius.

(Continued from page 302.)

PART II.—MICROSCOPICAL EXAMINATION.

AT different periods the juice of the sugar cane has been the object of numerous investigations. Chemistry has brought to light the different substances, the aggregate of which constitutes the liquid, and has described with more or less success the intimate value and qualities of these substances. It has besides determined with precision the modifications peculiar to each of them, under the influence of those agents which are made use of in the manufacture of sugar, and has by such means put the planter on his guard against those alterations which he had to contend against. If, however, the chemical properties of cane-juice have been carefully studied, it must be acknowledged nevertheless that its physiological condition has been altogether neglected. Even in those writers who have most recently treated on the composition of the sugar-cane, no precise indications will be found on this subject. It may, doubtless, seem at first to be a matter of astonishment that, after so many minute investigations of the structure of this plant, it should still be considered necessary to submit cane-juice to new microscopical researches, and that it is still possible to deduce from such investigations certain facts worth of remark.

But, as will presently be seen, this juice is not only a liquid in which a certain number of immediate organic and mineral substance are found in solution; but it contains, in addition, an organic mattar appreciable by the microscope, and which, in the manufacture of colonial sugar, has too great an importance not to be considered worthy of the attention of the manufacturer of sugar, and of a special examination on my part. It is my aim to investigate from a physiological point of view the nature of this substance and its functions in the phenomena of the nutrition of the cane and in the formation of its saccharine principle; nor have I traced for myself the plan of agitating such a question, and of establishing hypotheses which can only unprofitably turn aside our attention from the true path of investigation. My chief aim is to place in a clear point of view a well authenticated fact, and to indicate those consequences which daily result from it in our manufactories, during the extraction of the sugar, and which escapes our notice.

Whatever method be adopted for the extraction of this cane-juice, be it by the press or the mill, fragments of cellular tissue and residuum are always brought down with the juice which, after a certain time, form at the bottom of the receiver a more or less abundant deposit varying according to the degree of compression employed. Particles like these which are foreign to the liquid, are rarely recognised by the naked eye, while under the microscope they exhibit those appearances peculiar to the crushed and torn material when vegetable structures are subjected to heavy pressure. A period of subsidence of about three quarters of an hour is sufficient time for these substances to separate from the liquid and to become precipitated to its lowest stratum. But, however long this period of subsidence may be, even though it may last until fermentation has set in, this liquid, even in its upper portions, never become limpid, and always assumes a milky appearance. When it is brought under the microscope in this state, it is then found that all these fragments and cellular remains have entirely disappeared from it. Were the juice of the cane simply formed by water holding in solution a certain number of these substances, it might be more or less coloured; but after the precipitation of these organic particles, it should not however, retain that dim appearance which characterises it. This juice is, in fact, formed of two distinct parts, the liquid, and the solid. The first comprises the water holding in solution the immediate organic principles and saline substances; the second is formed by corpuscles or granules suspended through the entire extent of the liquid, and which cannot be eliminated by those means which are used to separate the most minute cellular remains. These corpuscles are globular, formed of a thin covering, though solid and transparent, and which contain a species of nucleus or semi-fluid matter. Their greatest diameter is from three to five thousandths of a millimetre. I therefore, name these globules the *granular matter* of the juice, and they form an integral part of this liquid to which they communicate that slightly milky appearance which is peculiar to it. They are with difficulty precipitated from the upper layers of the juice when left to itself, though they may be easily separated from it by being passed through filtering paper, when the juice then passes through this vehicle entirely freed from all solid substance, becoming limpid with a slightly brown tinge similar to that of clarified syrup.

What is very remarkable, the juice in this state may be kept for nearly twenty-four hours in conditions of temperature most favourable to fermentation without showing the slightest change indicating such an action; but after this period it becomes dim, and corpuscles are developed in its thickness; fermentation then sets in, and continues slowly, and it is only at the end of two days and at a temperature of 25° centigrade that well-formed bubbles appear in the liquid.

When the juice has been simply cleared from the fragments of vegetable matter, which it always carries down with it, fermentation on the contrary is rapidly produced after its extraction from the cane, and in a few hours the liquid becomes viscid. In the latter case, fermentation is almost complete, though it has not even commenced in the juice, the separation of the globules of which has been effected in the manner mentioned above. This granular matter then plays an important part in the fermentation of the juice, and should be regarded as the principal agent of that change which takes place in this liquid during the first twenty-four hours nearly which follow its extraction from the cane.

Cane juice at the boiling point becomes freed from the albuminous substance which it contains, and this substance, coagulating under the influence of heat seizes on the globular matter which it draws into the flakes which form on the surface of the liquid. This albumen of the cane juice has also great importance as an exciting cause of fermentation, for to its agency must entirely be attributed that change in the juice which, after boiling, has been completely freed from its albumen and its globules by means of filtration, may be kept perfectly fresh for two days at least, at a temperature of 30° centrigade. At the end of this period, a thin pellicle is seen extending along its thickness, and on the next day a slight cream-like appearance covers its surface, while at the same time the colour has changed; but it is only at the end of the third day that fermentation positively shows itself.

To resume, the juice filtered through a cloth and left to settle, becomes a liquid more or less of a disturbed and milky appearance, and of a yellowish green colour which is of a deeper hue in proportion as the cane is riper, and of a deeper tint, whether the plant be the striped or smooth species. In its normal state and after deducting the effect of the remains of the tissues, which are accidental and easily removed, this juice is composed of a solid granular portion and of a liquid holding in solution a certain number of organic and mineral substances. This solid portion consists of globules or organised bodies suspended through the entire extent of the liquid, and which differ essentially from the other vegetable principles contained in the cane-juice. These globules which, in their living state, without doubt possess special physiological qualities, are beyond all other substances contained in the cane, those which possess in the highest degree the power of exciting alcoholic fermentation, Its action would appear to begin with the remission of the juice from the cane, and it always becomes more manifest in two or three hours by a temperature above 20° centigrade. The abstraction of these globules from the liquid has the result of retarding by a day the process of fermentation; and when at the same time the albumenoid substance is withdrawn, the juice undergoes no appreciable alteration for the space of two whole days.

It is sufficient, then, to raise rapidly to the boiling point the newly-extracted cane-juice, and to filter it immediately, in order to have a perfectly limpid liquid which can be kept for a considerable time without any alteration.

On the one hand, the extremely fermentable property of the juice of the cane influenced by these globules and by the albuminous substance coagulated by heat; and, on the other hand, the possibility of eliminating these substances as well as the other organic remains by means of rapid boiling and filtering in such a way as to obtain a limpid fluid, are facts which simply require to be named in order to make their importance readily understood.

In the ordinary practice of the sugar manufactories in this colony at the present day, such a process would have three advantages :—

1. To avoid the immediate fermentation of the juice while being able to keep it a whole day at least without any trace of alteration.

2. To diminish the formation of uncrystallizable sugar.

3. To act on a limpid liquid which, being concentrated, preserves all its limpidity and primal purity.

I think it necessary to add a few words to demonstrate more clearly these last two advantages. The globular and albuminous substances essentially contributing to develope the acidity of the juice, are one of the principal causes of the glucose transformation of the sugar. When they are eliminated, it becomes, in fact, easy to determine that such acidity is only feebly increased by the action of heat, and always remains very inferior to what it would have been in the contrary case.

It is to be remembered, on the other hand, that the means made use of to effect the defecation and to purify the juice from the impurities it brings down with it, as well as from impurities produced during evaporation are, in spite of every effort employed, powerless to effect its complete purification, and it contains, when in the state of syrup, a very large quantity of particles principally of extremely minute fragments of coagulated albumenoid and granular matter.

These particles, by reason of their weak specific gravity, are with great difficulty separated when in a state of rest from the clearing materials employed, and are mostly found mixed with, and attached to, the grains of the manufactured sugar, the quality of which is thus always more or less changed. During manipulation they are also frequently the point of departure for the crystals about to form, and to which they communicate a dull and brownish colour, which being inherent in the constitution of the saccharine crystal, can only be removed by the process of washing by the centrifugal machine.

The presence of these corpuscles in a notable quantity gives a ready explanation of the difficulty experienced in turning out a white and brilliant sugar when the clarifying material, introduced too soon into the vacuum apparatus, has not been able to undergo sufficient cleansing in the open air. This, for instance, is what occurs in the so-called "triple effect apparatus," in which the juice is enclosed after defecation, a process inevitably incomplete according to the present method.

The method which might be based on the particularities which I have just described is, in my opinion, one of easy application to all our sugar-machines, and would prove a powerful auxiliary to the triple effect apparatus, which, for the reasons I have mentioned, is unable to produce a sugar of fine quality under the ordinary conditions in which the sugar manufacture of the colony is forced to proceed. The application of this method would merely require filters the shape of pails, furnished with a set of metallic cloths placed over each other by means of moveable frames, terminating in a plate pierced with holes, covered with one or two layers of flannel. The cane-juice as it flowed from the mill would at once receive that dose of lime necessary for the quality of the sugar to be produced, and would then rapidly be raised to the boiling point, and immediately after be thrown on the filters arranged in such a manner as to allow of a quick and perfect filtration.

III.—Density.

The density of cane-juice being one of its most easily determined properties, depending chiefly on the quantity of saccharine matter it contains, always attracted the attention of manufacturers, who even now do not have recourse to any other observation in order to specify the saccharine richness of the cane. But the clumsy and imperfect instruments which are still employed for this purpose frequently render such determination quite illusory; the error of which is still more increased by the circumstances under which they are made. Without taking into account the temperature and the aeration of the juice, as well as the organic remains which may be held in solution, a small glass instrument is introduced into the liquid which, generally speaking, has nothing in common with an areometer but the name and the form; and it is from such indications that the saccharine richness of the juice of the canes passed through the mill is estimated.

The density of cane-juice determined with care furnishes, however, valuable information, which being compared from month to month, and from year to year, may be made extremely useful in estimating the yield of canes manipulated under the same conditions; it will even sometimes furnish a sufficiently precise idea of the definite result of a crop which has been only begun. But in order to attain this end, it becomes indispensable to fulfil certain conditions, which fortunately are easily realised. The first is, to work always at the same temperature, namely, 25° centigrade, to which degree of heat the juice can easily be brought; for the average temperature of the first months of the sugar crop is 23° centigrade in the shade, and that of the last month, 27° The second is, the use of a correct instrument, however its scale may be graduated. The areometers of Braumé in ordinary use have on a very short stem relatively too many principal divisions to be accurately used in the juice, the extreme limits of which are for the canes usually employed, 8° and 12°. But in order to remedy this inconvenience, and at the same time to give such experiments more precision, I have arranged an areometer with a long and perfectly cylindrical stem, on which is marked only the degrees of 6 and 13, each of these principal divisions being divided into tenths. With this instrument the density of the juice can be registered to one-tenth of a degree. But in order that the indications of the areometer may be really useful to the planter, it is requisite that such an instrument should show him approximately the proportion of sugar contained in the juice the density of which he has ascertained.

For this purpose different methods have been proposed. Being based on the proportion of sugar which a certain weight of distilled water contains at a given temperature, they are defective, because a solution of crystallizable sugar, varying only in the quantity of saccharine matter it contains, cannot be compared to the juice into which there sometimes enter notable quantities of other substances besides crystallizable sugar, these substances themselves undergoing great changes according to the different areometric degrees. Experience alone—that is, on the one hand the determination of the density of a great number of juices, and, on the other hand, the comparative chemical analysis of these same liquids—could conduce to the formation of a table presenting any exactness.

Taking as a basis all the analyses of the cane-juice which I have made during a period of nearly two years, amounting to a hundred at least, I have framed the following table, in which opposite to the degree of the areometer will be found the quantities of crystallizable sugar for one litre of juice and 1,000 grammes of this liquid; that is, the corresponding quantity of sugar for the juice, regarded in volume or weight. In the fourth column of this table are recorded the considerable differences produced by the presence in the juice of other substances than sugar. To insist further on the modifications which these substances produce in the juice would be simply to anticipate what I shall have to say with regard to these substances themselves. It is, therefore, sufficient for me to point out the part to be assigned to them in the determination of the density of the cane-juice.

The qualities of sugar for a determinate volume or weight of juice, corresponding to the principal divisions of the areometer of Beaumé, and obtained directly by a series of experiments at 25° centigrade.

Areometer.	Grammes of Sugar for a Litre of Juice.	Quantity of Sugar in Weight.	Differences resulting from the influence of other substances besides Sugar (principally of uncrystallized Sugar).
Degrees.			
4	28	0·026	0·049
5	49	0·048	0·047
6	78	0·074	0·040
6	85	0·079	
6	91	0·086	
6	98	0·092	
7¼	105	0·099	0·036
7½	111	0·105	
7¾	118	0·117	
8	124	0·111	
8¼	131	0·123	0·032
8½	137	0·129	
8¾	144	0·135	
9	152	0·142	
9¼	159	0·149	0·026
9½	165	0·155	
9¾	172	0·161	
10	180	0·167	
10¼	188	0·174	0·021
10½	196	0·180	
10¾	204	0·187	
11	211	0·194	
11¼	217	0·200	0·115
11½	226	0·206	
11¾	230	0·211	
12	237	0·216	
12¼	244	0·227	0·013

(To be continued.)

THE PROPAGATION OF TROUT.

BY STEPHEN H. AINSWORTH.

SINCE the printing of the article on the propagation of Brook Trout, in which my name is mentioned, I have been overwhelmed with letters from all parts of the United States, asking further information in the various departments of their cultivation. This great desire for further knowledge, so extensively manifested by a large number of your readers induces me to ask you to print the following article, giving minute answers to the most important information required in growing trout, both naturally and artificially. Also a pretty full description of the celebrated Caledonia Spring Creek, the vast number of trout it yearly produces naturally, with Seth Green's gigantic operations in growing trout in it artificially, &c.

To cultivate brook trout successfully, the water must be pure, clean spring water, free from all sediment; but a tincture of lime, or sulphur, does no harm, as far as I have been able to discover in six years' observation and practice. I have seen them hatch and flourish remarkably well in such water.

The temperature of the water in the hatching races, or troughs, during the time of incubation must be between 36° and 48° to insure success. The best temperature, in my opinion, all things considered, is from 42° to 45°. When above this temperature they hatch too soon, and are too weak and tender. When below, more or less die during incubation. Consequently great care should be taken to place the hatching boxes for artificial propagation, or to make the spawning beds in natural cultivation, where the water will be within these temperatures during the coldest weather in winter. The temperature of our best springs is 48° the year round.

Trout will not do well where the water rises in the summer above 60° or 64° at most. The best temperature to grow them to perfection is between 50° and 58°

This fact should always be born in mind when constructing ponds, so as to have the size of the ponds correspond with the volume of water in the stream supplying them.

For example, a spring that produces as much water as will run through an inch square hole, will supply a pond 20 by 30 feet square, or 600 square feet surface, and keep the water below 64° through the summer, and if covered with a house, or boards, so as to shade the water effectually, it may be double this size. I have one of this size shaded, supplied with an inch stream, the temperature never rises above 64°, and the trout are always perfectly healthy in it.

When the spring or stream will fill a four inch square hole, then the pond may be sixteen times as large, containing 9,600 square feet, or a pond 80 by 120 feet square, and so on, according to the size of the stream.

For growing large trout, the water should be from 8 to 15 feet deep; for small ones, from 2 inches to 5 feet, according to the size of the trout.

An inch stream running through two perfectly arranged hatching troughs, will hatch 200,000 spawn, and grow them till about 1½ inches long, when a part of them, from time to time, must be put into other streams. This stream will grow 10,000 trout the first year, 2,000 the second year, and 500 the third year, thus decreasing rapidly in number as they increase in size.

A 16-inch stream might hatch 3,200,000 trout; grow 160,000 the first year, 32,000 the second year, and 8,000 the third year, and 3,000, or 4,000 the fourth year that would average one pound each.

Young trout, till from 1 to 2 inches long, do much the best in shallow water, say from two inches to 3 inches deep, but as they increase in size the water should be increased in depth. By the first of November, if well fed, they will be from three inches to 5 inches long. At this time the water may be increased to the depth of three feet.

The most difficult period in growing trout artificially is about the time they commence feeding. This period is from forty days to sixty days after hatching, according to the temperature of the water. At this time a large proportion of them are very weak, and are entirely unable to stand the least current, and consequently are carried with the current through the whole length of the hatching-box against the screen (if one) at the lower end of the box, and are soon suffocated and die. I have lost them by the thousand in that way. To obviate this, put a tank 12 feet square at the lower end of the hatching-box, so that the water will run into it, with a gentle current, carrying the weak trout with it into the tank, where they can rest in still water from 2 to 3 inches deep. In this way they will soon recover and come into the very slight current to look for food, and, as they grow stronger, run up the hatching-box again. By this arrangement I have decreased the mortality so that I lose but a very small percentage compared to what I did before.

I first feed boiled eggs rubbed very fine, also lobbard milk beaten very fine. One egg will feed several hundred thousand trout a day. After they get a little larger I feed hashed liver and lobbard milk. Trout feed and grow well on meat of any kind, but will not eat any vegetable matter with me.

The cheapest dam, when the soil will answer, is of dirt. When it is too porous, it can be built with a double stone wall, with a two-inch space between, and this filled with water lime grout ; or, when clay is at hand, it can be built of dirt with a foot of clay in thickness, the whole length of the dam in the centre, from bottom to top ; or with matched plank, as may be the cheapest and most handy to obtain.

Depopulated streams where trout have once flourished, can be restocked with spawn, or young trout with but proper spawning beds prepared, they would increase at little expense, and with wonderful rapidity, and if protected as private streams afford all the sport one or two anglers with fly and rod could desire, and furnish a meal of trout daily for a large family during the fishing season, and, if the stream is of some size, a large amount for sale in addition. By putting a small dam across the stream to raise the water a few feet, with a screen on top to prevent the trout from running over, with the creek well gravelled above to the spring, so as to make good spawning beds, the trout would increase naturally tens of thousands yearly, and produce a large income at the present price of trout, 1 dol. per pound.

There is a small spring brook in the town of Springwater, dammed and screened in this way, where the trout have increased naturally in a few years to over 100,000, and hundreds of them to over two pounds in weight each. I am told that the proprietor has lately sold the ponds stream, and trout for 8,500 dols. I visited the ponds three in number by invitation, last summer, with rod and fly, and took trout from one to two pounds in weight, almost every cast, in certain parts of the ponds. They were beautiful, fat and healthy. In other parts of the ponds I found one, two, and three-year olds in vast numbers. The creek was alive with little ones. The stream did not afford more than 30 square inches of water at the time I was there. This shows to what extent trout may be increased and grown by properly damming, screening, and gravelling smallspring brooks.

The most prolific streams for trout that I have ever seen, or of which I have ever heard or read, are the Caledonia springs, and brook from them. This celebrated trout brook rises from the rocks in the village of Caledonia, Livingston County, New York. Its whole length is but one mile, when it unites with Allen's Creek, one of the tributaries of the Genesee, in the village of Mumford. The stream falls about 50 feet from the springs to its junction with Allen's Creek. The country is all thickly settled, and one of the richest and best farming towns in the State. The surface of the land is quite level, with banks but little above the surface of the water.

The stream in places is very rapid, and in others has quite a gentle current, of a mile or more per hour. The springs as now situated, cover about six acres, being dammed slightly for milling purposes. They afford about 80 barrels of water per second, and make a creek from three to four rods wide, and from 18 inches to 6 feet deep, according to the current. The bottom is covered with small white shells and gravel. The water is clear, pure, and perfectly transparent, so that any object can be seen for three or four rods very distinctly. It is tinctured with lime and sulphur. Its temperature at the springs is 48° the whole year round, but down the creek, three-quarters of a mile it rises in the hottest days in the summer to 58° by night, but it is down in the morning to 52°. In winter it settles at times to 43° but generally keeps up to 45° or 46°. The temperature of the water to Allen's Creek is very even the year round, but very cold in summer, and quite warm in the winter, never freezing the very coldest weather. The water through the whole length of the creek, as well as every stone, stick, weed and blade of grass, is alive, and literally covered with numerous insects and larvæ of flies, summer and winter, so that the trout, however numerous they are, easily obtain all the food they want at all times of the year.

There is but very little surface water that makes into the creek, hence the volume of the water is very even, and seldom disturbed. The first settlers of the country found the creek literally filled with trout of great size and beauty, and it has remained so to this day, notwithstanding it has been almost constantly fished, night as well as day, from that time to this. The largest and finest trout are taken in the evening with a large artificial white or gray miller. Dark nights, the banks of the creek in spring and summer are often lined with fishermen, when they reel in the speckled beauties, hand over hand, and often carry them off by back loads. In this way they sometimes take some that weigh four pounds each. The most ordinary pupil of old Isaak can take them in the evening, when in the mood of rising, with the right miller, and with a small piece of angle-worm on the point of the hook, to induce them to hold on to the hook till the novice can make his twitch to hook them. But in the day time none can succeed but the expert. The water is so clear and they are so shy and so well educated, that it requires a 50- or 60-foot line, a fine 10 foot leader, and very small flies, or hackles, and those must be cast upon the water so gently and life-like, to induce them to rise and take the fly, and when they do take it they discover the deception, and spit it out so quick that but very few are ever able to so cast the fly and to jerk quick enough as to hook them. The fishermen among the oldest inhabitants tell me that at the least calculation there are 4,000 pounds of trout taken from the creek yearly, and yet they compute the number of trout now at 1,000 to each rod of the stream, or 320,000 in the creek, of all sizes, from four or five pounds down to five inches in length. On the 18th of this month I took 110 fine trout in about three hours, with the fly, from the creek, and put them into one of Mr. Green's ponds. The day was bright, and the water so clear and transparent that I had to fish with a 60-foot line, which took the most of the time to get the line out to this length and to reel in the trout against the strong current after being hooked.

The next day I took eighty-five splendid fellows from one place, hardly moving from my tract. These facts show how plenty they were, and how ready they are to take the fly in winter. These trout were as fat, active and gamey as ever I saw them in any other stream in May or June.

Seth Green, Esq., the celebrated marksman and fly-thrower of Rochester, bought this creek a year ago last Fall, for the purpose of growing trout artificially as well as naturally on an extensive scale. He has since prepared ponds, races, hatching-house and hatching-boxes and troughs for 3,000,000 of spawn, which he expects to fill during the spawning season, which is, with him, from the 1st of November to the 1st of April. Last winter his two best months for spawn were January and February, and he expects they will be this year.

He has one pond, only 75 feet long, 12 feet wide and 5 feet deep, which has 9,000 trout in it from 9 inches to 20 inches long, that will weigh from a quarter of a pound to three pounds each, as fat as seals and as beautiful as trout can possibly be, all caught with the fly by his own hand, since he bought the creek, and all can be seen now, any day, at one view, by any person who will take the trouble to call upon him Only think what a sight —9,000 such trout all in the eye at once. What a gigantic and magnificent aquarium !

I am certain that this is the largest and finest exhibition of trout in America, and, probably in the whole world. This alone would well repay a journey of any lover of Izaak from any part of the country to see. But this is not all. He has another pond, right by the side of this, 30 by 50 feet, which contains 20,000 beautiful trout, mostly one and two years old, from six to nine inches long, all taken by his own skill, as above. He has still another pond, filled with last spring's fry, from three to five inches long.

It seems incredible at first thought that such a vast number of large trout should live in so small a space, but it is also accounted for and made plain, when one learns that the water in the ponds are changed every minute through the day by the large current constantly pouring in upon them, of this cold, pure spring water.

Some of the trout produced 6,000 spawn each, and from that down to 200, according to size. Last year Mr. Green hatched as high as 98 per cent. in some instances—in others, about 80 per cent. This year he expects to hatch nearly all, as he has become master of the business, and knows the right time to take the spawn to insure perfect impregnation. I could see the young trout in almost every egg that had been taken fifteen days, with the naked eye, so that I know his success is perfect so far. With this continued success he will very soon be able to stock all the private streams and ponds in the country with spawn and young trout, as well as to furnish tons yearly for the table of this, the most delicious and costly of all the finny tribe.

It costs him but little to feed his trout. He tells me they get fully three-quarters of their living from the insects (as above) in the water running through the ponds. He thinks the trout in his ponds, and in the creek, devour fully 600 pounds of these various insects daily.

These facts show how profitable the cultivation of trout can be made with proper water and care, and also the ease with which all the depopulated waters of the country can be restocked.

The spawn can be transported from the eighth to the fifteenth day after impregnation, in glass bottles filled with water, by express to any part of the country with safety, and will nearly all hatch if distributed thinly over well-prepared gravel beds in the stream near the spring where the current is gentle, and the temperature remains from 40° to 46° through the winter, and will nearly all take care of themselves after hatching through the spring and summer, and grow to from 3 to 5 inches in length by fall. This is the easiest and cheapest way to stock all streams and ponds where the temperature and water will permit. But where they will not, then they must be stocked with trout.

An outlay of 5 dols. to 500 dols. in spawn, and preparing the stream and gravel beds according to the amount anyone may feel disposed to invest, will produce a corresponding show in the early spring of young trout. Some of these young trout will spawn in the fall, and all the fall following, and with proper care in a few years fully stock the stream or pond, and will pay the owner and angler for all the expense and trouble, in the very exciting sport of taking them with the fly, as well as a delicious meal daily.

Well-impregnated spawn can be obtained as low as 10 dols. per thousand.

The cheapest and best time to transport trout is while very small, or about the time they commence feeding, say in March or April. Then about 5,000 can be carried in a barrel half or two-thirds filled with water. They can be transported in this way any distance by waggon or railroad. All the care required is to keep the water cool, say from 50° to 60°, and in constant motion to fill it with air as fast as the trout exhaust it, or to change it often when standing still. Trout of this age can be had for 50 dols. a thousand.

Large trout can be moved in the same way just as well, only a much less nnmber in a barrel, say about seventy-five one, two, and three-year-olds. Trout of this age are worth 200 dols. a thousand.

With this information, anyone can consult his own desire and purse in the manner and extent of stocking his stream or pond.

From my experience in growing large trout, I would not advise anyone to grow them for profit to more than three or four years of age, or from eight ounces to sixteen ounces in weight. After this age and size it requires so much more to feed them, and water to keep them, and they are so much more subject to die, that I find it does not pay.

I have no spawn or trout for sale, and have never taken or grown any for that purpose, nor do I intend to hereafter. I commenced raising trout artificially in 1859 as an experiment merely for my own recreation and gratification. I have spent some time and money in these experiments, but have been abundantly paid in the information and gratification it has afforded me in these six years. I have hatched as high as ninety-nine spawn in the 100, and grown trout by the 1,000 to weigh from one to three pounds each during this time, and all with only one square inch of water during the dry weather in the summer.

TELEGRAPHING IN THE UNITED STATES.

New York is the centre of the great telegraph interest of the country. There are centred the head-quarters, the capital and the talent that this immense business demands. The inventor of the telegraph, full of years and honours, loaded down with royal and imperial favours, and what is of more worth to an American, crowned with the respect and gratitude of his countrymen, can be seen any pleasant day on Broadway. He was the son of a New England clergyman, a bold man in his day, who made his pulpit the fortress in which to battle for what he conceived to be the truth in dark and trying times.

In the year 1832 a packet ship left Havana for New York. The passengers were merry and intelligent. They beguiled the tediousness of the long voyage by scientific discussions. They talked of inventions; the discoveries of the day passed in review; wonderful things were told of electricity. A gentleman from Boston rehearsed the marvellous things brought to light in relation to that mysterious and subtle agency. Among the company was Prof. Samuel F. B. Morse. When the Massachusetts gentleman closed his recital, Prof. Morse quietly remarked—"If these statements are true, if such discoveries have really been made, then I can send a message by lightning round the world." Then and there the great discovery was made. On the wide Atlantic—as if the invention that was to change the face of the world scorned the narrow limits of States or Nations—on the wide sea, whose waters touch all climes and bind all the nations of the earth in bonds of amity on the great highway of the commerce of the globe, the great telegraph system came to its birth. The packet ship reached New York in safety. Prof. Morse had been from his family and native shore for three years. His friends were on the dock waiting to receive him; but he seemed to see them not. He made no personal or social inquiries for his family from whom he had been so long absent. He seemed like one demented. He accepted the warm and cordial greetings coldly. His friends were grieved that so short a time had so changed a genial friend into a morose and unfeeling man. He was big with a great discovery that was to agitate and bless the world. He had no thought, no feeling, no faculty for anybody or thing, till the telegraph was a reality and beyond dispute put by the side of the great inventions of the age.

The pathway of the telegraphic invention was through scorn, incredulity, and derision. It was the old story of the persecution of Galileo and the refusal of the old monks to look through the telescope lest they should be convinced. The old story of Harvey, demonstrating his theory of the circulation of the blood to a gainsaying generation, losing his practice, and, as men thought, losing his senses and going mad. The old story of the league with the devil, on the part of the poor printer, who cut out the first wooden types with his penknife, and brought to the eye of the terrified literati the full printed page. It was Columbus on his wild voyage for a new world, Jenner fleeing from his indignant countrymen and not daring to go out doors at night, because, he said, the great plague of the small-pox could be stayed. It was Fulton starting on his steam voyage up the Hudson, while a crowd of maligners looked on, wishing him an early and a complete failure.

The telegraphic demonstration was slow, great difficulties had to be overcome, and before the telegraph was a working success, Prof. Morse faced all opposition. He accepted ridicule and derision. His attempt to get subscribers to the stock of a company was nearly a failure. Shrewd men, men of forecast, would have nothing to do with the fiery scheme or the visionary inventor. One of the shrewdest men who might, if he would, have controlled all the lines in the land, shook his head at the proposal to take stock. "I will give Prof. Morse 100 dols. as a present," said the Great Bear of Wall street, "but not one dollar for investment." So the nation felt. A few men joined in the new invention, but they were as poor as the inventor. They had no money and but little influence.

An enterprising man in Western New York, who ran the first stage-line West, and ran the earliest expresses, saw the future of the telegraph. He grasped it with his whole soul. Men laughed at his folly. He told the deriders that the telegraph would succeed the mail. Then his friends were sure he was mad. Confident in the invention as a success and a public benefactor, Prof. Morse and his few friends clung to the great discovery. Poverty, like an armed man, came upon him. Inventors must eat, and those who manage the lightning cannot live on air. Men can now well afford to talk, and Prof. Morse, with his regal income, can afford to hear how he battled in those dark days to keep the wolf from the door, how poor was his dress, how mean his shoes, how meagre his face.

At last aid from the government was promised to run an experimental line from Washington to Baltimore. But the discreet government was to pay nothing till the line was in actual working order, and a *bona fide* message sent over the wires from Baltimore to the Capitol. It was to be no bogus message, but one sent over the wires to the satisfaction of the government. So little faith had the leading men of the nation at that time, that the thing was at all practical. Mr. John C. Spencer was at the head of the Treasury. He was, certainly, of the average intelligence of the people. He was to pay the money when the message had really passed over the wires. He had not the least idea of what the invention was, and in a conversation with a gentleman, Mr. Spencer asked, "how large a bundle could be sent over the wires, and whether the mails could not be sent that way." Who wonders that an old lady carried her umbrella into the office at Buffalo with a request that it might be sent to Cleveland by lightning? It was supposed by scientific men that a trench must be dug from Baltimore to Washington to complete the circuit, without which the lines could not be worked, and this delayed for a long time the completion of the trial lines to the National Capitol. Men were ignorant of the fact that the earth formed the most perfect circuit.

All the preliminary troubles over, the inventor saw the work of his brain demonstrated and take its place among the most beneficent discoveries of the world, and himself placed high among the benefactors of his race, He saw himself and children raised to affluence, which was liberally shared by those heroic men who stood by him and partook of his trials, and with him breasted the storms of contumely and scorn.

There is nothing like success. Stock could not be presented so fast as to meet the demand. Companies multiplied, wires spread under all parts of the heavens, and ran in all directions over the land and under the seas. Three great lines were created. The Morse Company, so well known, took the lead. House's line, which printed words, became popular, and Paine's, more curious and scientific than all, took down the message, and by a chemical process, changes the character by obliterating a part of the words, and doing all in an instant. But these three lines ran into one another. They interfered with the business of each other, underbid, and made a rivalry that allowed no profit, while the public was badly served. The companies were all poor and made no money.

A consolidation was suggested and agreed to between the three companies. All the lines, then in existence, and the consolidated company were called the "Six Nations Telegraph Company," after the Six Indian Nations.

A division was then made of the territory of the United States, and the companies occupying certain portions took each a name by which it was to be known. To the American Telegraph Company, to be located in New York, was allowed the seaboard from Halifax to New Orleans, with branches reaching to Canada. The United States Telegraph Company took the inland lines, and embraced the different telegraph companies in the land not consolidated in the American Telegraph Company.

This consolidation introduced a new era in telegraphing. It called into the service of the lines the ablest talent in the land. It made telegraphing the most profitable business in the country. It produced harmony, concord, and system among the lines. The public are and have been better served, so the Companies say. The monopoly has not only not increased the tariff of prices as they affirm, but has ranged the prices actually lower down than they were before, the Companies having resolved to make the telegraph a public necessity to every man and to put its facilities within the reach of all classes and conditions, rather than make gain by exorbitant charges. During the war, till the third year, the old prices ruled, and when they were raised they were raised only 50 per cent., while nearly all the business of the land was raised fully 300 per cent. But it is evident that a large portion of the people are debarred from the use of the telegraphs by the present high rates. Its use could be made as universal as the most common necessities that are found under every roof. Through the length and breadth of the land the now silent machines could click with unhesitating pertinacity like the spindles in a factory. The immense dividends of the companies and their profits indicate how easily such a reduction could be made and the telegraph be used no less by the labourer than by the millionaire.

One of the most interesting places for a stranger to visit, is the American Telegraph building on Broadway, corner of Liberty street. The great brown stone edifice, from basement to roof, is devoted to the work of the Telegraph Company. It has a capital of 2,200,000 dols. It employs 20,000 miles of wires. It has eighty officers in different parts of the country. A pay roll on which the names of 2,000 employés are written. The annual expenses of the Company fall but little below the great sum of 700,000 dols. No common men can be employed; the business demands persons of intelligence, quickness, and parts, and such men cannot be had without a good compensation. It takes 275,000 dols. to meet the demand of the pay roll—39,000 dols. is paid for messages alone, and the batteries call for the outlay of 26,000 dols.

The building is a curiosity. It smacks of mystery. Well was it that Morse lived not when witchcraft was an "abomination and a wizard was not allowed to live in the land." The office for messages is on the street floor, fitted up as elegant as a bank, where system and quietness rules disturbed only by the endless click, click, of the hundred instruments that fill the room. Here Morse, House and Paine meet, and each do their work. The House printing instrument is a model of accuracy and swiftness; no less than seven thousand words can be transmitted to Philadelphia in an hour. The telegraphing is done by the ear. The messages are written as they come clicking over the wires. The ear is proved to be more accurate than the eye, and fewer mistakes are made than in the old method of words or symbols. When the messages are over the words are all written, for they are taken down as fast as they come, and the message is ready for immediate distribution. All messages are numbered and recorded in a book with the accuracy of a bank acccount. The system is becoming an important source of evidence in our courts. The fact that a message was sent, to whom, from whom, the date, and the import, are all recorded.

The battery room is a study. The company use 1,700 cups or cells, and the complicated simplicity of the wires and the cupola on the roof where all the wires are concentrated, is a theme of constant wonder. Special wires are devoted to special kinds of business. The Brokers' board have one exclusively employed for their use. Express men, Railroad men, the Press, the Police have each a line to themselves. One line is devoted to Philadelphia exclusively; another to Boston. The messages are sent by one instrument and returned by another, so that message after message can be sent along with wonderful rapidity, one after the other in rapid succession and accuracy—despatch will follow despatch with no interruption. One of the most curious things in this office is a telegraph switch, not unlike in practical use the railroad switch on a railroad track. By this invention messages can be switched off at any moment to let an "incoming dispatch have the track." This is the invention of the talent of the office, Gen. Lefferts, the engineer, leading in the invention. It is a most curious machine.

The forecast of the men who conduct this business induced them to attempt to make the telegraph a common necessity—like the Croton water, the Express, the Post-office. It has been brought to the door of each man. Men buy and sell, travel and live by lightening. The American Telegraph Company embraces various companies, stretching from Halifax to New Orleans, from Sandy Hook to Montreal, covering the whole intermediate country with a net-work of wires vibrating with intelligence, borne on the wings of lightning. The great building occupied by this company, the perfection of the mechanical arrangement, the system and number of employés, and the telegraphic talent concentrated in this establishment, not only show the amount of business done, but make it worthy of a visit from any one who would know the wonderous march of intelligent mechanism. The company have in this city forty offices. Everything now seems to be done by telegram. It has become the great business of the day. It seems to go wherever light and water go. The system here is so perfect that it touches nearly every man's house within a circuit of twenty miles and is connected with the main office in the city. If a lady is sick she telegraphs to her husband's place of business, and requests him to come home and bring the doctor. If a gentleman concludes to go to Europe instead of going home he telegraphs for his carpet bag to be at the steamer at noon. If a merchant invites a friend home to dine with him he telegraphs, that his wife may have a good dinner on the table, and good looks on her face. The Chief of Police sits in his office and converses with his men in every station within the whole circuit of thirty miles through which his district extends. He can move men from any section, concentrate them at any point, and quell a riot before the rioters have time to act. Wires are connected with all the markets— with the drovers' rendezvous —with all cities and villages of importance around New York for a distance of twenty miles.

Not the least interesting part of this institution is that department assigned to women. It was early discovered that telegraphing was a work peculiarly adapted to women. They were invited to enter the field. They were instructed in the art. Rooms have been provided for those who wish to learn telegraphing, and, when instructed, employment and good pay are secured. The room adapted to female operators is cheerful and well carpeted and elegant. It is under the charge of a lady superintendent who has been in the American office five years, and has an annual salary of 950 dols. Most of the city business is done by female operators. Ladies are also employed on the line of railroads and in small country towns. They can do their sewing or reading, and pursue their studies, and yet attend to all the duties of their office, and at the same time earn a handsome salary. They make the best operators. Their ear is quick. They are more trustworthy than men, and more trustful. Some of them are elegantly dressed, all of them are in neat attire, none others being employed. Their influence is found to be good all along the lines. Men are more attentive and civil where lady operators are employed.

Nearly a quarter of a century has passed since Prof. Morse gave to the world this wonderful invention. The march of the business has steadily increased, and the end is not yet. The telegraph wires quiver with intelligence over all the civilised world. Soon, it is hoped, the Atlantic cable will bind the two Continents in bonds of perpetual amity and concord.

Reviews.

THE HISTORY OF SUGAR AND SUGAR-YIELDING PLANTS; TOGETHER WITH AN EPITOME OF EVERY NOTABLE PROCESS OF SUGAR EXTRACTION FROM THE EARLIEST TIMES TO THE PRESENT. BY WILLIAM REED. Longman and Co. 1866.

THOUGH a small, this is an exceedingly useful and comprehensive volume on an important subject, and one which is daily assuming a more decided interest for the general public. Mr. Reed has been for many years connected with the sugar trade, and is well known as the proprietor of the 'Grocer.' This circumstance has given him more than ordinary facilities in the treatment of such a subject, which requires considerable special knowledge. The statistics which accompany the volume, and which form an important as well as a very interesting portion of it, are arranged with great exactness, a matter not generally attended to by those who are forced to wander through the difficult mazes of Parliamentary Blue Books and similar documents. The volume is divided into eleven chapters; the first contains a history of sugar introduction into various countries, with notes on important patents for manufacturing purposes. The second chapter contains ample details on the principal sources of sugar supply, and the imports of raw and refined sugar from various countries for the last twenty years. The other chapters treat of the culture and variety of the sugar cane; the manufacture of raw sugar; the growth and manufacture of date, beet, and maple sugars; the manufacture of refined sugar in England; the prices of sugar from 1319 to 1864; the use and treatment of animal charcoal; English and foreign duties, and the consumption of sugar in the United Kingdom and in other countries.

All these topics are treated with precision and knowledge of the subject; and those who remember the angry and oftentimes illogical controversy which was carried on a few years ago, and which terminated in Mr. Gladstone's reduction of the duty in 1864, will indeed wish that such a compendious manual of sugar statistics had been in the hands of the public, who are so considerably interested in this question as consumers, and who are so often forgotten by statesmen in their seemingly well-arranged schemes. At that time beet sugar was not the formidable rival of cane sugar which it has since become, a rivalry which was ignored in Mr. Gladstone's compensation budget of 1864, but which, if the present anomalous differential duties are not changed, will have a fatal effect on the West Indies particularly, as well as on the other sugar-producing colonies, which will have to struggle against a fiscal injustice worse than any protection could be.

But as the TECHNOLOGIST is not the fitting arena of such a discussion as this, it will be simply necessary to remark that such chapters as the growth and manufacture of sugar from date, beet, maple, sorghum, &c.; the refined sugar manufacture of England, and the use and treatment of animal charcoal, &c., are ably written, and, would, if extracted, be very interesting to the general reader. But the chapters which will most interest those who look on the fiscal side of the question, will be those on the prices of sugars, and on the different duties imposed at different periods. What a suggestive instance of the short-sighted interference of government in the onward flow of commerce is the fact, that in the year 1700 the consumption of sugar in the United Kingdom was 10,000 tons, while at the present time it has increased to 500,000 tons, though its progress is still fettered with the remnants of red-tape legislation. Those who wish to estimate the value of such legislation, can turn to page 171 of Mr. Reed's book, where they will find the account of the sugar debates in Parliament in 1841, when Lord Melbourne's Ministry was wrecked in attempting a fairer system of sugar duties. The late Sir Robert Peel's argument in that debate was one which would teach every statesman how fluctuating is Parliamentary consisttency, and how vain it is to struggle against the spirit of the age. When Sir Robert said: "a sufficient quantity of sugar for home consumption may be obtained from the East and West Indies and Mauritius, without resorting to the slave colonies," he little foresaw what enormous advances the consumption of sugar was destined to make. Our limits, however, preclude us from any further reference to Mr. Reed's welcome volume. We may add, that as the working man, and the class above the working men, are intimately concerned in this question of tea and sugar, which are no longer the luxuries, but the necessary aids of daily life, this volume is just the sort of book a working man should read, and which, we trust, will find a place in every Mechanic's Institute library. Nothing can better elucidate the mischief of commercial restrictions than the history of the sugar duties; while nothing will more interest the consumer of sugar than the triumphs of science in extracting the beautiful and brilliant crystals of the present day from the cane, the beet, and we may probably add, the sorghum also.

Scientific Notes.

Rice in Italy.—Mr. Sackville West, in his 'Commercial Report on Italy for the year 1863,' says that rice is more extensively cultivated in Italy than in any other part of Europe, although the date of its introduction is comparatively recent. Its cultivation, for sanitary reasons, has always been more or less restricted by legislative measures, and the question as to whether it is really pernicious or not to the health of the surrounding populations has ever been and still is seriously discussed.

The rice which is grown in Italy must be cultivated nnder a system of irrigation. There does not appear to be sufficient humidity in the air to admit of the successful cultivation of the species "mountain rice" which was brought by M. Poivre from Cochin China to the Mauritius, from whence it was subsequently brought to Europe, where it is proved to have germinated and come to maturity in climates possessing the requisite amount of humidity. Neither the Greeks or Romans appear to have cultivated rice, although it is certain they knew of such produce as coming from Asia by the Red Sea to the ports of the Mediterranean. The Arabs are supposed to have cultivated it, and to have introduced it into Egypt and the southern parts of Europe with which they came into contact, but nothing is certain as to its existence in Europe until its introduction into Spain by the Moors in 1324, although a certain Peter Crescentius mentions it as growing in the marshy lands about Bologna as early as 1301. There are legislative enactments extant of Francesco Sforza and Ludovico the Moor, which prove that it was cultivated to a considerable extent in the Milanese in the fifteenth century. In the year 1585, the Spanish Governor of Milan, the Marquis Aymonte, prohibited it as a pestiferous production. Notwithstanding, however, all efforts to restrict its extension, it continued to spread throughout Italy, especially on the coasts of the Adriatic about Venice and Ancona in the valley of the Po. In Spain and Portugal sufficient care and attention were not bestowed on its cultivation as to render the crop important. It was grown to some extent in some parts of France until Cardinal Fleury put a stop to its cultivation, and at the present time it is by no means a profitable speculation. In Italy, however, the contrary is the case, and the crop is most remunerative, but it is a matter of serious consideration for the government to decide the question as to its pernicious effect on the health of the population, and if necessary, to adopt the most judicious measures to prevent the evil consequences consequent on an undue extension of its cultivation near great towns.

To the Editor of the TECHNOLOGIST.

Camp in Chumba, Lahore.

DEAR SIR,—In connection with an article on the shawl manufacture of Kashmir in a recent number of your Journal, some of the following may not be uninteresting :—

During a short tour in Kashmir some years ago, I paid some attention to corroborating, completing, or correcting some of the information connected with vegetable productions which Vigne gives in his 'Book of Travels' in that country, and among other things, made some inquiries into the nature of the dyes used there. The information that Vigne gives as to the dyes used in Sirinaggar (vol. ii. p. 127), may be condensed as follows. About forty different colours (and shades of colour) are in use for silks and woollens. Blues and purples are derived chiefly from indigo, yellows from a Punjab flower called *gul-i-kyser* and from a Kashmir grass called *woffangil.* Blacks and a light-brown are got from iron filings and wild pomegranate skins; reds from kermes, logwood, and a native wood called *lin.* A drab is obtained from walnut-skins, and the colour extracted from English green baize is employed to get their finest greens and a light blue. He elsewhere notes that the root of a plant called *kritz* is used in dyeing. The following constitutes the information as to dyes I picked up in Kashmir, and I have no doubt but that like Vigne's it may contain some errors :—

The blues for both silk and woollen are obtained from indigo and *lājward* (lapis lazuli). The latter is largely imported into Kashmir, and thence partly into the Punjab and Hindustan, from Tibet or beyond it. Purple is got from the application of *kirm* (cochineal), after lapis lazuli. Vigne's Punjab flower, which gives a yellow, is *gul kesar* (literally saffron flower), which is obtained from the *dhāk* or *palās, Butea frondosa,* which grows much more abundantly in many parts of Hindustan than in the Punjab (except in one or two districts in the eastern extremity of the latter). The rind of the fruit of the pomegranate, which is not uncommon wild in and near Kashmir, with the liquor of iron ash, is used for black. Wool is dyed red by means of *lākh* (seed-lac produced in many parts of India), and silk by cochineal. A non-durable red is got from *bakam,* the wood of, I think, *Cæsalpinia Sappan,* from Southern India, which probably constitutes both the logwood and the *lin* of Vigne. At all events, I could discern no native dyewood known by the latter name, and do not think I could have missed it had it existed. Drab is obtained from walnut skins without any mordant or preparation, but with the addition of a little black if necessary. As to green, I heard nothing of the use of green baize, but the only source of this colour was stated to be indigo after *wotīāngil.* This is the name of one or several species of Carpesium common in parts of Kashmir and its neighbourhood. For silk its root, and for woollen its leaves, are employed to give a yellow in the preparation of green. It was stated that for some colours a mordant is used of first *sajjī* (impure carbonate of potash), and then *phit karī* (alum), but I did not get details as to the use of these. *Krīss* is the name in Kashmir and to the westward of *Dioscorea deltoidea,* a plant common in many parts of the Western Himalaya. So far as I could learn, its root (a coarse yam, which is eaten by the people in places) is only used in washing the wool, &c., preparatory to dyeing. It would appear that at least one-half of the materials above enumerated, are derived entirely or chiefly from British territory (the rest being indigenous in Kashmir and brought from beyond it). So that if at any time it should be considered advisable to shut up the chief trade of the country—a very unlikely contingency—we could do so by stopping the supply of dyes, altogether irrespective of the power of closing the chief exits for the manufactured article.

L. L. Stewart, M.D.,
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THE TECHNOLOGIST.

RESEARCHES ON THE JUICE OF THE SUGAR CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

BY DR. ICERY.
President of the Chamber of Agriculture.

Translated by JAMES MORRIS, Esq., Representative of the Chamber of Agriculture of Mauritius.

(Continued from page 347.)

SECOND PART.—I. THE COMPOSITION OF THE SUGAR-CANE AND OF ITS JUICE IN GENERAL.

THE term "Juice" has been employed to designate the liquid extract of the cane when subjected to a greater or less pressure. When flowing freshly from the mill it contains a notable quantity of solid particles, sometimes of extreme tenuity, and which float along its whole surface. These are the fragments of the fibres and vegetable cells, the result of the crushing and tearing action of the cylinders of the mill. It is always easy by means of subsidence or common filtration to separate these minute bodies, and they cannot therefore, be considered as an integral part of the cane-juice. It is, therefore, erroneous to assign to them, as certain authors have done, a place among the elemental constituents of the liquid, designating them by the very unfitting name of *coloured fecula.* I have already shown, that deducting these amorphous products entirely accidental and foreign to the intimate nature of the cane-juice, there exists normally in this liquid, as in many vegetable juices, organised corpuscles in the form of globules with distinct and transparent membranes, from 3 to 5 thousandths of a millimetre in diameter, and I have indicated the importance which must for the future be attached to the presence of these microscopical particles by all our colonial sugar manufacturers.

The composition of this cane-juice properly so called, that is separated from all solid substance, has been differently determined by those chemists who have examined it at various times, and even at the present day, it is not known with complete accuracy. The analyses made at the end of the last century were naturally imperfect in consequence of the means employed by the organic chemists of the period, and the data which they furnished were of a general nature, the precision of which was often questionable. At the commencement of the present century chemists of acknowledged merit, starting with the object of throwing new light on the colonial manufacture of sugar, the imperfect processes of which were recognised on all sides, proposed to themselves the task of determining the exact nature and the proportion of the elements which constituted the juice of the sugar cane. The difficulty of preserving this liquid in a fresh state during a long voyage, rendered these first essays almost fruitless. The beet plant had been analysed and its structure and composition were perfectly known, when the sugar cane still remained the object of erroneous examinations.

It is only within the last twenty-five years that this juice has been studied with care and success by one of the most distinguished French chemists, M. Peligot. He first determined the relative quantities of water, sugar, and mineral and organic substances contained in the sugar cane, and the figures by which he has represented them, are still the data to be found even in the most recent works on this subject. This able chemist rendered a real service to all sugar manufacturers by discarding from the composition of the plant all those pretended substances which were only a source of useless complexity, and by giving them a clear and precise demonstration of the primal material on which they had to operate. It is nevertheless certain that, if instead of working in France exclusively on the juice of plants which had arrived at maturity, he had extended his researches in the colonies themselves, to the juice extracted from canes in different stages of development, he would have modified certain conclusions which are to be found in the learned memoir which he published on this subject. His opinion on the condition of the sugar in the cane, an opinion adopted by all succeeding chemists, might be perfectly correct according to the analyses he made; but it does not correspond to those facts which direct and often repeated experiments have brought to light. Cane-juice, in fact, does not, as is usually admitted at the present day, contain crystallizable sugar only; it contains uncrystallizable sugar, and the quantity of this latter substance varies in different parts of the same cane, and at different periods of its development. I shall dedicate a special chapter to the exposition of this question which is really so important to the colonial sugar industry, and place in evidence the fact I have just stated, and those conditions under the influence of which the state of the sugar in the cane is normally modified. I shall also examine in a special manner those organic substances besides sugar, as well as mineral salts which enter into the formation of cane-juice.

Regarded in a general manner, cane-juice is sugar water holding in solution a certain quantity of organic and mineral principles. Considering then particularly only the sugar and the water, and grouping the other remaining substances into two distinct categories, according to their vegetable or mineral nature, I have deduced the average composition of the juice of Mauritius canes of the different species cultivated in the Island, from numerous analyses, all of which were made, during the last two years, upon canes which had reached maturity, but grown in localities differing in soil and temperature.

Water	81·00
Sugar	18·36
Mineral salts	0·29
Organic substances ...	0·35
	100·00

The average composition of fresh cane, relatively speaking, can be deduced approximatively from that of the juice when the loss of a given weight of cane subjected to a complete dessication is known; but the juice contained in the bagasse being less rich in sugar than what has been extracted, and the washing of dessicated cane being also a long and difficult operation, it is easier, and at the same time more exact to have recourse to direct experiment. To determine this composition of the cane, so far as the water, the saccharine, and the ligneous matter alone are concerned, I analysed a certain number of canes of different species growing in localities which can be assumed as representing in respect to climate, the average of those in which the cultivation of the cane is carried out on the largest scale. I here append these analyses which were made on canes in average and comparable conditions.*

* The want of space has necessitated me to omit a long and elaborate table in which the results furnished by seventy-eight analyses are recorded, and which gives an exact account of the variations of these different substances according to the age of the cane, the period at which it has been manipulated, the portions of the plant examined, and the localities of its growth. The relative richness in saccharine matter of the various kinds of cane is also tabulated, as well as the differences in the quality of the sugar of the same canes subjected to various degrees of pressure. The indications of the polarizing saccharometer and the results of chemical analysis are also recorded; the whole table being a compendium of the series of experiments made.—(Translator.)

The analyses of different kinds of cane completely developed, in order to determine the relative quantities of water, saccharine, and ligneous substance.

Name of Sugar Estate.	Species of Cane.	Water.	Sugar.	Ligneous Substance.
Labourdonnais	Diard	0·698	0·200	0·102
,,	Guingham	0·682	0·209	0·109
La Gaieté*	Diard	0·703	0·197	0·100
,,	Pinang	0·678	0·196	0·126
,,	Bellouguet	0·716	0·197	0·087
,,	Bamboo	0·695	0·190	0·115
,,	Guingham	0·703	0·186	0·111
,,	Bellouguet	0·703	0·203	0·094
,,	Pinang	0·690	0·198	0·112
,,	Bellouguet	0·729	0·187	0·084
,,	Guingham	0·697	0·196	0·107
,,	Bambou	0·669	0.214	0·117
,,	Otaite	0·703	0·210	0·107

The saccharine matter is not equally distributed in the different parts of the sugar cane ; the central or medullary portion is richer than the nodular or cortical. When a piece of sugar cane is separated in such a manner as to be able to compress individually the knots, the parts between such knots, and the bark roughly detached and carrying away with it a certain quantity of medullary structure, results are obtained of which the following example will give an exact idea :—

	Medullary portion.	Cortical.	Nodular.
Density at 25° centigr. ...	1082 ...	1074 ...	1069
Quantity of sugar per cent. ...	18·4 ...	17·9 ...	17·1

Such an experiment as this is a complete justification of what I have stated above, that the relative richness of the juice depends on the pressure employed. Such richness would be still more appreciable were the knotty portions of the cane not always so much more completely crushed by the action of the cylinders than the part nearest the bark which as is well-known, is on issuing from the mill, the least bruised and the most humid.

Those canes which have been attacked by the disease which I described under the term "*degeneration*" about three years ago, do not generally contain less saccharine than the healthy canes with which they are compared. The analyses I have made in this respect confirm what the planters had already been able to recognise in the

* La Gaieté is the fine estate in the Flacq District of Mauritius, belonging to Dr. Icery.

ordinary processes of their manufacture. I may also add that such canes even when most extensively diseased, did not contain a greater relative proportion of uncrystallizable sugar.

II. The Primitive Condition of the Sacharine in the Cane.

As I have already noticed, the cane does not contain crystallizable sugar alone. In stating an opinion so directly opposed to the ideas of scientific men at the present day, I feel myself bound to declare at once that I have no intention to take up again the conclusions of the earlier chemists who gave a detailed analysis of the sugar cane. The error committed by them of admitting in the juice of the ripe cane, the pre-existence of a notable quantity of liquid sugar or molasses ready formed, could only be the result of experiments wanting in precision, and besides, such a theory has long been abandoned. I do not believe, and my own experiments agree perfectly with those mentioned by the most recent writers on the subject, that there exists in the healthy cane, which has reached the full term of its development, a proportion of uncrystallizable sugar, sufficiently appreciable to cause much importance to be attached to it. But I have arrived at an opinion entirely contrary to that which is now entertained, when the question is as to the results furnished by every other part of the cane, except that which has undergone the prolonged action of the solar rays, and as to the period at which this plant has been examined, and as to the primitive condition in which the sugar presents itself at different periods of vegetation.

In order to render more clear the details on which I am about to enter, it is requisite to recall in a few words the characters peculiar to those substances which have been indistinctly designated by the name of sugar. The first group of such substances, the only ones which are of interest to us to know, and which can enter into the present investigation, is formed of those bodies which have the remarkable property of being directly changed into alcohol and carbonic acid when treated with yeast.

Cane sugar ($C^{12} H^{11} O^{11}$) is distinguished from all other kinds by the property it has of crystallizing in large rhomboidal prisms, and the facility with which it is possible to obtain it in this state, when dissolved in water. To the present time it has only been found in the vegetable kingdom, and vegetation is the only influence producing it.

Glucose or grape sugar ($C^{12} H^{12} O^{12}+2\ H\ O$) is found both in the vegetable and animal kingdom, and can also be formed artificially by various chemical processes. It precipitates in small glandular crystals, when dissolved in water, and the solution is concentrated slowly, or when it is left to itself for any considerable time. Less soluble than cane sugar in water, it has a saccharine taste, about three times less pronounced than cane sugar. Treated by a warm solution of potass or soda, the glucose becomes oxydised, and communicates a deep brown colour to the solution. Boiled with the tartrate cupro-potassic, it reduces the metallic oxide, and gives rise to an abundant red precipitate. These two reactions enable us to discover traces of glucose mixed with cane sugar. The various terms, as sugar of fecula, of rags, of honey, of that found in diabetes, simply apply to glucose, the different sources of which they indicate.

Uncrystallizable sugar, called also interverted sugar, sugar of acid fruits, levulose &c. (C^{12} H^{11} O^{11} *) exists in most fruits, and is found ready formed in the stems of some plants. The action of acids on cane sugar will produce it in a direct manner; like glucose, it turns brown under the action of alkalis, and reacts energetically on the cupro-potassic tartrate. This uncrystallizable sugar becomes modified after a certain time, and is partly changed into glucose, which then appears as small granular crystals. For this reason, it has sometimes been considered as a compound of glucose and liquid sugar. Taking into account merely certain physical characteristics of this last kind of sugar, it is beyond doubt that it is not always identical in the vegetable organisation, and is there manifested under different molecular conditions, if not with a variability of its intimate composition.

There are some other substances which have a great analogy with the above-named bodies both in their properties and composition; such as lactine, trehalose, melitose, and melezitose; but it is sufficient to name these substances which, on account of their special origin, do not fall within the range of those mattters which are the principal object of these researches.

The action which polarised light exerts on the solutions of the different sugars which have been passed in review, furnishes valuable means for distinguishing them; and it is at the same time the surest and most precise method to determine their relative quantities in a liquid which does not contain other bodies, having equal power of reaction on polarised light. The modification which is communicated to polarised light by different kinds of sugars, is more or less marked, though not always exercised in an identical manner. Cane sugar, crystallized glucose, lactine, trehalose, melitose, and melezitose become on the right hand the plane of polarization of the light, the greatest rotatory power among these substances being possessed by trehalose, and after it come melitose, melezitose, cane sugar, lactine and glucose.

Diluted acids modify in an opposite sense the rotatory power of cane sugar which then diverts to the left the plane of polarization; glucose, however does not undergo such a change under the action of acids.

Like interverted cane sugar, the liquid sugar of acid fruits turns to

* Gelis gives us the formula of levulose or levulozine, C^{12} H^{10} O^{10}, that is, one equivalent less of water than prismatic sugar.

the left the plane of polarization. Important data like these, furnished by optical analysis powerfully contribute to the elucidation of certain questions connected with the presence and the formation of the different kinds of sugar already enumerated in the vegetable organization, optical saccharimetry employed in conjunction with the ordinary methods of chemistry, has already produced invaluable results.

(To be continued.)

ARTIFICIAL STONE MANUFACTURE.

That artificial stone of a durable quality can be made in most places and in any quantity is a proposition that may readily be granted; but when the further question for agricultural purposes at a sufficiently low price is appended, its successful reduction to practice becomes somewhat problematical. At the same time it must be admitted that this branch of art has of late been making considerable progress; that some important discoveries, which have hitherto been imperfectly carried out under patent and a too limited means, are becoming the common property of the public; and that the advances being made in the sister-branches of chemistry and mechanics are fast bringing it within the range of profitable practice, if we have not already attained this position.

The subject suggested itself to our notice the other day, in witnessing a labourer taking up an old gate-post, which had been fixed and held firm in its place by well-tempered concrete, the subsoil being a soft tenacious example of London clay. The concrete was as hard and solid as if it had been run together in a state of fusion like lava, or some specimens of conglomerate rock, making the pick ring at every stroke in breaking it up. To appearance, from a passing observation, it had preserved the gate-post from rotting below the surface, and held it as firm in its vertical position above ground as if it had been an iron post fixed in solid rock by lead. No doubt both these conditions depended in a great measure upon the soundness of the post when put in, together with the quality of the wood and concrete. This may be granted; but it is only profiting by the lesson which examples of more than ordinary success teaches, that leads to permanent improvement; for although some may fail in setting gate-posts firm in concrete, that is no rule to the contrary, but only proof practical of mismanagement.

Fixing gate-posts, however, is not the only agricultural purpose in which concrete can be used, as many of the old Pictish concrete buildings still standing prove. Some of these old castles thus referred to lead us back to periods lost in ages gone by, and to appearance seem as if they would stand to the end of time, the influence of the weather upon their structure not being greater than upon the solid rock that crops out and rises abruptly in some places above the surface of the ground. In examples where the progress of things render their removal necessary, blasting with gunpowder is the more economical process of manipulation, and even then the walls could be broken down and removed at less expense of money and at a still more reduced outlay of labour, had they been hewn out of the solid rock, owing to the peculiar toughness and tenacity and total absence of stratification or cleavage properties of the concrete; for with a sledge-hammer, you may pound it into dust, but you cannot split it up into fragments of a size easily to be handled.

In erecting such buildings, the Picts are said to have set their concrete in moulds; indeed, many of the walls still standing bear legible evidence of this method of building.

Agricultural buildings, from their plain and simple style of architecture, and also fences, are favourably adapted for this plan of building, and just now, when strikes among the building trades and the conduct of tradespeople generally; together with the extra expenses attending trade combinations—renders it difficult for landowners to erect homesteads, labourers' cottages, and fences on terms that will enable tenants to pay fair interest on capital thus invested—cannot the work of moulding concrete walls be greatly abridged and expedited by means of machinery and the advances recently made in this branch of chemistry? Now, for example, when we can by dint of discoveries in chemistry convert chalk into marble over night while our workmen are sleeping, and the drifting sand into a hard conglomerate sandstone or Bathstone, &c., of any colour, cannot we teach our portable steam-engines the art of building, so as to erect homesteads and cottages by the hundreds, and fences by the running mile, in a twinkling, and at no expense, comparatively speaking?

We are evidently fast approaching a period when experience will give an affirmative answer to the above interrogatory, thereby advancing the wages of those employed in this branch of industry—indirectly in the construction of machinery, and directly in using such machinery, at the same time greatly reducing the expenses of building, and increasing the health and comfort of man and beast, as occupants; houses thus built being much more healthy than the vast majority of the gingerbread structures now erected. The present buildings are not only expensive in a pecuniary sense, and of short duration, but they are also unhealthy, as compared with the more solid and permanent examples of Pictish masonry; and although the concrete style of the latter was plain and rude to outward appearance, yet we aver that the finest style of architecture can be affected by the moulding concrete and infiltration processes, and at less money than the current terms of this quality of workmanship; for it is already a well-established fact that the artificial stone in question takes the highest polish, and is susceptible of being worked into the finest and most elaborate decorative examples of art. But so far as the style of agricultural buildings is involved, a sufficiency of ornamental work can be easily effected, at comparatively no increase of expense—certainly at a less increase than it is at present done by manual labour.

Apart from improved mechanical means now at the command of builders, it has often occurred to us, when examining old Pictish masonry, that improvements could be made in the breaking and laying of the stones in the wall. The kind of stones used in the old fortified strongholds or castles and buildings to which we more especially refer, is chiefly sandstone. Few of them are larger than what one person could hand to another, and so shapeless in form and irregular in size, as to resemble very closely the rubbish of a quarry, broken-off in forming and dressing the large blocks for hewn work ; and the position of the largest of them is as often lengthways as vertically, instead of being placed in the mould or box lying on their flat sides, and more frequently in the centre of the wall, than on the outside, as seen over doors and windows, and in places where the wall had been broken down by artillery, under a lengthened siege, which it at one time sustained. Towards the outside and inside of the wall, however, thin, small fragments are more in a flat or edge position tranversely. Some say the stones were first placed in the box or mould, and the finely tempered mortar then poured in ; others, that the mortar was first poured in, and then the stones sunk in the semi-fluid mass ; but we could never reconcile the actual position of the stone, so far as visible to the eye exclusively, to either of these two plans ; for they evidently indicated rather that both processes had been carried on alternately at the same time—*i. e.*, sometimes the one and sometimes the other, in accordance with certain definite rules based upon the peculiar shape and size of the stones. We know from experience that the success of forming a good concrete foundation for a wall, or in fixing gate-posts, and the like, depends, in a great measure, nearly as much upon expedition, as upon the quality of the gravel and mortar ; and we aver that this rule of quick action entered largely into the theory of Pictish masonry, and that it must still be the rule of action in any successful attempt to make concrete walls, whatever may be their dimensions.

There was another peculiarity in the experimental lesson which the masonry of the old Pictish castle taught us in early life, relative to the durable quality of the stone. With few exceptions, the stones for example had been carefully selected, but here and there the end of a sandstone had given way to the weather, the mortar around it remaining hard and weatherproof to the hand of time. This further shows the reason why the Pictish mason put the smooth straight head of a large stone as often into the interior of his wall as to the outside, and why in putting the stones into the mould he studied the bonding of his work by the position of the mortar rather than by that of the stones.

But we aver that something better than Pictish concrete masonry is now attainable, and at a figure which recommends it to the favourable notice of landowner and tenant in many localities at the present time, where brick and stone are either bad, or not to be had at all, unless brought from a distance, such places yielding, at the same time, chalk or gravel, or sand of the finest quality, for artificial stone manufacture and building. Almost anybody can fill a long box or trough with sand from an adjoining gravel-pit; and when once the solution is known, or got from its manufacturer, it takes very little more skill to pour in the solution until it stands to the brim or surface of the sand, so as to run the whole together into a solid rock, layer upon layer, until the chimney-tops are attained in farm-houses and cottages, the top of the walls in buildings for cattle, and the coping of fences. In other cases, the sand or gravel and the solution might require to be incorporated, and then poured into the mould in a semi-fluid state. Thus, the steam-engine could be made to mix and work the mortar in a pug-mill, and then elevate and pour it into the moulds by means of an archimedian screw, so constructed as to be put up at different lengths to suit different heights of walls. Such hypothetical data, it is true, may not altogether coincide with the actual line of future progress upon which we are about to enter, but they nevertheless evidently lie in the same direction.

Again, artificial stone-roads for carts and horses, carriages, tramways for traction-engines, for steam-cartage and steam-culture, are other purposes that are embraced by our proposition. The ancient Romans made artificial stone-roads of almost incredible hardness and durability, of which we may instance the "Appian-way," on which the Apostle Paul appears to have travelled (Acts xxviii. 15), when sent a prisoner to Rome. Were tramways of such artificial stone as the Appian-way was constructed of, laid down on the principle of railways so as to reduce the gradients to what the traction-engines now in use require, the carrying of manure to the fields and the bringing home of the produce of harvest are works that would soon be realised, and we do not see a valid reason why England in the present boastful age should be behind the "Mistress of the World," in the days of "the Apostle of the Gentiles," or when Horace penned the oft-quoted oracle,

> "Rusticus expectat, dum defluat amnis; at ille
> Labiter et labetur."

If there is a reason at all, it must obviously be embraced somehow in this same oracle? It follows, therefore, that this part of our proposition, like the others, involves less novelty than some old-school opponents to progress may imagine. In short, what we propose is merely an improvement upon the old Roman tramway, because at present urgently demanded by the rapid progress now being made in the application of steam to the cultivation of land and the conveyance of its produce to market. In our animal mechanics, for example, the ground is the fulcrum to the foot of the horse and the wheel of the cart, waggon, and traction-engine. The Roman philosophers were better acquainted with this branch of mechanics than we were prior to the age of railways; hence the economy of muscular power affected by their stone-tramways, and the manifold loss we sustain when our teams are wading to the knees in our soft, sticky clays. About the economy of brute muscle we have hitherto cared less than common sense and our pockets have told us; but now that the steam-horse is puffing in our fields, the outlay in coals and other etceteras is begining to lecture on the subject of economy in another fashion, making the oldest people hear on the deaf-side of the head, and think likewise; for our wheels are endless levers, and as such they absolutely require something more solid than our plastic clays to work upon,—*i. e.*, artificial stone tramways.

And, lastly, we have the proposition of artificial stone main-drains and sewers; also the bottoms of open ditches, water courses, and rivers, so as to prevent the washing away of the land, and to carry off the largest quantity of water in the smallest drain or channel and in the shortest space of time. This of itself is doubtless a great subject. In discussing the problem of applying the sewage of the capital to sandy and other open and porous soils some nine or ten years ago, the representative of the "Indurated Stone Company" then offered to make sewers through the different kinds of soil in question, on terms which were highly encouraging both for covered and open work. And there is nothing in the chemical nature of such artificial stones to prevent their being also used for cisterns and ponds to hold water for cattle. On the contrary, they have much to recommend them, so as to obviate the present putrid water which is proving detrimental to the health of cattle and quality of the milk and meat they yield for our tables. Thus, in opening a ditch or watercourse through sandy soils, six inches of the sand in the bottom, or any other depth or thickness, can be converted into a solid stone, impervious to water, and more durable than the hardest sandstone.

With regard to moulds and the moulding process, the improvements made in practical mechanics since the days of the Picts and ancient Romans are greatly in favour of our proposition, as the work could now be done at a fraction of the outlay in time, labour, and money which it cost them. Indeed, so great is the balance in favour of modern improvement, that a comparison can hardly be drawn between it and the rude practice of the olden time; while it may be safely inferred that the progress already made is perhaps further behind the future than the past is behind the present.

Our proposition as a whole, it will thus be seen, is not unworthy of a hearing, but the contrary, has many special claims upon the attention of the agricultural public at the present time; nor is its importance confined to them, as the forlorn and ruinous architectural condition of many a provincial town and village proves. And besides their present experience as to inferior and unhealthy houses, the manufacture of artificial stone would afford an immense amount of profitable employment, thereby creating a new stimulus to the other branches of useful industry. In an improvement where the welfare of so many are interested, the benefit gained extends to all classes of the community.

THE TIMBER TREES AND USEFUL PLANTS OF THE BIJNOUR FOREST, HIMALAYAS.

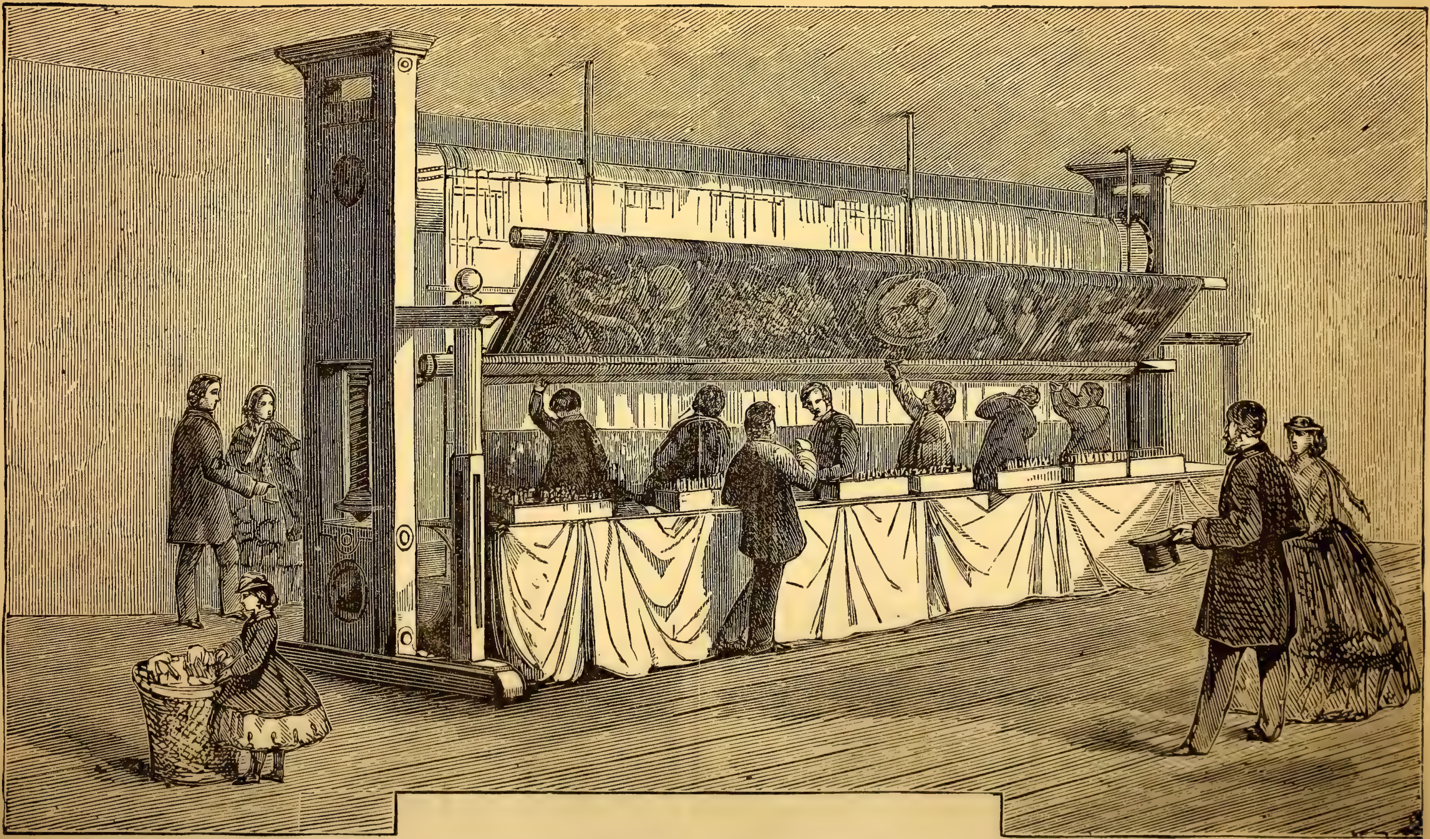
BY DR. J. L. STEWART, CIVIL SURGEON.

In proceeding to consider the individual trees and other plants yielding timber and minor products in the Bijnour forest, the preferable arrangement of them has been a subject of some perplexity. A botanical arrangement would be too technical and presents no compensating advantages, while on the other hand, an alphabetical catalogue of the native names, though seemingly simple, has great inconveniences, chiefly owing to the varying methods of spelling native words, and the fact that in some cases, several native names are given to the same tree within a few miles. I know of no circumstance against which, as throwing difficulties in the way of our identifying the products of Indian plants and systematizing our knowledge of their properties, botanical writers, from Buchanan and Hamilton to Hooker, have inveighed so strongly, at the tendency of many people to hold fast and swear by native nomenclature with its variations and uncertainties.

Any arrangement founded on the nature and uses of the various products seems beset with difficulties and inconveniences, and although I can hardly flatter myself that I have hit the *juste milieu* by arranging the botanical names in an alphabetical catalogue, followed by the respective native names, yet this method appears to me to labour under fewer disadvantages than any of the others.

I have included in the following list every plant, large and small, known to me in this forest, as yielding timber or any other useful product whether for home consumption or export, as well as one or two useful trees, &c., which are doubtfully indigenous in it, and a very few plants which from their striking appearance or connection with others which are useful, seem to deserve a place here.

The native names are spelt from pronunciation, as nearly as may be according to the system used by Shakespeare, so as to ensure some degree of uniformity, the ordinary way of spelling being added in cases



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THE MANUFACTURE OF GOBELINS TAPESTRY AND CARPETS.

when that differs much from the former. Native names derived from sources other than personal investigation, and in one or two cases native names in common use in neighbouring districts, are given in brackets. To prevent possible confusion the botanical name which has been commonly used for particular trees is always given, the more correct name where it has on authority been recently altered being inserted in parenthesis.

I have taken considerable pains to attain correctness in regard to the rates of price ; the first price given is that usually charged on the article ere removal from the forest, while the second is the ordinary price at Nujeebabad, the nearest mart.

1. *Acacia Arabica*, Willd : *babál kikkar*. This well-known and useful tree is common, planted in the open plain, but I am very doubtful if it grows anywhere in those forests truly wild. The timber is never of a large size in these provinces, but being fine grained and tough, it is in most parts of India much used for building, axles and wheels, and for making charcoal. At Bombay, kneed timbers for ship building are made from it. A gum (*babál ka gond*) identical with gum Arabic, issues from its trunk, and its bark is used in tanning and medicine.

2. *A. Catechu*, Willd : *Khair*. This tree is or has been abundant along all the minor portion of the forest-belt. It yields a hard, close-grained, heavy wood, which is *very* durable and is said to turn well. It is valued for plough-shares, axles, pestles, pins, &c., but its special use is for making the crusher (*chúran*) of sugar and oil-mills, for which purpose it is said to yield to tamarind only. 3 yds. × $\frac{3}{4}$ yd. 1/ to 3 rupees.

The fact of all the larger trees having been used up, is assigned as the reason why little or no manufacture of catechu (*kathá*) from its wood, is carried on, though a great deal for use in dyeing and medicine is made, east of the Rámgunga. $1\frac{1}{2}$ seer 1/.

3. *Acacia elata*, Grah : *kareo, baron*. I doubt if this tree, the timber of which is like that of the *siris* (No. 5), and is used for wheels, furniture, &c., comes outside the Siwaliks. It is common in the Doons, and is a tall, very handsome tree, with smooth, light coloured, greenish grey bark.

4. *A.* —— ? *siron*. This tree I only found on the skirts of the outer hills, though it is common in the Doons. It has a lightish grey bark, curiously wrinkled, and its timber is hard, light, and strong, and much valued in some parts of India.

5. *A. species : siris*. Although this tree grows well when planted in the plains, it does not seem to be truly wild anywhere in the forest. It is rapid grown, dark-barked, smooth-trunked, and wide-spreading, and its heart-wood yields a dark-coloured, hard, and very heavy timber, which is used for building, &c., and being durable and not liable to be attacked by insects, it has been recommended for railway sleepers. $4\frac{1}{2}$ yds. + $\frac{1}{2}$ yd. 3/. In this district it is frequently used for oil-mills

(*kolhú*), and the oil is supposed by entering its pores to make it stronger. It is less lasting than *sissú* (No. 47), and in Baker's experiments a bar 6 feet long, and 2 inches square broke with 709 lbs.

The bark is said to be used for application to hurts of the eyes, and a gum oozes from its trunk, but I am not aware of its being anywhere collected in quantity.

6. *Ægle Marmelos*, Corr : *bel.* Has been very abundant all over these forests, but recently much of it has been cut down for charcoal, for which it is well adapted. It grows to 20-30 feet and is a handsome though small tree, with a light grey smooth bark, and when old a columnar (fluted) trunk. Its flowers have a delicious honey smell. The timber is light coloured, hard, and strong, and is sometimes used for crushers (*chúran*) but is said to last only one year. $3\frac{1}{2}$ yds. × $\frac{3}{4}$ yd. —/12.

The fresh fruit is used for sherbets, and its dried pulp is much valued and of considerable efficacy in some forms of bowel-complaint. 1 maund 2/4 ; 1 lb. —/1.

The rind is used in dyeing yellow, and the Dutch in Ceylon are said to have manufactured a perfume from it.

7. *Andrachne trifoliata*, Rox : ? An exceedingly rare tree in the inner part of the forest (and occasional in the Doons).

8. *Andropogon involutus*, Steud : *bhábar.* This grass, which is abundant in this part of the Himalaya and occasional on the skirts of the Siwaliks, appears to furnish almost all the material called *bhábar* so largely used for string in these parts. Botanists, from Wallich and Royle downwards have stated this to be the produce of *Eriophorum comosum* (No. 54), of which, however, apparently only a very small proportion of that brought to the plains consists. 1 maund —/8. Dr. Brandis first drew my attention to the probability of the ordinary belief being erroneous, and subsequent inquiry has shown that the case is as above stated.

The string is very coarse, but strong, and although there is great waste in the manufacture, exceedingly cheap. 1 maund 2/—. It is well adapted for boat-ropes, the rope-work of bedsteads, and other ordinary purposes. Possibly the *bhábar* may come into play as a paper material, at least, it is worth the trial, and probably larger quantities of the raw article could be got than of any other fibre that I know of in this part of the Himalaya.

9. *Antidesma paniculatum*, Willd : *amlí mendla* (surshoree). Rare outside the hills, timber small and worthless. Its acid fruit ("*khatta mithá*") is eaten, and also applied as a discutient to boils by natives.

10. *Bambusa stricta*, Rox : *báns.* All the bamboo of this forest and the neigbouring Doons probably belongs to this species. It forms one of the most valuable products of the forest, and will be alluded to more fully hereafter.

The cut bamboos are divided into the following kinds, beginning with the least valuable, in regard to paying the forest rates, and for sale. 2,000 4/8—; 240 1/—.

1. *Chanejù*, long and thin; for roofs (*chhappar*).

2. *Láthi, láthíchúr*, thicker, shorter, solid, for walking-sticks and clubs.

3. *Bálù*, similar but much thicker, for sides of bedsteads, &c.

4. *Kanerwâ*, between the two last in thickness, but hollow; for *chhappar*.

5. *Saráicha*, much thicker, short, hollow; for *chhappar*.

6. *Dashatta*, similar but much longer.

7. *Bhengi*, thickest of all, and less hollow; for tent and doolie poles, &c. 40 1/—.

In the cavities of the joints of various species of bamboo, as is well known, the curious form of silex called tabasheer (*banslochan*) is found. It is used in medicine by natives, but appears, from its price, to be rarely formed or collected here. 1 seer 4/ to 6/—.

I may mention that the flowering of this species can be by no means uncommon, as each of the three years that I have botanized in or near the Siwaliks I have found a large percentage of the plants in flower.

11. *Bassia latifolia*, Rox: *mahwá, mowá*. This tree, if indigenous at all, is so exceedingly rare on the skirts of the Siwaliks, as to be economically valueless.

12. *Batis spinosa*, Rox: *mandā*. A small tree occurring in some places near the outside of the forest, but, so far as I am aware, no part of it is applied to any special use.

13. *Bauhinia parviflora*, Vahl., &c.

14. *B. purpurea*, L. *gúriál, kachnár*. Both of these small trees are common along the innermost fourth of the forest, and their wood is used for domestic puposes. 12 maunds 1/0—. The bark of the latter is said to be employed in tanning, but the buds (*kalli*) do not appear to be eaten here, as they are in the plains.

15. *B. racemosa*, Vahl. *málú, máljan*. This enormous climber is common only along the inner edge of the forest, close to the hills; within the latter it is abundant, and here, as in other parts of India, from its bark is extracted by beating and steeping a strong fibre from which ropes are made. The seeds (*toúlì*) are eaten by natives, and said to taste like cashew-nuts.

16. *Berchemia laxa*, Walleet? *dakki, kajei*. A small tree, occasional all over, of no special use.

17. *Bergera Kœnigii*, L. *gaudela gúndí*. A shrub, common along the outer and inner edges of the forest. Its aromatic leaves appear to be less frequently used for flavouring curries in this part of India than in the Peninsula.

18. *Bignonia Indica*, L. (*Calosanthes*, Blume) *úlú fareda* (*pharkath*). A small tree, occasional all over, wood soft, spongy, and useless. In the plains the paper-like wings and the seeds are applied to abscesses.

19. *B. suaveolens*, Rox: (*Stereospermum*, D.C.) *padál.* A tall tree with a smoothish grey bark, becoming dark, and flaking off irregularly. Common throughout, and furnishes a useful second-rate timber, for planks, small beams, &c. Cart load —/6 ; 4½ + 1½ yds. 1/8.

Its seeds (*gúthlí*) are by the natives applied behind the ears in certain eye-diseases, in domestic medicine.

20. *Bombax heptaphyllum*, Cav: *semal, sembul.* This tree, whose enormous buttressed trunk, and in spring its showy red flowers, render it a striking object, is or has been common all over the forest.

Its timber is soft, coarse-grained, and not durable, and is mostly used for boxes, planks, hollowed-out tubes, &c. 5 × 1½ yds. 1/2. *Nimchaks* for wells are also made of it, and from its lightness it is employed for hollowed-out canoes, which are in use on the Sardah and Ganges. It is useful also for floating timber rafts and on the Bombay coast for making fishing-boats. Its flower-buds (*simlantá*) are cooked with salt and pepper and eaten by natives ; 1 maund —/4., and an astringent gum (*mochras*) which exudes from the bark is collected and exported, being given in medicine for diarrhœa, &c. 1 maund 3/—.

21. *Bradleia sp.* : ? *daraula, geya.* A small tree occasional in various parts of the forest ; of no special use.

22. *Buchanania latifolia*, Rox: *kath-bhiláwa*, (*mūriā, piyál.*) A small tree with a thick, very dark bark, tesselated by furrows into small quadrangular pieces, common only along the innermost edge of this forest, but abundant in the outer Siwaliks. Its wood is soft and worthless. The large leaves are used as dishes by the natives. The bark is in some parts of India used in tanning ; and the oily kernel of the fruit appears here as elsewhere to be eaten like almonds in confectionery. In the Peninsula, a bland oil is occasionally extracted from the kernel.

23. *Butea frondosa*, Rox: *dhák, dhakká.* Inside the forest this gets to be quite a large tree, which it scarcely ever is outside in the plains, but it does not extend to the innermost part of the belt. 12 maunds 1/—. Except as fuel, and as supplying a light charcoal fit for gunpowder, its wood is worthless here, and it appears to be used for building, &c., in those parts of India only where decent timber is ever scarce.

Dhák Ke-gond is very similar to gum kino, and is used as an astringent in medicine and in dyeing blue. 1 maund —/4 ; 11 seers 1/—. I cannot find that its extraction is in this forest carried on largely, but the tell-tale incisions on the trees in many parts show that it cannot be long since it was so. The flowers (*kisú tisu*) are exported towards Central India to be used (with lime) as a red dye—in the *hote* powder—and as an external application in medicine.

In some parts of India a large amount of strong rope is manufactured from the fibre of the root-bark, which is here also occasionally employed for this purpose.

24. *B. parviflora*, Rox: *mendhārā* (*maulá*). An immense climber, growing only in the innermost part of the belt. In Southern India, its gum is used medicinally.

25. *Cœsalpinia sepinaria*, Rox: *aylan rárí*. A large thorny climber with showy yellow flowers which occurs in the innermost part of the belt. I am not aware that it furnishes any useful product. It is called the "Mysore thorn" having been much used by Hyder Ali for the boundary-hedges of his strongholds.

26. *Callicarpa incana*, Rox: (*duya*). A large shrub, common in various parts of the forest, and, so far as I know, useless.

27. *Cannabis sativa*, L. *bhang*. A common weed in all the forest clearings, but appears to be nowhere cultivated, nor is rope made or *charras* collected from it. Its tops, however, are frequently dried for home-use, as *bhang*, but this is not nearly so much esteemed as that from the hills, which alone is said to be bought and sold under the Government license.

28. *Careya arborea*, Rox: *kúmbh*. This tree is not found external to the skirts of the Siwaliks and its wood is here reckoned almost worthless, except for fuel, as its price indicates, but it is stated to be pretty durable if kept dry (a Bombay authority, however, says "it resists water well"), and being mahogany-coloured and well veined is employed at Monghyr for making ornamental boxes, and in the Peninsula for regimental drums. 12 maunds 1/. In some parts of India, a strong, coarse cordage is made from its bark, which here and elsewhere is used for gun-match (*torá*). 2 yds. 3 pie.

29. *Carissa diffusa*, Rox: *Karounda*. A shrub common in many parts, but not in the thickest of the forest. Its fruit is never aught but small, stony, and sour.

30. *Casearia tomentosa*, Rox: *chila* (*cheela*). A small tree whose wood appears to be very little used except as fuel; abundant all over the forest. Its fruit is put into streams and ponds to kill fish, which are said not to be rendered unwholesome by being thus poisoned.

31. *C. Hamiltonii*, Wall. *náro*. A shrub rarely found in the innermost part of the belt.

32. *Cassia fistula*, L. *amaltás, kitwáli, simhára*. The "Indian laburnum," conspicuous for its smooth very light grey bark, and fine yellow flowers; is common all over the forest, especially towards its inner edge, Its timber is worthless, being very brittle, and particularly subject to the attacks of insects. Its bark is used by dyers, 4 seers 1/—, and from the pulp of its fruit (*talwáli, amaltás*) are prepared confection (*gulkand* and pickle (*achar*); and it is also employed in medicine.

33. *Cedrela toona*, Rox: *tún, toon*. But very few specimens of this tree, even of moderate size, are left in any part of the forest. Old wood 1 maund /4; 2½ yds. + ⅜ yd. + 1 ft. 5/. Its timber is light, fine-grained, mahogany-coloured, and when properly seasoned is well known

as an excellent furniture wood; and on some of the Assam rivers, admirable boats are built from it. Its specific gravity is only 640, and a six feet bar two inches square, was found by Baker to support 800 lbs.

It is an interesting fact that in the small family to which this tree belongs, there are four others which yield valuable timber, and only one of them, mahogany (*Swietenia Mahogani*, L.), is extra-Indian. The others are satin-wood (*Chloroxylon Swietenia*, D.C.) *rohunna* (*Swietenia febrifuga*, Rox :) and Chittagong wood (*Chickrassia tabularis*, A. Juss :) all found in the Peninsula, the last also in Eastern India.

34. *Celastrus paniculata*, Willd : *málkagne*. This climber which occurs in the inner part of the belt, yields seeds from which is extracted an oil, used as a liniment in rheumatism. 1 maund /4 ; 13 seers 1/.

35. *Celtis Caucasica*, Willd. *kharak*. A tree with grey smoothish bark and curious circular wrinkles ; occasional all over the forest, yielding a soft white wood which is but little valued.

46. *Cissampelos Pareira*, L. *nirbasha*. An herbaceous climber, occasional in the forest (and abundant in the open plains) whose leaves are applied to abscesses.

37. *Citrus Medica*, L. *nímbú* (*bijoura*). The wild citron, occurs at one or two places in the forest. Its fruit is used for making pickle (*khatai*).

38. *Cochlospermum gossypium*, D.C. (*katera, gujra* ?]. A small tree with dark grey bark grooved by broad furrows, and with a very large yellow flower which appears before the leaves. This does not extend further outward than the skirts of the Siwaliks.

I cannot find that the gum of this tree (*katira ka gond*) is collected here, and what is sold in the bazaars is said all to be brought from the East. 5 seers 1/—.

39. *Colebrookia oppositifolia*, Smith ; *binda, baüsá*. A shrub which is common in the inner part of the forest and occurs all over. Wood, 12 maunds 1/. Its charcoal is (or was) much used for gunpowder.

40. *Conocarpus latifolia*, Rox: *dháorí* (*báklì*). This tree bears a very strong resemblance in general appearance and leaf to *Lagerstoemia parviflora* so that they are apt to be confused, and in fact frequently are so. This is a handsome, tall tree, with smooth, light grey bark, and is common over all the inner $\frac{2}{3}$ of the belt. Here the timber is in no request and is only used for planks, bedsteads, &c.; but in Central India and the Peninsula generally it is much valued, its chocolate coloured heart-wood in particular being reckoned extremely durable, and in various places it is used for beams and rafters, cart-axles and naves. Cart load—/8 ; 4+1½ yd. 2/—. It is said to be considered by the natives superior to almost any timber except teak for ship building.

The leaves are used by tanners, and from the bark exudes a gum which is collected here, as elsewhere in India. Here it (*dháorí ka gond*) is chiefly mixed with and sold as the inferior sort of gum of the *Odina Wodier*. 1 maund —/3; 10 seers. 1/—.

41. *Cordia incana*, Royle (*Gynaion vestilum*, D.C) *kúm* (*peen*?) This is no where within my knowledge, a common tree, but occurs occasionally throughout the inner part of the forest, but its timber is hard and lasting, and is used for mill work, naves of wheels, &c.

42. *C. latifolia*, Rox : *lisára*, *gája*. A well known, moderate sized tree having smoothish light grey bark with shallow spiral furrows, which is not uncommon (planted) in the plains, as well as throughout the forest.

Its timber is hard and heavy like that of the last, and is used for oil-mills, and for making the drag by means of which the clods in fields are broken up. $3+1\frac{1}{2}$ yd. 2/— ; 5 seers. 1/—. Its fruit is used in medicine.

43. *Crœtavà Roxburghii*, R. Br : *barná*. A small tree common in the inner half of the belt (and occasional, planted in the open plain). It yields no useful product here, so far as I know, although the root, juice, bark, leaves, and seeds of this, or a closely allied species, are all employed medicinally in the Peninsula.

44. *Cucumis pseudo-colocynthis*, Royle. *bislúmba*. The fruit of this is collected largely in and near the forest, for use in medicine. It yields a purgation nearly equivalent to our colocynth.

45. *Dalbergia lanceolasia*, L. *bilhúa* (*takolà*). A fine handsome tree, with a smooth, ash-coloured bark, which flakes off, common in several parts of the forest. Its timber here is said to be almost worthless, but it is reckoned valuable for many purposes in various parts of the Peninsula, where its seeds, leaves, &c., are used medicinally

46. *D. ougeinensis*, Rox. (*Ougeini dalbergioidis*) *sándam sanan*. This tree which is common in the outer hills, hardly extends beyond them, except in a very stunted and craggy form. Its timber is hard and strong, and very similar to that of its congener *Sissu*, and is much valued for wheels, ploughs, furniture, &c. 1 maund —/4 ; $1 \times 1\frac{1}{2}$ yd. 2/. In the Western Presidency a kind of gum kino is collected from it, but I cannot hear of any such product deing known here.

47. *D. Sissoo*, Rox : *sussú*, *sissoo*, *shisham*. Young trees are abundant in the forest, on islands and the banks of streams only. Its well known and excellent timber is seldom long and straight, but is in great request for furniture, building, and gun-carriages, and on the coast for use in the dock-yards. 1 maund —/4; $4\frac{1}{2} \times 1\frac{1}{2}$ yds., 5/—. It has a specific gravity of 724, and is very strong, a six feet bar, two inches square, having in Baker's experiments only broken with 1,104 lbs. It is said to be obnoxious to the attacks of white ants.

48. *Dioscorea versicolor*, Wall : (*Helmia bulbifera*, Kunth), *gíthí*. This climber is of considerable interest, as its large tubers furnish the yam which supplies great part of the food of the Boksas when grain is scarce. The plant is common throughout the forest, and its tubers, which grow

to several pounds' weight, are got at by digging from two to six feet. To remove their original acridity, they are always steeped for a night in ashes and water ere being cooked.

As a curious instance of the power of vegetation, I may mention the following. A piece of tuber about half a pound in weight having been put aside among some specimens, soon after the rains commenced I found that it had shot out a young stem a foot long through the folds of the paper in which it was wrapped. It was then tied up in a woollen stocking, without a particle of soil, hung up in a verandah, and liberally watered. In six weeks, until it was unfortunately broken off, it sent out, to a length of nearly twenty feet, its climbing stem with abundance of leaves, but without manifesting any disposition to flower.

This species of yam (allied to the common cultivated *rátalú* of these parts, and to the West Indian yam) is found in many countries within and near the tropics, and it, as well as several of its wild congeners, is used as food in various other parts of India. Its roots were largely eaten by the multitudes of starving poor who were employed on the Mohna pass road in 1861.

49. *Diospyros* ——, *tendú*, *abnus*. This tree, which grows to no great height, and has a dark-coloured bark cut into quadrangular tesselations, by longitudinal furrows and shallow transverse cracks, is not *now* to be found in large quantity in any part of the forest, and towards the western end appears to be quite extinct.

The *Diospyri* furnish most of the ebonies of commerce, some of which are in Europe largely used in cabinet work, but mainly only in veneering from their being liable to warp and crack. 1 maund —/3 ; 10 seers 1/—. The heart wood of this species, which is of a fine black colour, and not liable to the attacks of insects, supplies the local manufacture of ebony work-boxes, &c., at Nugeena; of which the carving, though rather plain, and perhaps somewhat unvaried, is very neatly executed. Ere a tree is cut down an incision is made into it, to find out if there be much *mal*, or heart wood, as the outer wood is entirely useless, and this practice, though necessary, doubtless injures many trees.

The fruit, which is globular and about the size of a pigeon's egg, has a sweetish, astringent, and not unpleasant taste, and is eaten by the natives.

50. *D. montana*, Rox : (*urdinia?*) This small tree, which is still more rare than the last, does not appear to afford any ebony, nor does it at all resemble the former in appearance, but it is not unlike the *Diospyros* (*D. Lotus?*) which produces the *amlok* fruit of Affghanistan.

51. *Ehretia aspera*, Rox : *chamror kodah*. A tree with whitish, very smooth bark, not uncommon throughout the forest. It grows to no great size, nor is its timber much valued. Cart load /6 ; 10 maunds 1/—.

Goats are fond of its leaves, and the herdsmen (*goriyas*) chew its bark with catechu as a cheap substitute for the regular *pán.*

I have included under this name more than one of the species of Royle and others, which, as existing here and to the north-west, seem to me, after collecting them in many places hundreds of miles apart, to be only variations of one species.

52. *E. serrata,* Rox : *panden pūná.* Uncommon outside the hills, but occasionally planted at villages, I presume on account of its fine honey-scented flowers.

Its wood is not valued here, but in some parts of the Peninsula is found to be tough, light, easily worked, and durable, and is much used for sword-belts and gun-stocks.

53. *Emblica officinalis,* Gœrt : *areolá, amla.* A well-known small but handsome tree with very smooth ash-coloured bark, common, planted at villages, &c., in the plains, and found all over the forest. Its hard, strong, straight-grained wood is valued for gun-stocks, &c., and is said to be particularly durable under water. $4\frac{1}{2} \times 1\frac{1}{2}$ yds. 1/2.

The leaves, bark, &c., are used medicinally in various parts of India, but the fruit is universally the chief product. It is not edible as plucked, being intensely sour (whence the native name), but is collected all over India for dietetic and medicinal purposes. It is made into pickle (*áchár*) and the soft part dried (*dál-áonlá*) is eaten as a relish. In medicine it is esteemed as a tonic and purgative, being generally administered in the form of "black salt," in which it is combined with common and other salts. It is also used for washing the hair, in making ink, and along with some of the other myrobalans and iron filings in dyeing black. 1 maund —/3.

In these forests it is gathered about January, and one person will earn about one anna a day selling what he collects to *pansarís* at one maund for a rupee.

54. *Eriophorum comosum,* Wall: *bhabar.* Commonly supposed to yield all the grass for rope so called, and probably does yield part of it, (see *Andropogon,* No. 8). It grows abundantly on the cliffs of the Siwaliks, as well as outside the forest, on the walls of the Fort at Nujeebabad, &c.

55. *Erythrina suberosa,* Rox : *doldhák, rimgarī.* The "coral tree," easily distinguished by its corky bark with distant wide longitudinal wrinkles, and long prickles on the younger branches, and its fine red flowers which appear before the leaves. Its wood is soft, white, and tough, and is largely used for making the hoops of sieves (*chalni ke ghera*) for which purpose a log is first cleverly split into radiating segments and then each of these into long strips concentrically. Cart load —/10 ; for 20 sieves —/1.

56. *Falconeria insignis,* Royle, *Khinna.* The timber of this small

tree is occasionally used for domestic purposes, but I hardly think it grows outside the Siwaliks.

57. *Feronia elephantum*, Corr : *kait.* Small specimens of this tree, which has a dark bark, very much wrinkled and furrowed, grow in various parts of the forest, and it is not uncommon, planted in the plains, but its timber does not appear to be valued here. It is white, with a tolerably close, even fibre, and in some parts of India is used for doors, rafters, &c. In Bengal a gum is collected from this tree.

58. *Ficus caricoides*, Rox : *anjīrī.* A small tree resembling the cultivated fig-tree, common in the open plain, rare in the forest.

59. *F. cordifolia*, Rox ; *kăbra, khabar (gujeeon).* Bears a strong resemblance to both the *pipal* (No. 64) and the *pilkhan* (66). Its timber, like that of all the family, is worthless, its leaves are given to elephants.

60. *F. Cunea*, Hamit : *khenna.* Common in the lower and outer hills, and occasional at damp places in the forest. Its very scabrous leaves are in the Peninsula used in polishing cabinet-work, and in some parts of India its fruit is employed medicinally.

61. *F. glomerata*, Roxb : *gálar.* This tree, which is common in the open plain, is rare—if wild at all—in the forest. Its fruit is greedily eaten by monkies, and is used in curries, &c., by the natives. Its timber is coarse-grained and brittle, like that of the other figs, but as it does not readily decay under water, it is here (and in Central India) used for well frames.

62. *F. Indica*, Lin: *bargad.* The "banyán tree," revered by Hindoos as the female of the *pipal*, is abundant all over the forest. Its leaves are eaten by elephants, and although the timber of the trunk has the faults of that of the family, the root stems are strong and elastic and used as dandy poles. Each —2*l*.

I have been informed that the red powder on the fruit is used for adulterating the *kamela* powder (No. 112), but I very much doubt the correctness of the statement.

63. *F. oppositifolia*, Roxb : *gobla.* A shrub which is occasional in the forest, and, as far as I know, quite useless.

64. *F. religiosa*, Lin. *pipal, peepul.* Not uncommon throughout the forest, and there very often quasi-parasitical on other trees. Timber worthless.

65. *F. Roxburghii*, Wal ; *timla.* I do not think this tree extends outside the Siwaliks. Its timber is always small but is occasionally used for domestic purposes.

66. *F. venosa*, Ait, *pilkhan, (pākar).* This handsome tree, which is common, planted in the open plain, occurs wild in the forest. Its leaves furnish elephant fodder, and on the Peninsula, a red dye is made from the root, and bowstrings from the root bark.

67. *Flacourtia sapida*, Rox *bhanber, bilāngra, kandā.* This small

tree, which has a light-ash-coloured, roughish bark, is, perhaps, less common than in the open plain. In the former I have observed it growing *on* the *pipal*, where its seed had been dropped by birds. Its timber is useless, the ripe fruit is edible.

68. *Garuga pinnata*, Rox : *kharpat.* A rather handsome, tall tree, whose old and blackened bark comes away in flakes leaving the fresh ash-coloured below. It is common throughout the inner part of the forest. The timber is little valued, but is used for planks, &c. The bark is collected by tanners, and the leaves, which are exceedingly subject to galls, are used as fodder, whence the name *khar-pat*—grass-leaf. Cart load /5 ; $4\frac{1}{2} \times /\frac{1}{2}$ yd. 1/2.

69. *Glycosmis pentaphylla*, Corr., *pīlīlū pīlrū.* A small shrub abundant in some places in and outside the forest, and only noted for its sweetly fragrant flowers.

70. *Gmelina arborea*, Rox : *kūmhār.* A fine tree, occasionally seen planted in the open plain, and common in the inner part of the forest. Its old, dark, outer bark peels off in broad irregular scurfy flakes, leaving exposed the new of a very light ash-colour.

The timber is very little valued here, except for making large bowls, the yokes of ploughs, &c., but it is tolerably close-grained and elastic, and it is said that very few timbers possess *so* much strength with so much lightness. 8 maund 1/—. Baker found a six feet bar, two inches square, break with 580 lbs. It is durable, does not warp and is not obnoxious to the attacks of insects. In the Peninsula it is employed in turnery, and for making carriage panels, drums, chairs, &c.

71. *Grewia elastica*, Royle, *phālsā, pharsiā* (*dhāman*). Common all over the forest, but never attains any great size. Its timber is like that of some others of its class, tolerably close-grained and elastic, and is in some places employed for making carriage-shafts, &c. Its fruit is eaten by natives and reckoned " cooling."

72. *G. oppositifolia*, Buch : *bhenwal, bhimūl.* Rarely extends outside the Siwaliks. In the hills its bark fibre is much used for making an inferior kind of rope.

73. *G. sapida*, Rox : *pharsia.* A small bush species only two or two and a half feet high, with edible fruit; abundant in most open places throughout the inner part of the forest.

74. *G. sclerophylla*, Rox : *banphālsā.* Rather taller than the last, and with the largest fruit of any of these Grewias. It is edible and said to be sent from the outer Himalaya to the plains under the name of *goorbhelee.* I do not think, however, that it extends outside the Doons, though it is common in them.

75. *Grislea tomentosa*, Rox : *dhārla.* Extends only to the outer edge of the Siwaliks. It has a very handsome appearance when in blossom, and its red flowers (*dhā*) are exported as a dye and medicine. 20 seers 1/—.

76. *Guatteria velutina*, Dec. fil: (*Unona*, Dun:) *gīdar rukh, gūiyasāl.* Frequent, but nowhere common throughout the inner and middle part of the forest. Its wood is not valued, though some of its congeners furnish very useful timber in other parts of India.

77. *Hastingia coccinea*, Smith: *kabbani, geya.* A fine red-flowered shrub, which hardly extends outside the Siwaliks.

78. *Helicteres Isora*, L., *maeorphali.* A large shrub abundant throughout the middle and inner parts of the forest. Its corkscrew-like fruit is used largely by the natives in colic, dysentery, &c., probably on the doctrine of signatures which natives believe in as thoroughly as did our ancestors 300 years ago. 20 seers 1/—.

79. *Hiptage Madablota*, Gœrt: (*madmālt*). A remarkably handsome climber, which is very rare outside the Siwaliks.

80. *Holarrhena antidysenterica*, Wall: *kūar, moriā.* A tall shrub, abundant all over, especially in the inner part of the belt. Its wood is white, soft, and fine-grained, and though rather more knotty than the *dūddhī* (No. 137) it is largely used for carving tobacco-boxes, and spoons and forks for Mussulmans. Cart load —/10; 10 maunds 1/—.

There is inextricable confusion in the books between this plant and *Wrightia antidysenterica*, as to which of them yields the febrifuge bark called *conessī* in Southern, and *indarjan* in Northern India. The bark of this plant is undoubtedly used by the herdsmen with that of *Rottlera* for fever, but I cannot find that it is collected for export, or is known by the name *indarjan.*

81. *Hymenodyction excelsum*, Wall: ? *beram, genta* (*bhoulun*). A large tree with a dark bark, very corky, and much gnarled, not uncommon all over. The timber is white, soft, and little valued, but near the Sutlej appears to be made into sword-scabbards. In the Peninsula the bark is employed in tanning.

82. *Kydia calycina*, Rox: *pattrā, paláo.* A moderate-sized bushy tree, with smoothish, ash-coloured bark, occasionally seen planted in the open plain, common over the inner half, and abundant in the innermost part of the forest. Its wood is little valued, but is occasionally employed for making ploughs and spoons.

The bark (*chūklá*) has much viscous juice and is taken to the plains in large quantities to be used in clarifying sugar.

83. *Lägerstroemia parviflora*, Rox: *báktī* (*dhánrī*). A fine tree with a columnar trunk, the dark old bark of which peels off in thinnish scales from the light grey beneath. Is common over all the inner portion of the forest, and apt to be confused with *Conocarpus* (No. 40). Its timber is white, close-grained, straight-fibred, and elastic, and is employed for building, and for ploughs, hatchet-handles, &c. Cart load —/8; $4\frac{1}{2} \times 1\frac{1}{2}$ yds. 1/8. In Bombay it is extensively used in the dock-yards, and I am told that by the Meerut coach-builders for buggy shafts it is reckoned second only to *sūndrī* (*Heritiera minor*, Lam.). I may note

that the latter, which is said to give name to the Soonderbunds, and of which large part of the supply for coach-builders in the N. W. provinces comes up as masts in Calcutta-built boats, was the toughest wood experimented on by Baker, a six feet bar, two inches square, only breaking with 1,030 lbs.

84. *Leea aspera*, Wall. *kumâlá.* An herbaceous plant with an edible fruit, not common outside the Siwaliks.

85. *Luffa amara*, Rox : *bindál.* The fruit of this bitter wild gourd is collected for use in veterinary medicine. 5 seers 1/—.

86. *Melia Azadirachta*, L. (*Azadirachta Indica*, A. de. Jus :) *nīm, neem.* This well-known small tree which is common, planted in the open plain, is doubtfully wild at one or two places in the forest, but not in sufficient quantity to be economically of value. In Bengal, its timber is said to be especially used in the manufacture of idols as it is so bitter that no insect will attack it.

87. *Mimosa rubicaulis*, Lam : *kīnglī, kīngreī.* A straggling, very prickly shrub, not uncommon in the inner part of the forest.

88. *Moringa pterosperma*, Gœrt : *senjna, soojna.* The "horse-radish tree" is common, planted in the open plain, and abundant wild all over the forest. The natives say its wood "is not fit even for burning," but its fruit is eaten, cooked as a vegetable or in curries. From incisions in its bark a gum exudes plentifully within a day or two ; this is collected for export to be used in medicine. Here one man can gather five seers a day, for which the dealers' agents give him —/1. 1 maund —/4 ; 16 seers 1/—.

89. *Morus parvifolia*, Royle, (*tootree*). The small wild mulberry tree of the open plain, is very rare or absent in the forest.

90. *Nauclea cordifolia*, Rox : *haldū, huldoo.* This magnificent tree, the trunk of which is frequently buttressed like that of the *semul* (No. 20), though not so abundant here as to the east of the Ramgunga, is or has been common over all the inner portion of the forest. Its smooth-fibred yellow timber is not much valued, but is used for planks, boxes, keels of boats, combs, writing-tablets, &c. Cart load —/8 to 3/—.

91. *N. parvifolia*, Rox : *keim, kangei.* This tree, which is occasionally seen out in the open plain, and whose dark smoothish bark peels off in irregular patches having the fresh light grey exposed, is not uncommon throughout the forest. Here the timber is used for similar purposes to that of the last, and is not much valued. Cart load —/6 ; 10 maunds 1/—.

92. *Nerium odorum*, Aitk : *kaner.* The oleander, well known in cultivation seems here to find its eastern limit for growing wild near the plains level. It just touches the skirt of this district at the mouth of the Kothri Doon in which it is abundant. Further east, it is only found at some distance within the hills in Kumaon and Nepal. Far to the

north-west again in the Upper Punjab, it is not uncommon by streams in the plains. Its bark, &c., is used medicinally.

93. *Bœhmeria salicifolia*, Royle, *tūsárá*. This shrub, the fibre of which is used for making ropes, hardly extends outside the Siwaliks.

94. *Nyctanthes arbortristis*, L., *kīera* (*harsinghár* of native gardens) common on the Siwaliks but hardly extends beyond their skirts. In Bengal the rough leaves are used for polishing wood ; and in most parts of India the flowers furnish a perishable yellow dye but they do not appear to be collected in the forest.

95. *Odina Wodier*, Rox : *jingan*. This quick-growing tree, which attains a large size, and whose dark bark splits off in thin scales is common all over the forest, especially in the inner part. The reddish heart-wood is said to be tolerably durablĕ, but the timber generally is little esteemed, and is chiefly used for planks, sides of cots, drums, and in other parts of India for sword-scabbards.

Large quantities of gum (*jingan* or *kanni ka gond*) exude spontaneously from the bark of this tree, and much is collected for export. It is used by dyers, cloth-printers, for making ink, and in medicine, and is practically divided into two kinds. These are 1st, the white, generally called *kanne*, of which a man can gather 1 seer a day, to be sold for about half an anna (?) to the dealers ; 1 maund —/4 ; 10 seers 1/— ; and 2nd, the black, *jingan kagond* which consists nominally of what has fallen to the ground, but is almost invariably mixed and sold with that of *Conocarpus* (No. 40). Of the black gum, one man can collect 5 seers in a day, which brings him in —/1. 1 maund —/3 ; 15-32 seers 1/—. Both are gathered about April.

96. *Orthanthera viminea*, Wight, (*chupkeea*). A bush common in stream-beds in the forest, the fibre of which has been recommended for cordage.

97. *Aralia digitata*, Rox : (*Paratropia venulosa*, W. and A.) A handsome climber which occasionally occurs.

98. *Pentaptera tomentosa*, Rox : *sein*, *asiu* (*saj*). This fine tree, which has a dark bark, rough and longitudinally furrowed, not unlike that of *sal*, is or has been common all over the inner part of the forest. The timber is reddish, tough, strong, and durable ; sp. gr. 986 ; a six feet bar, two inches square, was found by Baker to break with 903 lbs., and it was the most elastic of all the woods experimented on by him. It is employed for general purposes here, and in the Peninsula carriage-shafts are made of it. In some parts of India, but not here, the bark is used by dyers.

99. *Phœnix acaulis*, Ham ; *kajŭrī*. The stemless palm is abundant in the open parts of the inner half of the forest. The stalks of the fruit-branches are so short that the small dates are half buried in the earth. The ripe fruit is red, sweet, and edible. In Behar an inferior

rope is made from the bruised leaves. Royle was, I venture to think, mistaken in considering this to be merely a variety of the next species.

100. *P. humilis*, Royle, *chhota khajúr, khajúrī.* This, whose stem grows to five or six feet, is common in the Siwaliks. The ripe fruit and the flower, neither of which have I ever got, would go some way to settle if it is the same as the *P. farinifera* of the Peninsula, or merely, as I suppose, the wild form of the following:—

101. *P. sylvestris*, Rox: *khajúr.* This tree, though common about some villages and in certain soils in the open plain, appears to be nowhere truly wild near this district, and it hardly, if at all, enters the forest.

The trunk decays rapidly when exposed, but is used for indoor beams and supports, and in many parts of India for water channels. A beam – /2.

The leaves are made into mats (*chatai*). The juice (*tari*) is in spring tapped by means of an incision below the tuft of leaves, and is used as a beverage, but no sugar is here, as in Bengal, made from it. The fruit is edible though it cannot be compared with the dates brought from Affghanistan.

102. *Pinus longifolia*, Rox: *chīr, cheer.* Does not descend below the upper part of the Siwaliks, so its qualities need not be entered upon here.

103. *Potamogeton crispus*, L., *karelī senval*, and *P. gramineus*, L. ? *baliya senval*, are both collected largely in canals, &c., in the open plain, and in the Taraí, to be used in the clarification of sugar.

104. *Premna mucronata*, Rox: *bakr, bakar, malha.* This tree is occasionally seen at villages in the open plain (and there sometimes called *basota* from its strong smell), and is not uncommon all over the forest. It never grows to a large size, but its timber appears to be hard and strong, and is sometimes used for making cart wheels. The milk of the bark is applied to boils, in domestic medicine, and its juice is given to cattle for colic (*makra*).

105. *Pueraria tuberosa*, D.C., *sarar, sarwala.* A climber which is not uncommon beyond the skirts of the Siwaliks. I cannot find that its immense tubers are collected here, but from various parts of the hills they are said to be exported as *bilaī kand* to be used in cataplasms, &c.

106. *Putranjiva Roxburghii*, Wall: (*jīyapota, putra vīaj.*) This, which in other more southern parts of India, grows to be a large timber-tree, the close-grained wood of which is employed by turners, is found wild in one or two places in the forest, and I have seen it, planted, in the open plain. The Fakir's beads made of its hard seeds, however, appear all to be imported from below.

Randia. The native names of the species of this genus are very much confused, consequently the uses of their fruits are noted doubtfully:—

107. *Randia dumetorum*, Lam: *mendphal.* Common all over the inner part of the belt. It never grows large, and its wood is only used for fuel. The fruit when young and fresh, is employed for poisoning fish, and when ripe is collected for export. 1 maund 1/4. It is used in veterinary medicine, and given as an emetic to men, and applied to boils.

108. *R. longispina.* D.C. *pindálu* (*thanella*). This appears to be less common than the last. It grows to a larger size, and its wood is made into yokes, &c. The fruit appears to be collected as an edible, and to be applied to boils. 2 maunds 1/—?

109. *R. ulignosa.* D.C. *thanella* (*mendphal.*) Common throughout the forest. The wood is close-grained and hard, but has no special use. The fruit is employed to kill fish, and in medicine, and is also eaten.

110. *Rhus acuminata* D.C. (*Pistacia integerrima*, H.f. and T.) *kakkar.* Young specimens of this tree, which produces "zebra-wood," the handsomest of the furniture-woods of the N. W. Himalaya, occasionally extend just to the skirts of the Siwâliks. Nowhere within my knowledge is it an *abundant* tree, and the demand for its timber has rendered it exceedingly scarce over this part of the outer Himalaya.

Large horn-like excrescences (*kákrasinghī*) which are found on its leaves, are used in medicine.

111. *Robinia macrophylla.* Rox: *gaujá.* A fine luxuriant climber, which is abundant along the innermost part of the forest, and which I have occasionally found in jungles in the open plain.

112. *Rottlera tinctoria.* Rox: *rúinya kamela.* This large shrub is abundant throughout the inner half of the belt. Its wood is said to be obnoxious to the attacks of worms, but is always small and is not valued.

The bark is employed by tanners. 3 maunds 1/—. The red powder found on the capsules, is collected in large quantities, to be used as a vermifuge, and as a valuable dye for silk. 1 maund 1/—; 2½-5 seers 1/—. The ripe capsules are gathered off the bushes about March, and after being allowed to lie in heaps for a few hours, are rubbed and kneaded with the feet on the ground, to remove the powder,—the broken capsules being then separated by winnowing, sifting, and picking. One man will collect about a seer of the powder a day, which is bought by the dealers at 1/— for 5 seers. The above process would quite account for the commercial *kamela* not being very clean, but besides this, although the Boksas who gather it, deny any adulteration whatever on their part, it is said never to reach even the Nujeebadad market in its comparatively pure state. The substances added are stated to be the powdered bark of *Casearia* (No. 30) and the powder of *Ficus Indica* (No. 62.) On the other hand, *kamela* itself is said to be used to sophisticate arnotto.

113. *Saccharum.* Among the gigantic grasses of the forest and arāi, there are many species of Saccharum known under the somewhat

fluctuating names of *kans, sarar munj, kilik*, &c., &c. I shall not attempt here to disentangle these, but be content with mentioning that the principal useful species appear to be *S. spontaneum*, L., *S. Sara.* Rox: *S. Munja.* Rox: and *S. semidecumbens.* Rox: these, and perhaps some others, supply from their culms materials for screens, chairs, pens, brooms, and *sīrkī*, and parts of their leaves are used for making rope, thatch, &c. Various products from —/8 a cart load, *sar* for thatch to —/2 a maund for *sūik.*

114. *Salix tetrasperma.* Rox: *bed* (*bhynsh*). This, the common Indian willow, occurs occasionally by stream-beds, but is nowhere found in great abundance. I know of no special use to which its timber is put.

115. *Schleichera trijuga.* Willd: *gosam, gausam.* This tree, which is at times seen planted in the open plain, is not uncommon in the inner part of the forest, where however, much of it has been cut. Its wood is red, very hard and heavy, and its special use is for making the crushers of sugar, and oil-mills, and in some parts of India screws are made of it. 3 × ¾ yd. 1/—. The fruit is edible, and in the Deccan is made into pickle.

116. *Scilla Indica,* Rox: *kīmdrī, kūnda* (*iskil*). A slender Liliaceous plant with a large bulbous root. The latter is collected in the forest in large quantities, to be used by weavers for giving body to their thread. It is also employed medicinally, and being closely allied to, is almost a perfect substitute for the squill of European pharmacopœias.

117. *Semecarpus Anacardium,* L. *bhiláwa.* The "marking-nut tree" hardly extends outside the skirts of the Siwāliks. It has a peculiar, smooth, dark bark, furrowed with shallow wrinkles, and its wood is soft, white, and valueless.

The fleshy red calyx of the fruit is eaten, but in some people is said to produce swelling of the body. This effect is also sometimes attributed to mere contact with this as with some other members of the same family. The nuts themselves are collected for export, being used as an ingredient of ink, and given as a medicine to elephants. 16 seers 1/—.

(To be Continued.)

ON THE GROWTH AND PREPARATION OF RHUBARB IN CHINA.

BY FRED. J. FARRE, M.D. CANTAB.

It has often occurred to me that, while frequent attempts have been made, by personal inquiry and research, to discover the source and exact localities of the Chinese rhubarb plant, which have only resulted in deception and disappointment, we have in great measure neglected to avail ourselves of the more reliable information contained in Chinese books and manuscripts intended for the use and instruction of the Chinese themselves. An opportunity of obtaining such information was recently afforded me by Mr. Lockhart, who kindly supplied me with some valuable Chinese books, from which I extracted the facts which I have recorded at page 269 of Pereira's 'Manual of Materia Medica.' This information respecting the various localities of the rhubarb plant was sufficiently interesting to induce me to make further inquiries through the same chanuel. Mr. Lockhart undertook to convey my wishes to China, and if possible to obtain either the leaf, flower, or the fruit of the plant itself. He failed to obtain these, like others, he had often tried and failed before; but he procured from the Rev. Griffith John, a missionary residing at Hankow, the following extracts from the 'Pun-tsau,' or Chinese Herbal, which, as well as the 'Pieh-luh,' which it quotes, is a work of good authority. Wu-pu, Tau-hung-king, Kung, Su-sung, and Sung-ki are Chinese writers. I am indebted to Mr. John for the translation. The notes are added by Mr. Lockhart.

I give the extracts from the 'Pun-tsau' exactly as I received them, that they may be available to others as well as myself; but to make them more intelligible I have subsequently rearranged and condensed them, and have finally drawn from them a few conclusions.

Extract from the 'Pun-tsau.'

1. In the '*Pieh-luh*' it is stated that rhubarb grows in valleys west of the Yellow River, and in the district of Lung-si in the province of Shen-si. The root is extracted in the second and the eighth months, and dried by means of artificial heat.

2. *Wu-pu* says: As to the rhubarb which grows in Si-chwan (Sz-chuen), and probably Lung-si, in the second month* its closed leaves are of a deep yellowish colour, and its stalk is more than 3 feet (Chinese†) high. In the third month the flower is yellow; in the fifth month the seed is black; and in the eighth month the root is extracted. The root, which contains a yellowish sap, is cut up in slices and dried in the shade (*i. e.* without either sun or artificial heat).

3. *Tau-hung-king* says that the Si-chwan rhubarb is not equal in quality to that of Lung-si in Shen-si; that it is very bitter in taste, and extremely black in colour; that that which is dried in the shade in the west of Si-chwan is superior to that which is dried in the sun in the north of the same province; and that that which is dried by means of artificial heat is slightly charred, and not equal to the rhubarb in the west of the province in resisting the woodworm.

4. *Kung* says that the leaf and stalk of the rhubarb resemble those of the Yang-ti plant. Its stalk, which grows to the height of six or

* The Chinese months are lunar, the first beginning in February or March.—L.

† The Chinese foot is about 13 inches. It varies from 12½ to 14.—L.

seven feet, is crisp and sour, and may be chewed raw. The leaf is coarse, long, and thick; the root is red, and resembles that of the Yang-ti plant; its shape is like a basin, and is about two feet long; its nature is soft and moist, and it is easily destroyed by the woodworm. That which is dried by means of artificial heat is best. It is dried thus:—A stone is heated, and on it are placed the roots cut in horizontal slices about an inch thick. Being thus heated for a day, they become a little dry. A hole is then made in each piece, through which they are strung together like *cash*.* The root thus cut and partially dried is then hung up in the shade till it becomes perfectly dry and fit for the market. The rhubarb which grows in Shen-si, Kan-sub, and in the west of Si-chwan, is all of good quality. That which grows in Shen-si, Chil-li, and other places to the north of these, is smaller in size, and not equal to that of Si-chwan in point of strength. What *Tau-hung-king* says about the Si-chwan rhubarb being inferior to that of Lung-si is a mistake.

5. *Su-sung* says, that rhubarb grows everywhere in Si-chwan, east of the Yellow river, and in Shen-si. The Si-chwan rhubarb is fine-grained. Next comes that of Shen-si. The plant of the latter produces green leaves in the first month, which resemble those of the Pima (*Ricinus communis*, Linn.), and are as large as a fan. The root resembles a Chinese potatoe,† the largest being the size of a basin, and from one to two feet long. In the fourth month a yellow flower opens; in the second and eighth months the root is extracted, and the black skin which covers it being taken off, it is cut in horizontal slices, and dried by means of artificial heat. The Si-chwan rhubarb is cut perpendicularly, which makes the slices resemble the tongue of an ox, and, hence it is called the ox-tongue rhubarb ‡ The use and value of these two kinds of rhubarb is the same. Hwai-ngan-fu, in the province of Kiang-su, produces what is called Tu-ta-kwang, local rhubarb.§ The flower opens in the second month.

Sung-ki, who prepared some diagrams illustrative of the productions of Yih-chau, in Si-chwan, says that the rhubarb plant grows everywhere among the high mountains of Si-chwan. Its stalk is red; the leaf is large, and the root so large that it is used for a pillow in the medicine markets. He also states that the Lung-si rhubarb, in Shen-si, was considered best in his time. He lived in the Sung dynasty, between 1000 A.D. and 1270 A.D.

* *Cash* is a Chinese name for Chinese copper coins, called *tung-tseen*, with a square hole in the centre.—L.

† The Chinese potato is the *Dioscorea Batatas*, or White Yam, a long cylindrical root which has been recently introduced into England.—L.

‡ I believe what is intended is a thin diagonal slice, common in the shops, and which I used to buy. It might, by a lively imagination, be likened to an ox tongue. The others are transverse slices.—L.

§ The best rhubarb is Sz-chuen. The others, and especially that of Kiang-su, are called *local*, which implies inferiority.—L.

It seems that the Yang-ti plant has been mistaken by some for the rhubarb on account of its resemblance to it. Li-shi-chen affirms that it is quite a distinct species.

The foregoing account, as Mr. John observes in a letter to Mr. Lockhart, is far from satisfactory. The information is meagre and somewhat contradictory ; nevertheless, it appears to me to add something to our former knowledge, and to throw a little light on the species, as it certainly does on the localities of the rhubarb plant. It is probably by collecting and comparing such information that we shall ultimately get at the truth. Avoiding repetitions, the above mentioned statements may be arranged as follows :—

Localities.—The rhubarb plant grows in the provinces of Shan-si and Shen-si, which are situated respectfully east and west of the Yellow river, in the upper part of its course, before it turns eastwards towards the Yellow sea. Lung-si, in the province of Shen-si, is one of the best localities. It also grows in Chil-li and other places further north, in Kan-suh, which borders on Mongolia, north of Koko-nor, and the Nau-chan mountains, and everywhere among the high mountains of the province of Sz-chuen (or Si-chwan), which lies to the east of Thibet, and 3-400 miles north-east of the northern extremity of Birmah.

Description of the Plant.—The *root* resembles that of the Chinese potato, or white yam (*Dioscorea Batatas*). It is from one to two feet long, and thick enough to be used as a pillow. It is covered with a black skin, is soft and moist, and contains a yellowish sap. The plant puts forth its leaves in the first or second month. The unexpanded *leaves* of the Sz-chuen plant in the second month, are of a deep yellowish colour ; those of the Shen-si plant, in the first month, are green, as large as a fan, and resemble those of the Pima (*Ricinus communis*, Linn.) Kung describes the rhubarb leaf as coarse, long, and thick. In Sz-chuen, the *stem* is more than three feet high in the second month. According to Kung, who does not mention the locality, the stem attains the height of six or seven feet, and is red, crisp, sour, and eatable in its raw state. In the third or fourth month it opens its yellow flowers, which are succeeded in the fifth month by a black seed (nut). The root, leaf, and stalk of rhubarb, according to Kung, resemble those of the Yang-ti plant. This writer says that the root is red, but, in other respects, his description of it accords with that of the other writers.

Preparation and Drying of the Root.—The root is taken up in the seventh or eighth month, and the black skin which covers it is removed. It is then cut in slices, either longitudinally, as in Sz-chuen, or transversely, as in Shen-si and elsewhere, and dried in the shade with or without artificial heat. The following mode of drying is said to be the best :—a stone is heated, and the roots, cut in transverse slices about an inch thick, are placed upon it. By this means the pieces are partly dried. A hole is then made in each, and the pieces are strung on a cord, and suspended in the shade until they are perfectly dry and fit for the market.

Quality.—The rhubarb (*hwang*) which grows in Shen-si, Kansuh, and in the west of Sz-chuen, is all of good quality. That which grows in Shan-si, Chil-li, and other places to the north of these, is smaller, and not equal in strength to that of Sz-chuen. In Sz-chuen, however, the quality appears to vary, that which grows in the west and is dried in the shade being better than that which is dried in the sun in the north of the same province; while that which is dried by artificial heat is said to be slightly charred. Tau-hung-king, who makes the foregoing remark, adds that Sz-chuen rhubarb is not equal in quality to that of Lung-si in Shen-si; that it is black in colour, and very bitter. This, however, is altogether denied by Kung. Su-sung also says that Sz-chuen rhubarb is fine-grained, and next comes that of Shen-si. He adds, however, that the value of these two is the same. Sung-ki, who lived between A.D. 1000 and 1270, says that in his time Lung-si (Shen-si) rhubarb was considered the best.

Notwithstanding the want of precision and agreement in the above statements, I think that, taken in connection with extracts from 'The Rules of the Drug Trade in China' and from 'The Chinese Commercial Guide' they will warrant the following conclusions:—

1. Rhubarb grows in many parts of the Chinese Empire, but chiefly in Kan-suh south of Mongolia, about Ke-ko-nor, and on the Kwan-lun mountains, which form the northern boundary of Thibet; and also in the provinces of Shen-si, Shan-si, Ho-nan, and Sz-chuen. From the former districts the dried root reaches Europe at present by way of Moscow; from the latter it is conveyed along the Yellow and Yang-tse rivers to the ports of Shanghai and Hankow.

2. The descriptions of the plant are not sufficiently precise to show whether the roots of only one, or of more than one, species are collected for medicinal use. Any real differences in the descriptions are easily accounted for on the latter supposition. The contradictions, however, are more apparent than real. According to Kung the root is *red*, while Su-sung says that it is covered with a *black skin*, which is taken off. The black skin consists, as any one may see by examining the root of *Rheum palmatum* in the winter, of the black decayed bases of the sheathing petioles, which cover the rhizome, so that its red colour is not apparent until these are removed. The difference in the height of the plant and the colour of the leaves probably depends on age or locality. The most important feature in description is the statement of Su-sung, that the leaves of the Shen-si rhubarb plant resemble those of *Ricinus communis*, the only known species of *Rheum* whose leaves admit of this comparison being *R. palmatum*. Su-sung particularizes the leaves of the *Shen-si* rhubarb, as if this was different from the Sz-chuen plant. Possibly he was only acquainted with the Shen-si plant, and therefore spoke cau-

tiously. There appears, however, to be another species of rhubarb, which Kung calls the Yang-ti plant. This is said to be often mistaken for the ordinary rhubarb plant, on account of its resemblance to it; but Li-shi-chen affirms that it is a distinct species. It is, probably, also a species of *Rheum*, whose root, though known in the market as Yang-ti rhubarb, is smaller and of inferior quality, and therefore not called rhubarb by first-class dealers. Yang-ti rhubarb means sheep's-feet rhubarb, and is so called from a fancied resemblance to the feet of the sheep, as the Sz-chuen rhubarb is called, doubtless also from its shape and size, hoof or horse-hoof rhubarb. The Tu-ta-kwang or local—*i. e.*, inferior rhubarb mentioned by Su-sung, which flowers two months earlier than the palmate-leaved rhubarb of Shen-si, may be a third species. There are a few characters which do not correspond with *R. palmatum*, or indeed with any of our cultivated species. The resemblance of the root to a basin is far from obvious, and the so-called seed or nut is usually a rusty-brown rather than black. The objection to *R. palmatum* being the source, or a source, of the officinal rhubarb has, I believe, been chiefly founded on the statement of Pallas that this species appeared to be quite unknown to the Bucharians, and that their description corresponded most nearly with *R. compactum*, the seeds of which were sent to Miller from St. Petersburgh as the true *Tartarian* rhubarb. But still less has hitherto been known of the rhubarb which grows in China itself; and I think I have now shown equally good reason for believing that the best kind of Chinese rhubarb—namely the produce of Shen-si, and probably also of Sz-chuen—is *R. palmatum*, which, notwithstanding all that has been said against it, has always been considered to approach most nearly to Asiatic rhubarb. Kung, who does not mention any locality, but compares the rhubarb to the Yang-ti plant, says that the stalk is crisp and sour, and may be chewed raw. *Rheum palmatum* is not cultivated in England for culinary use; but Mr. Robinson, of the Botanic Gardens, Regent's Park, informs me that he has seen it so used in Ireland.—'Pharmaceutical Journal.'

THE BAEL FRUIT AND ITS PROPERTIES.

In the course of the last few years another valuable medical restorative has been made known to European and Australian physicians. It is the bael fruit (*Ægle marmelos*, Corr.) known in India as the Bengal quince, but in Ceylon as a kind of orange. Although incidental notices of this tree and its fruit are scattered through the pages of the Technologist, it may be useful to bring together the statements relating to it. It is a large tree, a native of all parts of the East Indies; flowers during the hot season and the fruit ripens after the rains.

The fruit is somewhat like an orange. The cells contain besides the seeds, a large quantity of tenacious transparent gluten, which becomes hard on drying, but continues transparent. The fruit is nutritious and occasionally employed as an alterative. It is very palatable and its aperient qualities in the removal of habitual costiveness have been well ascertained.

The statements we find in works on Oriental 'Materia Medica' are very various as to the qualities of this tree and its products.

Rheede says, decoction of the bark of the root is considered in Malabar, to be very useful in hypochondriacs, melancholy and palpitation of the heart; and that the leaves are used in decoction in asthmatic complaints;—the same author adds that the unripe fruit is of use in diarrhœa. Among the Javanese the fruit is deemed very astringent, Roxburgh correctly states the fruit to be delicious to the taste and very fragrant. In the 'Asiatic Researches,' vol. ii. p. 349., we find it stated that the fruit is nutritious, warm, and cathartic, its taste delicious and its fragrance exquisite, its aperient and detersive qualities, and its efficacy in removing habitual costiveness have been proved by constant experience. The mucus of the seeds is used as an excellent addition to mortar, especially in wall building. The bark of the root is given in compound decoctions in intermittent fevers, and the leaves made into poultices in ophthalmia. When dried before it is ripe the fruit is used in decoction against diarrhœa and dysentery; and when ripe and mixed with juice of tamarinds, forms an agreeable drink. A water distilled from the flowers is reported to be alexipharmic. A decoction of the ashy grey bark of the tree is given in palpitation of the heart, and a decoction of the leaves in asthma. A yellow dye is procured from the astringent rind.

From a paper read by Dr. Bennett, in Sydney, at the Acclimatisation Society's meeting, and a discussion upon it, it appears that fruits of the bael tree have been received by Mr. Moore, of the Botanic Garden, and that jams, and some of the usual medical preparations, have been made from them by Mr. Norrie; the seed contained in them were supposed not ripe enough to germinate; but a case of living plants had been written for by Mr. Moore. The tree, it is supposed, will grow at Port Macquarie and in Queensland, but not in Sydney, for want of sufficient heat. Shipments of the fruit, in a proper state, can readily be obtained there from Ceylon, by the monthly mail steamers. The whole tree, roots, bark, leaves, and fruit, it has been seen, contain medical properties of great value in diarrhœa, dysentery, incipient fever, &c. It is administered usually as a decoction or infusion. Its effects are to gently regulate and restore the tone of the bowels, acting as a tonic and astringent in cases of diarrhœa, and as a laxative in cases of constipation. Its use has been common in India and Ceylon for centuries, and it is there relied on as a certain specific for dysentery.

THE PENNSYLVANIA OIL TRADE.*

In the year 1863, the business of petroleum was at its height. Pennsylvania, Ohio, and Kentucky were in the fruition of their fame. The former was the mother of oil; the latter regions poured forth their quotas in the fulness of filial affection. The springs were gushing. Worthless lands were becoming valuable. Wall street had a new hobby, liquid to be sure, like a goblet brimmed full with gold, but a green frog in the bottom of the cup. There was money to be made, and it was made; there was money to be lost, and it was duly lost. People talked oily; they slipped smoothly in their ways; they were greasedly inclined; they formed themselves into lubricous companies, and petroleum became an institution.

Companies were formed. You saw the signs prominently noticeable in the street. Individual speculators rivalled the gold gamblers in point of numbers, noisiness and importance. Exchanges were constituted; men risked and won; men worked and failed; women were interested through their husbands, brothers, and agents; little children "went in" with consent of their guardians; old fogies invested their surplus on an oily margin; servant girls drew their savings-bank accounts, and clerks invested their savings; in fact, since the South Sea Bubble of two hundred years ago, since the gold excitement of California, there was probably never such a furore of speculation as in the new forthcoming of oil. When merchants made a surplus they invested in oil. The savings of actors or actresses waned or enlarged in fountains of oil. Greengrocers, butchers, and candlestick makers became interested in petroleum. In fact, petroleum became an institution.

The number and diversity of uses to which petroleum has come to be applied are almost unexplained in the history of any of the earth's productions. It gives us light in many forms; from clear, crystal-like candles, or from the depths of a hundred different kinds of lamps; the waven, twisted, or plaited wick gives forth the peculiar mellow, gentle, moon-like, but brilliant illumination, which has so largely taken the place of sperm, lard, and almost every other oil.

As a lubricator of machinery, it has also superseded, or is superseding, other oils. It is used in laboratories for the preparation of various chemicals, and forms itself the main element of a hundred valuable compounds. Indeed, it would be difficult to mention one-half of the wonderful uses to which petroleum is applied.

As an article in the commerce of this country, its value is so enormous as to be computed with diffidence and wonder. The iron yield of Pennsylvania is computed to possess an annual value of 50,000,000 dols.; the coal yield about 100,000,000 dols. Though yet in its infancy, to the

* From the 'New York Tribune.'

latter interest only does petroleum yield the palm. As an element of trade it exceeds in importance and magnitude the gold production of the Pacific States; and by its substitution, as an illuminator, for other and more expensive oils, unestimated and inestimable millions are saved.

The amount of business done in the present year is not so great as two years ago, when the business was in the acme of its furore. Nevertheless, the shipments from this part are greater than they were. The following table will show the relative export of petroleum from New York for the years 1863 and 1864:—

		1864.	1863.
To Liverpool	gals.	734,755	2,156,851
London		1,430,710	2,576,331
Glasgow, &c.		368,402	414,943
Bristol		29,124	71,912
Falmouth		318,492	623,176
Grangemouth		——	425,384
Cork, &c.		3,310,362	1,532,201
Bowling,		87,164	——
Havre		2,324,017	1,774,890
Marseilles		1,982,075	1,167,893
Cette		4,800	——
Dunkirk		232,803	——
Dieppe		79,581	46,000
Rouen		——	143,046
Antwerp		4,149,821	2,892,874
Bremen		971,905	903,004
Amsterdam		77,041	436
Hamburg		1,186,080	1,486,155
Rotterdam		532,926	757,249
Gottenburg		33,813	——
Cronstadt		409,376	88,060
Cadiz and Malaga		55,674	33,284
Tarragona and Alicante		16,823	33,000
Barcelona		25,500	——
Gibraltar		69,101	308,450
Oporto		17,474	2,339
Palermo		7,983	57,111
Genoa and Leghorn		635,121	329,674
Trieste		165,175	3,000
Alexandria, Egypt		4,000	——
Lisbon		167,195	64,662
Canary Islands		3,358	5,125
Madeira		——	400
Bilboa		2,500	——
China and the East Indies		34,338	36,924

		1864.	1863.
Africa		25,195	12,230
Australia		377,884	304,166
Otago, N.Z.		10,810	5,500
Sydney, N.S.W.		97,880	48,013
Brazil		148,676	160,152
Mexico		112,986	69,481
Cuba		414,034	356,436
Argentine Republic		20,060	24,470
Cisalpine Republic		78,552	117,626
Chili		92,550	66,550
Peru		169,061	256,407
British Honduras		6,072	440
British Guiana		7,881	15,104
British West Indies		70,976	60,931
Br. N. Am. Colonies		28,902	16,995
Danish West Indies		8,463	31,503
Dutch West Indies		26,638	12,143
French West Indies		16,020	9,104
Hayti		7,088	12,064
Central America		993	456
Venezuela		28,583	15,455
New Granada		57,490	107,837
Porto-Rico		20,026	59,439
Total	gals.	21,283,489	19,547,604
Exports since Jan. 1, 1864,	„	21,288,499	

The following is the quantity exported from other ports from January to December:—

		1864.	1863.
From Boston	gals.	1,676,307	2,049,431
Philadelphia		7,760,148	5,595,738
Baltimore		929,971	915,866
Portland		70,762	342,082
Total	gals.	10,457,188	8,703,117
Total export from the U.S.	„	31,745,687	28,252,721
Same time 1862		gals.	10,887,701

Of the exports for 1864, 24,000,000 gallons were refined, and more than 8,000,000 gallons crude, representing a money value abroad, at the price of two shillings a gallon for refined oil, of about 3,250,000*l.* in gold. At the current rate of exchange, during the past year, this has given us a purchasing power in European markets amounting to 45,000,000 dollars in United States currency.

Taking the low estimate of 25,000,000 gallons of crude oil for our home consumption during the same year, and averaging the price, say at 75 cents. per gallon for refined oil, it represents an additional sum of over 19,000,000 dols., besides effecting a saving to the community, by its use, in lieu of more expensive fish and lard oils, of not less than 40,000,000 dols. The exports for the year 1865 will probably not compare so favourably with the previous year. The quantity received in the present year will not equal that of 1864, and will probably hardly surpass that of 1863. The recent panic among the petroleum stockbrokers of New York, the failure of wells in the producing district and other causes, have conduced to decrease the receipts of the present year. In 1864, the receipts, as compared with the preceding year, were as follows :—

1863.		1864.	
Crude ...	bbls. 399,341	Crude ...	bbls. 199,942
Refined ...	... 197,490	Refined ...	... 220,772
Total ...	... 596,831	Total ...	... 420,714

In the same year, 1864, the shipments from Pittsburg eastward by Pennsylvania Railroad amounted to 945,781 barrels. The shipments east and west for the ten months of the same year reached 588,202 barrels. The shipments of November and December (the last two months of the year) were unusually large and would add, perhaps, 100,000 barrels to the total. This would give, in round numbers, a total of 800,000 barrels as the shipments of the year.

The receipts of petroleum at Pittsburgh, by the river, for the eleven months of 1854, were 208,749 barrels, in addition to 189,870 barrels received by the Alleghany Valley railroad from February 1 to December 1, and 78,320 barrels received in the bulk-boats and measured outside the city limits, thus making a total of 476,939 barrels. The total receipts at Pittsburgh for each of the last six years have been as follows :—

	Barrels.		Barrels.
1859	7,037	1862	171,774
1860	17,161	1863	175,181
1861	94,102	1864	476,939

It is not possible at the present time to give a correct exhibit of either the receipts or exports of petroleum for 1865. The former probably fall short of the exhibits of both 1863 and 1864.

The stocks on hand at the beginning of the present year are small as compared with 1863, probably owing more than anything else to the fact that, although the product has considerably increased, the demand for export and consumption has been enhanced in a still greater ratio. The following was a statement of the stock on hand in New York, January 1 1865, and will show the closeness of the demand to the available supply :—

STOCK ON HAND AT NEW YORK, JAN. 1, 1865.

	1864.	1865.
Crude, bbls.	7,933	14,512
Refined	18,718	64,448
Naptha	417	6,073
Petroleum	100	676

It is a frequently expressed opinion on the part of oil speculators that the oil springs of Pennsylvania are giving out, that they are exhausted, and that we must look to other and remote quarters to keep up the supply. Others are confident that the oil wells of Pennsylvania are inexhaustible, and only need to be regularly and properly protected from the influx of water to send up their lucrative fountains for ever.

Forty-six thousand nine hundred and eighty-two barrels of crude oil were received at Baltimore last year from Pennsylvania, and 1,117 from Western Virginia. The supply has now been sufficient to meet the wants of the refiners, but a much larger quantity is expected from Virginia in the present year. There are nine refineries in operation at Baltimore, and three new ones will shortly commence, and their united capacity will be 3,000 barrels a week. The receipts at Baltimore during the last four years were as follows, in barrels :—

	Crude.	Refined.	Total
1862	13,813	14,764	28,580
1863	43,626	19,563	63,189
1864	36,467	19,573	56,040
1865	48,152	12,409	60,561

The resources of Pennsylvania are not yet exhausted. Venago County—which produces nearly three-fourths of the oil that comes to our market—still pours forth its golden current of petroleum, if the streams come less copiously than of old, it is not owing to a lack of oil, but the decrease is occasioned by an overflow of water forcing the oil from its natural beds up into hills and peaks which have not yet been perforated. Thus an oil well lies in a valley, between two hills. At first the supply is ample. It spouts gallons per minute and barrels per hour. But presently the production decreases, until, at length, it ceases—becomes dried up—altogether. This is owing to a flood of water, rising uniformly through the land forcing the oil on its top; and, as the valley has been bored, it, being the lowest portion of land, is, of course, first deprived of its oil. If more is wanted, of course you must perforate the hills, where according to the same theory, the water, with the oil on its surface, lifts it upwards to the acquisition of man. We hear nothing as to what would happen after all the water was also expended. Is there oil below it, or what will be the nature of the next product cast up to view ?

The usual mode of protection against water is by means of "seed bags." These are sacks filled with flax seed, which are sunk around the shaft bore, in the manner of a boot.

If the existing oil springs should fail, of course there is no danger that the country or the world will fall short of oil. The article has only been discovered in four or five States, and we have others left wherein to "prospect" for new discoveries. There is oil in Illinois; there comes an oily murmur from Wisconsin, Nebraska, and Kansas; oil has been discovered in California. Young America with his enterprising caduceus, has smitten the gold-veined rocks of the Pacific coast, and they have spouted forth oil, as did the rocks of Syria to the stroke of Moses's wand, when his followers were athirst in the desert. The location of oil may be determined only by the geological formation of the ground, but there are many places in the broad compass of the United States where one can dig for oil and dig hopefully.

Petroleum may justly be considered as one of the greatest blessings ever bestowed by Providence on man. It increases our national wealth, gives employment to our railroad and shipping interests, and supplies the place of gold as a purchasing medium in foreign markets.

Its magnitude cannot be estimated even by the immense amount of capital nominally employed by the large number of companies already organised, which, in our principal cities alone, has already reached the enormous sum of over 500,000,000 dollars, exclusive of a large number of private companies, whose existence is entirely unknown to the public.

Its discovery seems to have been Providential, occurring just at the moment when our whale fisheries were giving out, and when we had but very little cotton or other produce for shipment to meet our obligations in foreign markets.

When we consider the enormous and valuable tracts of territory lying in West Virginia, Ohio, Kentucky, New York, and many other sections of our country, which are just as likely, judging from existing indications, to be as valuable oil-producing lands as any yet developed, we must admit that the trade in petroleum is but in its infancy, and that it is destined to become one of the greatest commercial interests in the world.

AMALGAMATION.

The 'Mining Record' of Victoria publishes the following:—A process which may, we consider, be correctly styled a discovery, has just been patented, by Mr. W. Crookes, the discoverer of the new metal thallium, a discovery of double interest, interesting on account of the singular properties of the body itself, and no less interesting from its having been effected by the admirable method of spectrum analysis. The patentee, who might safely rest his name on this one discovery alone, is otherwise a chemist of high-standing and accredited ability, so that we may, without restraint, bestow on his proposition at least a respectful attention. As might have been anticipated from the repute of its discoverer, the method is, regarding it in the light of a chemical proposition, a sound one—more than this, it actually does in practice what it undertakes to do. The technical problem, the question of its universal fitness, or of its adaptability to particular cases only—these and others of like kind, will all require to be settled by actual trials, and the process, in this sense, must stand or fall according to its own merits. Refraining from all arguments or commendations, we merely add that we look hopefully towards the method of Mr. William Crookes, because it appears to us to be actually new, very simple, and based on sound chemical principles.

The new process consists in the addition of the metal sodium to the mercury used for amalgamation. For the instruction of junior readers it may be explained that sodium is the base of soda, caustic soda consisting of water and oxide of sodium, nearly in the same way that the yellow rust of iron consists of water and oxide of iron. Sodium is a silver white metal, rather lighter than water, and so greedy of oxygen that it tarnishes in a second of time when exposed to air; it is otherwise so oxidizable that it will take oxygen from almost all its compounds. Sodium forms a pasty amalgam with mercury, and a little of this rich sodium amalgam is to be added from time to time to the bulk of the mercury in the amalgamating machine. The addition of this sodium amalgam produces the following results :—

1. The mercury is rendered more greedy of gold.

2. Water is gradually decomposed with evolution of hydrogen, thus preventing oxidation of all metallic surfaces, while the water is rendered alkaline, and what may be called grease-killing.

3. The iron surface in contact with the mercury, the iron basin of an amalgamating pan for example, is actually amalgamated over its whole surface, just as a copper plate would be by contact with pure mercury, and thus the chance of taking up or retaining gold is enormously increased, while the iron, being only amalgamated very superficially, is not rotted and disintegrated as a copper plate would be.

4. Sulphur compounds are decomposed, a sulphide of sodium passing into the solution. Sulpharsenides, as arsenical pyrites, are stated also to be decomposed, both copper pyrites and gray antimony ore in contact with this sodium amalgam afford immediate evidence of decomposition.

Whether the pyrites, in common cases and with mills working at the ordinary speed, will be all decomposed, and whether the advantages resulting in practice from this decomposition will admit of expression in dividends, is at present a problem; in short, the merits of this discovery, in the sense of practical results, have yet to be measured; but making this statement, it may be also at the same time fairly stated that the invention appears to be one of the most promising, if not the most promising of all those hitherto submitted to the quartz miner.

Sodium was once retailed at twopence per grain, or at the rate of over £58 sterling per pound avoirdupois; it was in those days a philosophical curiosity. From that to the present time it has gradually cheapened; and, owing to its recent and extensive use in the production of aluminium, it has receded in price so as to be quoted at 10s. per pound. We see it even stated that in large quantities it may be had at 5s. per pound —a price which, although doubtless very low, may be quite within the limits of modern means of production. This, then, should enable us to form a basis for our calculations. We are to accept the use of sodium at so much per pound— say at its Melbourne market price, plus royalty or licence; and we are to find our returns in gold heightened by as much more or less than the money value of the sodium thus used. The experiment on the large scale will demand a skilful, patient, not hasty, series of trials; and the patentee and public, both equally interested in the success of the trial, must alike abide by the result.

Scientific Notes.

West African Woods.—Notes on some woods sent to the Dublin Exhibition. 1. Black Mangrove (*Rhizophora Mangle*). This is the large twisted roots or branches of the common mangrove used for boat knees. timbers, &c. 2. Yellow Mangrove. This is the straight young trunks and branches of the same tree; used for house building, poles, supports, rafters, &c. 3. Oroku. This is a fine, hard, dark-coloured, durable wood, much used for floors, ceilings, walls, doors, and cabinet work. 4. Iki. This is a new wood which has not yet been much employed here; useful for cabinet work. 5. Brimstone Wood. A very serviceable wood, largely used here, principally in building, for floors, partitions, &c. 6. Native Oak: uses somewhat similar to Nos. 3 and 5. 7. Unnamed: used by the natives for making canoes, paddles, &c. 8. Similar to No. 7. Paddles are made of it; not much used. 9. Orupara. This is a fine hard wood, very similar to mahogany. It has never been tried yet, so we do not know its quality. I will send shortly the leaves of these trees for identification.—Edward J. L. Simmonds, Lagos, Feb., 1865.

Products of the Vacoa (*Pandanus utilis.*).—In the Mauritius, extensive use is made of the leaves of this tree. With the leaves, bags for packing sugar are made, for which there is a large demand—considering that the export of sugar averages 1,000,000 cwt. a year—into mats for bedding, into hats and baskets; the roots are split for cord to fasten thatch, split it is made into a whitewash brush, and it yields very white and good fibre for cordage.

The Precious Metals.—We glean the following interesting items from M. Roswag's new work on the subject, entitled 'Les Mètaux Prècieux.' From the year 1500 to 1848 America yielded 27,122 millions of francs in silver, and 10,028 millions of francs in gold. These numbers comprise 13,774 millions of silver drawn from Mexico, 43,059 from Peru and Bolivia, 230 from Chili, and 58 from New Granada. As to gold, the share of Brazil was 4,625 millions of francs; that of Granada, 1,952; of Mexico, 1,341; of Peru and Bolivia, 1,172; of Chili, 862; and of the United States, 76. Europe during the same period only produced 2,330 millions of francs in silver, and 1,600 ditto in gold. Africa yielded 2,500 millions from Guinea. Hence the total quantity of precious metals existing in 1848, including 1,000 millions supposed to exist before 1500, formed a total of 44,578 millions of francs—viz., silver, 30,152, and gold, 14,426. From 1848 to 1857 the stock of metals has been increased by 2,170 millions of francs of silver, and 6,004 of gold. Of the latter, California has produced 2,508 millions, and the rest of America 445. Australia has yielded 1,695, and Europe 733, including Russia for 678 millions. Asia has contributed 505 millions, and Africa 108. Of silver, Australia has yielded 9 millions; America, 1,827; Europe, 321; and Asia, 22; forming a total of 2,179 millions of francs. There consequently exist at present in the world 32,331 millions of francs of silver, and 20,430 of gold. The ratio of gold to silver, which before 1848 was as one to two, is now as two to three. In weight there existed before 1848 about thirty one kilogrammes of silver for every kilogramme of gold; in 1856 this proportion had fallen to less than twenty-four kilogrammes of silver for one kilogramme of gold. Since 1856 the total annual increase of the precious metals may be stated at 240 millions of francs of silver, and 500 of gold, being more than double the former. A Californian paper states:—About the year fourteen of the Christian era, the annual product of gold and silver was 5,000,000 dollars, in 1492 it was only 250,000 dollars, in 1853 it was 285,000,000 dollars, and in 1863, 240,000,000 dollars. In the year 14 also the gold and silver in existence is estimated at 1,327,000,000 dollars, and in 1863 at 10,562,000,000. The whole amount of gold and silver obtained from the earth, from the earliest period to the present time, is estimated at 21,272,000,000 dollars.

THE TECHNOLOGIST.

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THE TIMBER TREES AND USEFUL PLANTS OF THE BIJNOUR FOREST, HIMALAYAS.

BY DR. J. L. STEWART, CIVIL SURGEON.

(Concluded from page 391.)

118. *Shorea robusta*, Rox : *sál, saul, kandár*. I shall allude more fully hereafter to this tree which produces the second best timber in India. Outside the Siwaliks it only exists in restricted patches, and does not grow luxuriantly. The timber is reddish coloured, close-grained, even-fibered, and heavy, and is stronger than teak, but is said to be less durable. Sleeper, 1/8 to 2/—. Its sp. gr. is over 1·000 and Baker found a six feet bar two inches square break with 1,238 lbs. With careful seasoning it is an invaluable timber for all purposes requiring strength, and excels all others for gun-carriages. Crushers of sugar-mills are sometimes made from it but are said to last only half as long as those made of tamarind. Its bark is occasionally employed by tanners and a resin (*rál*) exudes from the bark which is burned as incense in Hindoo temples (and in ship-building yards is used as pitch). This resin does not appear to be abundant or to be collected even in the Doons near this, and the bazaars are said to be supplied from "the East." 3 Seers 1/—. From the resin, in Shahabad, an aromatic oil (*choya*) is procured by dry distillation.

119. *Sizgium Jambolanum*, D. C. *jáman*, (and a variety *jamáwa* ?) a tree with a smooth, light coloured bark, common, planted in groves in the open plain for its fruit, and not uncommon in the forest. Its timber is tolerably good, and used for planks, and domestic purposes. $4\frac{1}{2} \times \frac{1}{2}$ yd. —/8.

In Bengal and the Peninsula, the bark is used to dye brown, and in Bombay a gum like kino is extracted from the bark.

120. *S. venulosum*, Royle ? *rái jáman*. I hardly think this handsome tree grows *outside* the Siwaliks so far west as this.

121. *Solanum verbascifolium*, L. *asega* (*asheta*). A large shrub with curious mealy-looking leaves, which is very rare outside the Siwaliks. In Southern India the plant is cultivated for its berries which are used in curries.

122. *Spondias mangifera*, Pers. : *ámára ámabára.* Rarely found outside the Siwaliks and innermost part of the belt.

The timber is worthless. The fruit which is compared to a particularly bad turpentiny mango, is eaten by natives and made into pickle (*kahtái*). Various parts of the tree are in the south of India used in medicine.

123. *Sponia Wightii*, Planch : *Joūn* (*khusaroá*). A small tree with very rough leaves common but only locally in some parts of the forest and mostly found near streams. To the eastward and in Southern India, the leaves are used instead of sand-paper to polish wood and horn.

124. *Sterculia villosa*, Rox : *ūdála.* A small tree abundant at some places in the innermost part of the belt. Here, as elsewhere, a strong rope is made from the fibre of its bark, after a process of steeping and beating. In the south of the peninsula, elephant ropes are made of this, and in Bombay the fibre is employed for making bagging.

125. *S. Wallichii*, G. Don. *bodula.* Hardly extends outside the Siwaliks. Ropes are made from its bark also.

126. *Tamarindus Indica*, L. *imli.* The tamarind tree has properly speaking no business in a list of the plants of this forest as it nowhere grows wild near this, but on account of the excellence of its timber for special purposes it deserves some mention. The tree is well known in cultivation, being grown chiefly on account of the pulp of its fruit which is used both as food, and in medicine. The timber is finely veined, hard, heavy and strong, and is applied to various uses, such as for making naves, clod crushers, door-frames, &c., but is particularly valued as the best and most lasting wood for both parts (*churan and kohlu*) of sugar and oil mills. Kohlu up to 5—.

127. *Terminalia Bellerica*, Rox: *báhera.* A large tree, with bark tesselated by longitudinal and transverse furrows and cracks ; not uncommon throughout, and most frequent in the inner part of the belt.

The timber is used for planks, &c., but is not valued. Cart load—/5. $4\frac{1}{2} + /\frac{1}{2}$ yds. 1/2.

The fruit which appears to be a favourite food of the Senmopithecus (*langür*) is largely collected, chiefly for use in dying and tanning. $1\frac{1}{2}$ maunds, 1/—. The leaves also are employed by tanners, Cart load—/6., and in various parts of India different parts of the tree are used medicinally.

128. *T. Chebula*, Retz : *har harrá*, Not uncommon in the inner part of the forest ; the timber is of no value.

The fruit, which here is larger and finer than that which comes from the hills, is collected for export, to be used in medicine and by dyers. One man will collect one, or one and a half annas worth a day, the dealers buying from him at the rate of four and five *kacha* maunds for a rupee. 1. $1\frac{1}{2}$ maunds, 1/—.

129. *Tetranthera apetala*, Rox : *meda lakri.* A small tree common all over the forest, timber of no value. 12 maunds 1/—. The astringent fresh bark is applied to bruises, and it is exported largely for use in medicine. 1 maund—/1 ; 1 to $1\frac{1}{2}$ maunds, 1—.

130. *T. Roxburghii*, Nees. *masūr* (*meda lakri*). Occasional throughout the forest. There is some confusion about these two species, but I think the medicinal bark has been assigned to its proper source.

131. *Trophis aspera*, Willd : *sionra, kâr, chamra.* A small, scraggy looking tree, common wild in the open plain and occasional in the forest. Its timber is worthless and here no part of the tree appears to be utilized, but in Southern India its juice is applied medicinally and the rough leaves are used to polish ivory.

132. *Typha latifolia*, L. : *patera.* A tall bulrush, abundant in marshy places. Its leaves are collected for the manufacture of coarse mats (*boirya.*) Cart-load— 8.

133. *Ulmus integrifolia*, Rox : *papri* (*kunju*). A fine tall, and handsome smooth barked tree, with dark foliage ; sometimes planted in the open plain, and common in the inner part of the forest. Its timber is light, white, and liable to split, and its chief special use here is for making spoons. $4\frac{1}{2} \times 1\frac{1}{2}$ yds. 1/2. In Southern India it is employed for making carts, door-frames, &c.

134. *Vitex negundo*, L. *shamâlu* (*mewrce*). A tall shrub common in the forest as in the open plain. Its wood is too small to be of use, but its twigs are employed for wattling, &c. The fruit is said to constitute the medicinal *filfil bari* of the bazaars, and in Southern India various parts of the plant are employed in medicine.

135. *Wendlandia cinerea*, Dec : *pudhârá* (*chilkiyiá*). A large shrub hardly extending outside the skirts of the Siwaliks. Its timber is said to be useful in carpentry.

136. *Wrightia molissima*, Wall : *duddhi.* A large shrub not uncommon (but much of it cut), in the inner part of the forest. Its wood is white, fine grained, free from knots and easily worked, and is much used by carvers for making bowls, plates, &c. Cart load —/6 ; 10 maunds1/—

The following belong to a genus of which the Indian species are as yet somewhat undecided, but I think I have not gone far astray in arranging them provisionally as follows :—

137. *Zyziphus Jujuba*, Lam : three varieties.

A. jhaberi. Small and bushy, one of the most abundant wild shrubs of the open plain and common also in the clearer parts of the forest. Its wood is never large enough for aught but fuel, and its small red fruit is not edible.

B. khalis, ghuter, beri and *C. hatber* (*ghuter*), both attain a considerable size and are not easily distinguished. They approximate the cultivated variety of the plant, the fruit of which is much relished by natives. These are common throughout the forest. The timber is tolerably hard and strong, and is made into churn-sticks (*rei*), feet of cots, crushers, wooden shoes for bathing, &c., 10 maunds 1/—. In Southern India it is used for saddle-trees, and has been recommended for sleepers, but if correctly it must attain a much larger size than it does here. Cart load —/10; 3 maunds 1/—. The bark is much used by tanners and lac (*lákh*) is collected from the tree, to be employed in dyeing. 1 maund 1/4.

138. *Z. nummularia*, Gmel: *jhar bari.* Very similar to variety *a.* of No. 137, and found along with it.

139. *Z. Oenoplia*, Mill, *mako, bamolan.* Abundant in the open plain, very rare in the forest. Its wood is small and only fit for fuel; the fruit is eaten, and its juice used in medicine.

140. *Z. vulgaris*, Lam:——— ? A large shrub, occasional in the forest.

Besides the forest rates payable to contractors on timber, &c., the produce of certain trees, there are some general rates, such as on each cart load of firewood /4, of charcoal /10, on each rice-pestle (*músal*) a half anna, and on each oar three pice. Though these are apparently of minor importance, the first two probably contribute a considerable part of the revenue derived from the forest.

There are only I think two forest exports of commercial value to be mentioned here on which rates are levied, but which not being the produce of any or of special plants, are not included in the above list. These are lime, and wax (with honey). The *khera* earth from which lime is manufactured pays /3, the lime itself /6, and the limestone pebbles from which lime is burnt, /4 a load, but there is no reason to suppose that any very extensive manufacture of lime is carried on in, or with, materials drawn from, the forest. A good deal of wax and honey is collected, the forest rate paid on the latter being 1/4 and on the former 4/ a man.

Gold washing was I believe at one time a source of revenue to the district, as it was regularly carried on both in the Ramgunga and in the Ganges, the right to wash gold in each being leased. But it was never very remunerative to the washers, and if any gold is got now from the sand of the rivers within the bounds of this district, it must be of very limited amount.

In touching more particularly on some of the members of the preceding list, I may pass over without further remark all the fruits, drugs, dyes, tans and gums, which are yielded by trees and other plants growing here. Nor need I do more than give collectively the names of plants yielding fibre —: *bāhar* (Nos. 8 and 54), *múlâ* (15), *bhenwal* (72), *túsárâ* (93), *mûnj* (113), *udála*, (124), and *budûla* (125), as none of them except the *mūnj*, grows or is collected in very large quantity within our limits.

Bamboo has an intermediate place, as it can hardly be reckoned a minor product, nor, though mostly used for construction, is it, strictly speaking timber.

The best charcoal for furnaces, &c., is produced by *khaīr* (2) and *bel* (6); *behera* (128) and *ber* (138), furnishing a somewhat less valuable article, while the light charcoal of the *dhāik* (23) and *binda* (39) was in repute in former days when the manufacture of gunpowder was permissible.

The creed of the natives as to the most important timbers, is summed up in a local rhyme.

"*Sándan*, *shisham*, sona *sāl*
Jab chhil hota, nikle lāl."

Which may be paraphrased thus

"*Sāndan*, *shīsham* and *sál* so sound,
Redness follows the axe all rouud."

Perhaps as regards redness, strict truth has been here sacrificed to sound, but for quality of timber, it might not have been easy to make a better selection. Unfortunately for the Bijnour forest none of the timber for excellence is produced in large quantity within its limits.

Sál (118). The timber of the forests of the N. W. provinces, at some distance outside the skirts of the Siwaliks here as all along this tract for hundreds of miles to the eastward, only exists in isolated strips and patches. In these the trees never grow to any great size, but appear to be arrested at an early stage of their development, when according to several authorities, they become rotten and hollow without apparent cause.

In the Bijnour forest there are three principal strips of *sal*: one in the east beyond Kehur, another towards the centre in the Burrapoora district, and the third and largest to the westward in Chandee. In the last the trees appear to thrive better than in the other two places, in accordance with what has been observed elsewhere,—viz.: that *sál* prefers a high, dry and gravelly site. In these three situations as in other places the tree grows gregariously, and very large numbers of young plants may be observed in some parts. An immense proportion of these however must perish from the jungle-fires by which the tall grass is burnt down several times each year, to allow the fresh young herbage to come up for pasture. Whether or not the statement be true that the young trees absolutely rot at a certain stage, it is certain that for many years no *sál* larger than to form moderate-sized poles (*balli*) have been taken from this forest.

The following are the other trees furnishing the more useful and tolerably hard or strong timbers which are found here; *khair* (2), *bel* (6), *tūn* (33), *kūm* (41), *lisára* (42), *sádan* (46), *sisū* (47), *aonla* (53), and *gausam* (115). None of these require further notice than has been already given as to their qualities and frequency, except *tun* and *sisū*. Of the former almost none above the size of the smallest sapling are now to be seen in this forest, as the worth of its wood prevents it from attaining any size where anything like indiscriminate felling is allowed. Of *sisu* there are extensive groves of young trees along the banks of streams and stream-beds and on islands; just as on the Chandnee chauk islands of the Sardah and along that and other rivers in Oudh this tree grows in great quantity in such places there. But here hardly a tree of any size is to be seen, whether from the fact that the constant shifting of the beds by freshets prevents the saplings from ever attaining full growth, or because they are invariably cut down so soon as they become at all fit for use, it is difficult to say. Probably, both causes unite to account for the phenomenon, but I believe considerable effect must be attributed, to the the latter, seeing that those trees which do escape being drifted away by floods, must, if *left alone*, attain at least the respectable size of those in the open plain which grow under less favourable circumstances. At the same time it may be that the inhospitable sub-soil has a peculiarly deleterious effect on this tree. Just as the climate here outside the Siwaliks has on the *sál*.

The following are the trees which so far as regards their uses *here*, must be reckoned of inferior or third-rate quality for general purposes, although some of them are considered valuable in other parts of India. *pádal* (19), *semal* (20), *dhauri* (40), *kharpat* (68), *kumhar* (69), *beram* (81), *bakli* (83), *huldu* (90), *keim* (91), *jingan* (95), *sein* (98), *jaman* (119), *papri* (133), and *beri* (137). The frequency or rarity of each of these with their qualities, has already been sufficiently noted in the general list. *Kuar* (80), and *duddhi* (136), from their colour, texture, and softness, are useful for wood-carving, and *dolduk* (55), is of value to the sieve-maker.

The only other timber I need here specially mention is the ebony, *tendū* (49). It is very difficult to get exact information on such a point from natives, but I have no doubt but that this tree is gradually getting worked out in the Bijnour forest, although the manufacture of the boxes, &c., which are made from it is confined to one place (Nugeena) and their sale is by no means actively pushed.

Besides the timber and minor products there are two sources of forest revenue which require notice. One of these consists of the fees for wild elephants caught (50*l*. on each) which produce several hundred rupees a year, and the other, of grazing fees, which are of considerably greater importance. The grazing-rate charged by the contractors is 10/ a year for 100 cattle, 20/ for 100 buffaloes, and 4/ a year for a herd (*i. e.*, as many as are kept under one *chhappar*) of sheep or goats; a fee of from one to four annas is also imposed on each hide exported. I have no certain information as to the annual amount that is raised from this source, but it must be very large from the great numbers of cattle which are brought from both hill and plain, especially the former, to graze during the cold season. Their number is at present on the increase owing to the shutting of some of the Doons. The *pahárís* who bring their herds down for grazing purposes are mostly from Kumaon, the cause of which is said to be that cattle-raising is there more attended to, while there is less extent of waste land than in Gurhwāl. The principal product of this grazing is *ghee* (fluid butter), which is exported hence to the plains in very large quantities, being bought upon the spot by dealers.

Of the 260,000 acres (including a few thousand acres of cultivated land) contained in the Bijnour forest, nearly 70,000 are in private hands. This state of things was partly unavoidable, but the larger proportion of the 70,000 acres consists of that part of the Kehur estates which became forfeit after the mutiny. This might still have remained Government property, had we not here done as on the Nepal frontier. though on a very much smaller scale, in giving as rewards to those who doubtless deserved them well but might have been equally well-satisfied with *jaghirs* elsewhere, land we may one day wish that we had kept.

The management of most of the forest which remains to Government having hitherto been conducted on the plain principle of "clearing as rapidly and profitably as possible" has been simple enough. The Chandee forest, *i. e.*, the extreme north-west corner of the district lying to the west of the *Peelee Kas nuddee,* including some outlying spurs of the Siwāliks, and containing some 50,000 acres, has for special reasons been for the last eight or nine years under charge of the Kumaon forest officers, and there *all* wood cutting has been nominally prohibited, only bamboos and minor produce being allowed in the contract. But elsewhere the system has been that the forest in several segments has been put up to auction annually, the parties leasing it for the year having the right to all spontaneous produce, and being authorised to "cut and sell" all they can (*sál* excepted in one segment). What is realized by them for timber, bamboos, &c., is thus theoretically construed to be the *price* of these articles, but in reality is levied and considered as a rate or due paid to the contractor, by those who cut and remove timber and collect minor products (or graze cattle) in the forest.

It is possible that with the non-capitalist natives who at present generally lease the forest, it might not be easy to work any other system ; but the plan might be tried of letting it in much smaller segments, or, as is said to be the case in Chandee just now, monied men might be found to take the contracts. In either case such rules might be adopted and insisted on as would make the lessees work the forests systematically, so as to ensure not only the present but the prospective good of Government, the public, and themselves. The frequent changes of lessees, and sudden annual fluctuations of rent, do not indicate a very healthy state of things as to these leases.

The amount for which all the forest now in the hands of Government has let during the last few years has varied from 15,000*l* to about 32,000*l*. The larger amount, however, must be considered quite abnormal, as in the years approaching to that sum—viz., those immediately succeeding the mutiny, when the forest had had rest and could of course stand a larger drain, not only do the contractors appear to have done their best to ruin it, but some of them also to ruin themselves. The aggregate amount of the contracts is now about twenty to twenty-two thousand rupees, which appears to be nearly what the forest in its present state and on the present system will pay.

A tendency to increase of rent for some parts, of late years, chiefly depends on the fact that some of the forests of neighbouring districts have recently been closed, so that there is a greater demand for bamboos especially from these and others which are still open. It is, as yet very doubtful if the bamboos of the neighbouring strip of Gurhwal and of the Bijnour forest can stand the increased drain. In former years there seems no reason to doubt that each season's growth of bamboo was equal to supply the annual loss from cutting; except in Chandee, of which the bamboos are immeasurably more valuable than in any other part, and where cutting seems to be more terribly overdone than in the years above alluded to, and it will require a year or two's further experience to determine whether or not this may be the case, with the present increased demand. In the eastern and central parts, however, the quantity of bamboo is comparatively trifling, as there the boundary line of the district does not follow that of the skirt of the Siwaliks, beyond which this plant only extends a short distance, but follows the line of the main longitudinal sub-Siwalik road, which runs from Kalee doongee viâ Chilkiya and Laldhang towards Hardwar. Near Chandee again there is a great deal of valuable bamboo, for it not only contains the outliers of the Siwaliks already mentioned, but this part seems to be peculiarly favourable to the growth of the plant which may be found in some quantity in the rough ground near the Ganges towards Amsot, far outside the hills. It is note-worthy that not only bamboo, which is the most productive item in this forest, but sál, the best timber of the northwest, and teak, the most important timber-tree in India, or perhaps in the world, should all be gregarious in their growth.

It were out of my province to enter into much detail as to what *I* may conceive to be the best system of management of the Bijnour forest, but there are several aspects of this question which obtrude themselves so strongly that I cannot quite pass them over.

During last cold weather, in trudging on foot many miles through this forest, I could not but see that the great cause of destruction of the young *sál* and other young trees more or less valuable, arises from the frequent annual conflagrations, which, in their devastating progress, not only burn up the tall harsh grasses, as is intended, but destroy hundreds of tender saplings, as well as scorch up much of the foliage of, and thus render unhealthy, many of the larger trees; and I was corroborated in this view by Dr. Brandis when I subsequently met him in the forests of the Doons near this. But as Hooker has truly remarked, "whether as a retainer of miasma, shelter for wild beasts both carnivorous or herbivorous alike dangerous to man, or from their liability to ignite and spread destruction far and wide, the grass jungles are most serious obstacles to civilization," and they must be kept down somehow, and to these reasons we have to add the still more pressing utilitarian one that the young herbage must be allowed to come up as pasture, especially when we consider that the amount raised from pasture dues probably bears a very large proportion to the forest-rates proper. This is indicated by the fact that a few years since (about 1846) in the Kumaon Bhabur, the latter exceeded the former by only a few hundred rupees (9,756 to 8,973). It is only perhaps in isolated and special situations, as in the neighbouring small Doons, where the growth of *sál*, &c., is really of immense value, that it will pay to exclude the agriculturist and herdsmen altogether, and thus lessen the probability of fires, as well as prevent even the chance of indiscriminate cutting, so making sacrifice of a present minor advantage for the sake of future gain. At the same time it appears not impossible that means might be adopted to render these forest fires less destructive to saplings and trees than they now are.

Another and more practicable improvement which suggests itself is this. If it will in the end be a saving to keep a few men on the Eastern segment of the forest where alone (to the east of Peelee Rao) there is any conservancy establishment, might not similar conservation,—with of course a corresponding restriction of the lease,—be extended to some other places, where if the quantity of *sal* is much smaller, the establishment required would also be less extensive? And this not with the futile hope of even the third generation hence—(the tree in all probability nowhere attains any very great size in less than several scores of years,) cutting in these extra-Siwalik strips noble *sáls*, monarchs of the forest, such as possibly the last generation removed from the outer skirts of these hills, and the present is cutting within them, but merely for guarding the saplings till at twelve or fifteen years they be fit to furnish good poles and spars. One is the more inclined to believe it worth risking the small expense a few men for this purpose would entail, from being aware that some years since many thousands of rupees of *sal ballis* were in one season cut by a sharp contractor from similar strips in this very forest, and from having seen hundreds on hundreds of *sal ballis* brought into a neighbouring station near which all *sal* cutting is "strictly prohibited."

A larger and fully more difficult question remains for discussion. Even if the present system of managing this forest, so as "to clear it as speedily and profitably as possible," has hitherto been the best possible, will it henceforth be so? And this includes two subjects of very considerable importance—viz. 1st. does clearing imply that cultivation will follow? And 2nd, apart altogether from the larger and more valuable timber trees, is not the demand for firewood within a few years likely to be such as would warrant some conservancy? I do not think there is any doubt that within the last few years a great deal of land has under the present system been more or less *cleared*, but it by no means follows that the ploughman treads on the heels of the "lumberer." I am sorry I cannot give figures applying to the whole forest in this regard but the following may suffice. In the Nujeebabad forest proper, *i. e.* roughly speaking from the Khop and the head-waters of the Ganghun to the Peelee Rao and the Ganges, containing about 100,000 acres, there were at the time of the mutiny 4,990 acres cultivated, this year the amount of cultivation is 5,461 acres, and this is five years' progress in this direction. But still further, what increase of cultivation may have recently taken place within the forest bounds has in almost no case been effected within the the forest proper, when on the contrary within but a few years many villages have become waste. The fact appears to be that any considerable increase of cultivation within the forest bounds takes place in ordinary circumstances along its edges, and as has been before indicated, reasons connected with the physical structure of the tract and the scarcity of water render it almost impossible that it should be otherwise, and for similar reasons the cultivation from the inner edge must always be very limited, here much more so than opposite Kumaon where streams of some size are much more frequent.

With these views I cannot but consider any estimate, such as that given regarding the Chandee and Nujeebabad Forests, of 75 p. c. of cultivable land, as extremely fallacious, though doubtless something like that proportion may be *arable* in the literal sense of the term.

The very Boksas whom it has been the habit to suppose "to the manner born" seem only to have been originally driven to settle *within* the forest belt by external pressure, and now that pressure has been for many years removed even they tend to leave the intra-forest clearings. Several of these last have within the memory of man been deserted, and almost the only village which has increased in size by immigration is Bergnalla, which is *de facto* in the Tarai belt outside the forest proper. For many years at least and until every acre of available land outside of the dry forest has been brought under the plough, it seems very unlikely that men will voluntarily betake themselves to agriculture on the large scale in this tract where so many difficulties have to be faced.

Any large increase of the demand for firewood to be supplied from the Bijnour forest depends on the advance of railways, and in particular on the not improbable contingency of a lateral, longitudinal railway line with transverse branches, permeating Rohilkhund within a few years. As illustration of what will take place in such a case, I may mention that I have it on reliable authority that between Allahabad and Cawnpore, at the time of the commencement of railway operations, the price of fire-wood was about 9/ a hundred maunds, *i. e.* a very little over what the price of the same commodity now is at Nujeebabad a few miles outside our forest belt. *Now* (1863), the contract price of railway fuel between Allahabad and Cawnpore is 19/ a hundred maunds, *i. e.* the railway has more than doubled the rate. From a sufficiently near approach of the railway, a similar result may be expected here, if means are not taken to modify the effects of the increased demand.

More knowledge of details than I at present possess, and very probably a year or two's experience of the effects of such approach, would be necessary in order to determine the best possible steps by which to meet the increased demand for fire-wood. It appears to me however, that in order not only to meet this demand effectually but to lessen the railway expenditure as well as that of the people generally under this head, one feasible method would be to divide off the forest into manageable segments, in only a certain proportion of which alternately would any wood-cutting or any jungle fires be permitted each year. By some such plan the evils of indiscriminate cutting and trimming, under the impending contingency, might be guarded against.

Under the present system of working, the main part of the funds is expended on roads, of which 225 miles are in the Collector's Report, stated to be maintained in and near the forest. Within the limits of the forest there is not much thorough traffic, the only roads crossing it on which any great amount of such traffic exists being that from Kaloo Shuheed (at the mouth of the pass into the Patlee Doon) to Burrapoora, that from Koldwara to Nujeebabad,—and that from (the western) Laldhang to Amsote. On these roads besides the ordinary timber traffic a very considerable amount of merchandize comes from Gurhwal by Koldwara for several months of the cold weather when a depot of Bunyas is in full play there. I have in 2½ hours on a November morning, counted 200 men and boys with head-burdens of grain, red pepper, &c., &c., come into Koldwara. A good deal of *pahari* traffic is also done on the Laldhang and Amsote road.

Besides these three roads, the others within the forest are merely for timber-carriage, and do not require much to keep them in fair working order. The extension of the Sub-Siwalik road from Kaleedoongee by the eastern Laldhang towards Hurdwar, which it is expected will be completed this year by an additional 19 miles in this distict, is hardly an exception to this, for the amount of through traffic on it seems, at present at least to be very small. A much more important road, and one the state of which may bear very materially on the forest revenues, is the main longitudinal line, running parallel to, and at last on the outer edge of the forest from Nujeena to Nujeebabad, Amsote, and Kunkhul, on parts of which the amount of general and timber traffic is very large. It may be found that hitherto, the comparative amount expended on the internal forest roads has been smaller than it might have been, as the prospect of immediate or even direct return from them is not at once apparent, but perhaps in future more may be done in this direction.

The views as to future management deducible from the above remarks may be easily and briefly summarized.

1. Without indulging in the fertile hope of ever seeing any very large proportion of the forest cultivated which, were it possible, does not seem very desirable, so long as there is untilled land elsewhere in the Zillah, it is nevertheless an object to foster cultivation from either edge. That on the inner border and on the canals supplied from it, appears already to have rendered its profitable maximum or nearly so, and that outside will practically be limited by the the extent of capabilities for irrigation, at least until an absolute dearth of land for cultivation in healthier spots causes part of the non-productive dry forest to be reclaimed. From all I can learn, just as in the Kumaon Bhabur, from the fact of the typical Tarai being more fully developed there, and tolerably large streams being more abundant along its inner borders, the evils of the Sub-Siwalik tract were greater than here, so these very circumstances render its reclamation and consequent situation much more extensively feasible than to the west of the Ramgunga.

2. The adoption of some system of conservation for even the smaller tracts and steeps of *sâl.*

3. The careful selection, when possible, of respectable men with some capital as lessees, as they will probably be more amenable to rule and much less likely by indiscriminate cutting to exhaust the capabilities of the forest, especially in regard to bamboo, wherever it is found.

4. A large expenditure on the internal forest-roads, in particular the longitudinal Sub-Siwalik one, and the main transverse lines.

5. And last, as the railway lines approach, the adoption of some manageable system by which ⅓ or ½ only should be each year liable to wood-cutting and above all burning.

I fear that this paper with so many details that are often perhaps more curious than useful may give rise to the exclamation "Oh monstrous! but one half-pennyworth of bread to this intolerable deal of sack!" but in collecting the information necessary for it, I gradually came to the conclusion that the best way to treat it was to do so as fully as possible. And this for two reasons (1) no previous attempt has, so far as I know, been made to deal with the whole Sub-Siwalik tract, and (2) some of the topics treated of which may seem at first sight to have no very useful bearings, are in reality of some practical importance—*e. g.* the physical structure of the forest belt in its relation to the improbability of the whole ever being cultivated.

In conclusion, I may state the chief printed sources on which I have drawn for information connected with the various branches of the subject, to guide or supplement what I have personally gleaned.

In regard to the geography, structure, cultivation, &c., of other parts of the Sub-Siwalik belt near or remote, I have been indebted to Traill's Report on Kumaon, Mr. Batten's Report on the Kumaon Bhabur, Jones' Report on Rohilkhund Canals, Elliott's Supplement to the Glossary N. W. P., Strachey on the Physical Structure of the Himalaya, Jameson's Report on the Physical Aspect of the Punjab, and Hooker's Himalayan Journals.

Respecting especially the indigenous vegetation of various parts of the tract I have been aided by Hamilton Buchanan (in Martin's East India) Royle's Illustrations of Himalayan Botany, Griffith's Itinerary Notes, Hoffmeister's Travels in India, and Dr. Thompson's Western Himalaya.

And I have drawn largely on the following for information as to the production and qualities of timbers and vegetable products generally in neighbouring or distant parts of India. Madden on the Tarai of Kumaon (Journ. Asiat: Soc: Calcutta 1848), Col. Ramsay's Report on the Kumaon Forests for 1861, Capt. Pearson's Report on the Forests of Central India (1861), Col. Cuningham on the Stone and Timber of the Gwalior Territory, Munro on the Timber Trees of Bengal (J. A. S. 1847), Long's Indigenous Plants of Bengal (J. Agri. and Horticultural Society of India, vols. ix and x.), Drury's Useful Plants of India, Dalzell and Gibson's Bombay Flora, and Birdwood's Catalogue of Bombay Vegetable Products. To Col. Munro's paper in particular I owe the few figures I have given as to the strength and specific gravity of various kinds of timber, as opportunity and resources did not avail me to institute fresh experiments on the timbers of local growth.

Personally, however, I have had various advantages in investigating the geography and productions of the Bijnour Forest. Besides spending many weeks last cold weather (between Novr. 20th, 1862, and May 20th, 1863) in the forest for the pursuit of such investigation, I had the privilege of perusing Mr. Palmer's Forest Reports and examining the maps in his office, of making frequent inquiry on various points of Mr. Firm in charge of the Gurhwâl (and Chandee) Forests, and of constant reference to the official who of all in the district is, I conceive, best qualified to get and give information on such matters,—Anoop Sing, Tahseeldar of Nujeebabad. To each and all of these I have to confess my obligations, and I shall close with the expression of a hope that the multiform information thus acquired and here systematized may not prove altogether useless to future inquirers in similar fields.

RESEARCHES ON THE JUICE OF THE SUGAR CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

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(Continued from page 369.)

IN all my researches in order to determine the amount of saccharine matter in the sugar cane, I have always used simultaneously the optical analysis and the chemical tests generally employed. The agreement in the indications furnished in certain cases by this double method, as well the disagreement in other instances, have led me to conclusions extremely interesting, not only in a scientific, but also in a practical point of view.

I will not go into the details of the numerous experiments I have made on this subject ; the table and its explanations, which I have already given summarize, as it were, a great number of such experiments. It will be sufficient for me here to formulate the results obtained, the exactness of which can easily be verified.

1. When the cane, whatever may be its variety or the soil on which it has grown, reaches perfect maturity after a normal growth, the period at which it ceases to increase and when its constituent parts seem to experience neither gain nor loss—a period easily distinguished by the planter,—it contains almost entirely crystallizable prismatic sugar throughout the whole of that portion called the body of the cane, which stretches from the first knots of the root to those immediately situated under the green leaves still attached to the stem. The quantity of interverted sugar which the cane-juice then yields is always very small, and rarely exceeds the four-thousandth part of the weight of such juice, or the one-fiftieth part of that of prismatic sugar. Under the most favourable conditions, I have ordinarily found it to be the one-seventyfifth part. Thus the optical process, in such cases, furnishes directly, and after the inversion of the juice, notations which, for a determinate temperature, being referred to the rotatory powers of crystallizable sugar and of levulose, are generally similar, or only in the slightest degree dissimilar.

This quantity of uncrystallizable sugar, small though it be, is variable yet constant, when the examination is made of the juice from the entire portion of the cane. It increases in a marked manner when the juice is extracted from that portion between the knots of the cane nearest the top, and diminishes from this part to the middle of the body of the cane, where it is generally inappreciable.

2. If instead of examining the body of the cane, the examination be

made on that portion still covered with green leaves, sheltered from the direct action of the solar rays, there will be found in the extracted juice a considerable quantity of uncrystallizable sugar which, for ripe canes, may be averaged at one-sixth of the weight of the crystallizable sugar; and for unripe canes, at one-third of the same weight. It is then that the optical analysis leads to results considerably opposed to those of the chemical analysis; and what is noteworthy, and also showing the necessity of further investigation, these results are not always identical, for the same quantity of sugar shown by the chemical process. Under certain circumstances dependent on the age of the cane and the vigour of its growth, perturbations result which can only be explained by the marked differences in the rotatory power of the uncrystallizable sugar existing in the juice extracted from this portion of the cane. The saccharine liquid always causes the plane of polarisation to turn to the right; but after inversion, the notation to the left rarely agrees with the entire quantity of introverted sugar in the liquid, and is generally found to be represented by a figure lower than what should be attained. One instance from many I could cite, will be sufficient to give an idea of the considerable fall in value which such figure may ungo:—

Some juice extracted from the tops of some young Bellouguet canes with a density of 10·30 at a temperature of 25° centigrade, gave a direct notation + 8·3; and at 27° centigrade, an indirect notation—6·1, which indicated after acidulation a total quantity of sugar equal to the seventeen-thousandth part of the weight of the juice, whilst this very liquid really contained the fifty-four-thousandth part.

The proportion of uncrystallizable sugar in the head as well as in the body of the cane, increases in proportion to the distance from the lowest part, the maximum quantity being found in that portion which is completely shaded from the light by the sheath of green leaves. This portion of the cane top, the bark of which is uncoloured and very tender, is, so long as it is protected from the action of the sun, the principal seat of the liquid sugar which the cane contains; but immediately it becomes exposed by the drying of its leaves, it at once assumes externally a deeper tint, and at the same time the uncrystallizable sugar gradually disappears from its tissues, and yields its place to the real, or crystallizable sugar. This remarkable change can easily be observed on canes of the same kind and which form the same stems, by analysing at short intervals the portions of such canes more or less hid by the leaves, and then the corresponding portions of other canes as they drop their leaves and become tinted by the action of the light.

3. The age of the cane has appeared to me to be only an indirect cause of the phenomenon here noticed. In placing young canes in the conditions of aëration, light, and growth usual to this plant when it reaches the term of its maturity, I have thereby stated nothing special

with regard to the relative quantities of liquid and crystallizable sugar contained in the body or the head of the canes. It may be mentioned, however, in a general manner that the cane contains a greater portion of uncrystallizable sugar in proportion as it is younger; but it is to its active vegetation, and to the want of the action of sunlight on its stem so closed up by the fleshy sheaths of the leaves, that, in my opinion, is to be attributed the very large proportion of interverted sugar which it contains.

4. In this respect vegetation in an active state, or in a condition of diminishing activity has in fact an influence as great and as appreciable as that of light itself. Ripe canes which do not contain the least trace of levulose in the internodal portion of their length, become rapidly charged with a large quantity of this substance when brought again into full vegetation; and so long as their green and widely spread leaves are in an active state of renewal, and the buds detach themselves, and the plants preserve that appearance which is peculiar to them in their growing state, it can then be seen that their juice is highly charged with uncrystallizable sugar, principally in the newly-formed tissues and consequently less exposed to the light. In damp localities where the canes never ripen, and are constantly in full sap, uncrystallizable sugar exists in every portion of the plant, and sometimes in really considerable quantities. In the December of last year, after those continued rains which so deeply troubled the vegetation of the cane, the juice extracted from the body of a Bellouguet cane cut in one of the watered parts of the Island, contained 8·3 per cent. of sugar of which 1·7 was interverted and 6·6 were alone capable of crystallizing. During the entire period of the last crop, I experimented in different localities with a view to this specific subject, and the researches I then made confirmed the opinion I had already formed from the first experiments on my own estate. I have always found in the specimens of cane and juice which I have examined, and which came from localities the natural humidity of which had this year been increased by the abundant and unseasonable rains, a much greater quantity of uncrystallizable sugar than that contained in the canes which had been cut in the same localities in previous years. I thus found an average of 14 grammes of liquid sugar in 1,000 grammes of juice on an estate which had been abundantly watered during the whole of the crop, and only 4 grammes on another estate placed in more favourable circumstances.

When it is sought to determine the proportions of these two kinds of sugar in different phases of vegetation, it is found that the greatest quantity of levulose always exists in the canes which have pushed up the most rapidly; and, in this respect, those canes which are technically called "foolish," which sometimes grow in two months to a height of five feet with a transverse diameter of three to four inches at the base, are those which are to be placed in the first rank.

The analyses of one of these canes exhibits the largest relative quantity of uncrystallizable sugar which I have noticed.

Sugar	Crystallizable	8·6
	Uncrystallizable	2·4
Water, &c., &c., ...		94·0

It is important to remark that these "foolish" canes grow rapidly in the midst of extensive plantations which overshadow them, and they generally have a tender and uncoloured bark, one of the circumstances most favourable to the predominance of interverted sugar. When the canes, on the contrary, grow regularly and slowly in a field which receives the direct action of light, they hardly ever contain in their middle portion, even when the stems begin to lose their leaves, more than one-tenth of interverted sugar in the whole weight of saccharine matter contained in the juice. This proportion of levulose rapidly diminishes as the cane stem still more disengages itself, unless its growth suddenly assumes an abnormal activity.

5. Having admitted the preëxistence of uncrystallizable sugar in the cane, it becomes important to know the precise nature of this substance, and to determine if it proceeds or follows the formation of the crystallizable sugar which is equally found there; or in other words, if, by a process of modification, it gives rise to the former, or if on the contrary, it is not itself a product of the transformation of cane sugar properly so called. The inadequacy of the chemical means at present at command to isolate in a prompt and complete manner these two kinds of sugar without changing their original character, will not perhaps, until after a long interval, allow us to formulate the composition of the interverted sugar peculiar to the cane. My own optical experiments made for the purpose of appreciating the rotatory power of this substance, have, I am forced to confess, given me as yet but very uncertain results. It can however, be concluded from these experiments that the liquid sugar of the cane generally turns the plane of the polarising saccharometer to the left; that even this peculiarity is modifiable, and that under certain circumstances it has the property of partially turning to the right, and of not being interverted by the action of diffusive acids, as though it were then formed of a portion of the power of turning to the right, and a portion of the power of turning to the left, which is non-intervertable. Such an interpretation must be admitted in order to explain the contradictory indications furnished by the optical examination of the juice obtained from canes containing a high proportion of liquid sugar.

When after having directly examined this liquid, and interverted it, we again submit it to polarised light, it generally happens as I have said above that a deviation to the left indicates a smaller quantity of interverted sugar than what is furnished by the chemical analysis; but it also happens that the quantity is equal or only a little above that obtained by the direct notation before the acidulation of the juice. The rotatory power of levulose peculiar to the cane, without doubt stronger than that of sugar interverted artificially, is quite sufficient to explain what takes place in the first case ; but in the second case, it becomes necessary to admit that there exists in the juice a substance with a rotation to the right, which substance is something different from crystallizable sugar, and which is not susceptible of modification by acids.

Would not such a substance be the first state into which levulose enters in order to become crystallizable sugar? Without attempting to substitute hypotheses for facts, and theory for observation, it seems right to submit such a question as this, when we remember, as I have clearly established already, the predominance of liquid sugar in the cane, the juice of which has not as yet been completely elaborated ; the gradual diminution of this substance in proportion as crystallizable sugar augments ; and finally its continuance so long as vegetation is maintained, and its disappearence when vegetation becomes nearly stationary, and its reappearance when vegetative vigour recommences. Unless we make the absurd admission that the uncrystallizable sugar which, under similar circumstances, exists on the juice of the cane in its full vigour of growth is simply a product of change similar to that which fermentations and acids cause crystallizable sugar to undergo, it is difficult to regard in any other way than I have done, this transformation the phases of which I have described. Aaccording to this hypothesis cane sugar, that which definitely speaking, is found in its totality in the ripe cane, would not originate in the midst of the liquid which moistens the different parts of the vegetable tissue ; but it would be gradually formed at the expense of another body which, being greatly like it, would complete its modification under the double influence of vegetation and sunlight.

6. To resume : I may state that the sugar originally existing in the tissues of the cane differs in many respects from what is extracted from them in the full development and maturity of the plant ; and that it may readily be admitted that the crystallizable prismatic sugar is the definite result of an operation which takes place in the formation of glucose ; the latter however, is the lost term of an operation which can be produced artificially, while the former on the contrary, can only originate from the vegetable organisation and under the influence of the vital forces.

The processes I have followed in order to determine the nature and the quantity of sugar contained in cane-juice are those which at the present day exhibit the greatest precision, and which are generally employed under such circumstances. In having thus only followed the ordinary methods, I am thereby enabled to spare my readers a description of details which are familiar to scientific men. There is, however, a reagent which is personal in some measure to me, and which for this reason I take the liberty of remarking on before concluding the present chapter. This reagent is formed by the oxide of copper in solution in a concentrated solution of caustic soda ; and in its preparation some little care must be taken, without which the dissolution of the metallic oxide is not produced. A cubic demi-centimetre of a weak solution of sulphate of copper is introduced into a glass, upon which is rapidly poured about twenty-five cubic centimetres of soda, at the same time stirring the liquid rapidly in the glass with a small rod ; after decanting it, in order to separate a small quantity of the precipitated oxide of copper, a liquid of a beautiful deep blue is obtained which must be kept from the light. The contact of ammoniacal vapour must be carefully avoided, for any traces of this alkali would completely neutralise the effect produced by the solution. When required for experiment, about the proportion of one-third is added to juice which is thought to contain interverted sugar ; the mixture is then left to itself, and at the end of two or three minutes it changes from deep blue to violet red if there be the most feeble trace of glucose. No other substance existing in cane-juice has the property of producing such a decided change of colour, so that this reagent on account of its sensitiveness, and the great ease with which it may be employed, is very convenient when we wish simply to recognise the presence of interverted sugar in the liquid extract of any plant ; but on account of its instability, occasioned by the slow separation of the metallic oxide, it cannot be used as a means of testing, like the liquid of Frommherz.*

III. On other Organic Matters besides Sugar.

A considerable number of organic substances more or less defined have been pointed out as existing in cane-juice ; but as all of them are far from having the same importance during the operation of extracting the sugar from the cane, I shall at present confine myself to the examination of those only which have a positive influence on the qualities of the juice, reserving the others for some future occasion when they will be made the object of a special study. The basic acetate of lead mixed with the juice generates an abundant precipitate into which is drawn the greatest portion of the vegetable matters besides sugar ; this precipitate, as can easily be ascertained, contains also as salts of lead some of those acids found in the juice in combination with its alkaline bases. If

* This reagent as I showed several years ago, has the property of changing to violet under the influence of the albumen of egg, of blood, and of most of the liquid products of the animal organisation ; but it remains indifferent when in contact with albumen extracted from the vegetable kingdom, and that which is excreted in human urine in certain pathological cases. The azotised substances in the cane have not the power of changing the blue liquid to red ; interverted sugar is the only ~~body~~ capable of producing this transference of colour.

the acetate of lead be used to determine the quantity of these organic substances, we must then take account of the difference resulting from the action of this salt on the carbonates, chlorides, and sulphates of the juice; otherwise we shall be acting on a first product of too high a figure. The basic acetate has been employed; but from the precipitate obtained there has been deducted the weight of the quantity of those insoluble salts carried down at the same time with the vegetable matter. In the general table already given will be found the proportion of such matter for 1,000 grammes of juice from canes taken in different conditions of age, climate, &c., and I have estimated the average at 3·5 thousandths of the weight of the cane-juice. It has also been seen that pressure augments the quantity in the juice, which may thus occasion additional trouble to the manufacturer. Whatever kind of cane be examined, it is always in the uppermost portion that the largest amount of vegetable matters is met with. Those canes which are not completely developed, do not generally contain a larger quantity of it than the ripe canes, if we compare the weight of these substances to that of the juice, and not to that of the total matters dissolved as some writers on the subject seem to have done. If we group these different materials into three categories, the first embracing what has already been described under the name of granular matter; the second, the albumen of the juice or that substance capable of coagulation by heat; and the third one, or more azotized substances which can only be coagulated by alcohol and the metallic solutions, it will be found that they are on the average in the following proportions:—

Granular matter	0·287
Albumen	0·076
Other vegetable substances	0·637

and as they enter in totality into the juice for thirty-five ten-thousanths it results therefrom that one hundred parts of this liquid contain:—

Granular matter	0·100
Albumen	0·027
Other vegetable substances	0·223
	0·350

The albumen found in cane-juice coagulates at about 80° and is precipitated by powerful acids, without being re-dissolved in any sensible manner by an access of the reacting substance. After this albumen is separated by heat, there remains in the juice a complex organic matter which can be precipitated by alcohol and by the neutral acetate of lead, and which is very soluble in alkalis and acids, and even in tannic acid. Separated and purified by several precipitations in alcohol, this substance is without smell or taste, white, amorphous, without influence on polarised light, giving out ammonia when heated with lime or potash, and deliquescent, though only partially re-dissolving after its separation. Left in water, it forms a disturbed and viscid solution; mixed with sweetened water, it causes it to become equally viscid, and it appeared to me to be the real cause of that viscid consistence which the cane-juice and syrup assume before fermentation. This substance, escaping from the action of the agents used to purify the juice, accumulates in this liquid, and is found in considerable quantity in the syrups. It must, therefore, be considered as one of the chief causes which hinders the extraction of sugar at the second boiling, as it is a powerful obstacle to the regular crystallization of this substance. Complex in its nature, it plays an important part in the manufacture of sugar in the Colonies, and for this very reason it deserves to be studied in a more special manner. I shall presently determine the quantities of it which different kinds of syrup contain.

(To be continued.)

PIMENTO.

All the pimento which arrives in Great Britain comes from Jamaica, and is the produce of *Euginia pimenta*, Dec.—*Pimenta vulgaris*, Lindl. An inferior species (*E. acris*) with larger berries, grows in the Island of Tobago, and is occasionally imported into France. Jamaica enjoys a monopoly of this product. Every attempt to carry the seed to St. Domingo and Cuba, and to propagate it there has failed, and though the tree is found in Yucatan, the fruit is not exported thence.

The small, dry, reddish-brown berry is sometimes called Jamaica pepper, and often allspice, from its taste and flavour (qualities which reside chiefly in the cortical part of the berry) being supposed to resemble that of a mixture of cloves, cinnamon, and nutmegs. Its properties are chiefly due to a volatile oil. The pimento walks are situated in the mountains, on the north side of the island, where the trees grow in hundreds. It is a white-trunked, shapely tree, not unlike in shape and growth an English apple tree, but with a thicker, richer foliage, and dark, glistening leaves, aromatic, like its fruit, and resembling those of the myrtle, to which family it belongs. The trunk is white, because every year the bark strips. Nature seems to have intended that some useful purpose should be served by the bark, but hitherto it has not been made available commercially. The tree blossoms twice, but only bears once a year. The blossom that holds and sets to fruit appears in April. The trees form the most delicious groves that can possibly be imagined, filling the air with fragrance, and giving reality, though in a very distant part of the globe, to the poet's description of those balmy gales which convey to the delighted voyager

> "Sabean odours from the spicy shore of Araby the blest,
> Cheer'd with the grateful smell, old ocean smiles."

The tree grows spontaneously, and seems to mock all the labours of man in his endeavours to extend or improve its growth, not one attempt in fifty to propagate the young plants, or to raise them from the seeds, in parts of the country where it is not found growing spontaneously, having succeeded.

The usual method of forming a new pimento plantation (in Jamaica it is called a walk) is nothing more than to appropriate a piece of woodland, in the neighbourhood of a plantation already existing, or in a district where the scattered trees are found in a native state, the woods of which being fallen, the trees are suffered to remain on the ground till they become rotten, and perish. In the course of twelve months after the first season, abundance of young pimento plants will be found growing vigorously in all parts of the land, being, without doubt, produced from ripe berries scattered there by the birds, while the fallen trees, &c., afford them both shelter and shade.

At the end of two years it will be proper to give the land a thorough cleaning, leaving such only of the pimento trees as have a good appearance, which will then soon form groves, and except for the first four or five years, require very little subsequent attention.

In July and August, soon after the trees are in blossom, the berries become fit for gathering, the fruit not being suffered to ripen on the tree, as the pulp in that state being moist and gelatinous, is difficult to cure, and when dry becomes black and tasteless. It is impossible, however, to prevent some of the ripe berries from mixing with the rest, but if the proportion of them be great, the price of the commodity is considerably injured.

It is gathered by the hand. One labourer on the tree, employed in gathering the small branches, will give employment to those below (who are generally women and children) in picking the berries, and an industrious picker will fill a bag of seventy pounds in the day. It is then spread on a terrace, and exposed to the sun for about seven days, in the course of which it loses its green colour, and becomes of a reddish-brown, and when perfectly dry it is passed through a fanner, bagged, and is ready for shipment. The term sometimes used to denote the ingathering of the crop is not picking, but "breaking," because, with each cluster of berries a portion of the branch is broken off, the tree thriving all the better for the spoliation.

The returns from a pimento walk in a favourable season are prodigious. A single tree has been known to yield 150 lbs. of the raw fruit, or 1 cwt. of the dried spice, there being commonly a loss in weight of one-third in curing; but this, like many other of the minor productions, is exceedingly uncertain, and perhaps a very plenteous crop occurs but once in five years.

Before the war with Russia there was a large demand for pimento in that country, for use in spiced bread, but during the blockade it was found that a tree growing on the banks of the Amoor, yielded a bark which, when grated, was pungent enough to supply the pepper, and aromatic enough to yield the spice, and the Russian market was thus lost. Pimento is used as a spice in cooking, and in medicine in weak digestion, to relieve flatulency, &c. The dried fruit and flower buds of *Myrtus communis* were formerly used as a spice, and are said to be so still in Tuscany.

Pimento exists in sufficient abundance in many parts of the parish of Hanover, Jamaica, but the price has frequently fallen so low as 1½d. per lb., making it scarcely worth the expense of picking. From Hanover there were shipped 7,100 lbs. in 1855, 8,800 lbs. in 1856, 67,644 lbs. in 1857, and 184,459 lbs. in 1858.

In 1850, 1,022 tons of pimento were imported into the United Kingdom; in 1855, 2,115 tons, of which 1,200 tons were re-exported; in 1860, the imports were 1,000 tons, and in 1865, 1,279 tons.

NOTES ON THE RUSSIAN TALLOW TRADE.

BY J. R. JACKSON.

A Government Blue Book is not the kind of literature usually taken up to while away half an hour, still less do we see such a book in the hands of railway travellers or upon our drawing-room tables. A Blue Book indeed has an awfully official appearance, and perhaps is little known, except in particular instances, beyond the great commercial circles of London, Liverpool, Manchester, and those towns of smaller repute, but which fraternise with the above busy centres. If we take up the trade reports furnished to the British Government by Her Majesty's ministers abroad, though we may find an interminable list of figures, we shall also find much interesting matter. In a very voluminous report upon the present state of the trade between Great Britain and Russia recently laid before Parliament, are the following notes upon the Russian tallow trade, which may perhaps be interesting to the readers of the TECHNOLOGIST:—

Tallow is one of the principal articles of export from Russia, and in reality conduces more to the prosperity of the country than probably all the manufactures of Russia put together, and yet only one cask of P. Y. C. was deemed worthy of a place at the Exhibition of Russian

Industry in Moscow. The only conclusion to be drawn from such an absence of tallow exhibitors, is that the art is still in its rude primitive state, and that no improvements have been made in it that would secure honourable mention or a medal. Since 1856, Russia has, to a great extent, lost the monopoly of supplying Europe with tallow. The Crimean War stimulated the exportation of tallow from South America and Australia, and at its close the tallow speculators of Russia, still thinking they held the old monopoly, kept up its price artificially, and while in many cases ruining themselves, drove the consumers of tallow still more into other markets. In these, improved processes of melting have been adopted, and particularly in America, greatly to the advantage of the important article of commerce, both in quality and in price. The tallow trade of Russia has in the meantime retrogressed. No attention, or very little, has been paid to the improvement of native breeds of cattle, which have been left to the Steppes and the plague. Hundreds of thousands of heads have perished in this way, and the natural consequence is that the supply of tallow has been greatly reduced. While the cattle of the Steppes are still being swept off by disease in herds, the peasantry are not able to do much in the direction of improving their cattle, and the want of capital equally prevents the large landed proprietors from introducing a more extensive and improved grazing for cattle.

The cattle raised by the peasantry of Russia never gave much tallow, being of the leanest kind, and the murrain has made great havoc even amongst these—the last resource of the tallow-melters.

It is, therefore, not a matter of astonishment that the trade of Russia with foreign countries in tallow has fallen to nearly half its former extent, a decrease which is, of course, but little made up by a greater exportation of candles, which amounted in 1864 to 800 tons.

The home consumption of tallow has been at the same time on the increase. The manufacture of stearine, tallow, and other descriptions of candles is greatly increasing in Russia, and with it the price of the raw material.

The total quantity of stearine candles produced in Russia is only about 7,250 tons, or about 2,500 tons below the production of France. The total quantity of tallow candles manufactured in Russia is estimated at 95,500 tons. There were only twelve exhibitors of stearine candles at Moscow, of whom three were from Poland. The principal manufactory of stearine candles in Russia and in the world (the Neosky works, at St. Petersburgh), belongs to an English company. The prices ot stearine candles exhibited at Moscow ranged between 7d. and 9d.

EIDER-DOWN.

The genus *Somateria* is peculiarly marine. Dr. Sir John Richardson, whose opportunities of observing the northern birds were so great, and so well used, says that the king duck (*S. spectabilis*) and the eider duck (*S. mollissima*) are never, as he believes, seen in fresh water, their food consisting mostly of the soft mollusca in the Arctic Sea. They are, he adds, only partially migratory, the older birds seldom moving farther southwards in winter than to permanent open water. He states that some eider ducks pass that season on the coast of New Jersey, but that the king ducks have not been seen to the southward of the 59th parallel. Audubon, however, says that in the depth of winter the latter have been observed off the coast of Halifax, Nova Scotia, and Newfoundland, and that a few have been obtained off Boston, and at Eastport in Maine. The genus is remarkable for the high development of the exquisitely soft and elastic down so valuable in commerce, and so essential to the keeping up of the proper balance of animal heat in the icy regions inhabited by these birds.

Colonel Sabine mentions the eider duck as abundant on the shores of Davis' Strait and Baffin's Bay, but adds that, deriving its food principally from the sea, it was not met with after the entrance of the ships into the Polar Ocean, where so little open water is found. Capt. Lyon saw the eider in Duke of York's Bay. Capt. Sir James Ross notices vast numbers of the king duck as resorting annually to the shores and islands of the Arctic regions in the breeding season, and as having on many occasions afforded a valuable and salutary supply of fresh provision to the crews of the vessels employed in those seas. Speaking of the eider duck, he says, it is so similar in its habits to the king duck, that the same remarks apply equally to both. In Lapland, Norway, Iceland, Greenland, and at Spitzbergen, the eider duck is very abundant, and it abounds also at Bering's Island, the Kuriles, the Hebrides and Orkneys. In Sweden and Denmark it is said to be more rare, and in Germany to be only observed as a passenger.

Temminck states that the young only are seen on the coasts of the ocean, and that the old ones never show themselves. The down of the king duck is equally excellent, and is collected in great quantities by the inhabitants of the Danish colonies in Greenland, forming a valuable source of revenue to Denmark. A vast quantity of this down is also collected on the coast of Norway, and in some parts of Sweden. The eider duck is found throughout Arctic America, and is said to wander in severe winters as far south to sea as the capes of the Delaware. From November to the middle of February small numbers of old birds are usually seen towards the extremities of Massachusetts Bay and along the coast of Maine. A few pairs have been known to breed on some rocky islands beyond Portland, and M. Audubon found several nesting on the island of Grand Manan in the Bay of Fundy. The most southern breeding place in Europe is said to be the Fern or Farn Isles, on the coast of Northumberland.

Willughby, quoting Wormius, says that the eider "ducks build themselves nests on the rocks and lay good store of very savoury and well-tasted eggs, for the getting of which the neighbouring people let themselves down by ropes dangerously enough, and with the same labour gather the feathers (eider-doun our people call them), which are very soft and fit to stuff beds and quilts, for in a small quantity they dilate themselves much (being very springy), and warm the body above any others. These birds are wont at set times to moult their feathers, enriching the fowlers with this desirable merchandize. Willughby also remarks that when its young ones are hatched it takes them to the sea and never looks at land till next breeding time, nor is seen anywhere about our coasts."

This early account is in the main correct; but there are two kinds of eider-down; the live down as it is termed, and the dead down; the latter, which is considered to be very inferior in quality, is that taken from the dead bird. The down of superior quality, or live down, is that which the duck strips from herself to cherish her eggs. Its lightness and elasticity are such, it is asserted that two or three pounds of it squeezed into a ball, which may be held in the hand, will swell out to such an extent as to fill a case large enough for the foot covering of a bed. It is collected in the following manner:—The female is suffered to lay her five or six eggs, which are about three inches in length and two in breadth. These, which are very palatable, are taken, and she strips herself a second time to supply the subsequent eggs. If this second batch be abstracted, the female, being unable to supply any more down, the male plucks his breast, and his contribution is known by its pale colour. The last deposit, which rarely consists of more than two or three eggs, is always left, for if deprived of this, their last hope, the bereaved birds forsake the inhospitable place; whereas, if suffered to rear their young, the parents return the following year with their progeny. The quantity of down afforded by one female during the whole period of laying, is stated at half a pound net, the quantity weighing nearly a pound before it is cleansed. Of this down Troil states that the Iceland Company sold in one year (1750) as much as brought 850*l.* sterling, besides what was sent to Gluckstadt.

The haunts of birds capable of producing so valuable an article are not unlikely to be objects of peculiar care; we accordingly find that in Iceland and Norway, the districts resorted to by them, are reckoned valuable property and are strictly preserved. Every one is anxious to induce the eiders to take up their position on his own land, and when they show a disposition to settle on any islet, the proprietor has been known to remove his cattle and dogs to the mainland in order to make way for a more valuable stock which might be otherwise disturbed. In other cases artificial islets have been made by separating promontories from the continent; and these eider tenements are handed down from father to son like any other inheritance. Notwithstanding all this care to keep the beds undisturbed, they are not, as we shall presently see, scared by the vicinity of man, in some places at least. We proceed to give the personal observations of some of those who have visited eider settlements.

"When I visited the Fern Isles," (writes Pennant, it was on the 15th July, 1769), "I found the ducks sitting, and took some of the nests, the base of which was formed of sea plants, and covered with the down. After separating it carefully from the plants it weighed only three-quarters of an ounce, yet was so elastic as to fill a larger space than the crown of the greatest hat. These birds are not numerous on the isles, and it was observed that the drakes kept on those most remote from the setting places. The ducks continue on their nests till you come almost close to them, and when they rise are very slow fliers. The number of eggs in each nest was from three to five, warmly bedded in the down, ot a pale olive colour, and very large, glossy and smooth."

Horrebow declares that one may walk among these birds while they are setting without scaring them, and Sir George Mackenzie, during his travels in Iceland, had an opportunity, on the 8th June at Vidoe, of observing the eider ducks, at all other times of the year perfectly wild, assembling for the great work of incubation. The boat in its approch to the shore, passed multitudes of these birds which hardly moved out of the way; and between the landing place and the governor's house it required some caution to avoid treading on the nests, while the drakes were walking about, even more familiar than common ducks, and uttering a sound which was like the cooing of doves. The ducks were sitting on their nests all round the house, on the garden wall, on the roofs, nay, even in the inside of the houses and in the chapel.

Those which had not been long on the nest generally left it when they were approached; but those that had more than one or two eggs sat perfectly quiet and suffered the party to touch them, though they sometimes gently repelled the intrusive hand with their bills. But if a drake happen to be near his mate when thus visited, he becomes extremely agitated. He passes to and fro between her and the suspicious object, raising his head and cooing. M. Audubon saw them in great numbers on the coast of Labrador—where, by the way, the down is neglected—employed about their nests, which they begin to form about the end of May. They arrive there and on the coasts of Newfoundland about the first of that month. The eggs were of a dull greenish-white, and smooth, from six to ten in number.

Aububon states that, as soon as incubation has commenced, the males leave the land and join together in large flocks out at sea. They begin to moult in July, and soon become so large as to be scarcely able to rise from the water. By the 1st of August, according to the same author, scarcely an eider duck was to be seen on the coast of Labrador. The young, as soon as hatched, are led by the female to the water, where they remain, except at night and in stormy weather.

Sometimes two females deposit their eggs in the same nest, and sit amicably together. Both sexes assist in forming the nest though the female only sits ; but the male watches in the vicinity and gives notice of the danger. This seems to be confirmed by the account given of the nesting place at Vidoe.

The skin with the feathers on forms an article of commerce, particularly with the Chinese. M. Audubon is of opinion that if this valuable bird were domesticated, it would prove a great acquisition, both on account of its down and its flesh as an article of food ; and he is persuaded that very little attention would effect this. Indeed, it appears that the experiment was made at Eastport with success, but the greater number of the ducks were shot, being taken by gunners for wild birds. The same author says that when in captivity it feeds on different kinds of grain, and moistened Indian corn meal, when its flesh becomes excellent. Mr. Selby succeeded twice in rearing eiders from the eggs and kept them alive upwards of a year, when they were accidentally killed.

The eider duck has been, though with great difficulty, domesticated in a few places in Norway ; it lives there now with the greatest carelessness, and breeds even in the kitchens of the houses. Norway eider-down, from Tranoë, was shown in the Exhibition of 1862. A special kind of eider-down is collected by the Russians at Nova Zembla and Spitzbergen, it comes from the Gagka duck.

Capt. Beechey, in his account of Buchan's 'Voyage of Discovery towards the North Pole,' states, that on some of the islets in Magdalena Bay on the north-west coast of Spitzbergen, the king ducks were so numerous that it was scarcely possible to walk without stepping upon their nests ; and could we (he says) have divested ourselves of all consideration of the young birds, we might have filled several sacks with that valuable commodity, eider-down, of which their nests were composed. The down is of that tenacious character that it adheres to every rough substance it touches, and thus effectually prevents the nests being overturned or blown away by strong winds. The quantity of down required for one of these nests deprives the parent of a great portion of the down upon its breast, which is in consequence left nearly bare for a considerable time ; and it is quite pitiable to observe the condition of those which have probably been obliged to make a second nest. The males may also be seen occasionally with their breasts denuded of down, from their having contributed to the formation of the nests.

The following have been the imports of down into the United Kingdom in the last ten years, but the official returns do not show how much of it is eider down.

	lbs.	Value. £
1855	6,203	—
1856	2,147	—
1857	5,208	640
1858	2,995	337
1859	3,124	365
1860	3,464	393
1861	1,905	230
1862	18,610	2,514
1863	10,532	1,446
1864	10,204	1,403

ON THE PROGRESS OF THE SMALL ARMS MANUFACTURE.

BY J. D. GOODMAN.*

FROM the earliest times there is little doubt but that the smiths of Birmingham were renowned for the production of swords and pikes and other similar weapons, but it was not till the close of the seventeenth century, as we hear from the often quoted Mr. Hutton, that William III, at the suggestion of Sir Richard Newdegate, at that time one of the members for Warwickshire, employed certain manufacturers of the town to supply a quantity of arms for the Government service. Macaulay states that in 1685 the population of Birmingham was only four thousand, and at that day, he says, nobody had heard of Birmingham guns. Previous to this time England had obtained her supplies from the continent, doubtless chiefly from Liége. The gunmakers of Liége claim for their city the honour of being the most ancient seat of this manufacture. It is stated that in the principality of Liége it dates from the middle of the seventeenth century, when cannon were first introduced. Hand guns were invented about 1430. We hear of their being brought to England by Edward IV., when he landed at Ravenspur, in 1471, bringing with him 300 Flemings armed with hand guns. The match-lock was an improvement shortly afterwards adopted. This was followed by the wheel-lock, which was invented about the time of Henry VIII., and remained without change till the reign of Charles II., when it was superseded by the flint-lock. It was a demand for this gun, a few years later, by William III., that first introduced the manufacture into Birmingham. As the following letter may be regarded as the foundation

* Read at the British Association, at Birmingham, September, 1865.

of what has grown into one of the most important industries of the town, I make no appology for giving it at full length :—

"FROM CH. MYDDELTON, OFF. OF ORDNANCE, For their Mats. Service, to Sr. Roger Newdegate, att Arbury, near Warwick.

"These—

"Sr—Pursuant to an order of this Board, We have directed the sending to you by the Tamworth Carryer 2 snaphance Musquetts of differing sorts for patterns, desireing you will please To cause them to be shewed to ye Birmingham Workemen, and upon yor. returne of their ability and readiness to undertake the making and ffixing them accordingly—Or the making Barrells or Locks only, Together wth. the tyme a sufficient Quantity of Barrells can be made in to answer the Trouble and Charge of sending an Officer on purpose to prove the same according to the Tower proofe which is the Equall weight of powder to one of the Bullett alsoe sent you and their Lowest price, either for a compleat Musquett ready fixd or for a Barrell or a Lock distinct or together as they will undertake to make them. We shall thereupon cause further direction to be given as sha'l be most beneficiall for their Mats. service with a thankfull acknowledgement of yr. great favour and trouble afforded us herein.

"We are,

"Sr.,

"Your msot humble servant,

"CH. MYDDELTON."

"Office of Ordnance, 10th of January, 1689.

"J. Gardiner, Jos. Charlton, Wm. Butler."

Note by the late Sir Roger Newdegate, Bart. :—

"Before, all the guns for the Army were imported from Germany."

The term snaphance used in this letter is derived from the troops who made use of it.I These were a set of marauders whom the Dutch termed "snaphans," or poultry stealers. The use of the match-lock exposed them on their marauding expedition to this inconvenience, that the light from the burning match pointed out their position. They were unable to provide themselves with wheel-lock guns on account of their expense. In this dilemma they formed the snaphance from a study of a wheel-lock. The guns ordered from the Birmingham makers, although retaining the name, were of course an improvement on the original snaphance, and were no doubt a near approach to the flint-lock of modern times.

The first trial of the skill of the Birmingham men having resulted satisfactorily, we find that an order was afterwards transmitted to five manufacturers, Messrs. Wm. Bourne, Thomas Moore, John West, Richard Weston, and Jacob Austin to provide 200 snaphance muskets per month, for which they were to receive, on delivery of each hundred muskets 17s. each, ready money, in one week after delivery in the Tower of London, and that they were to be allowed 3s. for the carriage of every one hundred weight. This document bears date 5th January, 1693.

We have little or no information to guide us in tracing the progress of the manufacture till the commencement of the present century, when the military records enable us to ascertain the capabilities of the trade at that period, to which I will hereafter refer. Before referring to these figures, it may be interesting to trace the system at present pursued in carrying on this manufacture in Birmingham at the present time.

The manufacture of the various parts of the gun, or barrel, lock, &c., are distinct trades. These several parts are collected by the manufacturer, known as the gunmaker, and by him are set up.

The chief branches are as follows:—Stock making, barrel making, lock making, furniture making, oddwork making: and for military guns there are in addition, bayonet making, sight making, rammer making.

The stocks are of two kinds—beechwood and walnut. They are brought to Birmingham, cut from the plank into the form of the gun. Beech stocks are grown in this country, chiefly in Gloucestershire and Herefordshire. Walnut stocks are, with few exceptions, imported from Italy and Germany. One Birmingham contractor, to meet the demand occasioned by the Crimean war, established saw mills in Turin, and since that period has converted into gun stocks nearly 100,000 walnut trees. He has left but few sound walnut trees standing in the district in which he carried on his operations. The greater part of the supply was obtained in Piedmont, and smaller quantities from Ferrara, Bologna, and Modena. An average size tree yields about thirty gun stocks; those cut from the heart of the tree are most valued, and are used for first-class military arms and the best sporting guns. About one stock in five or six can be obtained "all heart;" the remainder are "sap and heart" and sap.

Barrel making is quite a distinct trade. For the manufacture of military barrels a somewhat large plant of rolling, boring, and grinding machinery is required. No barrels are made in England, except in Birmingham and its immediate neighbourhood.

The invention of making gun barrels by means of grooved rolls is due to a Birmingham manufacturer of the name of Osborne. It was on the occasion of the strike of the barrel welders that he was led to make the experiment. He was not allowed to introduce his system without opposition, for no sooner were his rolls set to work, than twelve hundred barrel welders, each armed with his forge hammer, proceeded to the private residence of Mr. Osborne, in the Stratford road, threatening its destruction. The military was called out before the disturbance could be quelled, and for many days afterwards a guard was placed over the mill in which the work was carried on.

Gun locks are made in Birmingham, and, on a still larger scale, in the neighbouring towns of Darlaston and Wednesbury.

Furniture, under which head are included the heel plate, trigger guard, &c., is made either of brass for military guns, or cast iron for common sporting guns, or forged iron for the better qualities.

The odd work, consisting of screws, pins, swivels, &c., is produced in Birmingham by manufacturers, who make also sundry implements connected with the trade, such as turnscrews, nipple keys, lock vices, &c.

The bayonets required for the military trade, form an important branch: they are made in Birmingham and West Bromwich. The sword bayonet, which has been largely adopted, is generally produced by the same manufacturers. Scabbard making is a distinct branch; scabbards are of two kinds, steel and leather.

On reference to the Birmingham directory of the present year (1865), we find 599 names as manufacturers, engaged in the different branches of the trade. Of these 174 are gun makers. Of the remainder the greater number are makers of different parts of the gun. Others again are workmen, such as stockers, finishers, engravers, &c. These are of the class who are out-workers, employing a few assistants, and work at the same time for different masters.

Gun making or "setting up," is again very much subdivided. It is only on the more important establishments that all the branches are carried on on the premises of the gun maker. More or less, outworkers are engaged in every branch. This system makes it extremely difficult to obtain a correct estimate of the number of workmen employed in the trade. Probably no master can tell how many hands he is employing at any given time, and the number varies from month to month with the demand. About ten years ago an endeavour was made to ascertain the number of hands engaged, and as the workmen themselves assisted in the enquiry, it was at the time no doubt a tolerably correct estimate. The number is less than at the present time, and probably it does not represent more than half the number called into requisition by the American demand during the war. With trifling exceptions, women are employed only in one branch, that of "making off," or giving the final sand papering and polish to the stocks, a light and not unsuitable employment. A few women are employed in polishing and barrel boring. It is difficult to say why such work has fallen into their hands, as it is both dirty and laborious.

The list of workmen employed estimates the total number at 7,340. Of these 3,420 are engaged in producing the materials, the barrel employing 700, the lock 1,200, the bayonet 500, and so on.

Setting up these materials into guns employ 3,920 men. Of these the three chief branches are the stockers, screwers, and finishers. Each of these branches, with its sub-branches, is estimated to employ 1,000 men. The stocker lets the barrel and lock into the stock, and roughly shapes the stock. The screwer lets in the furniture and remaining parts of the gun, and further shapes the stock. The finisher takes the gun to pieces, and distributes the several parts to the browner of the barrel, the polisher, the engraver, &c., &c., and when they are returned he puts the gun together, and finally adjusts the several parts.

The out-working system leads to the employment of a considerable number of young boys, who are employed mainly in carrying the work from one to another as it passes through its several stages.

No very correct estimate can be given of the rate of wages earned by the workmen in the gun trade. With very few exceptions the work is paid for by the piece, and the rate varies considerably with the demand. During the past ten years there is little doubt but that the wages earned in this trade have probably exceeded those in any other. Several branches require very high skill, and the remuneration is in proportion ; for instance, barrel boring and setting, stocking, rifling, lock-filing, &c. A judgment can be formed of the delicacy of workmanship required in the first of these branches, when I state that a military barrel has to be bored with such truth that it must receive a plug measuring 577 thousands of an inch, and is condemned as useless if it take one of 580. A workman in this branch, in full employment, has frequently been known to earn his 5*l.* to 6*l.* a week.

It is a very common practice in many of the branches for a workman to employ several assistants, whether working in the factory of his employer or as an out worker; such men, while paying those under them at the rate of 5s. to 10s. for boys, and 15s. to 26s. to adults per week, will take for their own share several pounds. A workman is held to be an inferior hand who, in any of the skilled branches cannot earn, single-handed, 30s. per week. It must be admitted that in many cases the high wages confer little benefit—the money is frequently wasted, and bad habits encouraged ; but, on the other hand, many are known to have saved money. Workmen in this trade will be found enrolled in one or other of the freehold land societies of this town, and living in houses of their own. The recent bank failure in Birmingham discovered savings which were little known before. In one case a finisher who had steadily remained in the employment of one master for twenty-five years, was found to have no less than 800*l.* lying in the bank.

Strikes have occurred in the gun trade, but happily not frequently. The gun makers engaged in the military arms trade are associated together, one object being the regulation of wages to be paid to workmen. The men, in like manner, act together, the respective leading branches having their own organisation. Master and men each know the strength of the other, and have on the whole so arranged their mutual dealings as to avoid disputes.

A serious strike occcurred in 1849, which lasted nine weeks. It was finally settled by arbitration. With that exception during the last ten years, but few difficulties have occurred.

The Birmingham workmen are much more highly paid than those of Belgium and France. We find it stated in evidence given by French gun makers before a Government commission, appointed to inquire into the state of the gun trade of France in 1860, that the average earnings of the French workmen were 3 frs. to 3 frs. 50 cents per day, or 14s. 3d. to 16s. 7d. per week. The same witnesses stated that in Liége the average earnings were 2 frs. 50 cents per day, or 12s. per week, but they included the earnings of women and children ; and as they were seeking protection from their own industry, were probably disposed to underrate the wages paid by their Liége competitors.

The low price of labour gives our Belgian rivals a great advantage ; on the other hand, the better paid and better fed English workmen can accomplish an amount of work considerably in advance of his Belgian workfellow ; and the English manufacturers possess a further advantage in the more extended application of machinery, the use of which in Liége is discouraged by the cheap rate at which hand labour can be obtained.

The Birmingham gunmakers have long been aware that a more extensive use must be made of the advantages which they do possess, and this has led to the erection in Birmingham of an establishment for the manufacture of guns by machinery, on the interchangeable principle. We must give America credit for the introduction of this system. It was from thence that it was brought into this country. The attention of the English Government was first called to the subject by a commission, of which Mr. Whitworth and Mr. George Willis, late head master of the Birmingham School of Art, were members. They visited the United States in the summer of 1853 for the purpose of inspecting the New York Exhibition, and while there, they extended their inquiries by visiting several establishments, among others the Government Arms manufactory at Springfield. Their report induced the Government to determine on the establishment of a manufactory at Enfield on the same system as that pursued at Springfield.

Before this resolution was carried out, the subject was warmly debated in the House of Commons. Mr. Newdegate, Mr. Muntz, Mr. Geach, Lord Seymour, and other members, strongly insisted on the impolicy of Government entering into competition as manufacturers with the private trade of the country, and it was agreed that a committee should be appointed "to consider the cheapest, most expeditious, and most efficient mode of providing small arms for Her Majesty's service." An opportunity was afforded to the gunmakers to give evidence. The result was that the committee recommended that the factory should be carried out only on a modified scale. The breaking out of the Crimean War shortly afterwards, however, led to this recommendation being disregarded, and the factory at Enfield was erected on a scale even larger than that originally contemplated. A second commission was sent over to the United States, with instructions to inspect the different gun factories in that country, and to purchase such machinery and models as might be found necessary for the proposed factory at Enfield.

The manufacture of small arms by machinery, owes its origin to the invention of a lathe for cutting irregular forms, which is due to an American of the name of Blanshard, a machine which the commission found had been used very extensively for about thirty years in the turning of shoe lasts, boot trees, oars, spokes of wheels, gun stocks, &c.

This machine was first used in the Springfield armoury, about twenty-five years ago. It seems to give only the external form to the stock. It was a work of time before other kinds of machines were perfected which were required for the subsequent processes of letting in the lock, guard, &c., but this was eventually accomplished.

I make no attempt to describe the great variety of processes employed to produce the sixty-two or sixty-three several parts which constitute the gun. It will be sufficient to say that the total number of processes under which an Enfield musket of the pattern 1853 undergoes is upwards of 600. Guns made by this system will interchange; that is, any part of one gun will fit another.

The factory of the Birmingham Small Arms Company, to which I have alluded, is now in working operation. The system is there carried out in its full integrity. It has been planned on a scale to produce a thousand guns per week. There are upwards of 300 machines at work, but at present it has not reached its full power. The number of guns now made there is about 500 per week.

The proving of barrels, with a view to the security of the public is a subject which has received the careful attention of the legislature. In 1637, a charter was granted by Charles I. to the gunmakers of London, for proving all manner of guns made within ten miles of London.

In Birmingham, the proof of barrels was left to each individual manufacturer, till in 1813 a public proof house was erected in Banbury street, and an Act passed rendering compulsory the proving of all barrels, made in England, either at the proof house of London or Birmingham. A second Act, giving more extended powers, was passed in 1815.

These regulations worked well for Birmingham, and the security which was felt in English guns materially aided in obtaining for our trade the high reputation which it enjoys. No change was made in the system pursued till 1855, when the inventions of modern times called for fresh regulations. They were embodied in an Act of Parliament passed in that year, which remains still in force. The security of the user was very greatly increased by the provisions of this Act. Under the previous one, barrels were proved only once, and that in a rather early stage of manufacture. It followed that certain descriptions of guns, as, for instance, rifles were grooved, and double guns when jointed together, were weakened after proof, and sometimes rendered unsafe. The present Act requires that all such barrels shall be proved twice, once "provisionally" as the Act terms it, and a second time "definitively," when the barrels are in a finished state, ready for setting up. The first proof may be regarded as the protection of the gunmaker, to secure him from the loss that would arise from bestowing his labour on an unsound barrel; the second proof protects the user.

Under this Act the gun trade is recognised as an associated body, to which all are entitled to belong who carry on the trade within ten miles of the borough of Birmingham, and who are rated to the poor at not less than 15*l.* A fee of a guinea is paid annually on registration. The trade is required to meet on the 9th of March in each year, when they elect the managers of the proof house.

I will now pass on to the amount of production in this country; and fortunately for purposes of accuracy I am enabled to refer to reliable statistics, giving the precise number of guns produced. I obtain this information from the several proof house returns, which have been most kindly placed at my disposal by the Government Superintendent of Small Arms, and by the authorities of the proof houses of London and Birmingham.

Before entering upon the recent statistics, I will refer to the information which we possess relating to the supplies produced at the commencement of the present century during the Peninsula war.

From a return published shortly after that period of the number of barrels made for the Government in the years 1804 to 1815, I find the total to be 3,037,644, or an average number of 253,137 annually. In 1804 the number produced was 80,000; it steadily increased up to 1813, when it reached 490,000 in that one year made for the Board of Ordnance alone.

During this period Birmingham produced barrels and other materials for the India Company, amounting to a million. This makes the total number of arms made in the twelve years somewhat over four millions, or 1,074 per working day. A large number of these materials, manufactured in Birmingham, were made up into guns by the London gunmakers.

To verify the traditional "gun a minute," said to have been the production of Birmingham during this war, we require 1,440 guns per day, or 525,000 per year. For this we must confine ourselves to the two highest years, 1812 and 1813, which produced respectively, including the India Company's supply, 581,682 and 654, 450.

It will be instructive to compare with the results now given the production of the French Government during the same period. The information is obtained from returns published in 1822, by M. Dupin, a field officer in the French service.

During the years 1802 to 1814, a period of thirteen years, the arms manufactured by France numbered 2,456,257, or about 200,000 annually. This number gives us for every working day 604 guns. The number made in England, it will be recollected, being 1,074 per working day.

At this time, it must be borne in mind, that France had at her command the resources of Liége and Turin, in addition to her own. St. Etienne, the most important seat of the arms manufacture in France, supplied 754,000, while Liége produced 279,900, and Turin 107,000. Seven other towns supplied the remainder.

With reference to the recent production of guns in our own country, I have collected the statistics of the last ten years, from 1855 to 1864.

The total number of guns and pistols proved in England during this period was 6,116,305. Of this number there were proved at the Birmingham trade proof house, 3,277,815; at the Government proof house in Birmingham, 978,249 (these last represent military guns made for the English service); at the London proof house, 1,355,139; and at the Enfield Factory, 505,102. The Enfield Factory has only been in operation seven years.

The average annual production will thus be :—

Birmingham trade proof house	327,781
„ Government proof house	97,824
London trade proof house	135,213
Enfield proof house	72,154
Making a total annual production for the whole of England	633,272

I have stated that at the Government proof house, in Birmingham, 97,000 military guns were annually proved, but these were not all made up into guns in Birmingham. The number includes those set up in London. The annual number divides itself into—

Birmingham	59,560
London	38,264

I have prepared tables showing the classification of the various descriptions proved at the Birmingham proof house. I may state that the proof house returns show that the proportion of barrels which fail in proof is as follows :—

	Per Cent.
Twisted barrels	5·67
Plain iron	4·57
Twisted military	1·20
Plain iron	1·35
Pistols	2·73
Average of all descriptions	4·15

It is difficult to give an idea of the range of prices of guns, as the the variety is so very great. There is one gun, however, of which neither the quality nor the pattern has changed for many years past, and which will serve as a barometer for the chief branches of the trade to indicate the variations in prices. It is the one known as the African musket. These guns are sent to the west coast of Africa, where they are interchanged for palm oil. No ship's cargo trading with that coast, is complete without a supply of them. Probably 100,000 to 150,000 of these guns, made in Birmingham, are annually exported. The cheapest made in the trade of this gun has ranged from 13s. 6d. the highest price in the twenty years, down to 6s. 6d. In the revolutionary year of 1848, it reached its highest point, from which it fell to 7s. in 1852. It rose from that time till in 1854, during the Crimean war, it reached 10s. 6d. The next highest point was in 1861, when it stood at 11s., since that period there has been a steady fall till it stands at this present moment at 6s. 6d., the lowest point touched.

From the returns I have in my possession, I have drawn out as accurately as I possibly can, the number of arms manufactured in Birmingham and elsewhere, for the Americans during the last four years. The first shot was fired at Fort Sumter on the 12th April, 1861. On the 9th May following, five purchasers of arms, some commissioned by different Northern States, others, private speculators, arrived in Birmingham. Each had so well kept secret the object of his mission, that when they found themselves all engaged in Birmingham on the same errand, they suspected each other of purchasing for the enemy, and their anxiety was increased accordingly to secure the few thousand arms that were then in store in Birmingham. The few on hand were at once shipped off, and large orders were given, which continued to occupy the trade at their full power, with one interval, till March, 1863. The interval I allude to was on the occurence of the "Trent" affair in November, 1861, which led to an embargo being laid on the export of arms on the 4th December, 1861. This embargo was removed early in 1862. On the removal of the embargo, one steamer took out from Southampton no less than about 40,000 rifles to New York. The trade worked at its full power, straining every nerve, till, I find by the return from the Birmingham proof house, that in one month, the month of October 1863, 60,345 rifle barrels were proved, being very few short of 2,000 per day from Birmingham alone, a number altogether unprecedented in the history of the trade. At that time the supplies produced in America at the Springfield armoury and elsewhere, began to tell upon the demand. We still find, however, that the numbers were 40,000 to 50,000 per month till March, 1863. They then fell to 14,000 per month, till in September, 1863, the Northern demand ceased altogether. Without notice the orders were suspended, and guns that had been sent over, were even returned to this country. The United States Government found at that time their factories were equal to supply the whole demand.

From the proof house returns I obtain the following numbers, showing the extent of the supply of arms from this country to America :—

Birmingham supplied	733,403
London	344,802
Making a total number of Enfield rifles sent to America of.	1,078,205

The figures now brought before you, have shown what Birmingham is capable of producing; but we must not wrap up in a mantle of self-satisfaction, and shut our eyes to what can be done elsewhere. It will not be uninteresting nor uninstructive to the gunmakers of this town, if we glance at what is being done by our competitors at Liége.

We have seen that during the last ten years the total production of England was upwards of six millions; but before we make a comparison with the Liége trade returns, we must deduct the number of arms made at the Enfield factory. This will bring our total to 5,611,203. The production of the Liége trade during the same ten years, according to their proof house returns, was 6,842,264, or something more than a million in excess of our make. It must be understood, however, that while the aggregate number produced in England is 17 per cent. less than that of Liége, the aggregate value of the English arms is greater. The Belgians make a very large number of pocket pistols at 1s. 0½d. to 1s. 11d. each. The proof house returns show that in ten years the number of pocket pistols proved was 2,305,176—more than one-third of the entire make of Liége. In the English returns we have only 588,477 pistols, or little more than one-tenth, and none of these are sold at anything like the prices of the common pistols of Liége. As the demand for English work runs on superior qualities, the English makers have never attempted to make pistols of this very low class.

We are enabled to arrive at a fairly accurate estimate of the value of the arms made by reference to the Customs' returns, which give us the number exported and their value. I have taken for my calculation the years 1857 to 1864 inclusive, as for those years I have also the value exported of Belgian guns, which is necessary for comparison. During those years the number of guns exported from England was :—

Number of guns	2,685,309
Declared value of ditto	£4,552,628
Value of each gun	£1 13s. 10d.

During the same years we have the Belgian value exported, but not the number of guns. I am obliged to assume that Belgium during those years exported as many of her entire make as England, although, in truth, she no doubt exported a great proportion, as we may be sure that the home consumption of Belgium would not be equal to that of England. The following statement will show the number of guns made and exported. The military guns made by the English makers for their Government, are excluded from the calculation :—

Number of guns made in England for ordinary trade	3,822,427
Of this number England exported	2,685,309
Number of guns made in Belgium for trade . .	5,390,675
„ assumed to be exported by Belgium . .	3,960,450
Declared value of Belgian exports	£4,743,296
Value of each gun	£1 5s. 2d.

The arms manufactured by the English trade for Government use, I estimate at 3*l.* each. This is somewhat below the real value, but it will be near enough for our present purpose. These data will give us the following results as the value of the production of the two trades during the ten years, 1855 to 1864 inclusive :—

Belgium		
Number of guns, at 25s. 2d. each . . .		6,842,265
Total value of Belgian guns		£8,609,849
England—		
Number of guns at 33s. 10d. each . . .		4,632,954
Value of ditto	£7,837,409	
Number of guns at 3*l.* each . .	—	978,249
Value of ditto	2,934,747	
Total number of English guns	—	5,611,203
Total value of English guns .	£10,772,156	

Although the value of our trade is thus shown to be more than equal to that of the only source of supply which at all approaches us in the extent of manufacture, it is manifest that the Birmingham gun trade must be on the alert if it is to maintain its ground. To contend against the cheap labour of Liége is not an easy task. The establishment of the machine factory, we hope, is a step in the right direction. It will secure for the town the trade in the highest class of military work, which otherwise would have gone to our competitors. Excessive prices for labour are still paid in certain branches of the work, particularly when sudden pressure comes upon the trade. A more uniform rate of wages would benefit all parties ; the master would feel more confidence in tendering for contracts at moderate rates, and the workmen would secure more regular employment. I hope the facts now produced will serve to call the attention of the trade to points so closely affecting its future progress and well-doing.

BLOOD ALBUMEN.

At the last meeting of the German Polytechnic Association held in New York, a late patent for the manufacture of albumen and prussiate of potash from blood, issued by A. H. Hirsch, in Chicago, was discussed. The old manner, still employed in Europe for this purpose, was described in detail, and amongst the disadvantages of the same it was mentioned that it consumed too much manual labour to be practicable in this country (America), as well as too much time, causing in the manufacture during warm weather the emission of unpleasant and unhealthy odours, which are the more objectionable here, as large quantities of blood can only be obtained in our larger very populated cities, especially the two great cities of the West, Chicago and Cincinnati, where the continual complainers about the "slaughter-house nuisance" loudly protested against any manipulation which would keep quantities of blood for several days in or near the city at a temperature most favourable for putrefaction.

In Chicago experience had shown that a wind blowing northward carried the most disagreeable perfume imaginable from certain glue-factories, situated about six miles south of the city, to the latter, pervading not only every street and alley all over its vast extent, but filling every house from basement to garret with the most abominable odour, sparing neither the marble palace on Michigan avenue nor the humble cottage in the distant prairie on the outskirts of the Garden City. The terrible scourge of the small-pox, which made such havoc in Chicago two years ago, and also made its appearance amongst the terror-stricken inhabitants last year, was chiefly attributed to this pestilence in the air, assisted by drinking water polluted with the decaying offal of the factories mentioned.

The old European, primitive method of manufacturing albumen has the other disadvantage of producing but a small yield of good albumen from the blood, the greater part being of a dark colour, making it unfit for calico-printing, the main channel for the consumption of albumen.

This was very apparent even to the superficial observer of the old method, which consisted mainly in receiving the fresh blood in shallow dishes, exposing the same to rest, and pouring the clear serum off from the fibrine settled at the bottom of those basins. Even in case of perfect separation this pouring-off can never be done completely enough to prevent the retention of a considerable amount of serum by the blood-corpuscles, or an admixture of the latter to the serum. Considering the old method of employing blood for the production of prussiate of potash, it had always been thought a disadvantage that this material was bulky, being, in the liquid state, not handled with such facility as other animal offals and sources of nitrogen.

The patent mentioned endeavoured to obviate these obstacles to the manufacture in the United States, which still are tributary to Europe for those products of industry, although the latter cannot boast of as enormous supplies of the raw material as we have at command in this country.

According to the same the blood, from whatever source coming, was run at once into tanks of sufficient capacity to hold the blood in question, filled partly with water, charcoal, iron-filings, and chemicals, to promote the separation of the liquid from the solid parts of the blood; the whole mass is thoroughly mixed by appropriate agitators and then exposed to rest, where the separation takes place readily in consequence of the dilution of the liquid and the nucleus, formed for the fibrine by the solid bodies present, the chemical nature of which prevents the evolutions of gases or odours of any description under all circumstances.

In place of rest, recourse may be had to a centrifugal for the separation of the serum from the blood-corpuscles, which will take place without loss of time, but requires some practical dexterity, so as to select a cloth of proper density and conforming with the speed of the apparatus for the complete separation of the serum without discoloration.

The clear serum is then evaporated in a vacuum to the consistency of syrup, and the concentration is completed in pans, in which it also might be carried through from beginning to end.

Another evaporator, used by the patentee, and offering an immense heating surface on the space it occupied, was described. It has but the advantage of cheapness over the other apparatus mentioned.

The albumen thus produced is transparent, of straw colour, while that made in the old manner was dark, the best sorts having the colour of common glue, running through all shades to complete black.

For the second portion of the patent the solid residue from the centrifugal was either calcined in peculiarly constructed carbonizers, which were described, or was mixed without calcination with melted potash in a furnace, having a cast-iron bottom, where an archimedean screw produced a thorough mixture of the residue and potash, both being used in equivalent proportions for the production of the prussiate.

As an additional source of nitrogen, the gases were used issuing from the carbonizers mentioned, where the blood-cakes, if advantageous, mixed with other animal offals, were charred. Also tar-water, if such was cheaply and conveniently to be had. The latter had its ammonia fixed by an acid, and the evaporated mixture is run slowly into the furnace.

The molten mass is then treated as usual, exhausted with water, and the resulting lye submitted to crystallization.—'American Artisan.'

PLATE GLASS MANUFACTURE.

The progress of the plate glass manufacture is very instructive. Owing to the obstruction of excise regulations, notwithstanding the reduction of the duty in 1819 to 60s. per cwt., the production in 1836 was but about 7,000 feet per week. In the latter year, however, the manufacture ceased to be confined to two houses; new establishments were formed, and in 1845 the production had more than trebled, at a great reduction of price. In 1845 the excise duties on glass were abolished, and Sir R. Peel, in proposing their abolition, said, "If you leave the manufacture altogether disburdened, as in France and Belgium, then, with your peculiar advantages of material, the command of alkali and coal, my belief is you will supply almost the whole world." And, thanks to the wisdom of that measure, freedom from fiscal regulation has opened the door to extraordinary advantages, by means of which the cost of production has been reduced to a point below that of any other country. In coal the savings effected by unrestricted action are no less than 80 per cent. in quantity alone, involving a corresponding decrease in the cost of furnaces, fire-clay, pots, tools, labour, and also in the erection of buildings that now suffice. The cost of coal, therefore, which in London, in 1826, exceeded 1s. 10d. on each superficial foot of glass, is now about 2d. per foot. Sand, also, which is its base, forming as it does nearly three-fifths of its composition, is now obtained near London in boundless supplies at 3s. 6d. and upwards per ton, of a quality superior to Lynn sand formerly used at 18s. per ton. The direct charge of labour, which in 1826 exceeded 1s. 6d. per foot, is now about 5d. per foot, and, notwithstanding this enormous reduction of more than 70 per cent., the average rate of wages for skilled labour is higher by 20 per cent. than forty years ago. In 1819 two furnaces, each having a huge chimney-shaft, were required to produce 1,000 feet per week, while at the present time two furnaces, with only one chimney-shaft, suffice for the production of 12,000 feet, with the same, if not a less, consumption of fuel. Similarly, though in a less degree, grinding and polishing benches which, then finished 200 feet each per week, now accomplish 500 feet to 700 feet, which, by judicious means, may be still further increased to 1,000 feet and upwards. By these means the whole cost has been reduced to nearly the price of common duty-paid window glass thirty years ago; and whereas in 1819 the British make was 3,000 feet per week, sold at 20s. to 25s. per foot, it is now 140,000 feet, selling at 2s. and upwards, according to quality. The former superior make of this country has, indeed, been greatly neglected, and this has led to a very large increase in the imports of the finest fabrics of France and Belgium, so that these imports amounted in 1862 and 1863 to about 16,000 feet per week, and those countries have had a corresponding sale in foreign markets in the absence of such supplies from England; but still the exports of British plate-glass have increased about tenfold since 1849. No manufacture of this description exists in all the eastern hemisphere, nor in the whole of America. The Japanese looking-glass still consists of costly, highly-polished steel. At home, glass is now extensively used in slabs for flooring and underground purpose, combining as it does greater strength than the York flag, with the additional advantages of conveying light; and flags tested at Woolwich dockyard have been found to bear a pressure exceeding a ton weight. About twenty-five years ago a supply of such slabs was required for the purpose of flooring a palace of one of the native princes of India, but the excise restrictions then prevailing precluded its supply from England at less than 30s. per foot; it could now be afforded at 3s. to 4s. The successful application of glass also to the sheathing of iron ships, as recently tested in the Royal Navy, and the consequent freedom from the incrustation inseparable from both wood and iron, indicates a new and important opening in the further progress of the trade. In fact, its true position has yet to be attained, when the resources of this country shall have stimulated that more full development of which it is susceptible, and Great Britain shall, as the author of the freedom of this industry predicted, "supply almost the whole world."

Persian Opium.—Opium is produced at Meshed, and is exported to Bokhara and Khokand. The opium produced at Yezd is said to be of excellent quality, but exporters have of late so adulterated it, that it is said the whole quantity which has lately been sent to China will probably be returned. A French gentleman went out last year to make inquiry as to the quality of opium produced in Persia, with a view to supplying the hospitals in France. He expressed himself highly satisfied with the result of his investigations, having found the best Persian opium to contain as much as 17 per cent. of morphine, but that it would be necessary to take great precautions in purchasing, to prevent adulteration.

Chefoo-Peas are largely imported in junks from New-chwang and are then transhipped on board foreign vessels, for conveyance to the southern ports, Canton (through Hong Kong) taking the largest quantity. When these peas are crushed into cakes (bean cake) they are exported to Swatow, at which port they are used as manure for the sugar crops. The number of mills employed in the manufacture of these cakes is considerable. The process is slow and simple. A huge stone wheel (to a pole passing through the centre of which a mule is harnessed) crushes the peas as it passes round a circular narrow causeway, into which they have been thrown. These, in their crushed condition, are packed in moulds and placed in a press, whence they are extracted free of the oil, which has passed into the receptacle prepared for it.

THE TECHNOLOGIST.

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POPULAR BOTANY, AN ILLUSTRATION OF SOME OF THE MOST INTERESTING PHENOMENA CONNECTED WITH VEGETABLE LIFE.

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The study of Natural History opens for us so many sources for moral reflections and pure enjoyments, and rewards us at the same time with so many valuable developments useful to practical life that it can hardly be sufficiently appreciated. Whoever has an opportunity should regard it as a duty, to aid and to sustain every branch of this science to the best of his ability. And as it was my fate to pass more than thirty years of my life among plants, where the most favourable opportunities were offered to observe and study their life and habits, it affords me great pleasure to communicate to those who take interest enough in this branch of natural history some of my own observations and reflections in connection with other facts more generally known. The main object of this essay will tend to sum up and explain some of the manifold and interesting phenomena connected with vegetable life; to show some of the important functions which vegetables have to fulfil in the natural economy, and also the great wisdom and care which have necessarily been bestowed upon them, with regard to their creation, preservation, propagation, and diffusion over the surface of our globe. It would be to me a great gratification should these remarks make a lasting impression on the moral feelings of those who peruse them, and lead to a greater interest in the study of Natural History in general.

In order to be more perfectly understood I will try to avoid as much as possible all scientific terms, and wish, therefore, to have this paper regarded as an essay on popular botany.

The English word Botany is derived from the Greek, and signifies that branch in Natural History which comprehends all that relates to the vegetable kingdom.

With regard to its purpose, botany is divided into two branches, namely :--The theoretical, which has for its object the investigation of scientific matters ; and practical, which aims to take advantage of this science for pecuniary profit. In the last named are included agriculture, floriculture, pomology, &c.

The origin of plants dates, without doubt, as far back as the period when the surface of our globe was sufficiently prepared for their reception and lasting nutrition ; at all events, the creation of vegetables must have been long before that of the quadrupeds for these being for their subsistence almost exclusively dependent on vegetables, either directly or indirectly, and as one single animal frequently devours more vegetable matter in one day than many thousand plants will produce during a whole year, an abundant number of the latter were needed for the continuation of animal life.

There is good reason to suppose that plants at first were constructed on much more simple forms than we are accustomed to meet, and that in the course of time and through the might of influences, they have gradually become more various and perfect.

This change in the forms of plants, however, passes on so very slowly that a man's life is not sufficient to observe them. The evidence for the supposition already mentioned must, therefore, be derived from other facts, namely, by excavations.

A great many well preserved antediluvial plants have been thus discovered, which are recognized as plants of our days, but more simply constructed.

The indispensability of vegetables in natural economy cannot be better illustrated than by the fact of their existence everywhere. Plants are found on our globe as far north and south as it has been explored ; their region extends from the deepest cave up to the boundary of snow on the highest mountains ; far beyond that of the spheres of animal life.

They grow in almost every kind of soil ; in sand, in gravel, clay, chalk ; in swamps, in water, on stone and rocks ; on living and mouldering wood, and even on living animals. It is obvious that according to their location and the different functions they have to fulfil, they must be differently constructed.

Vegetables are not only created for their own existence, but also as an indispensable means of maintaining animal life. Should it happen, for instance, that all the vegetables of our globe were destroyed, hardly any animal would be found alive in a short time thereafter. With regard to this great function, plants have been particularly favoured by nature, especially in regard to their independence, propagation, vitality and reproduction. While animals have been gifted with free will and voluntary motion, plants are chained to the ground ; but vegetables, in return, have been endowed with other advantages, which will counterbalance them to a certain degree. So, for instance, most of the plants are hermaphrodite, combining the conditions of propagation in one individual. When most of the land animals produce, as a general rule, from one to two young ones per annum, and rarely more than twenty, a single plant usually produces during the same time many thousands ; nay, ferns, lichens and mosses even several millions of seeds—each containing the germ of a new vegetable life.

Besides by seeds, the propagation of plants takes place in a natural way, by root-shoots, suckers, runners, layers ; by bulbs, by bending over of branches, by dropping of twigs and leaves—without regard to the many different artificial manipulations, whose success is really astonishing.

In regard to vitality and reproduction I refer to the fact that animals usually die when deprived of integral parts of their body ; plants retain their vitality when totally deprived of their leaves, branches, and even stems ; as the grass on meadows, where cattle graze, is eaten off and reproduced sometimes once in twenty-four hours. As further evidence for my statement, I will mention that plants produce, with the assistance of light, air and water, nourishment enough of themselves for the sustenance of their life and growth, independent of any other succour.

As soon, for instance, as the frost has interrupted the circulation of sap in vegetables, the leaves of most of the trees and shrubs, or the whole growth of annual and perennial plants drop to the ground ; and not only serve as a natural protection for the roots or seeds against the cold, but more warmth is also produced by the chemical process of decomposition, for the same end. From the dropped and decaying leaves, brushwood, and other matter, a quantity of humus or leaf-mould is produced, of which the rain-water will dissolve the soluble parts and penetrate, with them, the bottom ; from which latter the roots will absorb them again, in order to use them for the further growth of the plants.

Besides the nourishment from the humus, the roots also absorb some different liquid earth-salts out of the soil; while the leaves absord and decompose on their surface a part of the carbonic acid gas of the atmosphere. By this reason the foliage produced in this way weighs always more than both the absorbed humus and salt together would amount to. This fact has given rise to the introduction of a peculiar mode of manuring. In countries, for instance, where manure is scarce, poor fields are sown with the seeds of easy and vigourously growing plants, such as peas, vetches, lupins, &c., and as soon as they reach their maturity, they are plowed under. Now, by the decomposition of these vegetables, the ground will gain more manure or humus than the previous crop had absorbed from the poor soil, and in this way the fields are very much improved.

The constituent parts of the plants are, in general, roots, stem, leaves, calyx, corolla, germ, pistil, filaments, fruit, and seed. Besides these, many plants are found to have other organic parts which, however, would be too numerous to mention in this place. Every one of these organs has its certain function to fulfil. The root, for instance, serves simultaneously as an anchor to fasten the plant to the ground, and, at the same time, to absorb nourishment therefrom. In the tender stage the plant must depend on the root only for its support. Roots and stem always grow in their due proportion ; the former, however, must always be a little in advance, in order to fulfil its functions as the anchor, as well as supporter. The stem serves as the medium of communication between the root and the other parts of the plant. The leaves absorb and decompose a portion of the carbonic acid gas from the atmosphere. The calyx affords protection for the developing blossom. The corolla envelopes the delicate germ, pistil and filaments. The germ is the nucleus of the future fruit ; the fruit contains the seed, which latter, for the most part, furnishes the common means for future propagation.

It would become too tedious here to describe all the functions of the parts above enumerated ; I will therefore confine myself, on this occasion, to a few hints on the different ways and means of which Nature makes use for the distribution of plants over the surface of our globe. Although plants are not endowed by Nature with voluntary motion, still they will travel by degrees over the whole earth. One of the most common means for this effect is the wind. The seeds of many families of plants, as for instance, ferns, mosses and lichens, are so exceedingly dust-like that they are taken up by the wind in large quantities and transported to a distance of hundreds, nay, thousands of miles.

At certain seasons the atmosphere is filled with these invisible atoms by the million, and they are kept afloat until they come in contact with some object to which they adhere, and under favourable conditions they germinate and grow. This fact is easily observable on the shady side of brown-stone houses. Where there is sufficient moisture to germinate the plants, there we find a green substance accumulating particularly about the steps, which is nothing else than the young plants of mosses, lichens or ferns.

The seeds of many other plants are covered at the apex with a hair-like tuft—pappus—for instance, the thistle, dandelion, aster, &c. This renders such seeds also buoyant and susceptible of being easily floated through the air, yet not to so great a distance as in the former case. In other cases the seeds are enveloped in a woolly substance, as the cotton, willow, poplar, asclepias, &c., and they are conveyed away in the same manner as the former. Some seeds are provided with membranaceous and wing-like appendages, as the maple, ash, elm, pine, &c. These are also carried away by the same agency of the wind, to a shorter distance.

Another very important agent for the distribution of seeds is water.

By heavy showers of rain, producing inundation—a great number of different seeds will be taken up and transported from rivulets to rivers, and by these to the sea, and thus be wafted to distant shores, where under favourable circumstances they may germinate and find an asylum.

Another agency for this distribution we find in birds. These are in the habit of using berries for nourishment; they swallow them frequently without crushing the kernel. And as the digestive power of their stomach is not sufficient to destroy the vitality of the germ, and they sometimes fly to great distances before these undigested seeds are discharged through the natural channel; these seeds are frequently found to germinate and thrive in parts far away from the place where the berries were swallowed. Amateur gardeners in Sicily are in the habit of shooting migrating birds which return early in spring from Arabia, and to sow the contents of their stomachs, with the purpose of raising in this very manner new Arabian flowers for their gardens.

The same case will sometimes, though more seldom, occur with quadrupeds. But animals contribute to the distribution of seeds in other ways. Some seeds such as the burdock, agrimony, Bidens, &c., are provided with barbs. When animals come in contact with those seeds, they become fastened to the hair or wool, and thus they are carried often for a length of time, and frequently are not deposited before the hair or wool drops off. Sometimes such animals, covered with seeds, are killed, and their hair, wool, or hides exported to foreign countries. In cleaning these products, the seeds are often cast into the rubbish of the street, and thence they find their way into the fields, where under favourable conditions, they successfully germinate and occupy a new home. In this way many Asiatic plants were imported in camel hair; many South American ones in the hides of oxen and the wool of the alpaca, &c., and many Russian plants in Northern furs.

Plants are furthermore distributed by the elasticity of their seed-capsules. In approaching maturity, or when the capsules have attained a certain degree of hardness, the cohesion of parts will be broken, as that part immediately containing the seeds rolls itself up with great rapidity and a sort of spiral contraction, by which process the seeds are scattered about for a distance of sometimes ten yards, and even more. To this class belongs our common lady's slipper, Fraxinella, sweet peas, &c.

Another and peculiar process by which seeds are scattered abroad occurs with the *Momordica Elaterium*, a plant used in the old school of medicine, and which is one of the cucumber tribe. On approaching maturity the juice of this cucumber undergoes fermentation to such a degree that the contents of the same, pulps, seeds, fluids and gases are thrown off through the aperture of the fruit stalk with such force as to reach sometimes a distance of fifteen yards. This will happen, also, if the ripe fruit is pressed by a too careless handling, so that the uninstructed may be served a severe practical joke, and find themselves much surprised and annoyed on having the contents of this repulsive fruit thrown in their face.

Finally, one of the most extensive distributions of seeds is effected by the commercial exchangs of grains. Through this channel we find not only the desirable supply of breadstuffs and the useful products of different climes exchanging localities, but also the undesirable varieties of noxious weeds and foul plants, surprising and annoying the gardener and farmer, who only bargained for a new variety of wheat or some other grain. The greater part of these so-called weeds, and many other plants growing in the vicinity of cultivated grounds, have been introduced in this way. It is, therefore, now difficult to determine which of these plants are of American or foreign origin. I shall never forget my surprise on finding, in the year 1818, in the vicinity of Cologne, such a variety of strange plants. The weather in the years 1816 and 1817 was so exceedingly wet that no grain of any kind could come to maturity, on which account the government thought it prudent to import the necessary seed-grain from Russia at government expense, in order to prevent famine, and with these grains a number of Russian plants were introduced to the vicinity of the Rhine.

It is very interesting to observe with how much effort plants endeavour to produce seed, or to propagate themselves in other ways ; for instance, in the case of plants whose flowering season in a natural state is only of a short duration; if we pluck their flowers before they have matured their seed, the plants will persevere to flower again and again, as if never satisfied short of the full maturing of their seed, for succession. In accordance with this principle, amateur gardeners keep most of their favourites almost constantly in bloom.

As before mentioned, plants propagate themselves in many other ways than by the production of seed ; for instance, the weeping willow, the wild cotton tree, the weeping ash, &c. When their long pendant twigs reach down to the ground and are supported by the wet weather they take root, and by reaction the little twig becomes the trunk of a new tree. This tree, in its turn, elaborates the same process, until sometimes, in wild uncultivated countries, a space of even several miles in extent is thus spontaneously produced from one original standard tree.

The same occurs with some perennial plants, driving out runners ; for instance, our strawberries, ranunculus, Potentilla, &c. These plants send forth slender feelers, so far from the mother stock as not to interfere with each other, and then take root, and become independent plants. As soon as these young plants have attained a certain size, they also throw out their own feelers, and in this way we find often a considerable surface covered from a single plant. One of the most interesting of this kind of plants is the *Saxifraga stolonifera*, a plant most commonly used for hanging pots. This plant which grows, as far as I can recollect, at the northern sides of the Italian Alps, will certainly not reach the lower regions with the rapidity of the wild goat, but it will reach them just as well and surely with much less trouble and danger. Some other plants resemble those just described, but throw out their runners *under* ground instead of over the surface; for instance, our quackgrass, thistle, convolvulus, and others. These plants embrace some of the most troublesome weeds; as the smallest piece of root will become a new plant, if not carefully taken up after digging or ploughing.

The power of reproduction in many plants is so strong that small twigs or even dropped leaves, if placed in the least favourable position will take root and form a new individual.

Of many perennial plants the old root will decay every season, but not until it has produced a number of young roots, each of which will become a new plant at the next succeeding season.

The so-called bulbous roots, for instance:—hyacinths, tulips, crocus, and others, yield a brood of small bulbs every year. Some others, as *Lilium bulbiferum* and *Dentaria bulbifera*, bear besides those of the root, small bulbs between the leaf axil; and others again, as *Allium viviparum* the so-called grape onion, bear, entirely developed, small onions instead of flowers, and each of these little onions also often drive out another stem, each of which is crowded with still another crop of onions.

For their full development plants in general need a full share of light; without this they will pale, droop and die. The effect of this is nowhere more forcibly manifested than in very dense forests. As the light in such places can fall only from above, every tree endeavours to receive as much of light as can possibly be obtained, and for this end a strife as for life and death will ensue. Accordingly, the trees grow with an almost incredible rapidity to an enormous height; such are generally quite straight, but often not thicker at the bottom of the trunk than at the top. And should any one of them fail to keep up the contest he is lost! His neighbour trees will overgrow and then spread their branches over such a weary one; shut out from the necessary light the tree will suffer death, while the remains of his decomposition will serve as food for the more successful rivals.

Plants are generally organised in a way to live in soil of very different composition; the quality of the latter, however, bears still a great influence upon their habits. So, for instance, may a plant in poor barren soil grow to the height of ten inches which would reach the size of twelve feet in rich or more convenient soil. For this reason it is often very difficult to recognize these two so unequal individuals really as sisters.

Many other plants, however, are so dependent on a certain admixture of soil, that their appearance can serve as a true hint to geologists for the discovery of certain strata of earth. As, for instance, we can surely depend on finding a layer of zinc, where *Viola calaminaris*, *Statice Armeria* and *Spergula muscosa* grow naturally on the surface.

While these three plants indicate the presence of zinc, other kinds in return point to the layers of lead, copper, iron, coal, lime, chalk, gypsum, marl, &c.

A very interesting demonstration in regard to the abilities of plants to accommodate themselves to conditions of locality, presents itself to the naturalist in swamps which are occasionally inundated, particularly if the water on some places is kept running for some time. For instance, plants grown in swamps, and constructed to live in the open air, would certainly be drowned, when set under water for a long time, if they were not provided with the means to rescue themselves from such a dilemma. Under this difficulty, full grown plants begin once more to grow, not seldom to a great extent until they have reached the surface of the water, where the leaves lay down ; while the stem takes up again its ordinary functions. On places, however, where the water is running, the plants or their parts will appear in entirely different forms—namely, by the continual side pressure of the water the new growth will be unnaturally extended, or, as if it were pulled into the shape of long slender threads, and the foliage will undergo a similar change, whose flat forms were altered into long thin splits. In case such an extended stem should reach a place where the water stands still, the leaves will appear again in their original large shape. When the water on such inundated places runs off or is evaporated, the plants become so tender that they cannot live in the open air any more. The whole growth therefore, must decay as deep as to the roots, and the new plants which shall spring up from them appear also in their original form again.

These and other similar changes in the forms of plants bring young botanists often into great confusion, and have also given rise to many discussions and different opinions among the experienced.

I can hardly let this occasion pass without referring to the peculiar organisation of a plant which grows frequently in our ponds—namely, the *Utricularia vulgaris*, or bladder-weed. The stem of this plant is so herbaceous and weak that it cannot bear its own weight, and is therefore constantly submerged. These plants, however, belong to the annuals which, must bear seed every year in order to reproduce themselves anew ; but as the production of seeds cannot take place under water, and as the stem is notable to rise above the surface, Nature has found an ingenious plan. The setaceous leaves have been provided with a great number of small bladders filled with light gas, and by means of these buoys, the flower-stalks are raised to the surface, where the fructification takes place, and after the seeds have grown to maturity they drop to the bottom of the water, from which they spring up again at the following season.

Having now paid some attention to those plants which are accustomed to grow in soil and water, we will now turn to the parasites—such plants namely, as are in the habit of growing on trees, or stones and rocks, &c.

Those who have not visited primeval forests can form no idea of the beauty and the magnificence of such an appearance. In the forests of the tropics we frequently find trees of the greatest age and the most gigantic forms covered with those parasites from the bottom to the point. They generally belong to the tribes of ferns, lycopodia, bananas, orchids, &c. Such an old tree represents somewhat a botanical garden, where a botanist can easily spend a month or more in order to make his studies and collections. The most interesting among these parasites are the orchids, particularly remarkable for the shape of their flowers, the brightness and great contrast of their colours, &c., for which reason they are now so frequently cultivated in our hothouses. The parasites are used to live at the expense of the moisture of the atmosphere. We now arrive at that class of plants which commonly grow on mouldering wood, on stones, rocks, &c., namely, the mosses, ferns and lichens, and by illustrating their habits we shall find that their functions in natural economy are of much higher importance than would be generally supposed. These plants may be regarded as the true pioneers of vegetation. It has already been stated that the seeds of these families are so very light and dust-like, that they are taken up by the wind in large quantities and carried away to great distances, and frequently reach stones, rocks, and even distant barren islands, where they often germinate and grow, supported by the moisture of the atmosphere.. When in course of time these plants or parcels of them die and decay, a small layer of humus will be produced, in which the second generation, however, will grow and prosper more rapidly. By this continued change of growth and decay such an increased layer of humus is produced—though often not till after the expiration of centuries—that larger plants and even the largest trees can grow and prosper in it. If we had the means of tracing back to its origin the history of many an island, especially of coral-reefs, we should in all probability become convinced that vegetation on them began and continued in this very manner.

Among all the different functions of vegetables none are more interesting and of higher importance in regard to our own existence and health, than the manner in which these are instrumental in purifying the air by decomposing the poisonous carbonic acid gas of the atmosphere, and reproducing therefrom the necessary quantity of oxygen gas.

Although the explanation of this process is somewhat circumstantial and the comprehension of it requires some knowledge of chemistry, I will endeavour to the best of my abilities to illustrate this process in the most popular way.

In order to reach this my aim I am obliged to start with the explanation of many other facts, connected with the phenomenon alluded to. We are all familiar with the fact, that no being that breathes through lungs is able to live for even a short time without inhaling atmospheric air. Beside, that by the condensation of this air the animal heat is produced and sustained, the same effects also a very important alteration in our blood. When the air, consisting, as we all know, of about sixty-six per cent. nitrogen gas, and thirty-three per cent. oxygen gas—comes in connection with the so-called chyle in our lungs, both of them (namely, the air and chyle) undergo thereby a strange alteration. The white chyle deprives the air of a part of its oxygen, changes thereby its white colour into red, and is thereafter real blood, which is then pumped by the pulsation of the heart through the veins of the whole body, for the purpose of developing and nourishing the same to the remotest extremities.

As equivalent for the oxygen received, the chyle, however, delivers to the oxygen of the atmosphere a part of the superfluous carbon, producing thereby carbonic acid gas, which after this process is exhaled in company with the unchanged atmospheric air, nitrogen gas, and some moisture, which will intermix with the atmosphere.

Beside by exhalation, carbonic acid gas is produced by the process of burning, of fermentation, putrefaction, by volcanic eruptions, by escaping from natural mineral springs, and many others. If we now consider how many millions of human beings and animals have already lived and breathed since the Creation ; how much combustion has taken place, and how many substances, both vegetable and animal, have gone to decay, &c. ; and if we consider further more, that by all these occurrences oxygen is constantly absorbed from the air and carbonic acid gas produced in return, one would fear that after the lapse of time the oxygen would decrease, while the carbonic acid gas would increase in such proportions that animal life could no longer be possible.

The learned men of the olden times entertained this idea, hinting frequently at this danger, and as the effect of the carbonic acid gas is suffocating, when exceeding the proportion of four per cent. in the atmospheric air, they feared the time would arrive when animal life on our globe would entirely cease to exist. Most happily for us, however, as well as for our descendants, the apprehensions of the old naturalists have proved to be unfounded ; for since the science of analytical chemistry has attained so high a degree of perfection that its results may be considered scrupulously correct, the atmospherical air has frequently been analysed at regular intervals and in very different places and localities, the result always demonstrates that the proportion of the carbonic acid gas to that of the atmosphere is nearly constant, and in no place whatever exceeds one per cent.

For a long period the scientific world had speculated as to what became of the carbonic acid gas thus produced, until finally the German chemist, Liebig, proved, by facts, that the plants dissolve and decompose the carbonic acid gas of the atmosphere by absorbing its carbon for the formation of their growth by leaving the oxygen to escape as gas, which, by again dissolving into the air, begins its work anew. By this important process the equilibrium of the constituents of the air will be restored and preserved for ever!

The facts stated in the foregoing demonstration will clearly show that, and for what reason, the atmospheric air in the country and in the woods must be purer and more wholesome than that of densely populated cities; and that the trees are very instrumental in this action. Furthermore, they prove that the shade trees in our cities should not only be regarded as sheltering ornaments, but also as benefactors to our sanitary welfare. The consequences will, therefore, be entirely different, when we keep our shade-trees sound and enable them thereby to perform their duty as air-purifiers—or allow rotten trees, or even stumps, in our streets, which, besides their disgusting appearance, *consume* oxygen gas, and will produce dangerous miasmas in return. And these are the reasons why I have tried so frequently in the last five years to lead the attention of the public to the poor condition and the constantly increasing mortality of our shade-trees, and why I have ever been in a state of war against the destructive measure-worm!

Another very interesting phenomenon in connection with vegetable life is that which we term growth. This is certainly one of the greatest wonders in creation; and if this fact does not more seriously attract our attention, the reason is to be found in its familiarity. Let us suppose, however, that a certain person had never seen a tree, and some one should step forward with an acorn in his hand and endeavour to make him believe that this small, lifeless object, when planted in the ground would become alive and commence to grow. After a while it would send out a root that grows into the ground, and a stem that grows into the air. The latter would gradually extend in size until it reached 100 feet and more. It would also bring forth branches, twigs, leaves, flowers and fruits, exactly of the same shape as that in his hand; and from the latter another would spring up, and it would go on in such succession for all time to come! Would such a person believe the assertions, although all that was said about this acorn was the truth—nothing more than the very truth!

You are all sufficiently acquainted with the phenomenon which is called growth; the explanation of this process, however, is somewhat difficult to comprehend. I will, therefore, confine myself to the description of the practical effects connected with the growth, and will commence with the very seed-grain.

The seed in general is composed of the germ, the cotyledons, and an external coat. The germ is the embryo of the future plant; the cotyledons serve as protection and as a supporter, and the coat as a covering to keep the cotyledons together. In the embryo the disposition of the future root and stem is already existing, and the cotyledons contain some albumen or amylum. The seed-grain, after having remained some time in close contact with the damp soil, absorbs so much moisture therefrom that the albumen or amylum becomes liquid, and in this state they serve as the nourishment for the embryo. Starting into life, the embryo gradually gains in size, presses on the cotyledons, and these again on the coat, until they burst, even if they were the hardest nut shells!

The embryo begins thereafter to extend downward, forming the roots, and as soon as this penetrates the ground and is able to absorb nourishment from them, it supports the germ, which grows now upward, forming, in true time, the stem, leaves, branches, twigs, flowers and fruits.

What next will take us with surprise is the extraordinary diversity in the vegetable world. This is not less remarkable between the different kinds of plants, than between their parts.

Although the number of native plants, Cryptogams and Algæ included, may be estimated at about 200,000 species; nevertheless it is a rare case, to find two species, whose leaves are entirely of the same form.

The correct knowledge and description of all these forms can only be regarded as one of the most difficult tasks in the study of botany. It is called the terminology of plants; and fills many immense volumes with expressions, mostly derived from foreign languages.

For its monotony the terminology of plants may be regarded as the very touchstone for the earnestness and perseverance of young botanists and, in most instances, it becomes the rock where both may be wrecked!

Another very interesting quality of plants is the great diversity in their colours. The most prevailing is green, which colour is most pleasing and beneficial to the eye. Then follow white, yellow, red, and blue, with all the imaginable mixed colours, shades and nüances. The brilliancy of *flower* colours excels all that is found elsewhere.

It happens, not unfrequently, that the most brilliant colours in the most striking contrasts and in the most regular design are found in the small space of a petal of a more regular construction than the best artist would be able to produce.

Next to colours, the fragrance of many vegetables must be regarded as of great interest and value. In their delicate organism they frequently prepare fluids and gases which transpire through the leaves, flowers, and fruits, and produce that kind of sensation to the olfactory nerve which we call the smell. This odour is very agreeable in many cases, but often, however, it is the direct opposite and even dangerous.

The aromatic plants, or their parts, are frequently used for different purposes, as for perfumery, spices, medicines, &c.; in many cases, however, the essential constituents are extracted from them in the shape of extracts, tinctures, ethereal oil, &c.

Nearly all that has been said about odour, is also, in most cases applicable to the taste.

It has often been stated that it is the destination of the vegetable kingdom to spread over the surface of the earth. As, however, our globe is of very different construction, and particularly in the different zones, the plants, as a matter of course, must be organized in such a manner, as to answer all requirements in this respect.

In hot climates we find, therefore, most of the plants covered with very large leaves, as, for instance, the palm trees, bananas, caladium, and others, whose office it is to catch the hot sun-beams, and prevent the exsiccation of the ground.

In the cold climates the Coniferæ (pine tribe) are predominant, whose sap, as is well known, is of a resinous nature, and does not freeze, even in the coldest winters.

In the temperate zones the prevailing character of the plants is less distinct or observable, as they form, likewise, the transition from one climate to another. The general impression, produced by the predominance of one or another family of plants, is called the physiognomy of plants.

With regard to the facts just mentioned, the high mountains of the tropics offer a particularly interesting picture. From the base upward, to a certain height, the physiognomy is tropical; from thence farther up to about midway it is temperate, and the top is entirely that of a cold climate.

A great number of plants show a strong dependency on the geographical influence of our globe, while they grow only between certain degrees of latitude, over which they never extend without human aid. In this respect the conduct of different mountain plants deserves to be mentioned. These grow exclusively in certain regions, as, for instance, of the Alps, they do not cross their line, and disappear gradually towards the top and the foot, and are entirely lost at the lower flat ground. But, without meeting them somewhere else in any direction whatever, we find them at last back again on other mountains of the same character and the same region, often a hundred miles distant from the Alps, and separated from them by rivers and even by the sea.

That branch of botany which treats of the investigation of their natural boundary is called the geography of plants.

With regard to my former statements the most striking of the different phenomena connected with vegetable life can be attributed to their growth, the great diversity of their forms, and their colours, their odours, and their flavour.

The tiny grain of seed is developed into a stately tree, which latter, by the periodical course of events, undergoes the same process, and assumes eventually the same shape. Beneath the mighty oak we find the pigmy moss; by the side of the majestic *Victoria Regia* grows the tiny conferva. In the diminutive space of the petal of a flower we often find the most beautiful, brilliant, and contrasting hues and most remarkable and regular designs. What immense diversity of odour and flavour we find in plants, and the different effects produced by them on their parts! Take, for instance, the fragrance of the rose, the heliotrope and the orange blossom; how delightful, yet how widely different! And how great are the contrasts in the different parts of the last named plant. The flower, so delightfully sweet, so different from the smell and taste of the orange-peel, and the refreshing juice, or the bitter taste of the kernels! And yet all these widely different tastes and properties have been imparted to it through the narrow tube of the fruit-stalk. We behold the bitter vermouth in company with the sweet sugar-cane, and the most useful medicinal herb growing peacefully at the side of the most rank and poisonous plants.

If we examine the seeds from which the different plants have sprung, and the earth on which they have grown, we shall be unable to find the least clue to either the difference in taste or smell of any of the plants. Where shall we seek the power that endows the tiny embryo with life, and causes it to grow? Where seek the laws that so strictly govern and direct them to assume their respective shapes and to perform the different functions which all individuals are required to fulfil? Where is the power which propels the sap from the roots of the trees up to its very top? Where, lastly, shall we seek the laboratory wherein the crude liquid of the earth is transformed into so many different products of such diversity of colour, taste, flavour and properties? Can we do better than call this a miracle; and is this miracle perhaps less greater because we see it repeated daily before our eyes?

Referring, lastly, to the practical advantages for which we are indebted to the vegetable kingdom, for our daily bread we are dependent on the seeds of certain grasses or on some roots. The indispensable daily vegetables come to us in the shape of roots, tubercles, stems, leaves, fruits and seeds. Our fruit trees furnish us with apples, pears, peaches, apricots, quinces, plums, cherries, grapes, raspberries, currants, gooseberries, strawberries, and many others, which are frequently used in the natural raw state, or will be dried, preserved, prepared into confection, jelly, syrups, or wines, cider, beer, vinegar and distilled spirits.

The almonds, nuts, hazel, chestnut, pistachio-nuts and many others serve us as a welcome dessert.

Furthermore, there are coffee, rice, tea, sugar; all our precious spices; the greatest part of our dyestuffs, as indigo, logwood, sandalwood, camphor, tobacco, a great number of the most effective drugs; most of the fatty and essential oils, resins, gums, india-rubber, honey, wax, potash, and a thousand other articles of vegetable origin. Nor should we forget that cotton, flax, hemp, jute, and similar fibres, provide us with ropes and all the various spun and woven stuffs for our clothing, and even wool and silk belong to this class—however indirectly.

Plants, again, give us the means to feed our beasts of burden, whose services, bones, skin, hair, wool, horn, &c., and our domestic animals, whose meat, milk, cream, butter, cheese, &c., have become so indispensably necessary in our household. The trees of our forests produce lumber and timber for our houses, ships, and furniture of all descriptions.

For fuel we use the raw wood as well as peat, pitch, charcoal, coal, all of which are also of vegetable origin; and there is hardly any thing used to satisfy our daily wants of food, shelter and raiment, that is not either a product of this part of nature or, at least, in some way connected with it.

As with men, so a great many of the animals are dependent on vegetables. Not alone do the vegetables comprise their food wholly or in part, but a great many of the animals are dependent on the trees for their habitation, or as a shelter from the scorching rays of the sun, or against the rigors of winter, and also as a hiding-place against their natural enemies.

Nearly all animals are dependent on some particular kind of plant, or at least live on it in preference to others. Even poisonous plants have their votaries, and are particularly preferred by some animals, while the same food would cause the death of most others. This phenomenon is found most remarkable among the insects, as for instance, a great many of the caterpillar species would sooner starve than eat any other food than that to which they are used.

It is, therefore, but natural that a kingdom in nature, to which we are indebted for so many advantages—even for our very existence—should for ages have drawn the most serious attention to its study.

Plants have, therefore, been both scientifically and practically examined, described, and classified in many, more or less, serviceable systems. They have been divided into classes, orders, families, genera, and species, and each described with two names, the first denoting the genus and the last the species.

On dividing the classes, orders, families, and genera, the calyx, the shape of the corolla, the number and situation of the filaments, and the number of pistils, and, finally, the shape of the fruits and seeds, are generally used as characteristics; in the determination of the species, however, the shape and position of the leaves are mostly used for this purpose.

Before concluding, I wish to say something about cultivated plants, hybridizing or producing new varieties. Among the great number of plants cultivated for some purpose or other, hardly any exist in their original natural state. Some of them have largely extended in size by proper management and manuring, others yet have to undergo an alteration by change or admixture of ground ; by far the most of them, however, have gained a more constant character—namely, they have been improved by hybridizing.

In order to explain this interesting process more satisfactorily, I feel called upon to remark once more that each flower contains certain organs indispensibly necessary for the production of fertile seed. These organs are the filaments and styles. In most flowers these organs are combined, and they are, therefore, called hermaphrodites. The styles stand usually in the centre of the flower upon the germ and the filaments around them. In other plants the filaments and styles, though being both on the same plant, are separated from each other by different flowers ; and there are still other plants where they are so entirely separated that each of them appears as a different individual, one bearing none but female, the other none but male flowers. The filaments bear on their top a little bag, the anther, filled with fine dust called pollen. This little bag bursts, when ripe, and thereby the pollen is communicated to the somewhat sticky stigma of the styles. In cases where flowers turn into the double state by one cause or other, the sexual organs change into petals, and, therefore, of course, they are not fit to produce any seed. The fructification of flowers is very much assisted by the aid of insects, as flies, bees, wasps, and by the wind, particularly in plants of separated sexes.

Experiments have frequently been made, and with a uniform result, to show that no fruit at all, or at least, no fertile seed will be gained, if the style or filaments, or both of them have been carefully taken from the flower before the pollen had reached the styles.

Since we have become aware of this process by attentively watching nature, and experience has convinced us of its sure success, we make use of the same process for our own advantage. When in the ordinary course of nature the style is fructified with the pollen of the same plant, the new individuals produced by the seed of them must of course, be of the same character.

If it is, however, our intention to raise new varieties or hybrids in an artificial way, then we have to proceed as follows : Suppose we are in possession of two apple trees, one of which bears small, green, sour apples ; the other one, however, large, red and sweet ones. But we like neither sour nor sweet apples, but would prefer to possess some mixed varieties. Then let us take the pollen of the sour apple with a little brush, and bring it to the stigma of the flower of the sweet apple tree, or *vice versa* before the stigma of the latter has become impregnated by another pollen, and then we have done what is called crossing or hybridizing. This act does not produce an immediate effect or change on the fruit growing next after the crossing. When, however, the kernels of the fruit are sown, the new trees produced by them, when cultivated, will generally furnish about the following phenomenon :

Most of the trees will bear fruits similar to those of their mother, but many others will be similar to their father ; frequently they stand between both of them. Sometimes, however, some few trees will produce fruits which have not the remotest similarity to either of their parents, or any other variety of apples known. These we call a new variety, which will be named by the raiser, and frequently command very high prices. In this way, all the innumerable varieties of apples, pears, peaches, cherries, camellias, roses, dahlias, carnations, potatoes, carrots, cabbages, &c., were produced; and the larger the number of good varieties is already, the more difficult it becomes to produce something new, which shall differ from all existing varieties, and surpass them in beauty or usefulness.

The law according to which these changes take place has not been discovered yet. In order to meet with a certain success we have to work on a large scale, and leave to our good luck what it has in store for us.

One certain condition of the act of hybridizing is, that the two plants operated on must belong to the same kind, genus, or at least to the same family or tribe.

The preceding statements will suffice to prove the high importance of the vegetable kingdom in regard to our bodily wants, as well as our spiritual employments.

I cannot omit to recommend strongly to the rising generation the importance of forming collections of natural objects, particularly plants, in the shape of a so-called herbarium.

Love for such objects drives young people into the free and pure air, forces them into healthy bodily exercise, teaches them to stedfastly pursue a fixed aim, and prepares them pleasantly for the future and more arduous duties of life. Beside all these, constant additions to their collections will afford them equal and often purer enjoyment and satisfaction than will many a successful speculation to a business man. Finally, they lay up for themselves a rich treasure of interesting and useful knowledge, and in doing so, are prevented from spending their time in the streets or in dangerous company—a consideration well worthy the attention of parents or those who act in their stead.

RESEARCHES ON THE JUICE OF THE SUGAR-CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

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(Continued from page 427.)

IV. MINERAL SUBSTANCES.

AFTER numerous analyses I estimate the quantity of mineral salts contained in the juice of those canes best fitted for sugar manufacture, at 2·9 per 1,000 of the liquid. Saline matter, like organic substance, is found in a greater proportion in the head than in any other part of the cane. The results produced by the analyses of young canes have not always confirmed the often-expressed opinion that the salts in the juice of the cane are greater in quantity in proportion as the plant is farthest from the period of its development.

On the contrary, the nature of the soil has appeared to me to have in this respect a most marked influence, and it is to this influence that the variations stated in the figures representing the saline substances ought to be referred.

The fixed mineral matter contained in cane-juice is principally composed of potash, soda, lime, and the oxide of iron in the state of carbonates, chlorides, sulphates, biphosphates, and silicates, with which are found blended salts of alumina and magnesia. The following analysis made of the ashes of a great number of juices, extracted from canes of different species, and cultivated in soils of a different nature, may be considered as resuming the proportions in which those substances are found which are the most important to be determined :—

Potash and soda	18·83
Lime	8·34
Oxide of iron	1·99
Silica	11·48
Alumina, magnesia, and acids, in combination with the above bases	59·36
	100·00

The plantations of Mauritius having been on two different occasions compromised by the profound changes which, in the first instance, necessitated the Otahite cane to be abandoned ; and in the second instance, a few years ago, forced upon the planters the more moderate and rational use of the Bellouguet variety of cane, it seemed to me an interesting point to examine if the ashes of these canes presented, in respect to their constituent substances, any modifications decidedly appreciable. My researches have been without any result; I have always found over again those saline bases which are met with in the normal state, and I have, with regard to the fixed alkalies, determined neither an increase nor a diminution capable of being referred to any other causes than the varieties peculiar to these bodies, and the errors which are frequently found in similar analyses.

In order to terminate this part of the subject, I here give the average quantity of fixed salts contained in the four species of cane principally cultivated in Mauritius. Such average quantity has been determined by the incineration of fine portions of these canes, previously subjected for several days in a stove to a temperature of 100° centigrade:—

	Bellouguet.	Guingham.	Bamboo.	Penang.
Water, sugar, and organic matter	98·8	98·9	99·32	99·1
Salt	1·2	1·1	68	9
	100·0	100·0	100·00	100·0

THIRD PART.—I. THE MODIFICATIONS EXPERIENCED BY THE CANE-JUICE.

The modifications in the juice during its extraction from the cane, as practised in Mauritius, are inherent in the very nature of this liquid, or originate under the influence of external agents. The former, though sometimes useful, are more frequently contrary to the purpose of the manufacturer; the latter are always produced with the object of obviating determinate inconveniences, and of producing regularity in the process of manufacture.

The narrow limits within which I am obliged to confine myself do not allow me to specify all these modifications which, were they mentioned in detail, would considerably increase the space which I have apportioned to this memoir. I will, therefore, confine my remarks to the specification of that influence on the sugar of the juice produced by the different substances which have been more especially the object of my observations in the previous pages.

I will not repeat what I have already adduced in the chapter on microscopical examination regarding the granular matter, and the power it has of producing in a very short time the fermentation of the juice extracted from the healthiest canes. But this is the proper place to exhibit those remarkable differences which the various azotised substances naturally contained in this liquid impress on the fermentation which is developed in the juice. It is known that sugar subjected to fermentation furnishes products which are not always identical, and that the decompositions to which it then gives rise, depend on the fermenting element employed, or what is the same thing, on the substance producing such fermenting element. The azotised substances of the juice which I have already comprised in three categories, and designated by the terms granular matter, albuminous matter, and matter coagulable by alcohol, have all the property of exciting fermentation in this liquid; but all three do not act with the same energy, and one of them only is apt to determine alcoholic fermentation properly so called; whilst the other two—albumen, and the matter coagulable by alcohol and non-coagulable by heat—give rise at the same time to acid products, and are much slower in action. Granular matter is, therefore, the source of the most active fermentation developed in cane-juice in contact with the oxygen of the air, and it contributes besides in the most special manner to the transformation of sugar into alcohol and carbonic acid.

This remark leads us to an application, the utility of which can be appreciated by the distiller; it is the mixing of a small quantity of the scum taken from the surface of the juice when at the boiling point with the syrups which ferment with difficulty. The granular matter in this scum then gives rise to a fermentation which it would be useless to attempt to produce by ordinary means.

I will not just now insist further on these different particularities; for I think I have sufficiently traced the important point which this substance plays in colonial manufacture, and have shown all the advantages which would result by eliminating it from the juice even at the time it escapes from the mill. I have, however, pointed out a method which could incontestably render great service to our colonial industry were it brought into operation by some skilful mechanician.

The accumulation of this complex azotised matter mentioned above, in the "Claircé," and the syrups, is a fact which, to the present time, has not sufficiently arrested the attention of the sugar-manufacturer in the colony, but which, nevertheless, is well worthy of a careful and especial study. I have already shown that it is to this substance must be attributed that viscid consistence of the juice, and that alteration and viscid fermentation, the cause of which has been so differently appreciated by writers on the subject.

The presence in any notable quantity of so deliquescent a body in the syrup is an obstacle to the crystallization of the sugar, in which, besides, it excites rapid fermentation when a sufficient proportion of water is added to the saccharine liquid. It is essential to remark that no agent hitherto employed in our colonial manufacture of sugar has any effect on this substance, which almost entirely escapes, and becomes more and more concentrated in the liquids to be worked up by our machines. The use of an agent capable of combining with this viscid matter, and able to precipitate it in the syrups, would, without doubt, considerably increase the yield of sugar. The alcohol which is obtained in Mauritius at so reduced a price, would, in my opinion, here find a very useful application.

An idea may be formed of the augmentation of this substance when concentrated in the syrups, by reference to experiments I have made. From these it will be seen that the figures representing it follow a rapid progression, and are six or seven times higher for syrups in the third stage than for the "Clairce" at 22° Beaumé. They also equally show the increasing progression of the saline matters peculiar to the different syrups. These two kinds of substances are not always sufficient, however, to explain the resistance to crystallization exhibited by syrups produced under certain circumstances. There is a cause of very different activity, and that is the presence in these saccharine liquids during manufacture of a quantity of glucose more or less great, a substance which is the stumbling-block of colonial industry, and the source of the chief difficulties against which the sugar-manufacturer has incessantly to struggle. I have shown in the clearest manner that the liquid sugar was not, as generally thought, a product of the alteration of the cane, but a really radical portion of its organisation, and that such sugar was more abundant in proportion as the plant was furthest from the period of its development. I have also demonstrated that if the body of the ripe cane contained only traces of it, the head of the cane, on the contrary, contained a notable proportion; and that whatever tended to produce abnormal vegetation, had the effect of causing the re-appearance of this substance in the cane. We may, therefore, conclude from this fact that levulose is always present in the juice which is generally manufactured, and that its presence is greater in proportion as the canes operated on are less ripe, have grown in a damp soil, and have been cut at a sectional point nearer to the insertion of the green leaves.

The presence of interverted sugar in the juice being admitted, it is easy to understand the first difficulty which presents itself, and the almost absolute impossibility of effectually overcoming it. For how can we avoid so injurious an action as that of the lime on the levulose which, at the boiling temperature and in contact with this alkali, gives rise to those black products of glucose, the presence of which produces such decided change in the colour of the juice, and in the quantity of the sugar obtained from it? How can we avoid so real an inconvenience and at the same time stop the too great tendency which these juices exhibit to produce during boiling a considerable quantity of glucose?

The alkalinity of the liquid would, without doubt, fix a limit to this rapid transformation; but would not this very alkalinity, in similar cases, produce consequences more fatal than the evil to be subdued?

Lime, the usefulness of which is incontestable, but the importance of which we have been disposed to exaggerate, cannot be employed in excess without becoming the cause of one of the most injurious modifications which the juice undergoes, and which has for its immediate result the brown colour of the syrup, and for its ulterior consequence, the production of a dark, dirty, and clammy sugar.

Without going further into such well-known details as this action of the lime on the juices containing a certain quantity of levulose, I may say that the difficulties of sugar manufacture in damp localities, and the inferior quality of their production until the introduction of the vacuum-pan system, must be chiefly, if not entirely attributed to the large proportion of liquid sugar nominally contained in the leaves grown in these localities, and nearly always cut in full vegetation. When the juice contains only traces of this substance, which happens when the canes are grown in dry and airy localities, its manipulation becomes much more easy ; but even then the use of lime cannot be exaggerated without very manifestly injuring the quality of the sugar.

The speciality of lime in the modern manufacture of sugar must be limited to the purpose of neutralising gradually and moderately the acidity of the juice. When used in too small a quantity, this alkali will not oppose a sufficient obstacle to the glucose transformation of crystallizable sugar under the influence of that azotised matter which is not coagulable by heat, and the syrups will then be highly charged with levulose ; used in such a manner as to keep up in this liquid a slight alkaline reaction, cane sugar will hardly ever become interverted, though it will assume a shade of colour which will cause it to occupy a much lower rank in the sugar market. But since the most sought after and most remunerative qualities or shades of sugar can only be produced by means of a juice kept slightly acid, the attention of the manufacturer should be directed in such a manner as to produce these shades of quality with the least possible glucose transformation ; that is, for a given type never to exceed the degree of acidity which such type requires.

But it is particularly after the separation of the scum that the greatest attention must be paid to the acidity of the juice, for the temperature of the liquid then rises rapidly, and the intervention of crystallizable sugar then most easily takes place. This acidity increases in the ratio of the proportion of incoagulable albuminoid matters which thus become the indirect though active cause of the formation of glucose.

(To be continued.)

PETROLEUM IN EUROPE.

The constantly increasing importance of the trade in mineral oils has attracted attention to the oil deposits of Europe.

It is now certain that, in a period more or less brief, the old continent will no longer be tributary to America for oils for lighting extracted from the earth. Every day new natural reservoirs of petroleum are discovered; and, at the same time geologists are beginning to understand oil fields better, and the manner in which they are distributed over the globe. Already observations have been taken which enable researches to be made with much greater chances of success than when they were carried on at hazard.

Among the localities which already export petroleum is one which particularly interests the port at Marseilles—Moldo-Wallachia. This country is traversed by navigable rivers which fall into the Mediterranean; the Pruth and the Sereth arrive there by the Danube. The Dneister, too, although leaving Moldavia to the right, belongs directly to the hydrographical system of the Danubian provinces; and by the communication which it establishes between the Carpathians and the Black Sea, that river unites Galicia to the Mediterranean.

In the present state of things the port of Havre is the principal French market for petroleum. Marseilles is placed, as regards Canada and Pennsylvania, in an unfavourable situation; in fact, the great distance of the Straits of Gibraltar place it for the west in a position of marked inferiority. But it is destined by the force of things to become a large market when the European reservoirs shall be worked on any extensive scale, and when it can receive the mineral oils of Asia by the Isthmus of Suez.

There is an intimate connection between the reservoirs of petroleum in Galicia and in Moldo-Wallachia. These two oil-regions, in fact, only form one, which is exactly designed by the general line of the Carpathian mountains. Properly speaking, there is in this part of Europe only one and the same system of petroleum reservoirs—the Carpathian.

As regards Galicia, which during the last few months has been studied attentively, the localities in which oil has been discovered, and in which new discoveries are being made every day, are grouped to the south of the railway from Cracow to Lemberg, the extreme limits of the region being Sandec to the west, Drohobyez to the east, Jaslo to the north, and Komaneza to the south. In this region a new reservoir has very lately been discovered—that of Rzopedz. Such are the present limits of the region, but they will not be the same in a year, or even in a month, for the inhabitants of the country are beginning to be seized, like the Americans, with the oil fever, and are boring the soil. Unfortunately, however, they carry on operations somewhat blindly, and they are without good instruments; but foreigners are already beginning to bring tools and money, and that is all that is needed.

The distance between the widest points of the region is nearly 125 miles, and the width from the north to the south is about thirty-one miles. The surface is about 2,500,000 acres, but there are only twenty-five works for extraction, most of which have been established within the last three or four years. The reservoirs afterwards descend from Drohobyez towards Moldavia, taking the direction of the north-west to the south-east across Bukowina. We shall soon, it is hoped, have correct information on this part of the oil region of the Carpaths, as an eminent French professor is now examining it.

When we observe the distribution of the deposits of Galicia and Bukowina, and their general direction across Moldo-Wallachia, we are convinced that there is a great subterranean fissure which crosses Europe pretty nearly in a line from the mouth of the Oder to the mouth of the Danube. Already is this line worked out by the salt deposits of Wielieszkr, Bechina, Stravasol, Drohobyez, Delatyn, and Solka. The latter place, situated in Bukowina, at a short distance from the Moldavian frontier, is remarkable, like Drohobyez, because both salt and petroleum are found there. The same is the cause at Stravasol, in Galicia. The industrial importance of these facts is considerable.

There has been much discussion as to the origin of petroleum. In America it was first thought that this substance was produced by the dissolution of the coal and bituminous schists ; but this hypothesis has had to be abandoned as insufficient. The decomposition of vegetable tissues, and even of the bodies of gelatinous animals in the geological epochs, has also been considered the cause of petroleum and bitumen which are discovered in the four parts of the world, and the circumstances which have occurred during the search for, and the working of, the wells of America, do not permit this second explanation to be accepted as sufficient.

It is highly probable that there are great subterranean reservoirs, fed by the bituminous dejectives which come from the centre of the earth. In other words, that there are still eruptions of bitumen, as there are saline, sulphurous, and other eruptions. The petroleum which we collect comes, therefore, to us, in great part, from the interior, and not from the superficies of the terrestrial crust.

When petroleum is found in recent formations, as in Galicia, it is almost at 100 to 105 feet in depth, in wells which have to be sunk. The oil must be got out either by buckets or a pump. But in America, after emptying such reservoirs, strata, from which the oil springs to the surface, have been found. In some cases they have been reached by borings to a great depth. In the part of Europe, however, of which we are speaking, the upper reservoirs are in basins of rock. This rock is impenetrable but between clefts in it it is probable that the lower sheets will be reached, and that, as in America, the oil will spring to the surface. However this may be, the reservoirs near the surface of the earth present a wide field to commercial enterprise. It is of importance however, that explorers, in order to avoid disappointments, and to obtain the best results with the least outlay possible, should allow themselves to be guided by pure science. It teaches that there are oil deposits from the Oder to the Danube, and by seeking in that line success can hardly fail to be obtained.

THE GUMS AND RESINS OF NEW ZEALAND.

THE forests of New Zealand contain many trees which yield resinous gums suitable for various manufacturing purposes. Foremost among these is the kauri pine (*Dammara australis*), the finest forest tree in the Colony, and yielding in the greatest quantity gum of commercial value. Although the kauri is not now found further south than Tauranga on the East Coast, and Kawhia on the West Coast of the North Island, the gum is found imbedded in the soil in various other parts of the Colony, and it has been dug up even so far south as Stewart's Island, clearly showing that at one time the kauri flourished all over the Colony. The gum is also found in the coal-seams of the North Island. The kauri pine yields a large quantity of resinous gum, which at certain seasons exudes from the lower portions of the trunk, and from wounds caused either naturally or by the axe of the bushman. It is at first of almost the consistency and colour of cream, highly glutinous, and with a not disagreeable flavour of turpentine. It gradually hardens with exposure, assuming various hues, from a cloudy white, bright yellow, to a dark brown, and resembling amber very much in transparency and general appearence. When a kauri tree has been felled or cut, the place of severance is in a short time covered with this gum, which flows for a considerable time. When fresh it is often chewed by the Maoris, but for what purpose it is difficult to tell, as it does not possess any narcotic or stimulating properties, The newly exuded gum is of no commercial value ; that exported is gum dug up from the ground on the site of old forests which have been destroyed by fire many years before. It is found from a few inches to as many feet deep, and in localities entirely denuded of trees, and also in the soil at the base of living trees ; the gum in this case having flowed down the trunk and accumulated through many successive seasons. The pursuit of gum-digging is confined to the natives, to whom it has all the attractions that the search for gold has to Europeans. The natives assemble in large bodies, from various parts of the Colony, and work industriously at this profitable employment.

The chief gum-yielding localities are situated at the north of Auckland, the greatest quantities being shipped in coasting vessels at Wangarei and other adjacent ports, whence it is conveyed to Auckland, and thence exported to England. The trade is a considerable one, and from the number of natives it employs, who generally dispose of it to local European traders, is a source of considerable profit to the settlers. Its market price varies according to the demand, from 10*l.* to as much as 20*l.* per ton, or even higher. It is worth a good price in England, and yields a very handsome profit to the shippers. For some time its uses were enveloped in a good deal of mystery, but it is now known to be employed for a variety of purposes. It is largely used in the manufacture of varnish, its qualities not being unlike gum copal; and of late years it has been consumed largely by cotton manufacturers for glazing calicoes and other goods. Recently, a company in London has commenced the manufacture of candles into the composition of which kauri gum enters largely. They are said to burn nine hours, and to be no dearer than ordinary sperm candles. It has been used by an Auckland manufacturer to varnish buckets, and when boiled with pitch makes excellent application with which to preserve fences, or to keep out moisture in damp situations. Kauri gum is insoluble in water. When in clear, large lumps, it can be carved into many beautiful forms; ornaments made from it have somewhat the appearance of amber. It burns readily, and emits a dense black smoke highly charged with carbon, and from it an excellent lampblack can be prepared. The Maoris used to employ this black in their tatooing process. The supply of kauri gum is, however, rapidly falling off, and owing to the industrious digging of the Maoris and the gradual clearing of the kauri forests, it will at no very distant time become a rare commodity. Kauri gum is found embedded in the coal found at Drury, near Auckland, in small lumps and granulated pieces. The following figures show the quantity of kauri gum shipped from the Colony during the years 1853 to 1864:—

	QUANTITY. Tons.	VALUE. £
1853	830	15,791
1854	1,661	28,864
1855	356	4,514
1856	1,440	18,591
1857	2,522	35,250
1858	1,811	20,037
1859	2,010	20,776
1860	1,046	9,851
1861	856	9,888
1862	1,103	11,107
1863	1,401	27,026
1864	2,228	60,590

Combes and Daldy, Auckland, and B. W. Gee, of the same place, exhibit interesting specimens of this valuable gum. The first mentioned exhibitors are the chief exporters of kauri gum, and they sent to the New Zealand Exhibition a number of large specimens, just as they had been dug up from the ground. Mr. Gee's samples are small assorted pieces classified into three kinds—clear, cloudy, and dark.

The application of kauri gum to ornamental purposes was illustrated by a rose executed in this material. The Wellington Local Committee also exhibited wood, varnished with kauri gum varnish, which imparts a clear brilliant polish.

The rimu (*Dacrydium cupressinum*), another species of pine, yields a gum suitable for varnish. A sample of varnish manufactured from rimu gum is exhibited by Chas. W. Hornblower of Wellington, who can supply the article at twenty-one shillings per gallon. A specimen of wood, varnished with this material, shows the applicability of rimu gum to this ornamental purpose. It has all the appearance of copal varnish.

The *Phormium tenax* yields a gum, which, as the method of treating the plant becomes more fully understood, will doubtless prove valuable. The root-ends of the leaves of this plant are, at certain seasons, covered with a quantity of gummy matter of the consistency and appearance of strong size. This glutinous matter more or less pervades the whole plant, and in the preparation of the leaves for their fibre, this gum might be saved and utilised. James Mackay, of Nelson, exhibited a bottle of gum made from the leaves of the *Phormium tenax*. It is useful for many ordinary purposes in which solution of gum Arabic is employed.

Many other New Zealand trees and plants yield resinous gums, but as no specimens were exhibited, and as they have not as yet any commercial value, no extended notice of them is necessary. The Black Mapau (*Pittosporum tenuifolium*) and the White Mapau (*Pittosporum eugenioides*) yield a gum resin, but not in quantity to make it valuable. *Panáx Colensoi*, an ornamental tree with large trifoliate leaves, exudes a gum very similar to gum Arabic, and occasionally used for adhesive purposes.

Kauri gum has been asserted to occur also in the southern part of New Zealand, proving as it is said, that the Kauri pine flourished at one time, far south of its present habitat. Up to this time, among the numerous specimens of resin obtained from the tertiary formations of South Island, not one has been found identical in its physical properties with the kauri upon close examination. The greatest difference is found in their fusibility. Kauri resin even becoming so plastic at a heat of 180° or so, as to be capable of being moulded into any form, while the other resins uniformly require a much higher heat to affect them in a like manner. The specific gravity of kauri gum is 1·047; it evolves a light and pleasant aromatic odour when heated, burns readily with a clear luminous flame, becomes electro-negative by friction, and dissolves in concentrated sulphuric acid to a red solution.

Retinite, large masses of this resin were exhibited in the gold-fields and geological departments of Otago, at the New Zealand Exhibition. The former exhibits were obtained from Hyde, the latter were from Caversham, Tuapeton, Waitahuna, and the Dunstan diggings, and various other parts of the Province of Otago ; also from Borneo. It is a substance of very frequent occurrence in the brown coals, generally in the form of small nodules, sometimes, however as short, imperfect veins or layers, and rarely in such large masses as those exhibited.

As yet, no distinctive differences have been found to exist among these numerous samples. They melt without decomposition, evolving aromatic odours, and at a higher heat, burn with a smoking flame. When warmed at a gentle heat with alcohol, they become softened and are then very tenacious and adhesive ; their colour varies from pale yellow to a dark brown. The specific gravity of a sample from Caversham, was found to be 1·049.

The following are approximate analyses of two varieties of this mineral, No. I. being from Caversham, and No. II. from Labuan, Borneo.

	I.	II.
Soluble in alcohol	18·87	19·18
„ in ether	81·13	28·92
Insoluble in ether	—	51·90
	100·	100·

The whole of No. I. is soluble in ether.

THE AMERICAN WOOD-PAPER COMPANY, PHILADELPHIA.

The manufacture of white paper from wood, is one of the most important steps ever made in the progress of those arts which have the greatest influence in promoting human civilisation.

The largest establishment for the manufacture of wood-paper pulp is, we believe, that of the American Wood-Paper Co., known as the Manayunk Wood Pulp Works, situated at Manayunk, Pa., between the Schuylkill river and the canal. This pulp is now being manufactured into excellent white printing paper by Martin Nixon, at the Flat Rock Paper Mills, adjacent to the Pulp Works, and by Messrs. Jessup and Moore, at the Rockland Paper Mills, on the Brandywine Creek, near Wilmington, Del. These pulp works are amongst the most completely organised and appointed manufacturing establishments we have ever seen. Their erection cost half a million dollars, and the investment in them and the paper mills worked in connection with them is over a million. At the Flat Rock Mills there are straw pulp works, of a capacity to produce daily from seven to eight thousand pounds of straw pulp, a certain proportion of which it is found advantageous to mix with the wood pulp. The daily production of paper from these wood and straw pulp works and the paper mills run in connection with them will be fully thirty thousand pounds.

When the good German Guttenberg arranged his device of printing he little knew all that his contrivance was doomed to effect. In the olden times we made our paper deliberately—giving great time to each single sheet—and furnishing the monks and the palimpsest makers with heavy gray sheets from papyrus, and smooth and well-polished parchment or vellum. No writing of editorials in those dear old days, when Father Francis gave his life to one book, prayerfully, protesting, much abounding in virgins and saints and very long epistles. Monks and vellums have long gone to the worms or to the cheerful torch of the iconoclast, who made sad havoc in that anti-morning newspaper period of mankind. Those who wrote found sufficient supply in the sheep and the bulrush; and so we might have gone on in our condition of blissful ignorance if the quick-witted German had not placed his inky stamps upon paper and created a new world out of the chaos of manuscripts, and vellums, and scrawls long since gone to dust—let us thank heaven —and doing duty as fertilising loam.

But men must print and men must read, and the sheep was scarce, and the Egyptian bulrush passed its day of profit,and Nature was placed under contribution to give food to this insatiate Printing Press. Oh, wise Jack Cade! "Thou hast most traitorously corrupted 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, hast built a paper-mill." For which he was beheaded, thanks to my Lord Mortimer! China took her rice straw and the inner bark of trees to print the sayings of Confucius. Japan took the mulberry tree, and made a thin, silky paper, of good texture, delicate, and inviting—good, I should think, for love sonnets. In Spain, linen was used as early as 1178. Great scribblers, those Spanish monks, as Mr. Prescott and other historians found to their sorrow! Over a hundred years ago Germany exhausted rags and was forced to try straw, but with little success. Twenty years later France succeeded in making paper out of linden-wood, but the experiment was not pursued. Those Frenchmen eighty years ago had more bloody notions in their heads than making paper! Altogether our ancestors must have been as sorely pressed for paper as we who claim to be of the Age of Gab and Scribble. It is on record that in 1772 there were sixty varieties of paper made from sixty different materials, while in 1786 there were 103 varieties from the same number of materials. I spare the reader the catalogue. Principal among them, however, were rags, cotton-waste, gunny, hemp, India bagging, reed, canes, nettles, hops, moss, herbs and so on. Such a struggle with poor Nature for Gab and Scribbles stuff, and even now no rest!

In 1690 the first paper-mill was erected in Pennsylvania, near a stream called the Wissahickon, about two miles from the location of the present works of the Wood-Paper Company in the suburbs of Philadelphia. The founder was William Ryttinghuisen, of Holland, whose family had for generations made paper for the Dutch, and whose descendants to this day make paper in Manayunk. A good family that of Ryttinghuisen—thrifty and wise—who sensibly changed their name to Rittenhouse, and gave to science a grand-nephew of William, named David, much addicted to seeing stars among these high Wissahickon hills, and now known to all mankind as an eminent astronomer. I have seen a book made in the first mill, over 170 years since, bearing the Ryttinghuisen water-mark, "W. R., PENSILVANIA," with a trefoil, incased in a scroll—a neatly formed trefoil that any Irishman would accept as the shamrock, and as evidence that old William was a Fenian. The paper is hard—of good texture—browned by time, but showing signs of careful make, and as strong and nearly as smooth as the ordinary sheet of note paper on which these words are written. It was a noted mill in those days, and the poet of the Pennsylvania colony rhymed about it, something after this fashion :—

> "The paper-mill is here hard by
> And makes good paper frequently,
> But the printer, as I here doth tell,
> Is gone unto New-York to dwell.
> No doubt but he will lay up bags,
> If he can get good store of rags.
> Kind friend, when thy old shift is rent,
> Let it to the paper-mill be sent."

Let me state, as an annotation, that the printer thus recorded as leaving Philadelphia for New York was the celebrated William Bradford, who spoke his mind freely about the Quakers, and was accordingly banished, printing-press and all.

In those days, all paper was manufactured by hand. Each sheet was manufactured separately. The rags were made into a pulp in iron or stone mortars by trip hammers, it requiring several days to make a sample of dry finished paper. The capacity of the mill was about 1,500 reams a year. How many hundred years it would have taken honest old William to furnish one year's supply of paper for some of the dailies. The business grew rapidly in the colonies. In 1769 there were forty mills in New Jersey, Pennsylvania and Delaware, annually producing 133,000 dols. worth of paper. In 1787 the business commanded sixty-three mills, and required 250,000 dols. worth of paper. In 1786 it required fifty-three mills to supply Philadelphia with Gab and Scribble stuff (many gatherings of Congressmen, Conventions, young statesmen and juvenile Pub. Docs., in those days, at Philadelphia), the demand absorbing 71,000 reams. In 1840 there were 426 mills, with a capital of 4,745,239 dols., and an annual product of 6,173,092 dols. In 1850, 443 mills; capital, 7,266,844 dols.; annual product, 10,187,177 dols.; in 1860, 500 mills; capital 10,000,000; annual product 21,000,000—being in the printing and publishing year of peace, 1860. Total, 60,000 tons of paper, or about 2,800,000 reams; or, to be minute, over thirteen thousand two hundred million sheets. From 700,000 annual sheets, as the labour of honest William Ryttinghuisen, to more than thirteen thousand million, the work of this great Yankee nation. This is the story of the American paper trade in a sentence.

In time, as all the world began to read and write, the problem came to the minds of good men:—How can we hope to keep this vast demand so fully supplied that paper shall be cheap, and literature open to the poor—that the farmer may eventually have his Bible for a shilling and his weekly paper for a dollar a year. Rags were wanted. Who shall write the lyric of the great rag hunt of the last four years? "Even to Japan," said one papermaker to day—"all the world and Japan have been scoured for rags that Yankee people may read and write." The failure of the cotton crop, through war, increased the rag famine, white paper rising—50, 75, 100 per cent.—until timid men began to fear that a return to vellum and palimpsest, was all that remained. All sorts of contrivances were made. The problem was perplexing. Wanted first, a good substance that had fibre and body and could hold together. Wanted second, a substance that was cheap, abundant, inexhaustible, easy of supply, so that transportation and travel and foreign labour would not destroy its value. Cheap paper means cheap reading—cheap reading, national virtue. Industry and science had found ingenious mechanism capable of printing all the books of the world over again—where was the paper?

That is the problem now! We have tried a hundred substances—all good—but not answering every requirement of the problem. The rag—the best element of paper—has for years become more and more contracted in supply, while cotton waste and rope waste are so necessarily. Straw is a good agent, but we want a better one. Behold on these plains the tall poplar tree—the pretentious, unwelcome, unnecessary poplar—of little use in farm economy—to be cut down as cumbering the ground some day, perhaps. Stop! We will try this tall poplar tree in the American Wood and Pulp Works and see what hidden virtues it may possess. This is the experiment which has brought me to Philadelphia—which has kept me on the banks of the Schuylkill River these many hours, and which I now record as a contribution to the science and civilization of the world. Let me tell you, then, briefly, and with as few technicalities as possible, of what these works consist.

They are located in Manayunk, on the bank of the Schuylkill River, with canal and railroad adjoining. They were commenced in August, 1864, and completed in April, 1866. The buildings are built of stone and brick, in the most substantial manner, and occupy a space of 1,000 feet in length by 350 in width, and cost, when completed, over 500,000 dols. United with the Flat Rock Mills they embrace in all about ten acres of ground. They are said to be the most extensive works of the kind in the world, and are capable of producing from twelve to fifteen tons of paper pulp per diem. The works were projected by a company of gentlemen, from different parts of the Union, and the subscribed capital is estimated at from 10,000,000 dols. to 15,000,000 dols.

Before entering the inclosure we arrive at what is known as the "Settling Pond"—at the extreme north end. It is used for the storage of water, of which great quantities are used daily, and must necessarily be clear. The pond is protected on the Schuylkill side by a high strong wall, and is about 10 feet deep by about 300 feet square. Its capacity is 5,500,000 gallons. In close proximity to the pond are two lime kilns, which are kept constantly employed in making the best lime, which is used in the establishment, the stone for which is brought in boats from the quarries, some miles up the river.

The most important part of these works is the round house or evaporating establishment. This is the main feature of the works. It is known that one of the reasons why pulp has not been made from wood and other substances more successfully, is the high price of soda, and the necessity for its consumption in large quantities. By a process of evaporation which seems to be very successful here, the refuse liquor which has done its duty in disintegrating the wood fibre, is compelled to yield back its soda, at a saving of 80 per cent. This economy is the cause of the great success of this wood pulp process.

In addition, there is an alkali-house, where there are large tanks and filter vats. The wood-boiling house is 75 by 132 feet, and contains ten boilers, capable of producing 30,000 pounds of pulp (when dry) every twenty-four hours. Here also are large blow, condensing and hot water tanks, of great capacity. After the wood has been reduced to chips of small size, it is raised by steam power to the top of the cauldrons and thrown in. When the boilers, under which are strong heating furnaces, are filled, the liquor is run from the tanks, by means of a hose, into the boilers, the fire is set going, and the wood boiled to a pulpy substance of a dirty white colour. When it arrives at the condition required, the pulp is carried off in large iron cars, of which there are five run on tracks below, to the building where, perhaps a few hours before, it had been a hard, knotty log.

Adjoining the wood-boiling house is the chopping establishment, 82 by 124 feet, where the logs are cut into chips. The wood-choppers consist of two massive circular chunks of iron, resembling a solid wheel, about six feet in diameter, with large steel knives set in slats left in the iron for their introduction. The knives are movable, and can be placed or displaced at pleasure. They revolve with great velocity, and are capable of cutting from thirty to forty *cords* of wood every twenty-four hours. The chips, as they are cut, fall into iron cars, and are carried off as needed. Here are also three large pulp engines, each capable of holding 1,000 pounds of pulp, also two 84-inch wet cylinder cleaning machines, capable of cleaning from 25,000 to 30,000 pounds of pulp. There is also in this room the bleach-mixing apparatus, which is quite an important auxiliary in the manufacture of chips into paper. The whole of the machinery of this building is driven by two large Turbine water-wheels. Toward the river is the bleaching-house, where the pulp is bleached, and the drying-machine rooms, 36 by 118 feet, where are located one 84-inch thirteen dryer, three-feet cylinder machine, capable of drying from 14,000 to 18,000 pounds of pulp every twenty-four hours. These works are controlled by Messrs. Jessup and Moore, the great paper dealers, and Mr. Martin Nixon, the descendant of old William Ryttinghuisen aforementioned, who will manufacture the pulp into paper at their mills. By their erection it is estimated that the daily production of printing paper will be increased about 15,000 pounds, and the daily consumption of rags at the above-named mills diminished to about the same extent, which must have a tendency to cheapen the price of both articles; in fact, the price of newspaper has declined three cents per pound since the Wood Pulp Works were put in operation.

If, in the intricacies of masonry and mathematics, I have made my meaning plain, the reader will see that this process in the first place so perfectly disintegrates the wood that nothing but pulp remains. It does so at less cost by saving and securing the chemicals (soda especially) that enter so largely into the manufacture of paper. This economy is the great value of the present experiment. Other wood besides poplar can be used, although poplar is the most preferable. The capacity of the mills is very large, and if Messrs. Jessup and Moore succeed in making paper as perfect and useful as that upon which I am now writing (and which came from their mill), they will revolutionize the art of paper-making and greatly lessen the cost of knowledge. In the experiment hundreds of thousands of dollars have been spent, and this thin sheet of paper represents the patience of many toiling years, the intrepid sinking of capital in the interest of science, unwearied care, energy, patience, perseverance. Yesterday it was a comely tree, its roots deep in the earth, the birds hopping amid its branches, its leaves eagerly seeking the juicy dews of spring, and apparently destined for a long life in its forest home. But axe and alkali, and fiery furnace, and dreadful, tearing hooks, have done their mission, and the pretentious tree, no longer known to the village, carries my humble message. Thrice-honoured tree, with all its sad experience, if it be the means of sending the newspaper to its million readers, so cheap, and clear, and bright, that the poorest labourer in the land may always be enabled to welcome it to his humble home.

The following description, from the 'American Artizan' of New York, gives some further specific details of the manufacture :—

The process by which the wood, after being cut into chips, is reduced to pulp, and the apparatus employed in the reduction, are the subjects of the several patents of Charles Watt and Hugh Burgess, Morris L. Keen, and C. S. Buchanan. The process consists in boiling the wood chips in a strong solution of caustic alkali, under pressure in closed boilers, from which the pulp is discharged into expanding chambers, in which it is partly drained, and whence it is afterwards discharged into waggons, in which it is further drained before being taken to the bleachery, the discharge from the boilers and expanding-tanks being effected by the pressure of the steam above it. The pulp, when discharged into the waggons, is of a dark grayish-brown colour, but after having been drained begins to show some promise of eventually assuming the white colour it has after the bleaching process. Some idea may be formed of the immense scale on which the process is carried on when we state, that the ten boilers with the expanding-tanks and receiving-waggons fill a building 132 feet long and 75 feet wide. The waggons, while receiving the pulp, are arranged upon turn-tables, from which they are run off on a railway running the whole length of the building.

It may appear to the uninitiated that the expense of the enormous consumption of alkali involved in this process would be fatal to its commercial success, but fortunately no less than eighty-five per cent. of the alkali is recovered after every boiling, to be used over again with fifteen per cent. of fresh alkali for the repetition of the process upon a new supply of wood. To recover the alkali, the liquor drained from the pulp is collected in drains under the floor of the boiling-house, and thence conducted by underground pipes to the evaporating-house, where it flows through evaporating furnaces, subject to heat both below and above. The water having been evaporated in these furnaces, the recovered alkali is collected to be re-dissolved with the fresh alkali in immense tanks in a building called the mixing-house. In these tanks the dissolution and mixing are expedited by revolving stirrers within the tanks. The evaporating-house is a large circular building, 200 feet in diameter, resembling the locomotive sheds at some of the largest railway depôts. The trains of furnaces radiate from the centre of the building, and all communicate with one central chimney.

The wood best suited for the manufacture of pulp is of the kinds which are plentiful and the least valuable for other purposes—poplar, hemlock, and white wood. It is brought to the works in the condition of ordinary cord wood, and it is cut into chips by two immense machines having cutters attached to rotary discs, something like rotary straw-cutters. The feeding-troughs are inclined so that the wood is cut obliquely to the grain. These machines are each capable of cutting up between thirty and forty cords of wood in twenty-four hours. The chips are received in waggons, in which they are conveyed to the pulp-boiling house, and from which the chips are delivered by mechanical elevators into the boilers in which the reduction into pulp is effected. The pulp received from the boilers is conveyed to pulp-engines like those employed for the reduction of rags, and after having been worked in these engines is run through cleaning-machines, substantially like what are known as cylinder paper-making machines, but having no dryers. From the cleaning-machine the pulp is taken to the bleach-house, and after being bleached is fit to be made into paper in the same way as any other pulp. In the Flat Rock paper mills the wood pulp has mixed with it about twenty per cent. of straw pulp; this mixture making a better paper than the wood pulp alone. The paper made at these mills is of a quality suitable for ordinary newspapers, and much better than is often used, and its price is three cents per pound less than paper of equal quality made from rags.

ORCHID TEA.

BY JOHN R. JACKSON.

To have to look to the Orchid family for any large staple article of trade other than Vanilla, would be not only to look to a new field, but also to a very interesting one. The application of the leaves of one of these plants as a substitute for tea has lately come under my notice. The product has been heard of before in its native country, but never, so far as I know, in fashionable or civilised society. It has, however, now made its appearance in Paris as a regular article of trade, and is highly recommended as a most agreeable beverage.*

The plant yielding this new description of tea is the *Angræcum fragrans* of Thouars, an epiphytal orchid of the Island of Bourbon, where it is known and used by the natives under the name of "Faham." This word, once an obscure native name, is now, if we are to believe the enterprising French firm who has just introduced it, destined to become a "household word," for "Faham" is the name under which it is now sold in Paris, and the word appears in large letters upon the boxes in

* Attention was drawn to this leaf as a tea substitute in vol. 1, page 114—Editor.

which it is packed, as well as upon the circulars accompanying them. The headings of these circulars run as follows :—" Faham from the Isle of Réunion, imported from and manufactured at Réunion." There is also a rough, but not at all a bad cut of the plant producing it. The circular itself begins by saying that tea proper has never been well received in France, owing to the wakefulness resulting from its use, which has caused many persons to reject it altogether, while many of those who do use it drink it in default of a better substitute. The circular then goes on to state that it is for the purpose of remedying this state of things that the new infusion is intended; not to replace tea, which has indisputable advantages, but to afford an opportunity of choosing between two beverages, equally beneficial and useful. " Faham is not a new production. From time immemorial the natives of the islands of Réunion and Mauritius, though situated as it were at the very gates of China, have preferred it to tea ; every traveller has partaken of their preference ; one of our most illustrious writers, George Sand, eulogises it in the midst of the fine description which she gives of the Isle of Bourbon, an eulogy which cannot be suspected of puffery, inasmuch as it was written upwards of thirty years before the introduction of Faham into France was thought of. Every work on botany of any importance similarly places it into the foremost rank of the beneficial productions of this favoured clime. The difficulties experienced in the gathering and manufacture of Faham on a large scale, and consequently the almost impossibility of procuring a sufficient quantity to recompense the labour of obtaining it for consumption, and also its very high price, have alone prevented until now this valuable article of diet from being imported into France. After many fruitless attempts, these obstacles have been overcome.

" Faham belongs to the family of orchids ; it grows upon the high slopes of the Island of Réunion, in the midst of almost inaccessible forests. It possesses a taste differing greatly from that of tea, and is preferred by the majority of persons who have tasted it. It can be used as a substitute for tea on all occasions, as it combines its tonic and digestive qualities, free from the sleepless effect. It possesses an aroma of great delicacy, capable of being rendered more or less pungent according to the quantity used, and it gives forth a most agreeable perfume ; after being drunk it leaves a lasting fragrance in the mouth, and in a closed room the odour of it can be recognised long after. This beverage has the further advantage over tea, which requires to be drunk at the time of making, that it can be reserved for a future occasion if requisite, and may either be taken cold or made hot again. Milk, or spirits in small quantities, especially rum, serve to develop its aroma, and, lending it additional delicacy or greater strength, render it a delicious drink. Lastly, this valuable plant is made use of to flavour custards and ices, to which it communicates its delicate fragrance.

"To be taken as a warm beverage, the leaves and stalks should be placed in cold water in about the proportion of one gramme to a tea-cup, more or less, as the consumer may desire it of a greater or lesser degree of strength. The water should be immediately made to boil for about the space of ten minutes in the tea kettle or other closed vessel. It should then be emptied into the tea-pot or tea-cups and sweetened accordingly.

A sample of this new kind of tea has recently been received at the Kew Museum ; it was packed in a very neat canister-shaped box, similar to those now sold in Paris. These boxes are of two sizes, the smaller containing material sufficient for making 50 cups of Faham, and sold at 2f. 50c., and the larger 105 cups and sold at 5f. Upon opening the box in question the perfume emitted was exceedingly powerful, and very similar to that of the Tonquin Bean. The leaves, unlike those of tea, appear simply dried, not shrivelled by heat, but are as flat as we should find them in any herbarium. The absence of any artificial colouring matter, or roasting, accounts for the very light colour of the infusion.

No doubt there are many persons who would prefer the fragrance of this article to the aroma of Chinese tea, but for my part I give preference to the latter—perhaps prejudice may have something to do with it. The perfume from the tea-pot is certainly very agreeable, and is an undoubted novelty ; and if Faham came into general use, this domestic article would serve the twofold purpose of a tea-pot and a "perfume vaporiser." Doubtless if these leaves can be obtained in quantities sufficient for consumption as tea, the French perfumers might also import them to advantage, if for no other use. Powdered they would make excellent sachets.

In the Museum at Kew are some cigars made of the leaves of *A. fragrans* simply rolled in a tobacco thin leaf. They are probable very agreeable smoking, but I am unable to say if this application is a common one in the Island of Bourbon, or whether these specimens are rather a curiosity.

MAORI AND OTHER ABORIGINAL MANUFACTURES AND IMPLEMENTS.

BY W. H. HARRISON.

CONTAINING, as New Zealand does, an aboriginal population, numbering between 50,000 and 60,000 souls, articles of native manufacture, and specimens illustrative of the arts and customs of the Maori race, are most interesting. The Maoris have most deservedly been considered one of the finest and most intelligent of aboriginal races. Their interesting and physical powers have from the time of Cook downwards enlisted the admiration of travellers, and the respect of the Colonists. Compared with the native inhabitants of Australia, and of many of the uncivilised islands in the South Pacific, the Maoris stand out as their superiors in every respect. Their extreme aptitude has enabled them to adopt easily many of the habits and customs of European civilisation, and to throw off a great deal of the barbarism of their forefathers. When it is borne in mind that a great proportion of the Maori population now wear European clothing, eat and drink European food and liquor, use European tools and utensils, plough their lands with iron ploughs, and thresh and grind their corn by machinery, own and navigate vessels built and rigged in the European fashion, and fight with European rifles and gunpowder—when these things are remembered, it becomes increasingly interesting to study the rude tools, weapons, clothing, and other articles which they employed or manufactured in byegone days. Excepting in a few special articles, the traditionary manufactures and weapons have become almost obsolete amongst the Maoris, and it is acknowledged by themselves, that some of their formerly most cherished arts are being rapidly forgotten. If at any future time the native inhabitants should become amalgamated with the Europeans—if a century hence there remains a civilised and cultivated remnant of the Maori race—the relics of the past and the memorials of the rude but ingenious skill of their ancestors will become to them invaluable records. The arts and manufactures of a people are the most valuable records of its history. What important ethnological facts have been ascertained and established by means of bits of broken pottery or rusted metal! The history of the Maori race is still unwritten, but in their habits, language, weapons, tools and manufactures, we trace their affinity to other races, and are enabled at any rate to build up reasonable conclusions as to their origin. For many reasons it is desirable that collections of aboriginal implements and productions should be preserved. They are not only interesting, but instructive, and it was with this view that objects of this character were afforded a place in the recent New Zealand Exhibition, and they constituted by no means its least attractive feature.

In reporting on the numerous objects in this class, it is perhaps the most desirable plan to divide them into two classes—viz.: Articles of Use, the manufacture of which is partially or wholly preserved at the present day; and Articles of Ornament, Weapons, and miscellaneous objects.

Articles of use—All savage nations in some way or other make a convenient use of natural productions of the country in which they live. But there are great differences in this respect; there are degrees of barbarism as there are degrees of civilisation. Some races are endowed with greater ingenuity than others, and keener perceptions of what is applicable for their various purposes. Some savages know no other adornment or covering than perishable leaves, whilst others have carried the weaver's art to perfection, and placed all those members of the vegetable kingdom under tribute that can yield them a fibre. "The New Zealander," says the Rev. Richard Taylor, "is acquainted with every department of knowledge common to his race; he can build his house; he can make his canoe, his nets, his hooks, his lines; he can manufacture snares to suit every bird; he can fabricate his garments, and every tool and implement he requires, whether for agriculture or war; he can make ornaments of ivory, or of the hardest stone; and these too with the most simple and apparently unsuitable instruments, sawing his ivory without loss, with a mussel shell, and his hard green jade-stone one piece with another, with only the addition of a little sand and water; and all these works, it must be remembered, he could accomplish without the aid of iron, which was unknown before Cook's time. The native is not deficient in those arts which are essential to his comfort. His house constructed with great skill and elegance, his garments with much beauty, and ornamented with a border of elaborately wrought embroidery."

The articles of clothing used formerly and still partially retained by the Maoris, were in most cases manufactured from the native flax or *Phormium tenax.* The Maoris are very successful in the preparation of the fibre of this plant, as the beautiful silky texture of their mats shows. They cultivated the plant, carefully selecting the various kinds of leaves for the different purposes to which the fibre was to be applied. The coarser fibre was used for rough common mantles or mats, and the fine silky threads for their fishing lines and best garments. There are several kinds of flax mats. That kind called *kaitaka* is the softest and most valued; they vary in size, some being as large as twelve feet long and seven wide. They are made of close parallel lines of soft twisted flax, with transverse threads at intervals of about an inch. The "weft," if we may so call it, is knotted round the warp, six or seven threads of which are taken up in each knot. They generally have borders of about a foot in width, of closely woven material, beautifully embroidered in ingenious patterns with black or red threads. The weaving of one of these mats occupied one person eight months. The inhabitants of the East Cape were noted as the most expert manufacturers of this mat. There were several very fine specimens of the *kaitaka* mat in the Exhibition.

Another description of mat is called *korowai.* It is generally about six feet square, smooth inside, but having outside a number of black strings seven inches long dangling from it. This mat, like the *kaitaka*, has a very open texture.

The mat called *taupo* is made of flax leaves, seven inches long and three-quarters of an inch broad, attached to a smooth coarse mat; every third leaf is dyed yellow, and the rest black. This mat is perfectly impervious to rain. A specimen was exhibited in the Hawke's Bay collection.

The *pureki* mat is another waterproof covering, made of roughly prepared flax fibres, eight inches long, attached by one end to a coarse mat. It differs from the *taupo* mat in the flax being more scraped and not dyed.

The *tci* mat is made of flax leaves dyed black, seven inches long and three-quarters of an inch broad, twisted and torn so as to leave some green fibres. The *kupura* is a very rare mat, and is, like the *kaitaka*, without the border, and is dyed black.

The *kotikoti* is a mat which is so fabricated as to allow close rows of pipe-shaped tassels to hang down. These pipes are made by exposing the green flax leaf to the fire, which causes it to curl round in the form described. This mat rattles when the wearer walks.

The *pukupuku* is a mat of closely woven flax, and used as a sort of armour against spears.

Mats were also made of dogskin (*shupuni*), and of the feathers of various birds, especially the kiwi.

Although the Maoris have only a tradition to that effect, there is reason for believing that they were formerly acquainted with other methods of manufacturing cloth for garments. The inhabitants of many of the South Sea Islands, it is well known, make a sort of cloth by macerating and beating out the bark of the paper mulberry. The Rev. Mr. Taylor, in his work alluded to, says: "Tradition also states that they (the Maoris) had finer garments in former days, and of different kinds; that, like their reputed ancestors, they made cloth from the bark of trees; the name is preserved, but the manufacture has ceased." The name by which this bark-cloth is known is "*aute*." An exhibit in the Otago Museum Collection appears to throw a good deal of light on the subject. It is a piece of cloth found in a cave in the Dunstan ranges, Otago, and probably a portion of burial clothing. It is very much like the "*tapa*" of the Fijians, and is evidently made by macerating and felting together some fibrous bark or leaf. From apparent divisions in the texture about the width of a flax leaf, it was considered by some to be composed of that material, but it is most likely made of the paper mulberry or some other fibrous bark—perhaps the Hohere (*Hoheria populnea*) or Ribbon tree. It is in a very good state of preservation, and is a most interesting relic of native manufacture.

Very good collections of flax mats were exhibited by the Rev. Mr. Reimenschneider, and by the Waikouaiti District Committee.

The fibre of the native flax also supplied the Maoris with sails for their canoes, fishing lines, and nets. In the two latter much ingenuity was displayed. A specimen of a peculiar and rare kind of fishing line was contained in the collection exhibited by W. Colenso, Napier. From the flax-leaves the natives manufacture excellent baskets or kits, in which they convey their provisions and produce. Some are roughly made, and others display great taste in the pattern. To the present day most of the agricultural and horticultural produce of the Maoris, excepting corn, is conveyed to market in these kits, which find a ready sale amongst the Europeans in settlements near native villages.

Very interesting specimens of the native flax, in the different stages of preparation for the manufacture of mats, &c., were exhibited by W. L. Buller, Manawatu, and by William Davies, Otaki.— The floats used by the natives for buoying their fishing nets were made of a peculiar light and pithy wood called "Whau" (*Entelea arborescens*), the specific gravity of which is less than that of cork. Some specimens of this wood were exhibited in the Auckland department.

The tools employed by the Maoris for shaping the hull of their canoes, felling trees, &c., were made of various kinds of hard stone, shaped into the form of adzes and axes. Quantities of these old tools and weapons are found on the sites of old native villages, and in caves and other burial places. The stems of their canoes were ornamented with figure-heads and carved prows, the execution of which displayed wonderful skill and knowledge of art. These carvings were generally made of very hard wood, stained black. The pattern was always an open worked design, similar to the Indian and Chinese carvings in ivory —circles and intersecting curvilinear lines, tastefully and regularly arranged. The figure-head was generally a rude copy of a human head, the proportions and treatment of which exhibited a surprising degree of artistic skill. The Exhibition contained several beautiful models of canoes, made by the natives as memorials of some canoe of their ancestors. The paddles are made of various kinds of wood, those made of manuka being much esteemed. Their handles are occasionally carved, and their form is constructed so as to cause them to enter and leave the water easily and smoothly. Models of canoes and paddles were exhibited by Sir George Grey; the Auckland local committee; and by Donald M'Lean Superintendent of Hawke's Bay. This latter model had a special interest attached to it. It was made by a native chief of Hawke's Bay, and is supposed to be a model of an ancestral canoe called "Takitimu," in which the ancestors of the tribe came from Hawaiki to New Zealand. The canoe is often referred to in their speeches as symbolic of peace, or to announce that the descendants of their ancestors, who came to New Zealand in the canoe "Takitimu," would use every effort to preserve peace in Hawke's Bay.

The Maoris, unlike the inhabitants of the Fiji islands, appear to have been ignorant of the potter's art. Their drinking vessels and bowls were constructed of gourds, wood, or bark. At great feasts, the chief delicacies were placed in large *hua* or calabashes, or in ornamental dishes made of the bark of the totara. Their principal crockery—if one may use the term—was supplied by the *hue* or gourd. In it the New Zealander carried water, stores, potted fish, birds, or flesh ; he also used it as a dish, and even as a lamp. These dishes were often beautifully ornamented with tattooing. Specimens of these vessels were shown in the exhibition. Spoons and pronged forks were made of wood ; Mr. Colenso's collection included specimens of these.

Fish-hooks, in the construction of which the Maoris displayed great ingenuity, were made of human bone, wood, and sharks' teeth. Several examples of the various kinds of fish-hooks were exhibited by Sir George Grey, Mr. Colenso, and others. An ingenious saw, made of a row of sharks' teeth firmly lashed to a piece of wood, was shown in Mr. Colenso's collection. Beautifully carved boxes, the design and execution of which exhibited great skill, were exhibited by Sir George Grey and the Auckland local committee. They are about as large as a good-sized work-box, with projecting carved handles, the lid and sides carved in a small and graceful pattern.

Articles of Ornament, Weapons, and Miscellaneous Objects.—Like some of their more civilized brethren, the Maoris are passionately fond of adorning their persons with trinkets and other ornaments. At the present day many of the decorations formerly used have been discontinued. Ear ornaments are in general use, they are worn by both sexes, and are of great variety. Those of greenstone "poenamu" are the most highly prized; and sharks' teeth of large size are also held in high estimation. Sometimes ear ornaments are made of the feathers of the Huia or Tui birds. The neck ornament is generally of greenstone, carved into the resemblance of the human figure. These are called *heitiki;* the image is not unlike a Hindoo idol, having an enormous face, and badly shaped legs of disproportionate size. Some heitikis were about the size of shillings, others were as large as plates. This ornament was a sort of heir-loom, being handed down from father to son. When a long absent relative arrived at a village, the heitiki was taken from his neck and wept over for the sake of those who formerly wore it. Heitikis were deposited with the bones of the dead until they were removed to their final resting place. Every tradition respecting this image is forgotten, but it is evidently connected with their mythology. Haumia tiki tiki is the god of cultivated food amongst the New Zealanders, and tiki in various South Sea Islands is the name of an image. One of these ornaments was exhibited in the collection of Sir George Grey.

The ear pendants of greenstone vary in form; some are narrow pieces, from three to five inches in length, and others are round, thin and flat. They are suspended by a piece of black ribbon. The "Poenamu" (*Nephrite, Greenstone,* or *Jade*), of which the Maories make so many articles of personal adornment, and which in former times was extensively employed by them for tools and weapons, is found chiefly on the West Coast of the Middle Island. Captain Cook calls the whole Island *Tovai poenamu*, and *Te Wahi poenamu*, or the Water of the Greenstone is a name written in old charts against a lake in the Middle Island. The words are corruptions of *Te Wahe poenamu*, or the place of the greenstone, by which the Western portion of the Middle Island was known amongst the Maoris. In some districts of the West Coast the greenstone is found in large masses, and it is somewhat difficult to account for the high value placed upon it by the natives, excepting from the circumstance that the western portion of the Middle Island was but little known to them. Its geographical distance from the centres of population, added to the extremely difficult access to it, rendered the acquisition of the *poenamu* no easy matter. Certain it is, however, that this greenstone has for a long time been the most highly prized material employed by the Maoris in the adornment of their persons. The old Maori traditions placed the district from whence they derived their supplies about midway down the West Coast of the Middle Island, and some interesting particulars of a visit to it by Messrs. Brunner and Heaphy are given in an account by the last-named gentleman, contributed by him to the 'New Zealand Monthly Magazine' of October and November, 1862. Passing by the description given of the wild and rugged country through which the explorers had to pass, we come to the account of the native settlement at Taramakau :—

"At Taramakau, eighteen miles from Kararoa, we came upon the chief settlement of the Ngaterarua, or Greenstone people, some forty souls in all ; and every man, woman, and child indolently engaged in sawing, grinding, or polishing greenstone. Taramakau village was unlike any other native settlement in New Zealand ; every house had a chimney, and, there being no pigs or other neighbours, fences were unnecessary, and the taros and potatoes grew about and between the houses.

"That we had at length reached the veritable Greenstone country was very evident. Outside the principal house, the chief of the place had laid by a slab of poenamu, out of which he was sawing a *mere* when he came to welcome us. In another place, an old man—too old to move out to meet us—chanted some sort of song of welcome, and kept up a sawing accompaniment. Little children ran about with toy pieces of *kawa kawa* , and brought us smooth pebbles of it as presents ; *Heitiki* —the uncouth figures with red sealing-wax eyes that are worn hung round the neck—were receiving the last polish ; and fragments of greenstone—odd knobs, and rejected cross-grained pieces—were lying about the houses, and down the beach, in a way that would have made a Ngaphue crazy could he have beheld it.

"Along the whole extent of the West Coast—from Cape Farewell to Dusky Bay, that is the only Maori community. Some fugitive natives are occasionally to be found about the Sounds south of Milford

Haven, and the natives from Arahura make excursions to obtain a peculiar kind of greenstone from near Wakatipu, and may be occasionally seen at Jackson's Bay or Cascades, but there is no other regular village. The people are chiefly a remnant of the Nga-i-tau tribe that formerly occupied the country round Otago and Bank's Peninsula, and extended over the island to the West Coast, for the purpose of working the greenstone. Rauparaha and the Taranaki tribes, with their guns, scattered them in a series of bloody engagements on the East Coast, and afterwards the Ngatitoa tribe, under other leaders, came down from Massacre Bay, by the coast track that we followed, and defeated them on the west side. But the sight of the poenamu had a pacifying influence, and before long intermarriages took place; some of the Ngatitoa remaining at Taramakau, and others returning to Cook's Straits with a tribute of greenstone meris. * * *

(To be continued.)

Scientific Notes.

THE OREIDE OF GOLD.—This substance, of which so many articles called jewellery are now made, is simply an alloy of copper and zinc—a brass of a peculiar colour resembling "jeweller's gold" of about sixteen carats fine—copper and gold mixture. It is the invention of MM. Mourier and Vallent—two Frenchmen. It was patented in France in December, 1854, and in the United States in March, 1857. It is composed of 100 parts (by weight) of pure copper, 17 of zinc, 6 of common magnesia. 3·60 sal ammoniac, 1·80 quick lime and 9 of crude tartar. The copper is first melted in a crucible, then the magnesia added, then the sal ammoniac, lime and tartar separately, and in powder. These are kept from contact with the air, and all well stirred for about twenty minutes, until they are incorporated together. The zinc is now added in strips, which are thrust under the scum formed on the top of the crucible. The mass is now stirred, the lid put on the crucible and its contents kept fused for about twenty-five minutes; after which the crucible is opened, the slag skimmed carefully from the surface, then the molten alloy is poured out into ingot moulds if it is required to be rolled, or into iron rolls if designed for castings. When designed for works of art, however, it is best to cast it into ingot form first, then melt it in a furnace and cast it. This alloy is very beautiful, and well deserves the name of "oreide of gold," as it greatly resembles the precious metal. It is very ductile, and may be rolled into very thin leaf; but it is nearly as easily tarnished as common brass.—'Scientific American.'

THE TECHNOLOGIST.

AN INQUIRY INTO VEGETABLE FIBRES AVAILABLE FOR TEXTILE FABRICS.

BY H. SHERWOOD.

During many years past a considerable number of fibres easily obtainable have been brought into notice, some of which appear to possess peculiar excellencies; but, though recently the market value of the great staples of manufacture has been, and still continues high, and thus every inducement has been offered to bring into use some of those fibres, yet the advance towards this end has been but small. Cotton cloths and linen cloths remaining substantially the only vegetable fabrics possessed by us. Still, the public mind has been awake to the importance of the subject; and many attempts have been made, chiefly towards attaining an end laid down as the great necessity of the times,—viz the bringing of a fibre into the market in a state suitable to be worked on cotton machinery, and to fulfil all the peculiar uses of cotton. The object of these notes is to inquire how far a just view of the general subject prevails,—how far the endeavours towards utilising new fibres have been reasonable, and to seek light on the manner of their suitable treatment.

Of all fibres doubtless cotton is one of the most desirable. The evenness of thickness, the length, strength, and softness, of each fibre, together with its flattened spiral form, adapting it so admirably for spinning into high count yarns, will cause it ever to retain its prominence for an immense class of fabrics. Little also is left to be desired in the perfection of its manufacture. But, the day was when cotton was unknown in Europe; and in like manner as cotton has found its specially suitable uses, so doubtless other fibres will be found to have theirs, uses which are now usurped by the less suitable staples of flax and cotton.

Flax and its kindred fibres do not appear to have advanced very much in perfection of manufacture even from early ages. Evenness of yarn appears the chief aim in most proposed improvements in flax, which cannot be expected to be fully attained from fibrous material used with masses of cells agglutined together, and consequently liable to unevenness. Hemp might probably with great advantage have its uses considerably extended by improved states in which to use it. Jute is probably used to its full capabilities and certainly further than the public approve of.

Beyond these staples the utilization of other fibres appears almost confined to semi-civilised nations consuming local products. Their manner of using these, though some are probably worthy of consideration even by manufacturing Europe, are beyond the subject of this enquiry. The few which Europe has attempted appear to have been intended chiefly for mixing with other fibres now in use. But is it not doubtful whether this design in their use may not be in the main defective? Each fibre has its own speciality, which may be a peculiar excellency or a peculiar beauty, and many may produce cloths as totally different from cotton or linen, as these differ from each other. Is it not also doubtful whether the imperative necessity for fibres to be workable on cotton machinery be not the demand for idle machinery rather than of thinking men able to adapt machinery to requirements? Though some fibres exist which appear eminently adapted for mixing with silk and with combed wool, yet probably these fibres are destined to be more used alone than in any combination. But we may presume that the raw materials appearing on the market in a state suitable for the manufacturer, would create their own machinery, their own suitable uses, and their own demand.

The attempts at improvement in the use of fibres have very properly taken the direction of dividing the filaments from their natural state of further separation, or into the individual cells of which each filament is composed. Amongst the earlier attempts made during the last fifteen years appear prominent those of the Chevalier Claussen who unfortunately erred through claiming qualities for his products which could not reasonably exist. That split filaments of flax should dye much better than whole filaments equally cleansed from loose vegetable matter, is what cannot be conceded; nor that they should acquire a greater felting property than the corresponding increase of number of filaments would give. Neither can it be allowed that any fibrous material uneven in breadth of filament, should be suitable for mixing with wool or silk, if beauty of yarns be necessary. Nevertheless, though the material was rendered imperfect through erroneous treatment (the cause of the evil effects of which have since been demonstrated during researches on the rotting effect of silicates on cotton cloth), the state of fibre was manifestly a step in the right direction, and pointed to a new character of cloth, producible from less expensive fibres than flax, equidistant from cotton and linen, possessing more warmth and softness than the latter, and for heavy fabrics more strength and firmness than the former.

During the course of these remarks it will appear evident that many fibres exist well adapted for such a class of manufacture of desirable excellence, and at moderate prices.

The efforts to substitute the former supply of cotton claim prominence here. Amongst others we have those of Mr. Thompson of Dundee, who exhibited in Austinfriars, E.C., some beautiful samples of jute claimed to be suitable for this purpose and for mixing with wool. But it could not be supposed that a hard, brittle, and coarse-celled fibre, such as jute, should possess any of the properties required for cloths now produced from cotton (and the experiment certainly did not appear to have developed any qualities not previously known), whilst for mixing with combing wools, the average length of the individual cells (in which state alone it could be satisfactory for this use) appears shorter than the necessities of the trade demand, though doubtless some jute exists of elongated growth of cell which might be thus applied for some fabrics.

The praiseworthy attempts of Mr. Harben, to extract a fine fibre from *Zostera marina*, claim notice. Here a beautiful fibre really exists, constituting the bone of the leaf. It appears to possess brilliancy, softness, and many of the desired properties; and though, when completely separated, it is short and tender, yet it would be a desirable adjunct to our fibrous materials if it could be separated in sufficient quantity and at moderate prices. The latter seems doubtful from the small yield of fibre in proportion to bulk of weed containing it, joined to the difficulties of preparing it; irrespective of probable difficulties of cultivation to a large extent except over very extended distances. We may here pause to inquire whether sufficient attention has been given to the bye-products, say as a source of gum substitutes or of glucose. The mucilage itself appears closely allied to other mucilages which, as is well known, are easily convertible into other forms.

Considerable attempts have been made, and are still making (by a company recently formed for its development), in France, and to some small extent in England also, to produce a substitute for cotton from China grass. We have here a fibre naturally brilliant, with cells of from three to eighteen inches long, and bearing a striking similarity, when not too closely viewed, to some long-stapled hairs and wools. We shall best consider the attempted treatment of this magnificent fibre as a cotton substitute by the patent of Mersrs. Mallard and Bonneau, of Lille, upon which most of the later patentees appear to have rung their changes without imparting any substantial novelty. These gentlemen have operated by cutting the grass into lengths of about two inches and treating it with oil and alkalies. With the chemical part of this treatment we have, at present, no concern, but with the fibre alone. The cell, as compared with cotton is brilliant, straight, stiff, cylindrical, and more than twice the thickness. (About equal to medium and fine mohair.) When cut down, and rendered uneven by separating the fibre, considerable difficulty must exist in the spinning. Report gives it the character of producing a firm cloth. But its comparative coarseness and non-adaptability for long count yarns must hinder its bearing a high commercial value in such a state of preparation, whilst its magnificent length and strength, exceeding, with few exceptions, every other fibre, together with its peculiar beauties and qualities, adapt it for far more valuable employment than to enter into competition with coarse-stapled cottons, or, at least, to scarcely fill a place capable of being filled by fibres of half the cost. Towards its preparation for those more suitable and valuable uses, many attempts have been made with mediocre success. It appears generally to have baffled all efforts either to completely separate it into its cells, or to retain in these the length and strength which they naturally possess.

Much attention has been given of late, both in Canada and in the United States, towards producing a cotton substitute for flax. The government of the United States, with its usual fostering care, voted in 1864, a subsidy of 10,000 dols., to defray the expense of a commission to ascertain whether it be practicable to prepare from flax such a substitute. The success appears to have been moderate ; and some interesting samples have been shown of flax so prepared, both from the United States and from Canada. Some grounds of hope of complete success appear to exist, as it is proposed, or decided to extend the commission for another year with a further grant of money.

It is a consideration of much importance whether it has not been taken too much for granted that what may be termed "manufacturing properties," which specially belong to cotton, will be present in any or all fibres, when separated into their individual cells ; and, whether any of these fibres when so prepared will actually supply the peculiar place of cotton. Most of their properties would seem rather to point to a totally new class of cloths ; doubtless also, to a modified mode of working the fibres. A want of adaptiveness for spinning, appears to exist in a greater or less degree in all. The peculiarities of many which possess a similar length to cotton, consist in being gradually tapered from the middle to the ends ; stiff throughout, almost cylindrical, little twisted, showing under the microscope great brilliance and smoothness of surface. Some exhibit polarity enough to adhere in a long string when placed end to end. Some possess the remarkable softness of the fibrine of chamois leather, but are very short and tender. But other fibres exist which possess great evenness of thickness long as mohair. One at least has all the length and fineness of coarse middle draft silk. Yet with all these varied materials lying buried under chemical difficulties of a very slight character, compared with many which are continually overcome, except the isolated instance of China grass, we use to day nothing which Nature has not almost "prepared" ready to our hands !

Much misapprehension appears to prevail concerning the strength and other properties when prepared for fabrics, which exist in the natural filaments before preparation. A consideration of the widely differing states will at once convince us that is possible that the exact opposite may be the reality. Take *Phormium tenax*, the New Zealand flax, as an example. This fibre in its natural state is of immense strength, and is also worked by the Maories to a great degree of fineness in certain ways, that is, by cleansing and combing out the ends of the filaments as a fine lustrous fringe. The separated cells possess great brilliancy, but instead of being long and strong as has been inferred, they do not exceed $\frac{1}{4}$ to $\frac{3}{8}$ inch in length, and are amongst the weakest of fibres. But when it is considered that the fibres are coated with a large amount of vegetable matter, amongst which tannin is decidedly marked, which, with the proteic bodies invariably present in fibres, will form a sort of brittle leather, we cannot wonder that, when built up into long filaments, it should class amongst the toughest of fibres. No better familiar simile can be given of this difference of strength than a billiard ball now making, constituted chiefly of about the shortest of all fibrous substances, (paper pulp) which, when mixed with glue, becomes so tough that no fall or ordinary amount of beating can destroy it. The susceptibility of *Phormium tenax* for dyes has also been much spoken of. But will not this be accounted for by the fact of its being used by the Maories in a half-cleansed state when the tannin would naturally fix dyes forcibly. When fully cleansed, capable of being worked on European machinery, it appears to possess no such remarkable property.

The lists of comparative strength of other fibres published, as having been tested against each other at various times, though doubtless excellent practical tests of their value for ropes, or for sackcloth, form no criterion of their strength when prepared for manufacturing into fabrics, as is exemplified in the case of New Zealand flax. Their strength for this purpose being solely dependent upon the length and strength of their individual cells, and upon the surface form of these cells whether favourable or otherwise to binding together in spinning.

In resuming the subject we will endeavour to seek out the properties and adaptabilities of some known fibres, and conclude with an inquiry how far their attempted treatment accords with that required by their supposed chemical composition.

4 Albion villas, Hammersmith.

MAORI AND OTHER ABORIGINAL MANUFACTURES AND IMPLEMENTS.

BY W. H. HARRISON.

(Concluded from p. 494.)

THE poenamu is a vein stone, like quartz or felspar, and traverses rock of primitive formation. The river Arahura, nine miles from Taramakau, appears to cut through some veins of this stone, and to bring down fragments of it in the floods. On the subsidence of the water, the natives wade about searching for it in the river bed, and the heightened colour of the stone in the water soon reveals it to them.

Of poenamu there are the following kinds, viz—

"1. the inanga; 2. the kauairangi; 3. the kawa-kawa; and 4 maka tangi wai.

"The inanga is the most valued by the Maoris; it is rather opaque in appearance, and is traversed with creamy-coloured veins. The best *meres* are usually made of this stone.

"The kauairangi is of bright green colour, with darker shades, or mottled, and is the most translucent; it is a brittle material, and not easily worked—ear pendants are frequently made of it.

"The kawa-kawa is of a dark olive green, and has rather a dull and opaque appearance; hei-tiki (little images), and ear pendants are composed of it.

"The maka tangi wai is the least esteemed by the Maoris, but by far the most beautiful of all. It is of clear pale green, and is very translucent. The natives will drill a hole through a pebble of it and hang it to a child's ear, but do not care to fashion it into any shape. It is the only kind of poenamu that would be esteemed for purposes of ornament by Europeans.

"In order to make a *Mere*, a stone is sought of a flat, shingly shape —say of the size, and roughly of the shape, of a large octavo book. Among the primitive rocks of the Middle Island stones are not wanting of sufficient hardness to cut even the poenamu, and the Arahura natives lay in a large stock of thin pieces of a sharp quartzose slate, with the edge of which, worked saw fashion, and with plenty of water, they contrive to cut a furrow in the stone, first on one side and then on the other, until the piece may be broken at the thin place. The fragments that come off are again sawn by children and women into ear pendants. With pretty constant work—that is, when not talking, eating, doing nothing, and sleeping—a man will get a slab into a rough triangular shape, and about an inch and a half thick in a month, and with the aid of some blocks of sharp sanded gritted limestone will work down the faces and edges of it into proper shape in six weeks more. The most difficult part of the work is to drill the hole for the thong in the handle. For this, pieces of sharp flint are obtained from the Pahutani cliff, forty miles to the north, and are set in the end of a split stick, being lashed in very neatly. The stick is about fifteen or eighteen inches long, and is to become the spindle of a large teetotum drill. For the circular plate of this instrument the hardened intervertebral cartilage of a whale is taken; a hole is made through, and the stick firmly and accurately fixed in it. Two strings are then attached to the upper end of the stick, and by pulling them a rapid rotatory motion is given to the drill. When an indentation is once made in the poenamu the work is easy; as each flint becomes blunted it is replaced by another in the stick, until the work is done. Two *meres* were in process of formation while we stayed at Taramakau, and one had just been finished. A native will get up at night to have a polish at a favourite *mere*, or take one down to the beach and work away by the surf. A piece of poenamu and some slate will be carried when travelling, and at every halt a rub will be taken at it."

The above interesting description of what must at one time have been an important branch of Maori industry, shows how laborious was the process of greenstone manufacture, and supplies at least one reason for the high estimation in which articles made of the poenamu were held by the natives generally.

Weapons.—For personal conflicts the New Zealanders had several deadly weapons, and, like all races ignorant of iron, they used hard mineral for making keen-edged ones. Of these, the greenstone *Mere* was the most esteemed. It weighs about six pounds, is about a foot long, and in shape resembles a powder-flask flattened. Its edges are sharp as a knife, and in the handle is a hole for a loop of flax or leather, which is twisted round the wrist. Sometimes meres are made of wood or whale-bone, and in such instances are fashioned into various shapes and ornamented on their handles with carvings. The meres are deadly weapons at close quarters, and a single blow with one on the head will cause instant death.

There were several fine greenstone meres in the New Zealand Exhibition, in Sir George Grey's collection, and some noted ones were exhibited by various native chiefs. To all of these some legend is attached. The mere exhibited by Hohepa Tamaihengia, is called "Taturamoa," and has figured in many a deadly fight. Another fine mere was exhibited by the chief Waitaoro. It has been used in several engagements, and has a flaw in it done in breaking a Maori's skull. Oriwia te Hurumutu, daughter of the great chief Pehi, exhibited two meres, one of whalebone and the other of greenstone. Both have legends attached to their history; the former belonged originally to the father of the Rebel Chief, William Thompson.

The "Patu" is a wooden weapon, not unlike a violin in shape, and a little larger than the mere. One was exhibited by Sir George Grey.

The Maoris had five sorts of wooden clubs, which were occasionally highly carved, and ornamented with feathers and dyed flax.

The "Toki," or adze, was a favourite weapon. Its handle was made of wood, two feet long, and the adze of greenstone, jade, jasper, or granite. Many specimens were exhibited by various contributors. Peter Thomson exhibited a number of stone axes, ear ornaments, &c., found on the site of an old Maori settlement near Blueskin Bay. Spears, "Taiaha," were another kind of weapon; they were barbed with shark's teeth,, and ornamented with the feathers of the "kaka" or parrot. They are now only used as symbols of authority, and for flourishing about when haranguing. Taiahas were exhibited by Sir George Grey, and Hoepa Tamaihengia. Other spears, sharp at both ends, and from four to fourteen feet long, were formerly used, specimens of which were in the Otago Exhibition.

Miscellaneous Objects.—The Maoris were not without musical instruments. They had two—the flute and the trumpet. The flute, varying in length from two feet to three inches, was open at both ends, and had either two or five holes. In ancient times they were often constructed from the hollow bones of men, but latterly only wood has been employed. They played them by blowing into one of the holes, or into one of the ends ; the best instruments only produced five simple notes. A specimen of the bone flute was exhibited by Sir George Grey. The Maoris had also a kind of trumpet made of wood, seven feet long, and used for raising an alarm in time of war. A specimen made of supplejack was exhibited by Karaitiana. Combs for the hair were made of bone, a specimen of which was in Sir George Grey's collection. A curious genealogical staff is exhibited by Waru Werahiko Moeangiangi. It was the custom of the priests of several tribes to keep nominal lists of their hereditary chiefs, and for this purpose sticks were fashioned, upon which a notch was made as each warrior died. These sticks were preserved by the priest and called "papatupuna," and it was the duty of these holy men to keep this ancestral knowledge in the people's memories, in order to accomplish which they occasionally repeated before the assembled multitude the names of the tribe's dead chiefs. Dr. Thomson in his *Story of New Zealand*, says : "From a careful examination of several of these genealogical trees, I conclude there have been about twenty generations of chiefs since the arrival of the first natives from Hawaiki." The specimen in the Exhibition represents the pedigree of the tribe of the owner since their first arrival in New Zealand. It was with great reluctance that the owner parted with it for the purpose of exhibition.

The Maoris are great smokers, and are able to manufacture their own pipes in imitation of those of the Europeans. J. Grindell, Napier, exhibited three neat wooden pipes made by natives at the Wairoa. They are but slightly inferior in appearance to the wooden pipes sold by tobacconists. A pipe, mounted with a leaden rim was exhibited by A. C. Rees, Dunedin, this pipe was picked up in the Gate pah after the engagement at that place.

A number of relics to which a painful interest is attached, were exhibited by George Donne, Marlborough. They consisted of Maori tomahawks of stone, and rusted bayonets dug up recently at Massacre Hill, Wairau, Marlborough, and are most probably mementos of the terrible massacre of Captain Wakefield and his party in 1842. This affray arose out of a disputed land sale of the Wairau plains. The surveyors were at work on the plain, when the celebrated chief Rauparaha crossed Cook's Straits with an armed band, burnt down their huts and drove them off. They carried the news to Nelson, and the magistrate issued a warrant for the apprehension of Rauparaha on a charge of arson. The magistrate with Captain Arthur Wakefield, three other gentlemen and some special constables, went to execute the warrant. A collision ensued, and six and twenty men were slain. The Queen's Magistrate and Captain Wakefield were murdered in cold blood after the affair was over.

Fiji Islands.—Several exhibitors forwarded a variety of interesting articles from the Fiji Islands, concerning which some remarks are necessary. The inhabitants of the Fiji Islands possess many habits and customs almost identical with those of the Maoris ; but the different conditions of climate and mode of life, coupled with the difference in the natural productions of the country, have led to a considerable diversity in their arts and manufactures. The Fijians, judging from their tools, weapons, and clothing, are but little behind the New Zealanders in skill, whilst in some respects they are in advance of them —in the art of pottery for instance. The various objects from these islands which found a place in the New Zealand Exhibition, are not the less interesting because they are illustrations of the existing habits and customs of the Fijians.

Begining with the article of clothing, we find many beautiful specimens of cloth called "tapa," made by macerating and beating out the bark of the paper mulberry. The following interesting description of the materials used for clothing by the Fijians is taken from the most recent work on the Fiji Islands, *A Mission to Viti*, by Dr. Seemann :—

" Materials for the scanty clothing worn by the Fijians are readily supplied by a variety of plants, foremost amongst which stands the Malo or Paper Mulbery (*Broussonetia papyrifera*, Vent.), a middle-sized tree, with rough trilobed leaves, cultivated all over Fiji. On the coast, the native cloth (Tapa) and plaitings are gradually displaced by cheap cotton prints, a fathom of which is considered enough for the entire dress of a man. In the inland heathen districts the boys are allowed to run naked until they have attained the age of puberty, and publicly assumed what may be termed the *toga virilis*—a narrow strip of native cloth (Malo) passing between their legs, and fastened either to a waistband of string, or to a girdle formed by one end of the cloth itself. The length of the Tapa hanging down in front denotes the rank of the wearer. A fine kind of Tapa (*Sala*) is worn in the shape of a turban by those who let their hair grow long. The manufacture of native cloth is entirely left to women of places not inhabited by great chiefs, probably because the noise caused by the beating out of the cloth is disliked by courtly ears. The rythm of tapa-beating imparts, therefore, as thoroughly a country air to a place in Fiji as that of threshing corn does to our European villages. The Masi tree is propagated by cuttings, and grown about two or three feet apart, in plantations resembling nurseries. For the purposes of making cloth, it is not allowed to become higher than about twelve feet, and about an inch in diameter. The bark, taken off in as long strips as possible, is steeped in water, scraped with a conch shell, and then macerated. In this state it is placed on a log of wood, and beaten with a mallet (*Ike*), three sides of which have longitudinal grooves, and the fourth a plain surface. Two strips of Tapa are always beaten into one, with the view of strengthening the fibres—an operation increasing the width of the cloth at the expense of its length. It is easy to join pieces together, the sap of the fibres being slightly glutinous; and in order to make the junction as perfect and durable as possible, a paste is prepared of arrowroot, or a glue of the viscid berries of the Tou (*Cordia sprengelii*, De Cand.) I have seen pieces of native cloth intended for mosquito curtains and screens, which were nearly one hundred feet long and thirty broad. Most of the cloth worn is pure white, being bleached in the sun as we bleach linen, but printed Tapa is also, though not so frequently, seen, whilst that used for curtains is always coloured. Their mode of printing is by means of raised forms of little strips of bamboo, on which the colour is placed, and the tops pressed; indeed, the fundamental principle is the same as that of our printing books, the little strips of bamboo standing in the place of our types. The chief dye employed is the juice of the Lauci (*Aleurites triloba*, Forst.), and the pattern, though rudely executed, often displays much taste.

"The most simple form of an article of dress, and one much worn in Fiji, is called "*Liku*," consisting of a number of fringes simply attached to a waistband. Liku is made of many different plants, the most esteemed being the entire body of a species of *Rhizomorpha*. The plant is called vernacularly "*Wa loa*," literally, black creeper. It grows in swamps on decaying wood fallen to the ground; the threads of which it consists are several feet long, leafless, and not much branched. The threads, having been beaten between stones in order to free them from impurities adhering, are buried for two or three days in muddy places, and are then ready for plaiting them to the waistband.

"The Liku worn by the women are made principally of the fibres of the different species of Vau; the Vau dina (*Paritium tiliaceum*, Juss.), the Vau dra (*Paritium tricuspis*, Guill.,) and the Vau damudamu (*Paritium purpurescens*, Seem.) The bark of these trees is stripped off, steeped in water to render it soft and pliable, and allow the fibres to separate. The fibres are either permitted to retain their original whiteness, or they are dyed yellow, red, or black. The yellow colour is imparted with turmeric, the black with mud and the leaves of the Tavola (*Terminalia Catappa*, Linn.), and the red with the bark of the Kura (*Morinda citrifolia*, Linn.), and that of the tiri (*Guttiferæ ?*)

"Mats, with which the floors of houses and sleeping-places are thickly covered, are made of two kinds of screw pines; the coarsest, of the leaves of the Balawa (*Pandanus odoratissimus*, Linn.); the finest, of those of the Voivoi (*Pandanus caricosus*, Rumph.) The Balawa, or Badra as it is sometimes termed, is a tree twenty-five feet high, with leathery sword-shaped leaves. The Voivoi or Kiekie is a stemless species, with leaves ten to twelve feet long. Fans, baskets, and the finest mats are made of its bleached leaves. Occasionally, neat patterns are worked in, by introducing portions of the material dyed black, whilst the borders of highly finished mats are tastefully ornamented with the bright red feathers of the Kula—a parroquet. The bleached leaves are also employed for decorating the body, being tied by the men over the head-dress and on various parts of the person. A certain kind of mats, worn as articles of clothing, are called "Kuta," from a species of sedge (*Eleocharis articulata*), supplying materials for them, growing in swamps to the height of six feet or more. Baskets are also made of the leaves of the cocoa-nut palm, and the stem of the *Flagellaria indica*, Linn. split up in narrow strips.

"Fibre used for cordage is derived from three species of Vau, the cocoa-nut palm, the Yaka (*Pachyrrhizos angulatus*, Rich.), the kalakala-uaissoei (*Hibiscus diversifolius*, Jacq.), and the Sinu Mataiavi (*Wickstrœmia indica*, Meyer). Plaiting cocoa-nut fibre into 'sinnet,' afterwards to be made into rope or simply used for binding material, is a favourite occupation of the men. Mr. Pritchard, Her Majesty's Consul at the Fijis, mentions having seen a ball of sinnet six feet high and four feet in diameter. Some heathen temples used to be entirely composed of such plaiting. The fibre of the Yaka is principally sought for fishing nets; the Sinu Mataiavi, a sea-side shrub, serves the same purpose, its bark containing a readily available fibre."

Specimens of "Tapa" were exhibited by J. Le Quesne, Hawke's Bay, W. Colenso, Hawke's Bay; T. M. Hockin, Dunedin: and H. Nelson, Dunedin. The above-named exhibitors, as also Mrs. Muir, Dunedin, and William Jeffreys, Dunedin, sent a numerous variety of Fiji clubs and other curiosities. Some of the cocoa-nut mats are worked into various elegant patterns, and exhibit great skill in the manufacture. The clubs are very heavy weapons about five feet long; the spears are long, and pointed with the sting of the sting-ray fish. Girdles of Hibiscus fibres, six inches wide, and dyed black, brown, and yellow, are worn by the women. For tying purposes, the Fijians use the fibre of the cocoa-nut beautifully plaited into sinnet. Pillows are made of a thick stick with four legs, and are just put under the neck, so that the hair of the sleepers may not be deranged. The musical instruments of the Fijians are trumpets of conch-shells, flutes made of bamboo, and drums of sonorous wood. Rude pottery made without a wheel and dried in the sun, is made by the women in some of the Islands.

RESEARCHES ON THE JUICE OF THE SUGAR-CANE IN MAURITIUS, AND THE MODIFICATIONS IT UNDERGOES DURING MANUFACTURE.

BY DR. ICERY.
President of the Chamber of Agriculture.
Translated by JAMES MORRIS, Esq., Representative of the Chamber of Agriculture of Mauritius.

(Continued from page 472.)

IN order to appreciate the different quantities of interverted sugar produced both under the influence of the normal qualities of the juice employed, as well as in consequence of the greater or less degree of acidity in this liquid during manufacture, I have made various analyses which will be found in the two following tables, the sum of which shows so far as concerns the modification peculiar to the interverted sugar:—

1. That two juices, one of which comes from unripe though perfectly developed canes, and the other from canes of full maturity, when manufactured under identical conditions, give rise to a glucose transformation of crystallizable sugar faintly active for the second, but very energetic for the first, and in such a proportion that the *second* syrup, the produce of the unripe canes contains nearly equal parts of prismatic sugar and of levulose, that is to say, a quality of sugar which is worthless; whilst the *third* syrup, obtained from ripe canes, contains only 27 per cent. of levulose and is consequently fit for a new boiling.

2. That the acidity kept up in the juice for the purpose of obtaining certain qualities of sugar, is often carried beyond the conditions necessary to produce such qualities, and thus becomes the cause of a very appreciable loss, as the syrups can hardly ever be reboiled with any profit when the quantity of levulose exceeds 37 per cent. of the total weight of the saccharine matter which they contain.

Restricted by the limits of this memoir, I cannot further continue the study of the transformation of crystallizable sugar; but what I have already said on this important topic, and the results indicated in the tables alluded to, will always be amply sufficient to enable those who are unacquainted with sugar manufacture, to estimate the considerable part which levulose or uncrystallizable sugar plays in the colonial manufacture of this staple, as the canes to be worked up always contain a greater or less quantity of this substance.

TABLE

Showing the Quantities of Crystallizable and Interverted Sugar, and of Saline Matters contained in 1,000 grammes of Syrup at 25° centigrade, and at 41° Beaumé, the Quality of the Sugar made being nearly similar.

	Names of sugar establishments.	Reaction of the syrup.	Quantity of uncrystallizable sugar contained in the juice producing the syrup analysed.	Total of sugar found.	Crystallizable sugar.	Interverted sugar.	Proportion of crystallizable and interverted sugar per cent. of the total sugar.		Saline matter.
							Crystalizable sugar.	Interverted sugar.	
First syrup	La Gaiété	almost neutral	0·003	830	752	78	91	9	27
	Labourdonnais	acid	0.004	813	597	216	73	27	40
	Bel-Etang	almost neutral	0·012	718	544	174	76	24	
	Sébastopol	neutral	0·009	741	592	149	80	20	
	Moka	almost neutral	0·008	699	525	174	75	25	
Second syrup	La Gaiété	,, ,,		692	576	116	83	17	46
	Labourdonnais	acid		741	499	142	67	33	50
	Bel-Etang	,,		506	296	210	58	42	
Third syrup	La Gaiété	neutral		626	483	140	77	23	60

Determination of the Relative Quantities of Interverted Sugar and Saline and Albuminoid matters found in the Juice, and the Different Syrups produced from it, reduced to the same Temperature and Density.

	Temperature.	Density.	Reaction.	Absolute quantity of sugar.	Crystallizable sugar.	Uncrystallizable sugar.	Proportion of crystallizable and interverted sugar per cent. of the total sugar.		Ashes for the same quantity of liquid.	Albuminoid substances for the same quantity of liquid.
Canes at their full growth and ripe; juice manufactured with a neutral reaction after the separation of the scum.							Crystallizable sugar.	Interverted sugar.		
Juice of the above canes	25°	1071	acid.	0·167	0·164	0·003	98	2	0·0032	0·0039
Syrup from the same examined at the moment of boiling sent from the battery to the vacuum at 22° B	—	—	neutral.	0·165	0·158	0·007	95	5	0·0025	0·0032
1st. Syrup, the produce of the above after the extraction of the sugar of the first boiling	—	—	ditto.	0·147	0·122	0·015	83	17	0·0083	0·0063
2nd. Syrup, the produce of the above after the extraction of the sugar of the second boiling	—	—	ditto.	0·125	0·098	0·027	78	22	0·0108	0·0109
3rd. Syrup, the produce of the above after the extraction of the sugar of the third boiling	—	—	ditto.	0·114	0·083	0·031	73	27	0·0164	0·0213
Canes at their full growth but not yet ripe, and of a juice less rich, and manufactured with a reaction almost neutral.										
Juice of the above canes	25°	1071	acid.	0·114	0·129	0·015	87	13	0·0022	0·0047
Syrup from the same, examined at the moment of boiling, sent from the battery to the vacuum at 22° B	—	—	almost neutral.	—	—	—	—	—	—	—
1st. Syrup, the produce of the above after the extraction of the sugar of the first boiling	—	—	ditto.	0·125	0·096	0·029	76	24	0·0087	0·0071
2nd. Syrup, the produce of the above after the extraction of the sugar of the second boiling	—	—	neutral.	0·099	0·057	0·042	57	43	0·0110	0·0132
3rd. Syrup, the produce of the above after the extraction of the sugar of the third boiling	—	—	ditto.	—	—	—	—	—	—	—

II.—The Yield of Sugar from Different Juices.

The yield of sugar obtained by the processes used in the colony of Mauritius is necessarily affected in a very sensible manner by its glucose transformation, and it may be generally said that whatever tends to develop it, concurs doubly to diminish the quantity of saccharine matter to be extracted from the juice; for it not only produces the loss resulting from the passing of the crystallizable sugar into the uncrystallizable state, but it also introduces into and accumulates in the syrups a matter, the presence of which becomes more and more an impediment to the separation of the sugar which is still found there in considerable proportion.

The barrel of juice (247 litres) generally weighs 530 lbs. at least and 544 lbs. at most. In the first case it contains about 75 lbs. of sugar, and in the second, 121 lbs. on the average; this quantity of sugar may be estimated at 95 lbs. per barrel of the juice—the most usually manufactured. All things equal, the proportion of sugar obtained from a barrel of cane-juice will depend not only on the relative richness of this liquid, but also on the various circumstances in which the manufacture may be placed. And as such circumstances admit of considerable modifications, it becomes difficult to set down a figure which will represent the general and average yield of the sugar manufacture of the colony. I am, however, able to give, in this respect some particular indications which will allow an appreciation to be formed of the yield of establishments placed in the most favourable conditions. For this purpose I cannot do better than simply transcribe the information which has been kindly communicated to me by the Hon. C. Wiehé, the proprietor of one of the finest and best administered sugar establishments in Mauritius.

Labourdonnais Sugar Manufactory. The Hon. C. Wiehé and Company; Rivière du Rempart, January 31, 1865.

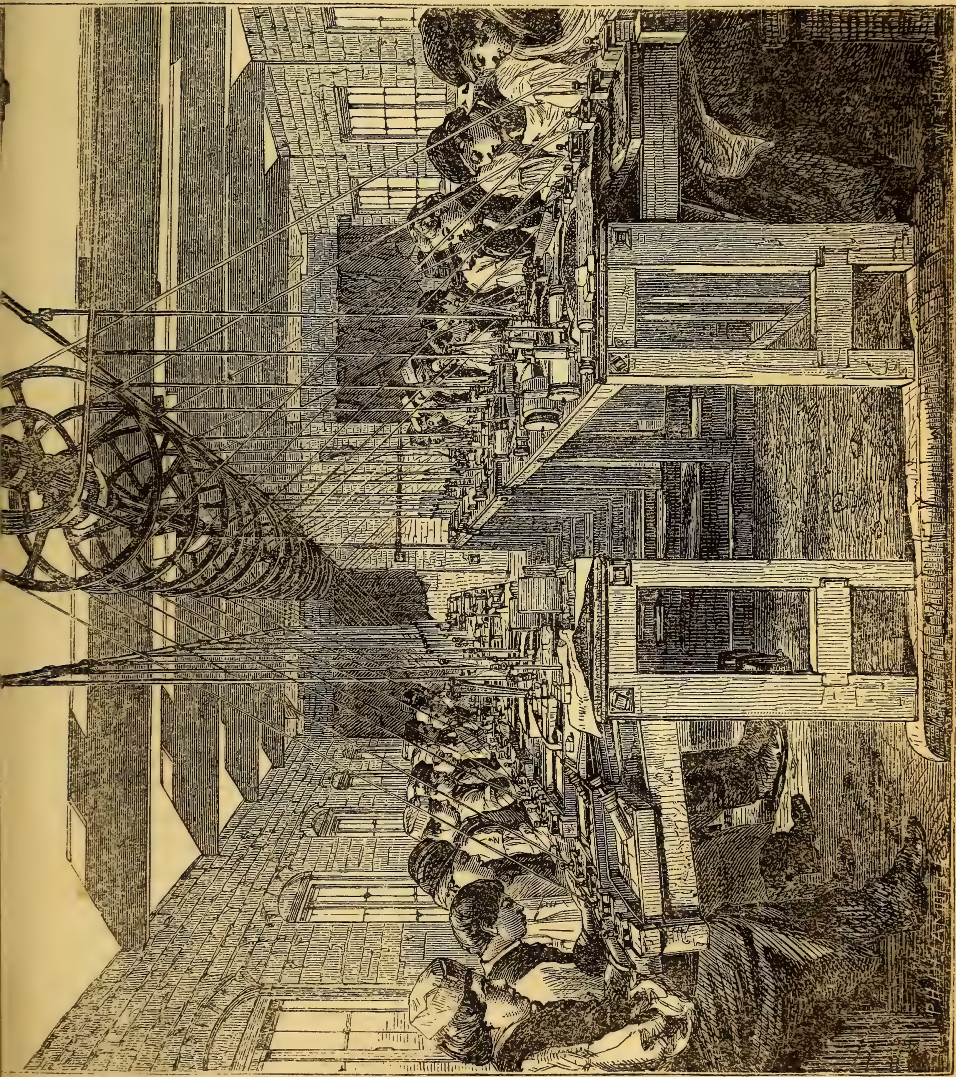
Average quantity of sugar per barrel of juice.		Net produce of the crop.	Average yield per acre.	Quantity of sugar of the second and third boilings per cent of the sugar of the first boiling.			Average barrels of liquid molasses for 100,000 lbs. of sugar.
Crop.	lbs.	lbs.	lbs.	Second boiling or sugar of first Syrup.	Third boiling or sugar of second Syrup.	Total.	
1854-55	80	3,008,137	—				
1855-56	$76\frac{1}{2}$	2,287,259	—				
1856—57	$77\frac{3}{4}$	3,381,800	—				
1857—58	73	2,790,000	—				
1858—59	72	2,891,776	—				
1859—60	70	1,902,336	—				
1860—61	$70\frac{1}{2}$	3,422,584	5,415	lbs.	lbs.	lbs.	
1861-62	$75\frac{1}{2}$	2,047,940	3,250	21	$6\frac{1}{3}$	$27\frac{1}{2}$	
1862—63	$75\frac{1}{2}$	3,374,761	4,712	22	$6\frac{1}{2}$	$28\frac{1}{2}$	$28\frac{1}{2}$
1863--64	75	2,662,924	3,848	25	8	$33\frac{1}{2}$	$33\frac{2}{3}$

As the results of my own experiments on my estate, La Gaiété, during the last two years correspond very nearly with the above, I do not think it necessary to reproduce them.

A VISIT TO THE BRITISH NEEDLE MILLS, REDDITCH.

Why are needles made at Redditch? Why should a beautiful and secluded part of the county of Worcester, many miles distant from what are termed the "manufacturing districts," contain a village, whose inhabitants, one and all, live directly or indirectly by making these little steel implements? The fact is demonstrable, but the reason is not. The good housewife who mends her child's pinafore, the milliner who decks out a lady in her delicate attire, the hard-working sempstress who supplies "make up goods" to the shops, the school girl who works her sampler—all, however little they may be aware of the fact, are dependent principally on a Worcestershire village for the supply of their needles. Their "Whitechapel needles" are no longer made at Whitechapel, even if they ever were; and though they may in some cases seem to emanate from London manufacturers, the chances are that they were made at Redditch. Not that other towns are without indications of this branch of manufacture; but in them it is merely an isolated feature, while at Redditch, as we shall presently see, needle-making is the staple, the all-in-all, without which, almost every house in the place would probably be shut up; for although there is a fair sprinkling of the usual kind of workmen, shopkeepers, dealers, &c., these are only such as are necessary for supplying the wants of the needle-making population. It is a strange thing that the Redditch manufacturers themselves seem scarcely able to assign a reason why this branch of industry has centred there, or to name the period of its commencement. Indeed, the early history of the needle-trade is very indistinctly recorded. Stow tells us while speaking of the kind of shops found in Cheapside and other busy streets of London, that needles were not sold in Cheapside until the reign of Queen Mary, and that they were at that time made by a Spanish negro, who refused to discover the secret of his art. Another authority states that "needles were first made in England by a native of India, in 1545, but the art was lost at his death; it was, however, recovered in 1650, by Christopher Greening, who settled with his three children at Long Crenden, in Buckinghamshire." Whether the negro in one of these accounts is the same individual as the native of India mentioned in the other, cannot now be determined, nor is it more clear at what period Redditch became the centre of the manufacture. There are slight indications of Redditch needle-making for a period of two centuries, but beyond that all is blank.

A reader, who associates the potteries with the clay districts of North Staffordshire, and the smelting works with the coal and iron districts of South Staffordshire, will naturally seek to know whether any features distinguish Redditch which will enable us to assign a probable origin for the needle manufacture there. A visitor, in any degree accustomed to watch the progress of manufactures, looks around him to seek for any



indications whence he may account for the location of needle-making; he looks for a stream or canal, or something which may be to the manufacturer in the relation of cause to effect; but very little of the kind is seen. Needle-making is nearly all the result of manual dexterity, requiring little aid from water or steam power. There are, it is true, a few water wheels employed for pointing and scouring the needles, but Redditch presents no other facilities for this purpose than such as are presented by a thousand other places in the kingdom. In short, there seems to be no other mode of accounting for the settlement of the needle-manufacture in this spot, than that which may be urged in reference to watchmaking in Clerkenwell, or coach-making in Long Acre. A needle-maker we will suppose—say two centuries ago—settled at Redditch and gradually accumulated round him a body of workmen. A supply of skilled labour having been thus secured, another person set up in the same line. In time, the workmen's children learned the occupation carried on by their parents, and thus furnished an increased supply of labour, which in its turn, led to the establishment of other manufacturing firms. By degrees so many needles were made at Redditch, that the village acquired a reputation throughout the length and breadth of the land for this branch of manufacture, and hence it became a positive advantage for a maker to be able say that his needles were "Redditch needles." This train of surmises may perhaps approach pretty nearly to the truth.

Let us, however, leave conjecture and proceed to facts. There are in Redditch about half-a-dozen manufacturers who conduct the needle-manufacture on a large scale, and employ a considerable number of persons. Some work in factories built by and conducted under the superintendence of the master manufacturers; while others work at their own homes. In no occupation, perhaps, is the division of labour more strictly carried out than in needle-making; for the man who cuts the wire does not point, nor does the pointer make the eyes or polish the needles. Both within and without the factory the same system of division is kept up; for a cottager who procures work from a needle-manufacturer does not undertake the making of a needle, but only one particular department, for which he is paid at certain recognised prices. Many of the workpeople live a few miles distant and come with their work at intervals of a few days, a plan which can be adopted without much inconvenience, since a considerable quantity of these little articles may be packed in a small space. It is, we believe, estimated that the number of operatives in Redditch is about three thousand, and in the whole district of which Redditch is the centre, six or seven thousand, of whom a considerable number are females.

The general name of "mills" is given to the needle-factories, each one having some distinctive name whereby it may be indicated. Thus the establishment which we have been obligingly permitted to visit, and the arrangements of which will be here described, is called the "British Needle Mills." To the British Needle Mills of Messrs. S. Thomas and Sons, then our visit is directed.

This factory has been recently constructed, and is situated at one extremity of the village. It consists of a number of court yards or quadrangles, each surrounded by buildings wherein the manufacture is carried on. The object of this arrangement seems to be to obtain as much light as possible in the workshops, since most of the departments of needle-making require a good light. Some of the rooms in the factory are small, containing only three or four men; while others contain a great many workmen, according to the requirements of the several processes of the manufacture. From the upper rooms of the factory, the surrounding hilly districts of Worcesterhire are seen over a wide extent, wholly uninterrupted by any indications of manufacture or town bustle; and it is while glancing over this prospect that one wonders how on earth needle-making came to speckle such a scene.

The sub-divisions of the factory correspond with those in the routine of manufacture, and we accordingly find that, while some of the shops are occupied by men, others contain only females, and others again furnish employment chiefly for boys. We should surprise many a reader were we to enumerate all the processes incident to the manufacture of a needle, giving to each the technical name applied to it in the factory. The number would amount to somewhere about thirty, but it will be more in accordance with our object to dispense with such an enumeration, and to present the details of manufacture in certain groups, without adhering to a strictly technical arrangement.

First, then, for the material. It is scarcely necessary to say that needles are made of steel, and that the steel is brought into the state of wire before it can assume the form of needles. The needle-makers are not wire-drawers; they do not prepare their own wire, but purchase it in sizes varying with the kind of needles they are about to make. We will suppose, therefore, that the wire is brought to the needle factory and deposited in a store-room. This room is kept warm by hot air to an equable temperature, in order that the steel may be preserved free from damp or other sources of injury. Around the wall are wooden bars or racks, on which are hung the hoops of wire. Each hoop contains what is called a packet, the length varying according to the diameter. Perhaps it may be convenient to take some particular size of needle and make it our standard of comparison during the details of the process. The usual sizes of sewing needles are from No. 1, of which twenty-two thicknesses make an inch, to No. 12, of which there are a hundred to an inch. Supposing that the manufacturer is about to make sewing needles of the size known as No. 6, then the coil of wire is about two feet in diameter; it weighs about 13 lbs.; the length of wire is about a mile and a quarter; and it will produce forty or fifty thousand needles. The manufacturer has a gauge, consisting of a small piece of steel, perforated at the edge with eighteen or twenty small slits, all of different sizes, and each having a particular number attached to it. By this gauge the diameter of every coil of wire is tested, and by the number every diameter of wire is known.

A coil of wire when about to be operated upon, is carried to the "cutting shop," where it is cut into pieces equal to the length of two needles. Fixed up against the wall of the shop is a ponderous pair of shears, with the blades uppermost. The workman takes, probably, a hundred wires at once, grasps them between his hands, rests them against a gauge to determine the length to which they are to be cut, places them between the blades of the shears, and cuts them by pressing his body or thigh against one of the handles of the shears. The coil is thus reduced to twenty or thirty thousand pieces, each about three inches long, and as each piece had formed a portion of a curve two feet in diameter, it is easy to see that it must necessarily deviate somewhat from the straight line. This straightness must be rigourously given to the wire before the needle making is commenced, and the mode by which it is effected is one of the most remarkable in the whole manufacture. Around the walls of the shop we see a number of iron rings hung up, each from three or four to six or seven inches diameter, and a quarter or half an inch in thickness. Two of these rings are placed upright on edges at a little distance apart, and within them are placed many thousands of wires, which are kept in a group by resting on the interior edges of the two rings. In this state they are placed on a shelf in a small furnace, and there kept till red hot. On being taken out at a glowing heat, they are placed on an iron plate, the wires being horizontal and the rings in which they are inserted being vertical. The process of "rubbing" (the technical name for the straightening to which we allude) then commences. The workman, as here represented, takes a long piece of iron, and inserting it between the two rings, rubs the wires backwards and forwards, causing each to roll over on its own axis, and also over and under those by which it is surrounded. The noise emitted by this process is just that of filing; but no filing takes place, for the rubber is smooth, and the sound arises from the rolling of one wire against another. The rationale of the process is this:—the action of one wire on another brings them all to a perfectly straight orm, because any convexity or curvature in one wire would be pressed out by the close contact of the adjoining ones. The heating of the wires facilitates this process, and the workman knows by the change of sound when all the wires have been "rubbed" straight.

Our needles have now assumed the form of perfectly straight pieces of wire, say a little more than three inches in length, blunt at both ends and dulled at the surface by exposure to the fire. Each of these pieces is to make two needles, the two ends constituting the points; and both points are made before the piece of wire is divided in two. The pointing immediately succeeds the rubbing, and consists in grinding down each end of the wire till it is perfectly sharp. The workman sits on a stool or "horse" a few inches distant from the stone, and bends over it

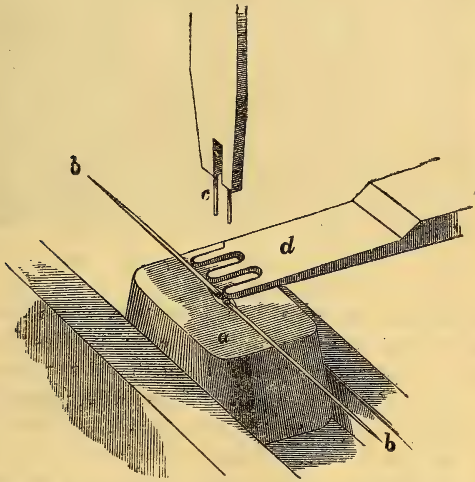
THE PROCESS OF "RUBBING."

during his work. He takes fifty or a hundred wires in his hand at once, and holds them in a peculiar manner. He places the fingers and palm of one hand diagonally over those of the other, and grasps the wires between them, all the wires being parallel. The thumb of the left hand comes over the back of the fingers of the right, and the different knuckles and joints are so arranged, that every wire can be made to rotate on its own axis, by a slight movement of the hand, without any one wire being allowed to roll over the others. He grasps them so that the end of the wires (one end of each) projects a small distance beyond the edge of the hand and fingers, and these ends he applies to the grindstone in the proper position for grinding them down to a point. It will easily be seen, that if the wires were held fixedly, the ends would merely be bevelled off, in the manner of a graver, and would not give a symmetrical point; but by causing each wire to rotate while actually in contact with the grindstone, the pointer works equally on all sides of the wire, and brings the point in the axis of the wire. At intervals of every few seconds, he adjusts the wires to a proper position against an iron plate, and dips their ends in a little trough of water between him and the grindstone. Each wire sends out its own stream of sparks, which ascends diagonally in a direction opposite to that at which the workman is placed. So rapid are his movements, that he will point seventy or a hundred needles, forming one hand-grasp, in half a minute, thus getting through ten thousand in an hour.

The reader will bear in mind, that the state of our embryo needle is simply that of a piece of dull straight wire, about 3 in. long (supposing 6's to be the size), and pointed at both ends. The next process is one of a series by which two eyes or holes are pierced through the wire, near the centre of its length, to form the eyes of the two needles which are to be fashioned from the piece of wire. A number of very curious operations are connected with this process, involving mechanical and manipulative arrangements of great nicety. Those who are learned in the qualities of needles—as that they will not "cut in the eye" and so forth—will be prepared to expect that much delicate workmanship is involved in the production of the eyes, and they will not be in error in so supposing. Most of the improvements which have from time to time been introduced in needle making, relate more or less to the production of the eye. In the commoner kinds of needles, many processes are omitted which are essential to the production of the finer qualities; but it will show the whole nature of the operation better, for us to take the case of those which involve all the various processes.

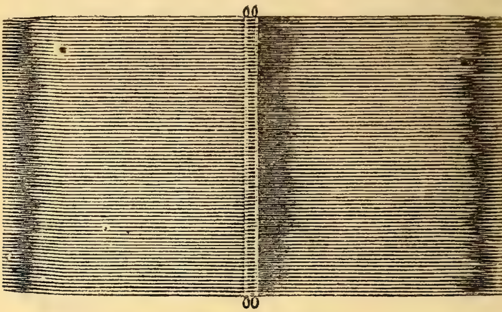
After being examined, when the pointer has done his portion of the work to them (an examination which is undergone after every single process throughout the manufacture), the wires are taken to the "stamping shop," where the first germ of an eye is given to each half of every wire. The stamping machine consists of a heavy block of stone, supporting on its upper surface a bed of iron, and on this bed is placed the under half of a die or stamp. Above this is suspended a hammer, weighing about 30 lbs., which has on its lower surface the other half of the die or impress. The hammer is governed by a lever moved by the foot, so that it can be brought down exactly upon the iron bed. The form of the die or stamp may be best explained by stating the work which it is to perform. It is to produce the "gutter" or channel in which the eye of the needle is situated, and which is to guide the thread in the process of threading a needle.

But besides the two channels or gutters, the stampers make a perforation partly through the wires, as a means of marking exactly where the eye is to be. The device on the two halves of the die is consequently a raised one, since it is to produce depressions in the wire. The workman holding in his hand several wires, drops one at a time on the bed-iron of the machine, adjusts it to the die, brings down the upper die upon it by the action of the foot, and allows it to fall into a little dish when done. This he does with such rapidity that one stamper can stamp 4,000 wires, equivalent to 8,000 needles, in an hour, although he has to adjust each needle separately to the die.



(*a* is the lower die on which the needles *b* are placed, to be pierced by the points *c*, guided by the apparatus *d*.)

To this process succeeds another, in which the eye of the needle is pierced through. This is effected by boys, each of whom works at a small hand-press, and the operation is at once a minute and ingenious one. The boy takes up a number of needles or wires, and spreads them out like a fan. He lays them flat on a small iron bed or slab, holding one end of each wire in his left hand, and bringing the middle of the wire to the middle of the press. To the upper arm of the press are affixed two hardened steel points or cutters, being in size and shape exactly corresponding with the eyes which they are to form. Both of these points are to pass through each wire, very nearly together, and at a small distance on either side of the exact centre of the wire. The wire being placed beneath the points the press is moved by hand, the points descend, and two little bits of steel are cut out of the wire, thereby forming the eyes for two needles. As each wire becomes thus pierced, the boy shifts the fan-like array of wires until another one comes under the piercers, and so on throughout. The press has to be worked by the right hand for piercing each wire, and the head of the boy is held down pretty closely to his work, in order that he may see to "eye" the needles properly. Were not the wires previously prepared by the stamper, it would be impossible thus to guide the piercers to the proper point, but this being effected, patience, good eye-sight, and a steady hand effect the rest.

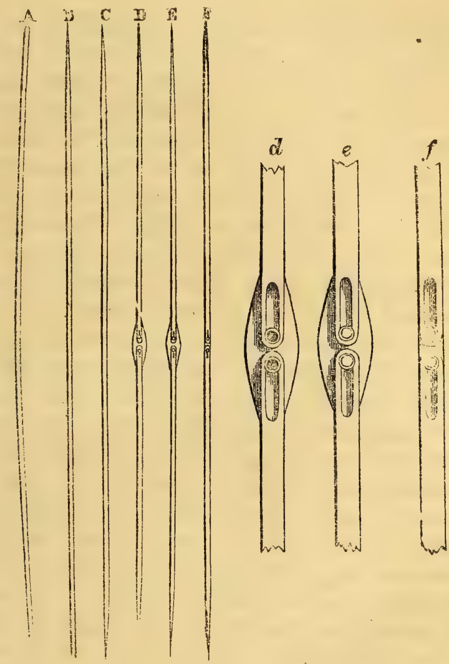


THE WIRE "SPITTED."

There are several processes about this stage which are effected by boys; some of these little labourers take the needles when they have been "eyed" and proceed to "spit" them, that is, to pass a wire through the eye of every needle. Two pieces of fine wire, perhaps three or four inches in length, are prepared, the diameter corresponding exactly with the size of the needle eye. These two pieces of wire are held in the right hand, parallel, and at a distance apart equal to the distance between the two eyes in each needle-wire. The pierced needles, being held in the left hand, are successively threaded upon the two pieces of smaller wire, till, by the time the whole is filled, the assemblage has something the appearance of a fine toothed comb. A workman then files down the bur or protuberances left on each side of the eye by the stamper.

It must be borne in mind that throughout all these operations the needles are double; that is, that the piece of wire, three inches in length, which is to produce two needles an inch and a half long is still whole and undivided, the two eyes being nearly close together in the centre, and the two points being at the ends. Now, however, the separation is to take place. The filer, after he has brought down the protuberances on each wire, but before he has laid the comb of wires out of his hand, bends and works the comb in a peculiar way until he has broken the comb into two halves, each half "spitted" by one of the fine wires. The needles have arrived at something like their destined shape and size, for they are of the proper length and have eyes and points. In the annexed cut (p. 519) we can trace the wire through the processes of change hitherto undergone.

But although we have now little bits of steel which might by courtesy be called needles, they have very many processes to undergo before they are deemed finished, especially if, in accordance with our previous supposition, they are of the finer quality.



(*A* the wire for two needles; *B* the same, pointed at one end; *C* pointed at both ends; *D* the stamped impress for the eyes; *E* the eyes pierced; *F* the needles just before separation; *d, e, f,* enlargements of *D, E, F.*

The needles are by this time pointed and eyed, but before they can be brought to that beautifully finished state with which we are all familiar, it is necessary that they should be "hardened" and "tempered" by a peculiar application of heat. After being examined to see that the preceding processes are fitly performed, the needles are taken to a shop provided with ovens or furnaces. They are laid down on a bench, and by means of two trowel-like instruments spread in regular thick layers on narrow plates or trays of iron. In this way they are placed on a shelf or grating in a heated furnace. When the proper degree of heating has been effected, the door is opened and the needles are shifted from the iron tray into a sort of colander or perforated vessel immersed in water or oil. When they are quite cooled the hardening is completed, and if it has been effected in water the needles are simply dried; but if in oil, they are well washed in an alkaline liquor to free them from the oil.

Then ensues the tempering process. The needles are placed on an iron plate, heated from beneath and moved about with two little trowels until every needle has been gradually brought to a certain desired temperature.

We now leave the furnace-room and proceed to one of the upper rooms of the factory, where a multitude of minor operations are conducted. The needles have become slightly distorted in shape by the action of the heat in the processes just described, and to rectify this they undergo the operation of "hammer straightening." A number of females are seen seated at a long bench, each with a tiny hammer, giving a number of light blows to the needles ; the needles being placed on a small steel block with a very smooth upper surface. This is rather a tedious part of the manufacture, the workwomen not being able to straighten more than five hundred needles in an hour, a degree of quickness much less than that which we have had hitherto to notice.

We leave the tinkling hammers and follow the needles to the only part of the manufacture which involves apparatus other than of a small size. This is the "scouring" process. In one of the lower rooms of the factory are machines looking like mangles, or, perhaps more correctly, like marble-polishing machines, a square slab or rubber working to and fro on a long bench. The object of this process is to rub the needles one against another for a very long period, till the surfaces of all have become perfectly smooth, clean, and true. This is effected in a curious manner. A strip of thick canvas is laid open in a small hollow tray, and in this a heap of needles is laid, all the needles being parallel one with another, and with the length of the cloth. The needles are then, with soft soap, emery, and oil, tied up tightly in the canvas, the whole forming a compact roll about two feet long and three inches in thickness ; these are placed under the runners of the scouring machines, two rolls to each machine. A steam engine gives to the runners, by connected mechanism, a reciprocating or backward and forward motion, pressing heavily on the rolls of needles, and causing all the needles of each bundle to roll one over another. By this action an intense degree of friction is exerted among the needles, whereby each one is rubbed smooth by those which surround it. For eight hours uninterruptedly this rubbing or scouring is carried on, after which the needles are taken out, washed in suds, placed in new pieces of canvas, with a new portion of soap, emery, and oil, and subjected to another eight hours' friction. Again and again is this repeated, insomuch that for the best needles the process is performed five or six times over, each time during eight hours' continuance. This is one of the points in which the difference is shown between various qualities of needles, the length of the scouring being correspondent with the excellence of the production.

Again we accompany the needles to another part of the factory, being that which is technically termed the "bright shop," in which many processes are carried on in reference to the finishing of needles. The needles are examined after being scoured, and are placed in a small tin tray, where, by shaking and vibrating in a curious manner, they are all brought into parallel arrangement. From thence they are removed into flat paper trays, in long rows or heaps, and passed on to the "header," generally a little girl, whose office is to turn all the heads one way, and all the points the other. This is one among the many simple but curious processes involved in this very curious manufacture, which surprises us by the rapidity and neatness of execution. The girl sits with her face towards the window, and has the needles ranged in a row or layer before her, the needles being parallel with the window. She draws out laterally to the right those which have their eyes on the right hand, into one heap, and to the left those which have their eyes in that direction, in another heap.

About this time, too, the needles are examined one by one, to remove those which have been broken or injured in the long process of scouring, for it sometimes happens that as many as eight or ten thousand out of fifty thousand, are spoiled during this operation. Most ladies are conversant with the merits of "drilled-eyed needles," warranted "not to cut the thread." These are produced by a modern improvement, whereby the eye, produced by the stamping and piercing processes before described, is drilled with a very fine instrument, by which its margin becomes as perfectly smooth and brilliant as any other part of the needle. To effect this, the needle is first "blued"—that is, the head is heated so as to give it the proper temper for working. Next comes the drilling. Seated at a long bench are a number of men and boys, with small drills working horizontally with great rapidity. The workman takes up a few needles between the finger and thumb of his left hand, spreads them out like a fan, with the eyes uppermost, brings them one at a time opposite the point of the drill, and drills the eye, which is equivalent to making it even, smooth, and polished. He moves the thumb and finger, so as to bring the opposite side of the needles, in succession, under the action of the drill, and thus gets through his work with much rapidity. The preparation of the drills, which are small pieces of steel three or four inches long, is a matter of very great nicety, and on it depends much of that beauty of production which constitutes the pride of a modern needle-manufacturer.

We next pass into a large room (see illustration on page 511), where a multitude of little wheels are revolving with great rapidity, some intended for what is termed "grinding," and setting the needles, and some for polishing. The men are seated on low stools, each in front of a revolving wheel, which is at a height of perhaps two feet from the ground. All the wheels are connected by straps and bands, with a steam engine in the lower part of the factory. A constant humming—

noise is heard in the room, arising from the great rapidity of revolution among a number of wheels, and it is not difficult for the ear to detect a difference of tone or pitch among the associated sounds, due to differences in the rate of movement. The workman takes up a layer or row of needles, between the fingers and thumbs of the two hands, and applies the heads to the stones in such a manner as to grind down any small asperities on the surface. As the small grindstones are revolving three thousand times in a minute, it is plain that the steel may soon be sufficiently worn away by a slight contact with the periphery of the stone.

The grinders and the polishers sit near together, so that the latter take up the series of operations as soon as the former have finished. The polishing wheels consist of wood coated with buff leather, whose surface is slightly touched with polishing paste. Against these wheels the polishers hold the needles, applying every part of the cylindrical surface in succession; first holding them by the pointed end, and then by the eye end. About a thousand in an hour can thus be polished by each man; and, when they leave his hands, the needles are finished.

We have still to see the needles papered. In one of the rooms a number of females are cutting the papers, separating the needles into groups of twenty-five each, and folding them into the neat oblong form so well known to all users of a "paper of needles." So expert does practice render the workwomen, that each one can count and paper three thousand needles in an hour. The papered needles then pass to another room, where boys paste on the labels bearing the manufacturer's name. Even here there are sundry little contrivances for expediting the process, which would scarcely be looked for by common observers. When the papers have been dried on an iron frame, in a warm room, they are packed into bundles of ten or twenty papers each; which are further packed in square parcels containing ten, twenty, or fifty thousand needles, inclosed, if for exportation, in soldered tin cases. As a means of judging the bulk of the needles, we may state that ten thousand 6's form a packet about six inches long, three and a half wide, and under two in thickness.

Thus have we followed the manufacture to its close. None but the best needles undergo the whole of the processes enumerated; but we have wished to give them as a means of estimating the complexity of the manufacture of an article apparently so humble.

The arrangements of the "British Needle Mills," as to apparatus, &c., are adapted to the production of two hundred millions of best needles per annum. These are startling results, and show that, in considering the seats of manufacture in England, we must not forget to include the remarkable Worcestershire village of Redditch.

BOTANY BAY, OR GRASS TREE, GUM.

BY THE EDITOR.

This remarkable resin which is known in different parts of Australia under various local names, as "black boy" gum, grass tree gum, &c., would seem to be obtained from several species of *Xanthorrhœa*, of which there are six or seven well defined species in Australia. The resin has long been known among druggists as gum acroides. It was generically named by Swartz from its peculiar colour.

This resin was first described in Governor Phillips' voyage to New South Wales in 1788. Mr. Phillips states that it was employed by the natives and first settlers as a medicine in cases of diarrhœa. The resin of *X. hastilis* as it occurs in commerce sometimes forms masses of considerable size, but as it is very brittle, although tolerably hard, it usually arrives in small pieces, and in the state of a coarse powder. Its colour is a deep yellow, with a slightly reddish shade, and considerably resembling gamboge, but darker and less pleasing. The colour of its powder is greenish yellow. When chewed it does not dissolve or stick to the teeth, but tastes slightly astringent and aromatic, like storax or benzoin. When gently heated it melts, and when strongly heated it burns with a smoky flame, and emits a fragrant odour resembling balsam of tolu, containing apparently cinnamic acid mixed with a very little benzoin. The quantity of carbazotic acid which this resin yields when treated with nitric acid is very great, and it is easily purified. Incidental mention has already been made of this resin (Technologist, vol. ii., p. 25, iii., p. 19, and v., p. 227), but as it appears to be occupying increased attention in Australia just now, some further details respecting it may prove useful.

The grass tree is one great characteristic of the scenery and of the vegetation of Australia. It puts one in mind of a tall black native with a spear in his hand ornamented with a tuft of rushes. On the spear is found an excellent, clear, transparent gum, and from the lowest part of the tree oozes a black gum, which makes a powerful cement, used by the natives for fastening stone heads on their hammers. The resin may be obtained in inexhaustible quantities. *X. hastilis, Australis,* and *arborea*, seem to be the most generally diffused species.

A late Melbourne paper thus speaks of the tree :—"There are few who have ever travelled any distance in Victoria but have met with the grass tree, which is to be found in nearly all parts of Australia. Up to a few months ago it was supposed only to be a useless growth encumbering the land. A few knew from the natives that it contained a very tenacious gum. The blacks used it as a glue for joining parts of their weapons, but it is only within the last few months that the following valuable articles have been obtained, after great labour and expense, by a Mr. Dodd, St. Romain's. The place where Mr. Dodd has erected his works to carry on the experiments is situated about eighteen miles in a southerly direction from Colac, and here for some months past experiments have been carried on in connection with the grass tree. The root is the portion used in these experiments, and usually weighs from 10 lb. to 50 lb. The root is composed of the stems growing in a close mass around the inner portion or kernel. From the outer portion of the gum shellac in large quantities is obtainable ; the refuse contains a large quantity of gas, and can be made available for lighting the works. From the inner portion is extracted, by pressing distilling, a spirit equal to the best brandy ; after distilling, a quantity of saccharine matter remains, from which sugar can be extracted. The present supply of grass tree in the neighbourhood of St. Romain's is computed to be equal to a supply of 600 tons per week for the next ten years. Great quantities of young grass trees abound, which will keep up the supply, and doubtless cultivation would enlarge the roots."

In a paper which we read before the Society of Arts in 1855, "On the Gums and Resins of Commerce," we entered rather fully into the character and uses of this resin. We therein stated that Capt. Wray, R.E., submitted a report to the local authorities of Western Australia in 1854 on the manufacture of illuminating gas from the *Xanthorrhœa* at one-third the expense of lighting with oil or candles.

The plant grows in abundance all over Western Australia, and is composed of a core of hard, fibrous pith, about half of its whole diameter, round which there is a layer of resin, varying from half an inch to one inch or more in thickness, which forms the connexion between the leaves and the core. Between these leaves and also adhering to, and covering them, is a considerable quantity of resin ; resin also exudes in large lumps from the sides of the plant.

The method of obtaining the material in the colony for this purpose was as follows :—In the first instance, the leaves and resin were separated from the core by breaking up this plant with an axe and sifting the resin from the leaves, but it was found by experience that as much gas was obtained from an equal weight of the leaves and resin together, as from the resin alone. The quantity of resin obtained from an average sized "black boy" was about 45 lb. weight. This was collected easily at the rate of 5 lb. per hour, by a person having for his tools an axe and a sieve.

Should the resin be collected for export, I am satisfied that by a proper arrangement of crushers and sieves, a labourer, at 4s. per diem (the colonial rate), could collect at least one hundred weight per diem, enabling the resin to be brought to market, at Freemantle, for 4*l.* per ton, the ton weight measuring forty-five cubic feet when pressed. The quantity of pure gas obtained by Capt. Wray's experiments was at least four cubic feet to the pound of resin and leaves, but much more might be obtained by a more complete apparatus.

A cart-load of the plants, eight in number, weighed 1,048 pounds. When the core was removed, the leaves and resin weighed 628 pounds. This core is very good fuel when mixed with other wood. The specific gravity of the gas is 888. The products of the distillation are gas, tar, and coke. The tar obtained was about one quart for every 10 lb., and this, when re-distilled, gave 8 per cent. fluid ozs. of naphtha, and 20 per cent. of a sweet, spirituous, non-inflammable liquor. The coke remaining was about one-quarter of the original weight, and with other fuel burns well. The coke of the leaf has a bright shining appearance, and when ground with oil, is a very good substitute for lamp-black in paint. The gas has a smell somewhat similar to coal gas, not nearly so offensive, but sufficiently strong to make any escape immediately perceptible. Its illuminating power appears to be very superior to coal gas, and its light very white.

Captain Wray is of opinion that when the production of the gas from the resin of the *Xanthorrhœa* is conducted with suitable apparatus, the cost per annum will be materially reduced, so far, indeed, that the resin may become a large and profitable export from the colony, to places which are not lighted at all, or lighted with oil. The supply is almost unlimited, and even were it not so, it would be advantageous to get rid of the plant from all the land fit for cultivation. Should it be found, however, that the plant was likely to get scarce, the resin might be obtained by tapping.

THE SHARK FISHERIES OF NORWAY.

BY MR. CONSUL-GENERAL CROWE.

THERE are four species of the shark tribe which inhabit the northern latitudes, viz., the *Scymnus borealis*, or *Squalus glaciales*, *Selache maximus*, *Squalus acanthias*, and *Squalus spinax niger*.

The Greenland shark, (*Scymnus borealis*), frequents in numbers the banks which are traced in a line nearly along the whole of the western coast, at distances varying from fifty to one hundred miles from the main; in greater abundance, however, on that portion which line the coast of Nordland and Finmark, as far as the North Cape, and between the latter and Cherry or Bear Island. They are to be met with, however, all over the North Sea and Arctic Ocean, as well as in most of the large fiords on the west coast, at depths varying from 100 to 200 fathoms. The Norwegian name for this shark is haakiaerring.

This fishery, which affords such lucrative employment to the inhabitants of the northern districts, has not attracted the attention in the southern part of the country which it deserves, not from the scarcity of fish, but the deficiency of appliances and absence of that experience which is considered necessary to success. A prevailing opinion, however, exists that, if properly prosecuted, it would become equally as lucrative in the south as it has proved to be in the north.

Formerly it was exclusively confined to the immediate vicinity of the coast, but of late has been more specially and lucratively prosecuted on the banks, commencing in about latitude 68° to the North Cape, and between that and Cherry Island. The banks are not quite continuous, as occasional breaks or deeps are met with, as well here as further south. These are supposed to be valleys or rifts, like the fissures on the mainland, which now form the deep fiords, and that the banks are simply continuations of the mountain ridges or spurs of the same. The vessels employed on this fishery generally range from twenty-five to thirty-five tons, manned with a crew of six men. They lie at anchor on the banks, with 150 to 200 fathoms water, by a grapnel weighing about two cwt., with a warp about 300 fathoms in length, and from four to five inches in circumference.

On the approach of bad weather this warp or line is run up by means of a double purchase, and the vessel put under easy canvas. It is but seldom they are compelled to seek harbour from stress of weather during the fishing season.

The warps are occasionally broken, but this is attributed more to the unevenness of the ground than to inclemency of the weather.

A box perforated with holes, or a canvas bag containing the residium or refuse blubber, after the oil has been extracted by boiling, is attached to the line not far from the bottom, near the grapnel; globules of oil are found to ooze out, or to percolate through the holes or bag, and to float away in a continuous stream, serving as a decoy, in a similar manner as the cod-roes are applied in France, where they are thrown into the sea as ground-bait to attract the sardines.

Led by this stream the sharks are guided to the main bait, which is attached to a thin iron chain, of from one to two fathoms in length. This is fastened to a line of about the thickness of the stem of a common tobacco-pipe. At the end of the chain the hook is fastened, which is usually of the size of a salmon-gaff, and is baited with some kind of fish, or, what is preferable, about a pound of seal-blubber.

The seals from which this blubber is taken are generally caught at Spitzbergen, and there salted fresh. No kind of bait appears so efficacious or so attractive as this, and it throws off readily its fatty particles, which, being carried to a considerable distance, form a trail to the bait, which the fish greedily take, if of blubber, but it has been observed not so readily if the blubber is at all rancid.

Five barrels of blubber is considered necessary for the season, and appears to be the average quantity used by each vessel.

On hooking the shark, he is hauled to the surface of the water by the aid of a single purchase. Each vessel is furnished with four of these, two on each side. The line, being small, is only calculated to bring the fish to the level of the water ; his nose is then hauled a little above the surface, a smart blow is immediately struck, by which he becomes stunned. A large hook at the end of a pole, attached to a strong tackle, is then driven into the fish, and by this means he is hoisted on deck. The belly is cut open and the liver taken out ; a hole is then made in the stomach for the purpose of inflating it with wind, which done, the hole is again tied up, the fish got into the water and permitted to float away.

The stomach, being inflated, prevents the fish sinking, and soon drifts out of sight. By being kept afloat, the fishermen imagine that the carcase cannot injure the fishing grounds. The length of the fish varies from 10 to 18 feet. The value depends upon the size, quantity, and quality of the liver, which yields from one-half to two barrels, or from fifteen to sixty gallons of fine oil each.

This shark is also caught nearer the coast, as far as the Waranger fiord. It does not, however, commence until the coal fish or sey fishery (the *Merlangius Carbonarius*) is finished, which is generally about the end of September. It is then continued through the winter, until the end of February, with deep-sea lines, in so-called "fembörings" (five-oared open boats), manned by five men. These boats usually lie at anchor by a strand-rope made out of spun hemp. At the end of this a chain ten fathoms in length is attached, proportioned to the size of the rope, which connects it with the grapnel. This chain is, at the same time, secured to one of the claws by a smaller but strong piece of rope, which is fastened to the shank of the grapnel as well, so that, in case of need, it can be weighed by the claw.

The lines used for this fishery are what are called Hambro' lines, of such a thickness that fifty fathoms weigh rather better than four pounds.

The hooks are mostly home-made, of hardened steel, ten inches in length, with a curve of four inches in diameter.

The bait preferred is either porpoise or seal-blubber. The hook is attached to a chain of about one fathom, and the line with which this is connected, is served with sailcloth and twice with twine, to the extent of three fathoms, as a preservation against the line being cut after the fish has been hooked, as it sometimes happens.

Here, likewise, a box with holes or a bag is sunk, as on the bank-fishery, containing blubber, for the purpose of forming a trail. This is suspended about ten fathoms above the bait.

The line is retained on the finger, and, as soon as the man feels that the bait has been touched, he gives a sharp jerk in order to fix the hook more firmly in the jaws of the fish. Some skill and experience is required to effect this at the proper moment, as the fish no sooner finds himself caught than he spins round the line, and it is on these occasions that the line is liable to be severed by the sharp edges of the skin. The greatest celerity, at the same time, is requisite in hauling the fish to the surface, in order to check this rotatory movement.

When the fish has been brought to the surface and alongside the boat, he is despatched by a sharp blow on the nose from a club, which must always be at hand ready for the occasion. The belly is then cut open, and the liver extracted, which done, a hole is made in the stomach, as described above, and the carcase allowed to float away, or, if near the land, is towed to the shore.

It happens not unfrequently on these occasions that several sharks come to the surface of the water in the wake of the one hooked, and swim round the boat, and are caught by means of a swivel hook fixed to a long gaff which each boat is furnished with. They are then secured by a hook and strong line to the stern of the boat until they can be hauled alongside.

The result of a fishery carried on in open boats depends greatly on the wind and weather. When a boat's crew obtain from two to four barrels of liver, they are satisfied. Under favourable circumstances, however, they obtain from seven to eight; and if, during the course of the winter they can get from forty to fifty barrels, the catch is esteemed a good one. Besides the liver, when the fish can be towed to the shore, the flesh is converted into food for the cattle, when a scarcity of dried fish-heads, which are prepared for that purpose, arises.

It is occasionally used also for human food, but then as "rakling," which is prepared by being cut up into long strips and wind-dried in the open air, or buried in the ground until partially decomposed, when it is taken up and prepared in a peculiar manner, so as to become edible and fit for human food. It requires, however, an Arctic stomach to digest it.

The basking shark, (*Selache maximus*), another of the genus, the largest of sea-fish, is found all along the coast from Ryvarden, latitude 59° 31′ 35″, up to Finmarken; but in some localities it has become more rare than in others.

This important and remunerative fishery was, a century ago, totally unknown. We first hear of its being carried on in the north of Norway, in the district of Namdal, round Hitteröen, and as far south as Nordmör, about the year 1760. In the southern parts of the country it was at the same time pursued with great avidity and perseverance, and with such success as for a series of consecutive years to form the staple and chief support of the inhabitants of the districts in which it was carried on. Of late years, however, this shark has either been driven away from his then favourite haunts in the south, or their numbers have so far decreased as to diminish the importance it had for years maintained. The increased herring fishery which immediately followed fully compensated the decline.

This shark differs from his fellows in not being a voracious fish; consequently, is neither to be enticed nor caught by the same kind of bait, or mode of fishing as pursued with the *Scymnus borealis*, but rather that followed with the whale. About the last of the dog days, when the water and weather is at its highest temperature, this shark makes his appearance on the coast, when the fishery immediately commences.

Large open boats are generally employed, from thirty-seven to forty-two feet in length, each boat being manned by four men, and furnished with harpoons similar to those used in harpooning the sturgeon.

The harpoon is attached to a line proportioned to the depth of water on the ground selected, which usually is from 300 to 400 fathoms. This rope lies coiled up in the bow of the boat.

Thus equipped, the fishermen, selecting a light breeze and warm weather, cruize about under a triangular sail, near the mouth of the fiords the fish are in the habit of seeking. They are generally found lying perfectly still near the surface, apparently basking in the sun, and slowly to follow in the wake of the boat as soon as discovered, the large fin on the back standing prominently above the surface of the water, indicating his presence and movements.

The fishermen imagine, from his following the boat, that he is decoyed to the surface by the small triangular sail, which he mistakes for the fin of another fish. Certain it is that, whatever the temptation may be, the fish follows closely the boat, without being disturbed for a considerable time, although sometimes carrying a stiff breeze.

When the fish approaches close enough, the harpooner, watching his opportunity, urges his harpoon as deep into the body of the fish as he is able. Then arrives the perilous moment, as the fish no sooner feels the weapon than he dives with great celerity.

Everything must be clear to allow the line to run out freely; and it does so with such rapidity as to require one of the men to be incessantly pouring water on the swivel over which the line traverses, to prevent its igniting. Should the line unfortunately catch any projecting piece of wood, or meet with any impediment, the boat is inevitably capsized. Or, should either of the men, through carelessness or accident, be caught by the line round the leg or arm, which has occasionally happened, he gets hauled down by the fish. Another man, therefore, always stands ready with an axe to cut the line; but when such an accident does occur, generally both man and fish are lost. When the fish has reached the bottom, he proceeds along it, continuing to drag the boat with him, until his strength becomes exhausted.

A lean fish holds out longer than a fat one, and will sometimes continue dragging for four and twenty hours; while a fat one generally gets tired out in three or four hours.

When thoroughly exhausted, the fish is hauled up to the surface, alongside the boat, and with a long sharp knife, the fin is instantly cut off to prevent his striking, as a blow would readily smash the boat. He is then speared until quite dead.

Before commencing to extract the liver, the fish is fastened by sundry ropes to the mast and turned, when one of the men, provided with a long knife for the purpose, opens the fore part of the belly, which enables him to take out a large piece of the liver. He then insinuates his arm in, and separates all the fibres and integuments, so as effectually to release the liver, which operation requires carefully to be performed. When completed, the stomach is ripped up from end to end. The liver then floats out, the belly fills with water, when the fish is cast adrift and immediately sinks. The liver is then taken into the boat, and the fishery is concluded.

The size and fatness of the fish vary considerably. The prevailing size varies from thirty to thirty-five feet. They have been caught as long as forty feet, but this is now a rarity. Young fish are never met with; they doubtless keep in deep water until of mature growth. The size of the liver depends greatly on the condition of the fish. They usually render from five to seven barrels of liver, occasionally as much as from ten to sixteen. Instances even have been known when as much as twenty-four barrels have been obtained from a single fish; but this is of very rare occurrence.

When the liver is rich, six barrels will produce five barrels of oil of thirty gallons each to the barrel. No other part of the fish is utilized. Of the remaining species of the shark tribe, there are only two besides the foregoing, which are of any importance on this coast.

The one is the picked dog fish, *Squalus acanthias*, and which in former times, was in great abundance along the whole coast from Gothenburg, and afforded lucrative employment to the fishermen. At present the fishery is carried on during the whole of the summer from the Naze to North Cape, in the fiords, as well as along the coast.

This is a ravenous fish, and is caught in various ways. About midsummer he is observed to swim near the surface, and can then be taken in nets, as well as with lines, precaution being taken to protect the line by proper serving for a short distance beyond the hook, to prevent its being bitten off.

This fish is eaten sometimes fresh, but must be skinned before being cooked. It is, however, mostly smoked, and in this way it is considered rather a delicacy. It is also dried as split stockfish for consumption in the country, as well as for export to Sweden, where it is greatly appreciated. The yolk of the egg, which is about the size of a pigeon's egg, is used by the inhabitants as a substitute for other eggs in their domestic economy.

The skin is employed by joiners and turners for polishing purposes.

The liver is exceedingly rich, and makes a very fine oil.

The other species is called in Norway the kulp or haatorsk (*Squalus spinax niger*), and is the smallest of the shark tribe.

It is met with in all the deep fiords along the coast, where it commits great mischief by nibbling off the baits from the deep-sea lines which are set out for the ling and the torsk (*Brosmus vulgaris*).

Lines with single hooks are never laid out to catch this fish; but at the end of the summer and autumn—and, in some fiords, all the year round,—instead of a single hook, they employ ten to twelve, placed one above the other, which they bait with half decayed, or tainted fish. The depth of water selected is from sixty to a hundred fathoms.

As the "kulp" is a sluggish fish, bites lightly, and is small, some experience is required to know when he bites, and he is secured on the hook, especially if there is any wind. The line, however, is not brought up each time the bite is felt, as there are many hooks; a simple tug is given at every supposed bite. The fish, being once hooked, generally remains quiet, as you usually find eight or ten fish caught when the line is drawn up. As this fish comes in shoals and takes the bait freely, an experienced skilful fishermen will occasionally, during a single night, obtain a rich booty. The kulp will not bite during the day. It is not eaten, but sought after exclusively for the liver, which is unusually rich, and yields a very superior kind of oil.

M'GOWAN AND DANKS, GREAT WINDMILL STREET, HAYMARKET.