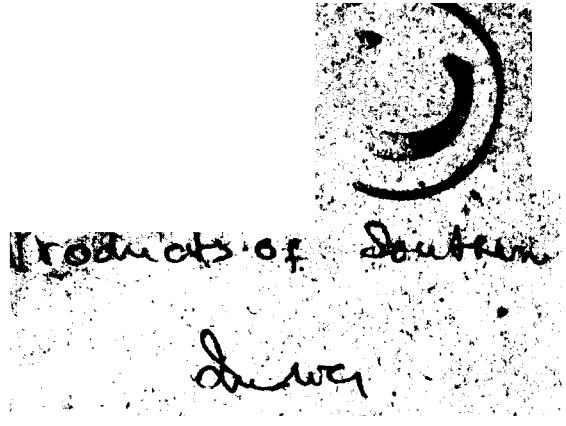

PRODUCTS OF SOUTHERN INDIA.

CORN.

INTRODUCTION.—The word *corn* is used as a general name for various kinds of grain—such as the grain of wheat, of barley, of oats, of rye, and of maize, or Indian corn.

The different corn plants are only grasses of a... larger kind. They are all *annual*,—that is, the plant, root and all, does not live more than a year, so that

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Line 6. "The plant, root a... the position of the negative, ...Langing "The plant, root and all" is an ...lives" ...ry part of the plant;" "all" here a... saying ...; else; the expression "root and all" simp... ...to any ..., including the root." In Tamil, it must be... ...as the ...நதப் பகுதியாகது" [or ஒரு பகுதியாகாது with a ... 10... ...gative verb, so that "no part grows" is the English equi... 10... ...lent for the Tamil "எந்தப்பகுதியாகத் தளைத்து ... 105 ...ல்லை" (any part does not grow). This ... ... 106 ...iom requires study: the Tamil cannot say, "no part ... 107 This ...he introduction of the word எல்லா would ... 107 ...aning: nor would, "முழுப்பயிர் ... ... many ...ா வளருகிறதில்லை" do, as this wo... ... ... Tamil is ...the *whole* did not live more than a ... ... 113 ...English sentence is "the w... ... ...year" *might* mean tha... ... ... 117 ...however, ambig... ... ... 122 ...&c.: the T... ... ... 129 ... ... 133 138

plants and the grasses is merely in size. Other grass seeds might be used as food if they were large enough to make it worth while to collect them for that purpose; most of the grass plants being perfectly harmless even if they are not nutritious.

The cultivation of the soil is called *agriculture*, from two Latin words, *ager*, a field, and *cultura*, culture. In this part of the country, the size of a field is known by the number of *cawnies* it contains,—a cawny being almost exactly an English acre and a third.

The first operation necessary in agriculture is that of ploughing or breaking up the ground by means of a

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Lines 1 to 5. A difficult sentence, "being" establishes a sort of causal relation which must be seen first. Next it must be observed that there is no assertion that any grass plants are not nutritious. It merely says that, 'even supposing any are not nutritious, such are still harmless.' The para. might be rendered:—

ஏறக்குறையப் புல்லைமையத்தேர்ந்த பயிர்கள் தே
காதாமற்றவை யென வைத்தாலும் அவை விக்கின
மில்ல வையாகையால், வேறு வகையான புல்
பயி ன் தானியமும் போசனத்திற்கென்று சே
க்கத் குந்தவையாகப்படத் போதிய பருப்புள்ள
வையுமாயிருந்தால், அவகளோயுஞ் சாப்பிடலாம்.

"Grasses" as here used, is the name of a class, and has not an equivalent in the Tamil ல்.

Line ... The root of *cultura* is "colo," I cultivate, and the ...d for *ploughshare* is கொழு often pronounced கொளு. ...plough is also கலப்பை; so that there is probably ...nate relation between the three words

plough. In England, the plough is a large and heavy implement with two handles, and is drawn by two or more horses. It is provided with a broad curved piece of wood, called the mould-board, adapted so as to throw over the slice of earth which the plough cuts up as it passes along. The Indian plough, however, is of the simplest kind. It consists merely of a couple of pieces of wood with a third piece to fasten to the yoke of the oxen. The ploughshare, the only iron about the instrument, is a narrow piece about $1\frac{1}{2}$ feet long, reaching to the point. It has no contrivance for turning over the mould, and, having neither width nor depth, it is incapable of stirring the soil. Ploughing with it is, therefore, little more than scratching, and in order to make the operation effective, it is necessary to plough across the furrows first made, and often to cross these again diagonally, or from corner to corner. Even after these repeated crossings, a field will have numerous small bushes remaining as upright in it as before the labour commenced, while the plough has not gone more than three inches below the surface.

The earth is broken up by ploughing, and fresh portions of it are exposed to the influence of the sun and air. Also old roots and weeds are partly buried in the earth, where they rot and form manure which fertilizes the land.

The land, however, generally requires other substances to be put into it to add to its fertility. These substances, consisting of the dung of animals, mud from the bottom of tanks, dead leaves, ashes, straw, &c., are classed under the word *manure*, and the process of mixing them with the soil is called manuring the land. When the land is properly prepared and a little rain has fallen, the seed-corn is sown.

This is done in one of two ways according to the seed. Most seeds are sown by the sower taking a handful out of a basket which he carries under his arm, and scattering the seed on the surface of the ground by swinging his arm in a circular direction, while he opens his hand at the same time. This is called *sowing broadcast*. Sometimes, however, seed is sown by a drill, similar to that which will be found described below. Each seed produces more than one stalk. When the plants come up, weeds appear with them, and these require to be pulled out or otherwise got rid of.

A practice exists among the Hindoos of sowing, indiscriminately on the same spot, various species of seeds, mustard, flax, wheat, millet, and many others, which ripen at different intervals. This is condemned by some as the most irrational practice that ever found existence in the agriculture of any nation; while others consider that it displays a practical knowledge of the climate with which the native has to deal, inasmuch as any plant which preserves its greenness attracts moisture. The small grain, or millet, is, therefore, sown, and produces a good crop if the season should send rain; and pulse is also sown, that the farmer may not only reap pulse in the event of a drought, but that he may even then perhaps obtain

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Line 1. Plough = লাঙ্গল, in Latin 'aro' = I plough. The two words are undoubtedly cognate, লাঙ্গ being connected with the Sanskrit

with it a little accompanying grain. The growing plants produced in a field, thus prepared and sown, are called the *crop*. When ripe, the crop is cut down or *reaped*.

The usual mode of separating the grain from the ear is by beating it out with a stick; or sometimes the plants are laid on the ground in one part of the field where the earth has been made very hard by clay smeared over with cowdung, and then cattle are driven round and round over it to tread out the grain with their feet. The animals' mouths are sometimes tied up to prevent their eating the grain. It is remarkable that, under the law of Moses, the Jews were prohibited from muzzling the mouth of the ox that trod out the corn. After it is trodden out, the grain is separated from the chaff by throwing the whole up against the wind on a windy day. The chaff being light, is blown away; the grain being heavy, falls to the ground by itself. This is called *winnowing*.

Grain is sometimes used whole, but often it is reduced to a mealy powder, called flour, by being ground between two stones, the upper of which is moved against the lower by a person working a stick round and round. Rice is bruised by being beaten in a stone mortar with a wooden pestle shod with iron. In England, the grinding is performed in a large mill where the upper stone is moved over the lower one by the power of the wind or water turning round certain

Line 24. "Shod with iron," the Tamil has no verb equivalent to shod, so the phrase must be rendered by "இரும்பு [illegible]" [idiomatic for "இரும்பு [illegible]"]

wheels in the mill. These wheels are connected with the mill stone. The *wind mill* is placed in an exposed situation and has large fans to catch the wind, which blows against them and causes them to revolve. The *water-mill* is placed near a stream or tank, and the water turns a large wheel. In some cases, the water flows under the wheel, catching, as it passes, boards which project from the wheel, and so turns it round; in others, the water runs on to the top of the wheel, where it is caught in buckets formed in the wheel and the weight of the water so caught turns the wheel.

The operations of winnowing, and threshing, reaping, sowing, and ploughing, are frequently performed by machinery in England. The employment of machinery saves money where labour is scarce, and the work is more effectually done than it can be by hand labour.

Machinery is very little used in agriculture by the natives of this country, but a kind of *drill* for sowing seeds is in use in many parts. A model of one from Masulipatam was exhibited at the Madras Exhibition of 1855. This drill consisted of a long and heavy rake, to which were fixed a beam and yoke for bullocks. The teeth of the rake were made of hollow bamboos, considerably bevelled off at the back, to allow the seed to escape into the furrow which the teeth made in passing over the ground. These hollow bamboos proceeded from

Line 23. "Bamboos considerably bevelled off at the back" requires a little expansion in rendering thus:— "[illegible]"

a large bowl in which the seed to be sown was placed. The bowl being filled, the seed would descend through the bamboos and teeth into the furrow. Thus the teeth answered the double purpose of making the groove and depositing the seed.

The general division of land in this Presidency is into *dry* land and *wet* land. On the former, all kinds of small grains are cultivated; on the latter, chiefly rice or paddy, which requires to be inundated till it is almost ripe. The Tamil people call the latter ground *nanje*, and the former *punje*.

The ground is sometimes ploughed several times, and sometimes dug with a hoe, this latter method being preferred. About the beginning of June the seed is sown broadcast, and covered with soil by means of the hoe. The field is then divided into small plots separated by banks like those of rice fields. Channels also are formed, winding through the plots, so that any quantity of water required is readily conveyed to any part.

After this the ground is smoothed with the hand and manured. It is then watered at intervals and weeded. The grain ripens in three months, is cut, tied up in small sheaves, and stacked for four days. It is threshed out by beating the sheaves against a log of timber. To separate the awns the grain is then beaten

Line 1. "The seed to be sown,"--fully "the seed which was to be sown." The English idiom allows us to omit the relative; the Tamil very concisely gives it: — "விதைக்கிற விதை."

with a stick. Radishes are sometimes planted on the mounds which divide the squares.

In the Carnatic, the plough for wet cultivation is made of a hard brittle wood which does not readily absorb moisture. The ploughshare is smaller than that used for the high grounds, being about eight inches in length. The mode of renting the ground to the farmers depends on the way in which it can be watered. If it is supplied by channels from rivers and tanks, the rent is higher than where the water has to be raised by a machine. The punje or high ground, which cannot be watered, is let out at a stipulated rent according to the kind of grain it is able to produce. The cheapest ground is such as produces gram, dholl, &c. There is also a great deal of uncultivated ground in the low country, as there is, indeed, in all countries where the soil is not good enough to make its tillage remunerative.

WHEAT.—Wheat is the most esteemed of all kinds of corn, and is always preferred for food where it can be cultivated, and the people are not too poor to use it. Wheat grows readily in almost every climate, from the torrid to the frigid zones, and its flour is remarkable amongst the corn-plants for its *strengthening* power. It is thus that wheat flour has come to be the principal article of diet of the finest races of men in the world. In appearance the stalk and plant of wheat may be said to resemble rice, but the grain is arranged in

ear.

Lines 15, 17. Note the different meaning of the word "country" as used in these two lines

Wheat grows more abundantly in temperate than in hot climates. Little attention seems to have been bestowed upon its cultivation in this Presidency, and in 1849 it was calculated that not more than six hundred garce were produced. Its growth was limited chiefly to the table lands of elevated districts, such as Mysore, the Hyderabad and Nagpore territories, &c. Nagpore wheat is celebrated as the most nutritive and productive in India. It requires only three months to come to perfection; it grows from two to three feet high, and its ears are loaded with seeds. The Neilgherry Hills are well adapted for the growth of wheat. A small quantity is raised by the Burghers, but the cultivation might be greatly extended. The Shevaroy Hills near Salem, and the Pulney Hills near Madura, would also probably produce considerable quantities of wheat.

Wheat is also grown in the rich soil in the beds of tanks, after their water has been expended in irrigating rice or sugar fields.

When the river Godavery is made navigable, the expense of carriage will be so small that wheat may be brought down by water from Hyderabad and Berar.

Wheat is imported into Madras chiefly from Calcutta, and is brought down by Dhonies or small coasting vessels.

Wheat-flour is made into bread by being mixed with a small quantity of fermented toddy, together with water and salt. These ingredients are well worked about

with the hands until they are thoroughly mixed; after which the mass is left to ferment. When it has become sufficiently spongy and porous, it is made into loaves and baked in the *oven*, which is a brick chamber with an arched roof, where bread or anything which it is desired to bake, may be exposed to considerable heat without being burned. The under-part of the loaf rests upon the bottom of the oven, and, therefore, becomes less crusty than the top, which is exposed to the full heat; this is the cause of the difference in crustiness and colour of the under and upper sides of a loaf.

Millet.—This corn-plant yields an abundance of small seeds, and exists in many varieties. It is second only to rice as an article of food, being consumed in large quantities by poor people who cannot afford rice.

In Mysore perhaps, and in the Deccan generally, the different kinds of millet surpass all other crops in importance.

These plants are cultivated largely in the southern parts of Europe, but they are grown most extensively in Hindustan, China, Arabia, Syria, Egypt and Nubia. The produce is a small yellowish seed growing in dense clusters. Millet grows best on light dry soils in India. The ground being prepared, half a bushel of seed to the acre is ploughed in at the commencement of the rains. The crop ripens within three months, and the usual produce is about sixteen bushels to the acre. Millet does not require much labour or manure.

Line 12. "This corn-plant exists in many varieties."—in other words,—"There are many kinds of millet."

Spiked millet and great millet are known in Tamil by the names of *Cumboo* and *Cholum* respectively. In Telugu they are called *Gentalu* and *Jonnalu*. The former is cultivated in Mysore and the provinces to the north. From one to four seers are sown on a bijjah of land, and the yield is about four maunds per acre. It is sown after the heavy rains commence; and the plough serves to cover the seed. The crop is ripe in three months, and the ears only are taken off at first; afterwards the stem is cut down close to the surface of the soil to be used for thatching, for it is not much in request as fodder. As cumboo is a grain of small price, it is a common food of the poorer class of natives, and yields a sweet palatable flour. It is also excellent as food for fattening poultry. It is likewise boiled whole like rice. Cumboo is made into cakes. In Mysore, cholum is often sown for fodder, as the land is not of much value. It requires less rain than raggy, and if a crop of raggy has preceded it, the ground does not want manure. Cholum is not much eaten at Madras. Dr. Heyne, however, speaks highly of this grain. He says the natives of all places where it is the principal food are a stout healthy people and of a larger size than those who live chiefly upon rice. He attributes this to the superior nourishing qualities of cholum, and observes that even the straw seems to partake of this valuable quality. Cholum often grows to a great height, and, in some places, a regiment of cavalry marching through a field of it appear as if *drowned* in the grain.

"Little millet," called *Varagoo* in Tamil, is remarkable for the smallness of its seeds, but the number borne upon each stalk is so great as to counterbalance that disadvantage. It is from this circumstance that the name millet is said to be derived, it having come from the Latin word *mille*, which signifies a *thousand*.

Raggy, which forms a principal article of diet along the Western Ghauts, and is also common in other parts of the Peninsula, is one of the varieties of millet. In Mysore, raggy is reckoned the most wholesome food for labouring people, but they who have been used to rice would not like to live upon it. Raggy flour is dressed in various ways. Sometimes it is made into a kind of pudding, or into cakes which are fried in oil or ghee. The cakes are sometimes eaten with jaggery and cocoanut. A crop of raggy always has intermixed with it dholl or some such plant. When the raggy succeeds, the pulse is overgrown by it; but if, as often happens in some districts, the raggy fails, the pulse spreads widely and gives a very considerable return. Raggy does not attain so great a height as cumboo and cholum. In Mysore, raggy straw is reckoned superior to that of rice for all kinds of cattle.

Rice.—This plant is a native of India, from which country it has spread over a great part of the world, especially in Asia, where it forms the principal portion of the food of the inhabitants. It is still found in a wild state near the borders of the lakes in the Northern Circars. Rice is chiefly cultivated in India, China, Eastern Africa, the southern portions of the United States, Brazil, and parts of South America, as well as

the south of Europe. In most European countries, however, the warmth of summer is not sufficiently great nor sufficiently long continued and regular to favor the cultivation of a grain which requires so much heat. Rice is considered one of the most prolific of grains. In Hindustan, two crops in a year, of from one hundred marcals each, are the ordinary produce of a cawnie of well-watered ground, and under favourable circumstances even three crops may be obtained.

It is stated that two crops in the year from the same land do not yield much more than one good crop would do. But the seasons are sometimes uncertain, and the latter crops liable to fail: the ryots therefore cultivate as much as possible for the first crop. This is reaped in the rainy season when the straw cannot be preserved, and as rice-straw is almost the only food which the cattle have in many districts, it is necessary to sow the second crop for fodder.

This is the case in certain tracts watered by the Cauvery, where there are often three crops produced on the same field, but this is with the coarsest rice, which only requires seven weeks from the time of planting to that of reaping. The middling sort of rice takes about four months, and the finest nearly six months, before it can be reaped.

Throughout India there are three modes of sowing the seed of this plant. In the first mode, the seed is sown dry on the fields that are to grow it. In the second mode, the seed is made to vegetate before it is sown, and the field is reduced to a puddle before it

is fit to receive it. In the third kind of cultivation, the seed is sown very thick in a small plot of ground, and when it has shot up to about a foot high, the young rice is pulled up out of the muddy soil and tansplanted into the field where it is to ripen. The great peculiarity in the cultivation of rice is the large quantity of water it requires. Even in the dry seed cultivation, the field must be kept inundated for a considerable time. In the second mode of cultivation, which may be called the sprouted seed cultivation, the seed is prepared by being put into a pot and kept covered with water. It is then mixed with rotten cow-dung and laid in a heap in some spot sheltered from the wind. The heap is well covered with straw and mats; and, at the end of three days, the seed, having shot out sprouts about an inch in length, is found fit for sowing. This manner of cultivation is much more troublesome than dry seed cultivation, but it gives time for a crop of pulse on the same field and saves a quarter of the seed. In preparing the ground for the rice crop, manure is used, especially near Madras, and in places where it is plentiful. It has sometimes been thought that the Hindoos are not accustomed to apply manure to their fields; the truth, however, appears to be that they are often unable to procure much, but that they do use it when they can obtain it.

A rice crop presents a beautiful appearance to the eye from its green colour, and forms a very refreshing

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Line 27. "Presents," the Tamil hardly admits of those fine distinctions between 'presents,' 'gives,' 'shows,' &c., that we have in English: so by the word "forms," in line 28.

contrast to the burnt-up aspect which is often seen in the surrounding country.

About a week before the corn is fit for reaping the water is let off the rice field that the ground may ...dry. The corn is cut down about four inches from the ground with a reaping-hook. It is then put into small stacks, in which the stalks are placed outward and the ears inward. Here it remains a week or fortnight. It is then trodden out by bullocks and put ...into heaps which are covered over with clay and straw; and it is so kept until the division of the crop between the Government and the cultivator has taken place.

The grain is always stocked in the husk, and there are various ways of keeping it. Some preserve it in

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Line 1. 'Burnt-up aspect'

"உலர்ந்து வரண்ட தன்மை."

"உலர்" and "வரள்" both mean 'become dry,' and as is often the case in Tamil, the joining of the two words is necessary to give the notion of intense dryness expressed by the English words "burnt-up."

Line 1, &c. 'A rice crop forms a very refreshing contrast to the burnt-up aspect which is often seen in the surrounding country,' may perhaps be rendered thus :—"உலர்ந்து வரண்ட தட்சிணையற்கற்றும் பலதாறும கண்ட கண்ணுக்கு நெற்பயிரானது குளிர்ச்சியயும் இன்பத்தையும் உதவுகிறது." For 'contrast' எதிர்கை ற்றும் might perhaps be used, but it would be incomprehensible to many; "to the eye which sees" gives the full meaning, and simply.

Line 13. "Stocked" has hardly a Tamil equivalent. இருக்கவிடு is perhaps the nearest, though வை would be the word generally used

large earthen jars; others in pits, and others in storehouses floored with plants to keep out the rats.

Rice fields, with the arrangements for watering them, give a peculiar appearance to the country. A tank is generally formed by throwing a bank or *bund* across some little valley; this retains the water after rain, and enables the cultivator, by means of a sluice or floodgate, to irrigate his fields as they require it. The fields themselves are generally small, and are divided by a little raised bank just wide enough to walk upon. A little opening at any place in the bank serves as a channel to convey the water to an adjoining field, while the breach is easily repaired if it be desired to stop the supply. Rice fields are also watered by the *Paicotta* or *Ettam*, when the water of the tank is expended before the crop has ripened. In the Carnatic this machine consists of a lever resting on an upright support which is generally a tree planted near the well. A long bamboo rod is attached to the lever, and to the end of this rod is fastened the bucket. One or two men mount on the lever and walk backwards and forwards on it to raise or sink the bucket. Another man stands at the mouth of the well to empty the bucket

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Line 5. "Bund" = that which is "bound," just as "anicut," [a Tamil word, really, it being "அணைக்கட்டு"] means the "built dam."

Line 7. Sluice = "கண்வாயடைப்பு;" or, among the ryots who use it, "அடைப்பு."

Line 15. "ஏற்றம்" from ஏறு, ascend, or, more correctly, from its "பிறவினை :—ஏற்று," the ஏற்றம் being that which causes the water to rise

into a trough. Sometimes the bucket is counterbalanced by a large lump of mud placed on the lever, and then one man can work the machine. The Paicotta is commonly used in Madras for watering gardens.

If the water be very near the surface it is often thrown out to irrigate the land by two men swinging a leather basket fixed to ropes.

Any person ascending a hill which commands a good view of the plains will perceive the whole country to be dotted with these tanks, on the lower side of which will be seen beautiful green patches of vegetation larger or smaller according to the size of the tank and the slope of the ground, all the part watered by the tank being richly cultivated and affording a striking contrast to the surrounding country. Interspersed he will see villages and topes of palmyras or cocoanuts. Some of these tanks are many miles in circumference. The tank at the Red Hills near Madras is large enough for boating parties to amuse themselves on it.

Excellent rice-fields are also formed in extensive open plains which are watered by large rivers, especially if the rivers overflow at certain seasons, as the fields then receive fertilizing matter from the muddy water. In some places the water has been prevented from running out of the rivers into the sea and so becoming wasted by a large dam thrown across the river near its mouth. The water being thus kept back can be

Line 1. "Counterbalanced by" requires very careful translation.
Line 16. "Tope," a Tamil word [illegible], which is taken from [illegible], a collection from [illegible] to collect.

diverted by channels to any part where it is required. These great dams are called *Anicuts*. There is one across the Cauvery near Tanjore, another near Trichinopoly, and a very large one across the Godavery, and another across the Kistna.

The varieties of rice are very numerous, but for all practical purposes there are but two kinds, the upland or mountain rice, and the lowland or watery kind. In this Presidency the various kinds of rice appear to be very differently distributed. In Tanjore, the most richly watered district in the Presidency, there are upwards of seventy kinds, whilst in Cuddapah and Guntoor there appear to be but very few. Mountain rice grows without irrigation at elevations of from 3,000 to 6,000 feet on the Himalaya mountains, where the dampness of the summer months compensates for the want of artificial moisture.

Line 6. In simpler words;—"There are a great many kinds of rice;" to be rendered "நெல் பலவகைப்படும்;" while the sentence in the text would be nearly the same; "நெல் விளைது வகை பலவாகும்."

Line 15, 16. Putting 'there' for 'where,' to make the sentence complete, it may be rendered:—"[illegible] பதிலாக அவ்விடத்தில் [illegible] உதவுகின்றது."

The translation of "compensates for" here should be compared with the way in which "counterbalanced by" on the last page has been rendered in the class.

Line 11. "Irrigation."
Line 16. "Artificial moisture," equivalent expressions, and so regarded in the last translation.

Rice is no doubt the grain which yields food for the largest portion of the human race, but even in India there are great numbers who do not eat rice; in fact, in all the North-West Provinces, wheat is the principal crop. Rice abounds in nourishment, and is light, wholesome, and easily digested.

It is constantly eaten with curry both by natives and Europeans. Large quantities of rice are exported from this country to England, especially from Bimlipatam and other places in the Northern Circars.

The rice grown in Carolina in the United States is a better kind than that commonly grown in India. This description has been tried near Madras and to the northward, and appears to answer well, producing more grain and ripening a month sooner than the surrounding crops. The cultivation of this new variety is very desirable, on account of its value in the market being greater than that of the Madras rice.

It is remarkable that, although rice has been cultivated in India for perhaps twenty centuries, while it is not much more than 150 years since it was first introduced into South Carolina, yet the cultivation and preparation of rice in that country is conducted in a manner greatly superior to that which prevails in India, where the people are too much accustomed to follow the manners of their fathers, without exercising their own powers of reflection and invention. Not only is

Line 14. Answer well = succeed = நன்றாய்ப் பலன்கொடுத்தல்.

Lines 13 & 16. Which words in these lines are used as equivalents?

the Carolina rice the best in the world, but it is prepared for the market in a manner which contrasts strongly with the Indian modes of effecting the same object. The rice in sheaf is taken to the steam threshing-mill where it is threshed, the straw taken off, and the grain winnowed and screened, sometimes at the rate of more than a thousand bushels of clean rough rice in a short winter's day.

Rice with the husk on is called *paddy*, and a good deal is now exported in this rough state, as the grain is found to keep better so than after it has been cleaned. When the separation of the husk from the rice is performed in India, it is commonly done by beating the grain in a kind of rude mortar of stone, the pestle being of heavy timber shod with iron. The paddy is also sometimes boiled in water and then dried in the sun. By this means the husk is more easily removed with the pestle and mortar.

Bread can be made from rice, but it soon becomes dry and harsh. In England, rice is used chiefly for puddings and other dishes, though it is sometimes mixed with wheat to make bread in times of scarcity. A fermented liquor, commonly known as *Arrack*, may be manufactured from rice. The word *Rice* is derived from *Oryza*, the name by which this production was known to the ancient Greeks and Romans, or from the Arabic *Aruz*, which seems to be the origin of the Greek name.

Line 26. The similarity of the word அரிசி to *oryz* and *rice* is remarkable; it is, however, to be noticed that அரிசி does not mean rice only, but any grain freed from the husk, thus "கொள்ளு யரிசி." Rice being *the* grain with the natives, அரிசி means that when the word is used alone. The similar use of சீமை, a foreign country, to denote England as *the* foreign country, is worthy of note

MAIZE.—This plant is also known by the name of Indian corn. It is a native of America, but is largely cultivated in other countries. Next to rice, it supplies food to the greatest number of the human race.

Maize is the largest and handsomest of all the grasses cultivated for food, and when growing luxuriantly it attains a height of from five to six feet. It consists of a strong, reedy, jointed stalk, provided with large leaves springing from the joints alternately. The leaves are broad, and hang down from large rough sheaths which surround the stem. The top of the plant produces a bunch of variously coloured flowers, which is called the *tassel*. Each plant also bears one or more spikes or ears, the usual number being three. These ears consist of a cylindrical substance of the nature of pith which is called the *cobb*, over the entire surface of which the seeds are ranged and joined in straight rows, each row having generally about thirty seeds. The grains of maize are of different colours, the prevailing hue being pale-yellow. Maize requires for its cultivation land that is naturally fertile, or has been made so, but it has the advantage of being very productive and of being less subject to disease than the other corn plants. Blight and mildew are unknown to it, and it is not liable to be beaten down by rain or wind.

Line 23. "Subject to" may be rendered in various ways; by இடமாயிருக்கிறது in such a sentence as "The fields are subject to inundation"—by ஏதுவாயிருக்கிறது in the text,—by உட்படுத்தியிருக்கிறது, in "He has rendered himself subject to punishment." These various ways are nearly the same, the slight distinctions to be learnt by practice only.

The largest variety of maize is that known as American Indian corn, which is found growing wild in many of the West Indian Islands as well as in the central parts of America. It has sometimes been known to attain the gigantic height of fourteen feet. This variety will rarely come to maturity in northern climates, and could never be securely relied on for a crop in any part of Europe. In some particularly favoured spots of the Mexican States it has been known to yield an increase of 800 to 1. The system of husbandry employed is to sow the seed in rows, sufficiently far apart to admit of the passage of a small plough between them, for the purpose of loosening the soil around the roots, and of removing the weeds.

When maize is fully ripe, which is not until the sheath of the ear opens and appears quite dead, the ears are pulled off and laid in a dry place; the seed keeps better thus than when it is separated. The operation of shelling is easily performed. The only implement required for the purpose is a piece of iron in shape like a sword-blade, but blunt. This iron is fixed across the top of a tub, and the ears being rubbed hard over the edge of the iron fall into the tub. In America they have a simple machine which does the work quickly.

Maize is a very useful plant. Although not generally used for bread in Europe, yet it is employed in boiled messes and soups, and it is not only the ripe grain which is eaten, but the ear in every state from that of a green vegetable to unripe corn. It is boiled, stewed, and baked; it is a substitute for cabbage

and green-peas in its early state. Nothing can be better than ripe maize to fatten hogs or poultry with, and when the young stem is cut down quite green it proves one of the best and most abundant varieties of green food for cattle. The stalks can also be used as fodder for cattle after the maize has ripened and the ears have been removed. The coble makes tolerable fuel. Maize bread is not so palatable as wheat or rye-bread, but by mixing it with certain proportions of wheat it makes a very pleasant food. In the Northern States of North America it forms almost the only bread eaten by many of the people, and in the Southern States it is the only bread that the Negroes eat. In America and Italy they stuff mattresses with the dry sheath of the ear and thus form a cool and elastic bed. One variety of maize is used in the preparation of beer in Germany. Ardent spirit is also said to be extracted from it. Humboldt a celebrated traveller, informs us that the Mexican Indians, previous to the conquest of their country, were accustomed to express the sweet juice from maize-stalk for the purpose of fermenting it into an intoxicating liquor.

In this part of the country maize is but sparingly cultivated. Dr. Buchanan describes it as being planted in Mysore along with turmeric. The plot of ground is well dug up and manured, and then formed into squares, in which are planted small cuttings of turmeric

Line 8. "Palatable" = tasty = ರುಚಿಕರವಾದ, ರುಚಿಯಾದ.

Line 9. "Certain proportions" would generally be rendered by "ಪ್ರಮಾಣಗಳು," but more correctly by "ಕ್ರಮಗಳು."

Line 20. "Express" used literally here.

root with a seed of maize between every two. In three months the maize is ripe, but the climate does not appear well suited to the growth of the plant. Each stem commonly gives one head and very rarely more than two. It can hardly be called an article of food, as the natives have a prejudice against it, conceiving that it produces gripes.

At the Madras Exhibition in 1855 the maize exhibited was for the most part indifferent. A good sample was produced from Bangalore, the product being about 500-fold. Another variety was exhibited from Tinnevelly.

PULSES.

Horse Gram.—Neither this plant nor dholl belongs to horse-plants, but they are reckoned amongst the pulses or plants of the pea and bean kind. Like dholl it is an annual. It attains a height of about two feet, and has oblong pointed leaflets and scimitar-shaped hairy pods. It is cultivated on dry land, and generally on the worst soils, in fields that are used for nothing else; near Madras it is sown in January, and becomes ripe in four or five months. When ripe, it is pulled up by the roots, spread in the sun to dry, and trodden out by bullocks. It is used chiefly for feeding horses, for which purpose it is boiled till it becomes soft. It is also eaten by the poor, who sometimes make

Lines 8, 9. "The maize was for the most part," or "most of the maize was" — *Vide* note on page 2

soup with it. Green gram, black gram, &c., belong to the same description of plants.

Bengal gram is the food commonly given to horses on the banks of the Ganges, and it is very well fitted to make them fat and sleek, but does not appear to be very strengthening. In these parts of India it is given once a day to some horses, and to Pegu ponies; but it is too dear to form the general food of horses, and indeed even for men it is considered rather a delicacy.

DHOLL.—This plant is cultivated in many parts of India during the dry season, and its seeds are extensively consumed by the poorer natives. Its cultivation is like that of gram; and like that plant it has yellow flowers. After the seed has been threshed out, cattle eat the husks. The straw is used for fuel.

The Mussulmans use dholl to mix with rice and ghee, sometimes adding spice and meat. This dish is called *kitchadee*. The Hindoos generally boil the dholl and mash it as soon as it becomes soft; they then eat it with rice. They sometimes also use it for soup. Brahmins and other caste people are fond of this seed.

DRUGS.

Southern India is abundantly supplied with drugs appropriate to the cure of the diseases to which persons living within the Tropics are liable, and there is reason to suppose that many other medicines besides those already known exist in the country.

Out of these numerous medicinal products of the Presidency we shall notice four—opium, sulphur, salt, and saltpetre.

Opium.—This drug is the thick juice or milk of the unripe fruit of the white poppy. This plant is largely cultivated in Bengal on account of Government, who manage the collection and sale of it; and it forms a principal source of revenue to the country. The districts in which it is cultivated are Behar and Benares. It is also grown largely in Malwa, but as this province is under independent princes, the cultivation is unrestricted, although a heavy duty is levied on the exportation of the drug. The whole revenue derived from the sale of the Bengal opium, and the duty paid on that from Malwa, had increased from less than three crores of rupees in 1848 to more than five crores in 1856. In this Presidency it is only grown sparingly in particular places.

The cultivation of the poppy is very simple, though the weeding requires care. The plants are carefully watered and manured, the watering being more copious as the period of flowering approaches.

The cultivation takes place in the cold weather, and the collection of opium begins very soon after the flowers fall, as the fruit, which is at the base of the flowers, rapidly enlarges, and it is from this that the opium is collected. The people go into the field, after sunset, with small knives, with which they make incisions into the unripe fruit, returning in the morning to scrape off the opium which may have exuded

or run out. The quantity collected is then rubbed together in a mortar to reduce the whole to a half fluid mass, which requires to be dried as quickly as possible in the shade.

When opium is good, it is very heavy and somewhat soft; its colour is a very dark brown yellow, and it has a strong smell and bitter taste. The opium most esteemed is the Patna opium, which is grown in the district of Behar. In this and the Benares districts, opium is made into balls about the size of the double fist, and covered with a hard skin, made of part of the flower of the poppy. The chests in which it is packed for the market are made of mango-wood, each consists of two stories or stages, and each story has twenty compartments to contain twenty balls, so that the balls of opium are all kept separate. The average weight of a chest is about 140 pounds.

The commercial history of a pound of opium is as follows:—The Government pay about 6 Annas for the juice to the ryot cultivator, and they incur a further expenditure of a Rupee and a half or so for the different processes the opium has to go through before

Line 8. "Most esteemed;" this is an expression of a kind seldom translated accurately, *e. g.*, "விசேஷயம்பத்த" would be given by nine out of ten as the meaning; but it is altogether incorrect. This means simply "much valued" [lit. 'commanding a high price']—whereas the meaning of the text is "more esteemed than any other," and the correct Tamil is the equivalent for this, viz., "மற்றெல்லா வபனிதரும் விசேஷமான" "too far,"—"too much," &c., are expressions to which the same remarks apply

it leaves their hands. They receive, on an average, say 6 Rupees from the merchant who buys at the Calcutta sale, and their profit consequently is nearly 4 Rupees. These sums must be taken simply as showing how the price rises, and not as the actual price for any one year. The Government have sold at $3\frac{1}{2}$ Rupees per pound, they have sold at $10\frac{1}{2}$ per pound, according to the general state of affairs in India or in China, and their profits have been proportionally affected. The principal market is China, but the drug is also in demand in various Eastern countries as the Malay Peninsula, Sumatra, Borneo, and other islands of the Indian Archipelago. In all these opium is admitted by the authorities, but in China it is a prohibited article, and, consequently, cannot be introduced into the country without smuggling.

In Europe, opium is almost wholly employed as a medicine. That used in England is imported chiefly from Turkey. In the Eastern countries, however, especially in China, it is used for the purpose of intoxication. The Chinese rarely eat opium; they generally smoke it, and are very particular concerning its quality. When the opium is about to be prepared for the smokers, the balls are cut open, steeped and simmered, strained and boiled until they assume the state of a pasty mass, which is spread out and dried. The process is then repeated until the drug is free from impurities, when it is put into small buffalo horn boxes. The prepared opium

Line 9. "Proportionally" is rather an awkward word; the sentence may perhaps be rendered "அவர்கள் வாபமும் அந்த விசேஷமான ஏற்றத்தாழ்வுக்கிடப்பட்டது."

is smoked in pipes formed of heavy wood, having an earthenware bowl at one end, and a cup that serves to collect the ashes after the combustion or burning of the opium. The smoker, lying upon a couch or bench, holds the pipe with the bowls near a lamp, the lamp and the couch being so placed that the opium can be kindled without disturbing the lazy smoker in his position. A piece of opium, about as large as a pea, is placed in the hole of the bowl and kindled at the lamp; then one or two whiffs suffice to draw in all the smoke emitted by the burning drug. When the pipe is burnt out, the smoker repeats the charge until his prescribed dose is exhausted, or until his means of purchase are expended. There are smoking shops by hundreds in the towns within moderate distance of the coast, and these shops, we are told, are kept open day and night. The opium shops of Singapore, which are like those of China, are thus described. "In these houses, devoted to their ruin, these infatuated people may be seen at nine o'clock in the evening in all the different stages. Some entering half distracted to feed the craving appetite they have been obliged to subdue during the day; others laughing and talking wildly under the effects of a first pipe; whilst the couches round are filled with their different occupants, who lie languid, with an idiot smile upon their countenances—too much under the influence of the drug to care for passing events, and fast tending to the wished-for consummation. The last scene in the tragic play is generally a room in the rear of the building, a species of dead house, where lie stretched those who have passed into the state of bliss which the opium eater

madly seeks, an emblem of the long sleep to which he is blindly hurrying."

When opium is eaten, it is generally taken in the form of pills. It is stated that, to persons unaccustomed to its use, the eating of less than a grain of opium generally produces a stimulant action; the mind is exhilarated, ideas flow more quickly, a pleasurable condition of the whole system is experienced difficult to describe, and there is a capability of greater exertion than usual; but that is followed by a diminution of muscular power and a decreased sensibility to external objects; a desire of repose comes on, hunger is not felt, but thirst increases. Very soon, however, the craving for opium becomes greater, the pleasant stimulus is only renewable by increasing the dose, insomuch that a portion of a grain no longer produces the result desired. When the quantity reaches two or three grains at a dose, the stage of excitement is soon followed by the stage of depression; the pulse is full and rapid, then faint and slow, the skin becomes hot, the appetite diminished, the thirst increased, the organs of sense dull, the ideas confused; in short, the pleasurable stage is brief compared with the painful stage that follows it. Four grains to a person quite unaccustomed to its use are likely to be fatal: but to an opium eater or smoker this is only a very moderate dose. Dr. Oppenheim, in speaking of the Turkish opium eaters, says that the habitual opium eater is instantly recognized by his appearance. An attenuated body, a withered countenance, a lame gait, a bending of the spine, and glossy, deep, sunken eyes, betray him at the

first glance. The digestion is in the highest degree disturbed, the sufferer eats scarcely anything; his mental and bodily powers are destroyed. As the habit becomes more confirmed, his strength decreases, but his craving for the fatal drug becomes even greater, and he is obliged continually to increase the dose in order to produce the desired effect.

The medicine called *laudanum*, which is a poison, is a preparation of opium.

In India, poppy seeds are used in sweetmeats and cakes which the wealthy eat. Where the seed has been allowed to ripen, the husks of the fruit being beaten with jaggery and water are made into an intoxicating liquor, which is much used both by Mussulmans and Hindoos.

A little opium is produced on the Neilgherries, but the Burghers who cultivate the poppy do it rather for the sake of the seed than for extracting the drug from the capsules of the plant. While the Neilgherry opium is small in quantity, it is very superior in quality, and meets with a ready sale in the bazaars of Ootacamund, amongst the Mysore and Malabar coolies and others, who eat it in its raw state, but do not appear to smoke it. Opium was formerly cultivated to a considerable extent in Mysore, and small quantities of it are still produced in that country.

Sulphur is an *elementary* substance. By an elementary substance is meant a substance which is not capable (so far as is known) of being resolved into any component substances. Water, for example, can be resolved into hydrogen gas and oxygen gas, which

are therefore its component parts; but elementary substances cannot be thus separated into any simpler forms of matter.

Sulphur is abundant, and is met with both pure and in various combinations. It combines, for instance, with numerous metals, as iron, copper, lead, &c. It also enters into some vegetable substances; and plants which contain it have often an offensive smell, to which most probably it contributes. Such plants are assafœtida, garlic, and mustard. It is also found in some animal substances, and its presence in the white of eggs is the cause why silver egg-spoons become blackened after being used with eggs. Sulphur is separated from the substances with which it is found in combination, and has different forms given to it. Thus, when melted and cast into wooden moulds, it is called *roll* or *stick sulphur;* and when the vapours of sulphur are condensed in a large chamber, it has the form of powder and is called *sublimed sulphur* or *flowers of sulphur*. The common name for sulphur is brimstone. Sulphur is insoluble in water, but dissolves in oils, such as linseed and turpentine oils. It is very *volatile*, and when it is rubbed in the dark on any substance by which it is slightly heated, an extremely weak blue flame arises, exhaling a peculiar odour. This flame is not, however, occasioned by combustion or burning, but merely accompanies the evaporation of the sulphur, as is seen from the fact that a cold body held over it is covered with flowers of sulphur.

Sulphur is used in medicine both internally and

externally, and it is of great service in the treatment of certain diseases of the skin.

It should be noticed that fumes of sulphur rise abundantly from the neighbourhood of volcanoes.

Sulphur is found in several districts of the Presidency, as Canara, Trichinopoly, Salem, Nellore, Masulipatam, and Cuddapah. It occurs along with a mineral called *gypsum* in mari and clay beds, and also very largely in combination with metals.

Dr. Heyne mentions a shallow lake near the Godavery where sulphur is found in small heaps and in tolerable abundance. There were not in the locality any volcanic products.

The natives are acquainted with the modes of subliming sulphur, and prepare it for the manufacture of gunpowder.

SALT.—Common salt is a combination of two elementary substances, of which one, *Chlorine*, is a gas, and the other, *Sodium*, a metal. This valuable substance is found in the greatest abundance, and in situations where both man and animals can easily obtain it. Thus the waters of the ocean contain a very large quantity; a certain amount exists in almost all spring and river water; and it is also met with in a solid form known as rock salt. This universal distribution of a substance so invaluable to man is one of the proofs of the foresight and goodness of the Creator.

Pure salt is a white crystalline solid, of a peculiar taste, and dissolves readily in water, to which it imparts its peculiar flavour. Salt is the only solid *mineral* substance that is consumed with, or for, food by animals. It is supposed that the effect of salt is either to make some change in the matter taken into the stomach or else that it mixes with the juices secreted from the organs of digestion, and that it increases their energy, although it does not itself permanently remain in the system.

Salt is one of those articles of food known by the name of *condiments*. These impart flavour to what is eaten, without increasing the nutritive qualities of food.

Salt is used in Europe in immense quantities in curing or drying fish. It has also the valuable property of keeping flesh from becoming putrid, and it is therefore employed in preserving meat for sea voyages. When used for the preservation of meat for a short time, the salt is either rubbed in dry, or the flesh is soaked in *brine*, which is water saturated with salt. By its being *saturated* with salt, we mean that no more salt can be dissolved in it. Beef, or pork for taking to sea must be salted by placing the pieces, alternately with layers of dry salt, in barrels or chests. The natives preserve meat by mixing salt, turmeric, chillies, and other substances with it and then drying it in the sun.

There are salt mines in Poland, France, Spain, and other European countries. The principal part of the salt of England is made in Cheshire, where there are both salt mines and salt springs.

In this Presidency the Government monopolized both

the manufacture and sale of salt, that is, it prohibits any one from making or selling it on his own account.

The best salt in this part of the country is procured by the evaporation or drying up of sea-water. Low grounds near the inlets from the sea are chosen for this purpose, and shallow reservoirs are dug, into which the sea-water is raised by the Paicotta. When the brine has, after some days, acquired a certain strength or saltness, it is let off into still shallower enclosures or *pans*, where the sun and wind soon dry up the water and the solid salt is then left encrusting the bottom and sides of the salt-pans. From these it is removed to dry, and then stored up for sale. The places where this manufacture is carried on are situated on the Coromandel Coast and on the Canara portion of the Malabar Coast. Near Ennore, in the neighbourhood of Madras, there are large salt-pans. In some districts salt is produced spontaneously in marshy swamps. It is also extracted from earth in the interior of the country, where it is used by the lower classes. But the manufacture is not permitted except in Bellary, Cuddapah, and Kurnool. For the manufacture of this salt a mound of common earth is raised and its top made hollow. The saline earth is then collected and thrown into the hollow, and water is poured upon it. The water filtering down becomes impregnated with salt, and drains into a reservoir constructed at the foot of the mound. The brine thus obtained is exposed to the heat of the sun in small beds until the water is evaporated and only salt remains. The best kind of earth salt is made in Bellary, and is a very wholesome article.

Under the head of salt we may notice another compound of the metal *sodium*, viz., *carbonate of soda*, which is found commonly in this Presidency in an impure state, and is known by the name of Dhobies' earth, from the use made of it by washermen in cleaning cloths. The method of its collection and preparation is similar to that adopted with common salt. It is found most frequently in a red soil containing iron, and the spots where it abounds may be discovered by their barren aspect and by the black colour of the mould at an early hour of the morning. This is occasioned by the salt having imbibed moisture from the air and by its retaining it until it is expelled by the heat of the sun.

SALTPETRE.—Saltpetre is otherwise called *nitre* or *nitrate of potash*. A great deal is found in India as a natural product, mixed with earthy matter in the soil. It is also formed by the putrefaction of animal matter.

Saltpetre is colourless and without smell; it has a cooling, sharp, salt taste, and can be readily dissolved in water. If it is dissolved in *hot* water, it forms in crystals of very considerable size on cooling. Saltpetre occasions much cold during its rapid solution in water, so that an ounce of it is capable of reducing the temperature of five times its weight of water fifteen degrees. On this account it is constantly employed by Europeans in India to cool water, beer, and other liquors. In Madras, ice is used for this purpose, as it cools the liquor much more effectually. Large quantities of ice are brought from North America for consumption in Madras, where it is stored up in a building called the Ice House.

Saltpetre is added to brine for salting, as experience has shown that the action of the liquid is thus improved. It is also largely used for making gunpowder, which contains about 75 parts of nitre to 15 of charcoal and 10 of sulphur.

Saltpetre is prepared from the ground in much the same way as common salt, and is afterwards refined by boiling. Different substances are used for clarifying it, as soap, milk, eggs, the twigs of the milk hedge, &c.

Large quantities are exported from this country to England. Saltpetre is said to be an excellent manure for sugarcanes, chillies, and raggy.

SPICES, Etc.

The term *spices* is applied to certain vegetable productions which are highly aromatic, or pungent, or both. They are, in most cases, of agreeable taste and smell, and are used for flavouring food as well as to assist in preserving it. Taken in small quantities they are not unwholesome, as they assist digestion, in large quantities they are extremely hurtful.

The spices are all produced in tropical climates, and chiefly in the East and West Indies.

Spices have always been regarded as luxuries, while their small size and consequent facility of transport caused them to be amongst the first articles of commerce obtained from remote countries.

Among the ancients, spices of all kinds, as well as frankincense and myrrh, were burnt at the altars of the gods and at the funeral piles of the nobles on account of their perfume. The country of the Sabeans, situated in Arabia Felix, was celebrated for the abundance of these aromatic plants, and it was on this account that the name Felix or "happy" was given to that part of Arabia.

ALLSPICE.—This spice is also named Pimento, and sometimes Jamaica Pepper, on account of its being chiefly obtained from the island of Jamaica. Allspice is the berry of a tree somewhat resembling the myrtle in appearance. This tree grows to the height of about thirty feet; it has a smooth brown trunk and shining green leaves; its branches, coming out on all sides, are clothed in the most luxuriant foliage. In July and August the trees are covered with a great number of small white flowers which contrast beautifully with the dark green leaves; whilst the rich perfume sent forth renders an assemblage of these trees one of the most delicious of plantations. In Jamaica, the allspice is cultivated largely for the sake of its fruit, which is the berry we use as spice. These are plucked by the hand before they are ripe, and dried in the sun until the seeds inside rattle when shaken. During the drying, the berries change in colour from green to a reddish brown. If they are allowed to become ripe on the tree they turn purple, and, when dried, are found to have lost their aromatic odour and flavour, and are useless as spices. The name of *allspice* is given to this spice because its taste and smell seem to be compounded of those of cinnamon, cloves, and nutmegs.

CINNAMON.—This spice is the inner bark of a small tree which grows in this Presidency, in Coorg, and on the Malabar Coast, but which is cultivated most extensively in the island of Ceylon. The tree in its wild state will attain a height of from twenty to thirty feet, but when cultivated for its bark it is not permitted to rise above ten feet.

When the leaves of the cinnamon tree are first developed, they are of a bright red hue, then of a pale yellow, and lastly of a dark shining green; the mature leaves emit a strong aromatic odour if broken or rubbed in the hands. When in full bloom, cinnamon bushes have a very beautiful appearance, the small white petals of the flowers affording an agreeable contrast to the flame-coloured extremities of the upper, and the dark green of the lower foliage. The cinnamon tree flourishes only in a small portion of the island of Ceylon, and the cultivation centres principally around Colombo, the capital.

When about six or seven years old, young cinnamon bushes are from four to six feet high; they are, however, usually suffered to grow unmolested until they are nine years old, at which time the young shoots or branches that are about three years old are lopped off.

The bark is then slit up lengthwise and cut across so as to be readily turned back from the branch. It is then tied up in bundles for 24 hours, during which a sort of fermentation takes place; and this greatly facilitates the separation of the outer skin, which is carefully scraped off. The bark is then rolled up into *quills* or pipes about three feet long, which have a

slit down one side where the bark was cut. The smallest quills are rolled up inside the larger; and the whole are tied up in bundles and wrapped in cloths made of hemp. The article is then ready for exportation. The best cinnamon is obtained from the stalks or twigs which shoot up in a cluster of eight or ten together from the roots after the parent bush or tree has been cut down. These shoots are cut once in three years close to the ground.

Cinnamon, as a medicine, is a powerful stimulant, but it is not much used alone, its general use being to conceal the disagreeable odour and taste of other medicines.

A kind of camphor is sometimes made from the roots of this tree.

The bark of the *Cassia* tree resembles cinnamon in smell, taste, and appearance, and is said to be extensively substituted for it. It is probable, however, that what passes in commerce for cassia bark is produced by several cinnamon-like plants, and it would appear that even cinnamon bark from old trees is exported from the Malabar Coast under the name of Cassia. The Chinese cassia is incomparably superior in perfume and flavour to any other. Cassia bark is inferior to cinnamon bark, but is extensively used on account of its cheapness. *Cassia buds* are the dried flower buds of the tree, and are mostly brought from China. They bear some resemblance to a clove, but are small, and when fresh have a rich cinnamon flavour.

Both cassia bark and cassia buds are produced in this Presidency, in Mysore, Travancore, and Malabar.

The export of cassia buds from the Malabar Coast is now considerable, and the spice deserves to be better known.

CLOVES.—Cloves are the unopened flowers of a small evergreen tree which is a native of the Moluccа Islands, but which has been introduced into all the warmer parts of the world. Although Europeans have known the use of this spice for more than 2,000 years, it is little more than 300 since they learnt whence it was obtained. The Persians, Arabians, and Egyptians formerly brought cloves and nutmegs to the ports in the Mediterranean, whither the Venetians and Genoese resorted to buy the spices of India, until the Portuguese, in 1611, discovered the country of their production. These did not long enjoy the fruit of their discovery, however, for the Dutch soon drove them from the Moluccas, and for a long time retained a very strict monopoly of the productions of these islands.

The clove is a small evergreen tree of the same order as the cinnamon. Its flowers are small in size, and grow in larger numbers in clusters at the very ends of the branches. The cloves we use are the flowers gathered before they have opened and whilst they are still green. As soon as the cloves are gathered they are smoked by a wood fire to give them a brown colour, and then dried in the sun. Each clove consists of a round head, which is the four petals or leaves of the flower unexpanded; a square stalk, which is the tube of the calyx or cup of the flower; and what looks like four teeth, which are the divisions of the calyx. All these parts may be distinctly shown if a few cloves are soaked for a short time in hot water, when the leaves of the flowers soften and readily unroll.

Cloves contain a very large proportion of essential oil;* so much, that when the cloves are newly gathered, it may be obtained by pressure. A part is often so taken, but the robbed cloves are easily detected, as both their taste and smell depend on the quantity of oil they contain.

Cloves are grown in Travancore, Tinnevelly, Canara, and Cochin.

The name *clove* is a corruption of the French word *clou*, a *nail*, and the name was probably suggested by the resemblance of the dried clove to a nail.

GINGER.—This spice is the produce of a plant which is a native of the south-east of Asia and the adjacent islands, but which has long been cultivated in the West Indies. In its appearance this plant somewhat resembles a reed or sedge. It has a perennial† root; but the stem is annual. The root creeps and increases under ground in tuberous joints, what is called the *tuber*, being in reality only the thickened part of a subterranean stem. From each of these joints arises a green reed-like stalk about two and a half feet high, which bears narrow lance-shaped leaves. The

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* Essential or volatile oils are those which evaporate without leaving any stain on paper. They are usually procured by distillation.

† The term perennial is applied to plants that exist more than two years.

flowers of the plant, which are white and lilac, grow on a separate stem. The ginger we use as a spice is the root, to obtain which the plant is cultivated in much the same maner as potatoes are, and when the stalks have withered the roots are dug up. The best and soundest of them are selected, scraped quite clean, and carefully dried in the sun, after which they are ready for exportation. These form the *white* ginger of commerce. This is not so thick or knotty as the *black* kind, which is generally supposed to consist of the inferior roots, scalded in boiling water instead of being scraped. Some, however, are of opinion that the difference between black and white ginger is owing to their being the produce of different plants. The colour of black ginger is a yellowish grey, that of white ginger, a light yellow. The taste of the latter is much more pungent and aromatic than that of the former. The young roots of this plant make an excellent preserve. Ginger is a valuable medicine, and is as wholesome as so powerful a stimulant can be.

In this country, black and white gingers are distinguished in the bazaars as *green* and *dry* gingers. Ginger is cultivated in Malabar and on the West Coast. The Malabar ginger, which is mostly exported from Calicut, is the produce of the district of Shernaad, south of Calicut. The soil of Shernaad is very luxuriant, and well suited for the cultivation of ginger. The cultivation generally commences about the middle of May after the ground has undergone a thorough process of ploughing, &c.

At the commencement of the monsoons, beds ten or twelve feet long and three or four wide are formed, and

in these beds small holes are dug at short intervals and filled with manure. The roots, hitherto carefully buried in sheds, are dug out, and the good ones selected and cut into pieces of about two inches long. These are then buried in the holes, and the beds are covered with a thick layer of green leaves which both serve as manure and also prevent the beds from becoming too wet during the heavy rains. Rain is essentially requisite for the growth of the ginger, but great precaution must be taken to form drains between the beds, as the crops will be ruined if they are allowed to remain inundated.

Ginger is extensively diffused through the Indian isles, but the ginger of the Indian Archipelago is inferior in quality to that of Malabar and Bengal. In the cultivation of this plant in India there is room for great improvement and saving of expense. The garden plough and small harrow should be used. The ginger grown in the West Indies is considered superior to that grown in the East, doubtless because more care is paid to the culture and the drying of the root.

NUTMEGS AND MACE.—These two spices are the produce of one tree, which is a native of the Molucca Islands. This tree also grows in several islands in the eastern ocean, in the Straits of Malacca and in some other places. The tree is of larger growth than the clove, attaining a height of thirty feet, and has its leaves broader in proportion to their length than those of the clove. The upper surface of the leaves is bright green, the under greyish. When the Molucca Islands were in the possession of the Dutch, they

endeavoured to extirpate therefrom the nutmeg tree, through a desire to maintain a monopoly of the spice in the isles of Banda. It is remarkable, however, that the mace-feeding wood-pigeon has frustrated this jealous policy by conveying and dropping the fruit beyond these limits in other islands of the Archipelago.

The tree begins to bear when it is about nine years old. Its fruit is of the size of a small orange, and the outer part is smooth, pulpy, and about half an inch thick. As the fruit ripens, this outside covering bursts, and discloses a thin bright scarlet membrane like a leafy network; and when this membrane is dried, it forms *mace*. The nut, which is enclosed by the mace, consists of a thin hard dark brown shell, enclosing an oily kernel which is the *nutmeg*.

As soon as the fruit is ripe it is gathered; the outer end is first taken off and thrown away; after which the mace is carefully separated from the nut and dried. During the operation it loses its bright scarlet and becomes of a reddish orange colour. It is then packed lightly in bags for exportation. Good mace is very oily and has an agreeable aromatic odour. After the mace has been removed, the nuts are dried first in the sun, and then over a fire, until the kernel has so shrunk that it will rattle in the shell. The shell is then broken, and the kernels, which are the nutmegs, extracted. These are soaked in sea water and lime to preserve them, and are then laid in a heap where they heat and get rid of their superfluous moisture by evaporation. The nuts are about an inch long and have a furrowed surface. Inside they appear

marbled. Nutmegs are grown in Cochin and Travancore, but it does not appear that any attempt to grow the tree as a speculation out of its natural limits will answer. It has been found that it refuses to flourish out of the Malay Archipelago except as an exotic, and all attempts to introduce it largely into other tropical countries have hitherto failed. Wild nutmeg is found in Mysore and Canara: it is much used as a substitute for the true spice, but possesses no aromatic flavour.

Nutmegs and mace are used medicinally as aromatic stimulants and condiments. The fleshy part of the fruit is made into a preserve.

Pepper.—This article, being simply hot and acrid, but destitute of aromatic flavour, is more generally reckoned amongst condiments than amongst spices. The species of pepper are very numerous, but the common pepper of commerce consists of the dried seeds, ground to powder, of a climbing plant of the East Indies. In these regions it is extensively cultivated, being grown to a great extent in Sumatra, Borneo, and other countries. The best pepper, however, comes from the province of Malabar. The pepper vine is a creeping plant with a dark coloured stem which requires support. It is usual to plant a thorny tree by the side of this plant that it may have something to cling to. In Malabar, the Jack tree is often made thus to yield it support, but Dr. Buchanan tells us the natives prefer the Mango tree for this purpose as its fruit is not injured by the pepper, while they think the fruit of the Jack tree is both diminished

in quantity and injured in quality, its flavour somewhat resembling that of the pepper. The stem of the pepper-plant entwines round its support to a considerable height; the branches then drop downward, bearing spikes of green flowers which are followed by the pungent berries. These berries hang in large bunches like grapes, but the fruit grows distinct on little stalks. Each berry contains one round brownish seed, which becomes nearly black when dried: this is the pepper of commerce.

The plant is propagated by shoots which do not produce fruit until the fourth year. In their eighth year they bear most, then gradually decline, and rarely give fruit for more than two or three years longer. The pepper-plant produces two crops in a year, and when in full vigour is very prolific; each bunch usually contains from 20 to 30 berries, and sometimes as much as five or six pounds of pepper is obtained from one tree. The berries are gathered while yet green, before they are perfectly ripe, and are quickly dried on mats, when they turn black. In Malabar, the berries intended for white pepper are allowed to become quite ripe.

The *black* and *white* sorts of pepper are both the produce of the same plant, the latter being made of a greyish-white colour by being soaked in water and having the outer black rind rubbed off. A great deal of white pepper, however, consists only of inferior shrivelled seeds, which, falling from the tree, have been blanched by exposure to the air and sun.

Pepper is a regular crop on the Western Coast, and is

cultivated in Coorg, Mysore, and Canara, as well as in Malabar. An immense quantity is exported annually. It seems to grow spontaneously in the northern parts of Canara, on the sides of valleys where the soil is so rich and moist as to produce lofty trees close to each other, by which a constant coolness is maintained. In such cases the pepper vine runs along the ground and propagates itself by striking its roots into the soil and then again sending out new shoots. The natives say that, without assistance, it cannot ascend a tree, and that it never produces flowers unless it is exposed to sun and air. In order, therefore, to procure fruit, the proprietor cuts all the underwood, and leaves only the large trees and a number of small ones sufficient to allow a free circulation of air without exposing the vines to too much sun. He then applies leaves by way of manure and ties up the plants. The pepper thus grown is as good as that produced in gardens.

The moderate use of pepper with raw vegetables or other substances difficult of digestion is to be approved, but its employment in excess is hurtful to the liver.

The *Betel leaf vine* is another species of pepper, the leaves of which are constantly used by the natives to chew, along with the nut of one species of the Areca Palm, and quicklime, commonly called *chunam*. The Betel vine is cultivated in Madras and other parts of this Presidency. It is generally grown in separate gardens which are divided by little trenches into a number of beds. The vine cuttings having been planted, branches of certain trees are placed at intervals near them

These branches are intended to grow up to trees as supports to the vines. The garden is generally surrounded by a quick set hedge or a dead hedge of prickly bushes. The palm which bears the nut called *betelnut* is described as the most beautiful palm in India with a remarkably straight trunk, often from forty to fifty feet high, equally thick in every part, and smooth. The nut is about the size of a hen's egg, of a reddish yellow when ripe, and with a firm fibrous rind about half an inch thick. It has a rough astringent flavour and is not eatable alone; but mixed with lime, which no doubt destroys its acidity, and with the leaf of the betel pepper, it becomes milder and more pleasant. The mixture is, however, after all, so hot and acrid as to be unfit for the use of any but persons accustomed to it. It is said to be aromatic and stomachic and also to produce intoxication in beginners, but it is very doubtful whether all these qualities are not rather to be ascribed to the betel pepper leaf than to the nut of the palm. The habit of chewing betel stains the lips and teeth of a deep red colour. The presentation of betel is common on visits or occasions of ceremony.

CARDAMONS, [sometimes spelt Cardamomums.]—Cardamons are the production of various species of plants of the same tribe as the ginger, and might be profitably cultivated with that root. They are the oval capsules which contain the bright yellow seeds of the plants, the seeds themselves being used in medicine as aromatic tonics and carminatives; and in cooking, for curries, soups, &c.

The best sort of cardamoms is that known as *clustered* or *Malabar Cardamoms*, the produce of which is in great request throughout India, fetching as much as 300 Rupees per candy of 600 lbs. These are grown both in Travancore and Malabar. The plant flourishes on the mountainous parts of the Malabar Coast and in the Wynaad district among the western ghauts. The bulbous plants, which grow three or four feet high, are produced in the recesses of the mountains by felling trees and afterwards burning them; for, wherever the ashes fall in the openings or fissures of the rocks, the plant naturally springs up. This no doubt arises from the seeds being widely scattered about the soil. In the third year the plant comes to perfection, bears fruit abundantly for a year or two, and then dies. Where cardamoms are planted they are much inferior to those grown in the wild state. The plant may be propagated by cuttings or divisions of the roots. The seed capsules are gathered as they ripen, and when dried in the sun are fit for sale. They should be full, plump, and difficult to be broken, of a bright yellow colour, and of an acrid bitterish taste. The natives call this plant the *Adum* shrub.

Not more than a hundredth part of the cardamoms raised in Malabar are used in the country. They are sent in large quantities to the ports on the Red Sea and the Persian Gulf, to Bombay, Sind, and Bengal. They constitute the most esteemed of the condiments employed by the Turks, Persians, and other Eastern nations, entering into all their pillaus, curries, &c.

Middle sized, and known as "Small Cardamoms" are the fruit of another species believed to be a native of Sumatra, but also growing in Malabar. Its capsule is egg-shaped and oblong, and of a yellowish colour. It contains many angular dark-coloured seeds which have a pleasant aromatic odour and a warm agreeable taste. This species is grown also in Mysore, Coorg, Canara, and Travancore.

It appears that cardamoms formed part of the early commerce between the Western Coast and Arabia, from which latter country they must have become known to the Greeks, as they are mentioned as early as the 5th century B. C.

CAPSICUM.—Capsicum, called also Bird Pepper, is the name of a number of plants comprising several species which are natives of the East and West Indies and other hot climates.

The name is also applied to the long roundish taper pods divided into two or three cells and full of small whitish seeds which constitute the fruit of the capsicum plants. This fruit is also known by the name of *chillies*, *chilli* being the Mexican term for all varieties of capsicum. When the fruit is fresh it has a penetrating acrid smell, and is extremely pungent to the taste, producing a most painful burning in the mouth. The pod dried and reduced to powder forms *Cayenne pepper*, which is used as well in medicine as with food. In Europe, the capsicum enters largely into the seasoning of food and the preparation of pickles, and in warmer countries it constitutes one of the first

necessaries of life, either green or ripe. The fresh capsicums used in Europe are obtained principally from a species found wild in South America and the West Indies. It grows from one to two feet high, forming a dark-green bush; the flowers are small and white; and the fruit is generally red or yellow.

Chillies are useful in assisting digestion. Even birds have recourse to the seeds, and many parrots and other birds die, when taken to Europe, for want of this natural stimulant.

The consumption of chillies in India is immense, as both rich and poor constantly use them, and they are the principal ingredient in all chatnies and curries; ground into a paste, between two stones, with a little mustard, oil, ginger, and salt, they form the only seasoning which millions of people eat with their otherwise insipid rice.

Capsicums of different species are cultivated all over this Presidency, chiefly for the purpose of making cayenne pepper and chilli vinegar.

OTHER SUBSTANCES USED FOR FOOD.

ARROWROOT.—This substance is prepared from several plants, but the best or *West Indian Arrowroot* is the produce of a plant which is a native of South America. The herb from which it is made is a perennial which rises to the height of two or three feet, has broad pointed leaves, and is crowned with a spike of small

white flowers. The starchy matter for which the plant is cultivated is prepared by the following process:— When the roots are a year old, they are dug up, and having first been well washed in clear water, are either grated or beaten to a pulp in large wooden mortars. This pulpy substance is next thrown into clean water, and, after the whole has been agitated for some time, the fibrous parts are collected in the hand, squeezed, and rejected. The milky liquor which remains is a mixture of starch with water, and this, after being strained through a hair-sieve to separate such fibrous particles as have escaped before, is left for some time to settle, and then the water is drained off. The white pasty mass is then again washed and allowed to subside as before, and this process is sometimes repeated three or four times. When the pulp is considered to be sufficiently cleansed, it is dried on clean white cloths in the sun. It then forms an extremely pure starch, which, when reduced to powder, constitutes *arrowroot*. This powder is mild and insipid, and has scarcely any taste. When pressed with the hand it emits a crackling noise. In England, potato starch is frequently used to adulterate arrowroot, but it is not soluble in cold water as arrowroot is.

This plant is cultivated extensively at Chittoor, and at Royapooram near Madras, as well as in other parts of India.

East India Arrowroot is prepared in large quantities on the West Coast, and is also produced in Mysore, Vizagapatam, and Ganjam. The mode of preparation

similar to that already described, but the *farina* or starch is extracted from the fleshy tubers of several plants, most of which are of the same genus as the turmeric plant. It affords an excellent substitute for the West Indian article, but its commercial value is considerably lower. It is less used as an article of food, but is largely purchased for the purpose of making starch.

Arrowroot may be used with advantage as the food of young children, or of persons in delicate health, since it is very nutritious and easily digested. It is used either mixed with hot water or boiling milk, or in the form of puddings.

The name of *Arrowroot* is derived from the practice of the South American Indians, who used a plant often confounded with the arrowroot plant as an antidote to the poison in whiel the *arrows* of hostile tribes were dipped.

Sago.—The substance so largely imported into Europe under the name of sago is the produce of two species of a particular genus of palms. The trunk of these trees is large, and often tall, with a crown of leaves at the top. The flowers are somewhat red and arranged in spikes. The trees flower but once during the term of their existence. Their fruit is dry and scaly. All the species inhabit the islands of the Indian Archipelago, where they form extensive forests almost exclusively composed of their own kind. The sago palms grow in marshy spots. While young they are admirably protected by long and stout spikes from the wild hogs which would otherwise destroy them. As the tree

grows and the trunk hardens, the spikes drop off. In order to procure the sago (which is a farinaceous pithy matter found in the stem) the tree is cut down just before the large spreading flower appears, which it generally does when the tree is seven or eight years old. The trunk is then split into logs a few feet in length, and the soft interior is extracted, pounded, and thrown into water, which is drained off from the pulpy mass, when the starch comes away with it; and after this settles it is prepared and purified by successive washings. It is calculated that a tree fifteen years of age will yield from six to eight hundred pounds of this nutritious matter. In the stump of the tree a new stem will spring up and become fit for the axe. The sago meal, as it is called, is the form in which this starch is procured, although it is not commonly exported in this state, *pearl sago* being the usual form in which it is met with as an article of commerce.

Singapore is the principal, if not the only, place in the East Indies where the refining or manufacturing of pearl sago is carried on; the process is said to be the invention of the Chinese. The best sago is the produce of Siak on the north coast of Sumatra, whence it is conveyed in native boats to Singapore. It is there washed, strained, pounded, and sifted. After it has been sifted it is placed in large cloths, which are tied to cross sticks in the form of bags hanging by cords from the roof of a building; Chinese are then employed in shaking the bags backwards and forwards for about ten minutes, by the end of which time the whole has become granulated and is fit for the market.

Sago flour or powder also is brought into a granulated state before it is exported. This is done by moistening it and passing it through a sieve into a very shallow iron pot held over a fire. It thus assumes a globular form, and will keep a long time after it has been half baked. The grains of sago are inodorous and almost tasteless. They swell in cold water, and are nearly soluble in boiling water. The tree above described yields the best kind of sago, but, as has already been said, this starch is also extracted from other plants. In Canara, the pith of a particular kind of palm is much used. Dr. Buchanan says that the heart of the upper part of the tree is converted into a kind of very coarse sago, but Dr. Roxburgh tells us that, in the countries where this palm grows, the pith is said to be equal to the best sago. The natives make it into bread and boil it into thick gruel.

The word *sago* signifies, in the language of the Papuans or inhabitants of New Guinea, *bread*, since it constitutes the principal article of food of the tribes of the Eastern Archipelago and other parts where the plants which yield it grow.

TAPIOCA.—This preparation is remarkable as being obtained from a plant abounding in a highly poisonous juice. The plant called *Cassava* is thought to be a native of South America. It attains a height of from four to six feet: the stalk is slender, woody, and knotted, and is furnished with smooth alternate leaves. The root is tough, branched, and woody, and its fibres swell into those farinaceous masses for which alone the plant is cultivated. Two species of cassava are culti-

vated for human food, the *Bitter Cassava* and the *Sweet Cassava*. Although the former is poisonous, yet it is cultivated almost to the entire exclusion of the latter, on account probably of its being more easily ground or rasped into flour. The poisonous principle of the Bitter Cassava is easily dissipated or decomposed by heat or fermentation: hence the flour becomes perfectly wholesome in the process of making Cassava bread, which is often in high repute amongst those who have been accustomed to its use.

The tubers from which the cassava flour is made are spindle-shaped, about fifteen inches long. When dug up they are washed and peeled, and the root is ground or grated. In Brazil, where the preparation of *mandioc* (as cassava is there called) is carried on to a larger extent than elsewhere, the roots, after having been peeled, are pressed against the face of a wheel, which is made to revolve with great velocity, and in this manner they are ground, a trough being placed beneath the wheel to receive the pulp. The next process is that of expressing the poisonous juice by pressing the pulp in bags. The pulp is then placed on a hot iron, where it settles down into the form of a pancake. This cake is turned and moved about until it is sufficiently baked on both sides to be ready for use. When cassava flour is prepared by drying on hot plates it becomes granular and is known by the name of *Tapioca*, a considerable quantity of which article is exported annually from Brazil to Europe. This preparation is capable of being made into excellent pudding, and is a very wholesome food for children or invalids.

Cassava meal is produced in Travancore; and tapioca has also been manufactured at Rajahmundry.

Sugar.—Sugar must be considered as one of the most valuable vegetable substances with which we have become acquainted, and it is so universally used that it may be regarded as a necessary of life.

The sugar of commerce is a sweet crystallized substance most commonly prepared from the expressed juice of the sugar-cane, but sometimes from beet-root, from the sap of one or more species of maple, and from other vegetable productions. Saccharine matter is indeed one of the most common of vegetable secretions, that is to say, sugar forms a constituent part of very many plants, but it is only from those above mentioned that sugar has been extracted to any great extent as an article of commerce, and of these the sugar-cane is by far the most extensively used. In India, however, sugar is sometimes obtained from the sap of the Date and Palmyra palms.

The sugar-cane belongs to the order of *grasses*; there are several varieties, varying in height from ten to twenty feet, and in the arrangement of the knots on the stems. It is stated to have been originally brought westward from China; till, soon after the discovery of America, it was transported thither and it has spread so rapidly, and thrives so well there, that at present that continent, with the West Indian Islands, supplies the greatest part of the civilized world with sugar. The stem of the sugar-cane is jointed and without branches. The leaves, which are very long and

narrow, rise singly from the joints, and form a sheath to or embrace the stem to the next joint above, like the leaves of grasses. The top of the stem ends in a loose bundle of small downy flowers, of a kind of pale-pink colour, and about two feet long, giving to the plant a most elegant appearance. In the West Indies these blossoms are not seen as the plant is cut down before they make their appearance. The sugar-cane is always cultivated by planting cuttings, the top joints being selected for planting when the cane is cut down. In preparing a field for planting with the cuttings of cane, the ground is marked out in rows three or four feet apart, and in these rows holes are dug eight or twelve inches deep and two feet apart. The planting of canes does not require to be renewed annually, as fresh canes will spring up from the same plant for fifteen or twenty years in succession, but the quality of the produce deteriorates in the course of a few years and fresh cuttings have to be planted.

The plants are carefully weeded and watered and also freed from insects during their growth. When they have attained their proper ripeness the canes are cut down nearly close to the ground, divided into convenient lengths, tied up in bundles, and carried to the mill. This mill is formed of three iron cylinders or rollers, so situated that when the canes are passed between them the juice is expressed from the stems.

As the juice exudes it is collected in a cistern, from which it must be immediately transferred to the boilers, otherwise fermentation sets in and spoils it. A certain quantity of lime or brine water is added to the

juice for the purpose of promoting the separation of the impurities contained in it. These impurities rise in the form of scum to the surface of the liquid and are skimmed off. The juice is then boiled as rapidly as possible for the purpose of evaporating the superfluous water and thus hastening the granulation of the sugar, which takes place as soon as the boiled syrup cools in the shallow pans into which it is poured for that purpose.

When the sugar in the 'coolers' has come to the state of a mass of crystals imbedded in a thick viscid fluid, which is the portion of saccharine matter that will not crystalize and which is called *molasses*, it is put into hogsheads which have one or more holes in the bottom through which the molasses drain away. The sugar is then ready to be exported, and is called *brown* or *raw sugar*.

Clayed sugar is a superior kind of raw sugar: to produce this, the boiled sugar is allowed to cool and then placed in conical moulds with small holes for the molasses to drain through. After a time the surface of the sugar is covered with clay, and moistened to the consistency of paste, and the water which is contained in this gradually soaks through the sugar and washes out a further quantity of molasses, which escape with it through the hole. The sugar is then dried gradually and crushed into a coarse powder for exportation.

Loaf sugar is hard white sugar of a conical form, this is not commonly seen in India. It is obtained from raw sugar by *refining*, a process which was formerly

performed by boiling the raw sugar with white of eggs, bullock's blood, &c., but now improved means have been adopted. The raw or moist sugar is first dissolved in water heated by steam, lime-water being added at the same time; the liquor is then filtered through thick folds of cloth. By this process it is freed from many impurities and becomes transparent though still coloured. The next stage of the process is making the syrup colourless; this is effected by allowing it to filter through beds or layers of *animal charcoal* or *bone black* formed by heating bones in close iron vessels. This charcoal retains the colouring matter of the syrup, which, consequently, comes out of the filter perfectly colourless. It is then pumped into covered boilers and boiled down at a low temperature by the aid of steam. These boilers are known by the name of *vacuum pans*, because the air is partly exhausted from them, and it is this partial exhaustion of the air which admits of the lower temperature, for fluids will boil at a much lower temperature in a partial vacuum than when exposed to the ordinary pressure of the atmosphere. This boiling down is continued until part of the sugar is ready to become solid, when the whole is poured into iron moulds, where it cools into a solid mass. A small hole is then opened at the bottom of the mould and a small quantity of impure syrup drains out; this is the substance sold as *treacle*.

Loaf sugar as thus obtained is a granular substance, formed of a number of small white hard crystals adhering together. If pure it has no smell, and its taste is simply sweet without any other flavour.

The native process of making sugar is much the same in principle with that already described, but the instruments employed are rude and the manufacture imperfect. After being strained, the juice is boiled down in open boilers into a thick syrup, and the scum which rises during the operation is removed. When enough of liquid has evaporated the residue is removed into earthen pots to cool, and in these it becomes a dark coloured, soft, sticky mass, called *jaggery*. Sometimes a little quicklime is added to the juice before boiling, which partly clarifies the jaggery and so renders it capable of being formed into cakes or lumps. In general, however, the juice is merely boiled down and sold in pots in a granular state to the boilers or refiners, and these conduct the subsequent process.

The refiners separate much of the molasses by squeezing the jaggery in a coarse cloth. The sugar is further purified by boiling with water an alkaline solution, and milk. When this has been continued till scum no longer rises upon the liquor, the latter is evaporated and sometimes strained, and afterwards transferred to wooden pots or jars, wide at the top but coming to a point at the bottom, where there is a small hole stopped up with the stem of a plaintain leaf. Through this hole the molasses drain off. The sugar is rendered still purer and whiter by covering it with the moist leaves of some succulent aquatic plant, the moisture from which drains slowly through the sugar and carries with it the dark-coloured molasses.

The sugar mills used by the natives are of a rude description. One kind is like the common oil mill and

consists of a tree hollowed out, with a cylindrical piece of wood working in it. This is turned round by bullocks.

At Bimlipatam, Aska, and Rajahmundry in the Northern Circars, and at Astragram in Mysore, there are large sugar factories under European management.

Sugar candy.—This is the only kind of refined sugar made by the natives in India and China; and it is made of the finest quality by the Chinese, who export it in considerable quantities. For making it the syrup is poured into moulds in a more or less refined state, and is there allowed to crystalize very slowly upon strings or twigs. The crystals vary much in shape, and are hard and transparent.

From the molasses of sugar the best *rum* is made. This is an ardent spirit largely consumed in the navy, and is obtained by *distillation*. [The Hindoos are also acquainted with this process, and use for the purpose earthen jars.] This process depends on the principle that different degrees of heat are requisite to convert different liquids into vapour. Thus, in making rum, the spirit contained in the molasses is more easily converted into vapour than the watery part. If, therefore, a moderate heat be applied, sufficient to evaporate the spirit but not enough to convert the water rapidly into steam, and the vapour be collected and condensed in a separate vessel, the liquid will be found to be *stronger* or to have more spirit in proportion to the water than that from which it was obtained. The condensation is effected by the application of cold water to the pi[illegible] containing the vapour.

As an article of food, sugar is very nutritious, especially in the cane. It is noticed that during the making of sugar the negroes in the plantations, and even the horses and cattle which are fed on the green tops and refuse, grow fat and strong, though their labour is at that time much increased. Moist or raw sugar is considered to be more nourishing than that which is highly crystalized. Sugar possesses the power of preserving animal and vegetable substances from decomposition, and is constantly added to preserves and jellies. When employed for preserving fish, meat, &c., it renders less salt necessary, and allows the preserves to retain more of the natural taste and flavour. Many medicinal substances are preserved by means of sugar.

Before the discovery of America, sugar was a costly luxury in England, and used only on rare occasions. It is now so cheap as to be within the reach of the poorest. A considerable quantity of sugar is exported from Bimlipatam, Munsoorcottah, and other places. Jaggery is also sometimes exported for refinement in England.

Coffee.—The coffee plant is a native of Arabia, or, as some think, of Abyssinia, but it has for a long period been successfully cultivated in most tropical countries. It belongs to the large order of plants which furnish the genuine Peruvain bark, Ipecacuanha, and other valuable medicines. The coffee plant is a small evergreen shrub attaining the height of from three to five feet, not much branched, and with oval leaves. The flowers are numerous, and like those of the jasmine, are

consists of a tree hollowed out, with a cylindrical piece of wood working in it. This is turned round by bullocks.

At Bimlipatam, Aska, and Rajahmundry in the Northern Circars, and at Astragram in Mysore, there are large sugar factories under European management.

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brilliantly white; they open very rapidly, and possess a delicious scent. Each flower is succeeded by a small berry, having a pale and somewhat glutinous pulp, enclosing two hard oval seeds; one side of the seed is convex, while the other is flat with a little straight furrow along it.

The finest coffee is that known as *Mocha* coffee, which is grown in the Jabel hills in Arabia, where the climate is healthy and temperate, and water abundant, both from rains and from numerous tanks and wells. For the cultivation of coffee the best suited locality is one where the heat of tropical plains is counteracted by elevation, where water can always be commanded in abundance, and especially where the air is pure and cloudless. It will be seen from the above that many parts of the hills in this Presidency are well adapted for the cultivation of this plant. A great part of Ceylon is also excellently suited; and within the last few years the quality of both Indian and Ceylon coffee has so much improved that each commands a high price in the European market.

Coffee trees are generally raised from seeds in nursery grounds and are afterwards planted out at regular distances according to the nature of the soil. Where this is very dry or gravelly, the trees are rather stunted and may be planted five feet apart, but in rich soils where they attain a greater height the plants should not be so crowded. They begin bearing berries when about two years old, and they are in full bearing in the third year. The berries are ripe for gathering when they present a dark-red appearance, and if not gathered

at that time they will drop from the trees. The Arabian planters do not pluck the fruit but shake the trees and collect the ripe berries which drop off, in cloths placed beneath to receive them. The berries are then spread out and exposed to the sun's rays until perfectly dry; the husk is broken by means of rollers or heavy stones, and after it is removed the kernel is again dried, and then packed for exportation.

The method employed in the West Indies differs from this. Negroes are set to gather such of the berries as are sufficiently ripe and put them in a bag slung round their necks. In curing coffee the berries are sometimes exposed to the sun's rays in layers five or six inches deep on a platform. The pulp then ferments and dries in about three weeks, the husks being afterwards separated from the seeds in a mill. Other planters remove the pulp from the seeds as soon as the berries are gathered. The pulping mill used for the purpose consists of a fluted roller acting against a board in such a manner as to bruise the pulp but not the seed; the pulp is then washed away and the seeds dried. It is next necessary to remove the membranous skin which covers the seed. This is effected by means of heavy rollers, and the seeds are afterwards winnowed to separate the chaff.

In a raw state the berry is of a pale brownish yellow and has but little taste or smell, but the application of heat in the process of roasting produces important changes. The bean increases considerably in size, it gives out a powerful aromatic smell, and becomes bitter and crisp. The roasting should take place in a

close iron cylinder which should be turned round over a moderate fire, the process being discontinued when the beans have acquired a light chesnut colour. Coffee should never be kept for any length of time after it has been roasted, and should never be ground or pounded until it is required for use. Coffee is a stimulant and a preventive of sleep; if taken at night strong, it retards sleep for several hours; after dinner it promotes digestion; and it fits the system to resist the influences of cold and damp. In warm climates it removes the languor which oppresses those who are exposed to excessive heat. It is not, however, suited to certain states of the body.

The cultivation of the coffee plant has spread rapidly in this Presidency within the last few years, and beans of very good quality are produced from the fresh forest land of the Western ghauts. The slopes of the Neilgherries, the Shevaroy Hills, and parts of Mysore afford excellent coffee ground. The Shevaroy Hills are almost entirely occupied with coffee plantations.

The word coffee is derived from the Turkish *kahve*. The Arabic word is *kaheah* and signifies wine, as a substitute for which the decoction was used; although the legality of the practice was long a subject of dispute amongst the Mahomedan doctors.

INDIGO.

This plant, a native of Hindustan, yields a blue dye which is prepared from the leaves and small branches.

Indigo is not now confined to its native country, it having been transplanted to Mexico and the Little Antilles, and afterwards to South Carolina and Louisiana. It is also cultivated throughout Arabia, and several wild species of the plant grow there. Modern dealers in this useful article of commerce have, therefore, a much wider field of selection than those of ancient times, when the rearing of the plant was confined to the East Indies.

The indigo plant rises in a single, hard and brittle, woody stem, about two feet high, covered with a grey bark, ash-coloured towards the bottom, green in the middle, and reddish at the extremities. The leaves, in pairs ranged around the stalk, are oval shaped, soft to the touch, furrowed above, and of a green colour on the under side. Clusters of reddish blossoms proceed from the extremities of the branches, to each of which is attached a small rounded pod, enclosing cylindrical shaped seeds of a shining brown colour. Indigo is generally sown in spring, and moisture causes this plant to shoot up in three or four days. About two months after planting it is considered ripe when it begins to flower. It is then cut, and if the weather be a little rainy is again cut at the end of every six weeks. In two years it begins to degenerate.

Great care is necessary in gathering, to preserve the valuable *farina* which lies on the leaves, and which is liable to be shaken off. As soon as they are gathered, the plants are thrown into the steeping vat until it is about three parts full. Water is then

poured in upon them, and to prevent the plants from bouying up, a number of rails are laid along the whole length of the vessel, and firmly fixed at the sides by the weight of beams of wood. The softest water is preferred, and as much is poured as the plants will imbibe, covering them with a surface of four or five inches. They are then left to ferment. In about twenty-four hours the contents of the vat becomes so hot that the hand cannot be held in it, and if the process of fermentation is succeeding, the mast will bubble up, and from a glistering yellow will gradually change to green, which again will be succeeded by a dusky blue colour.

Considerable nicety is required in choosing the precise moment for drawing off the liquid, as, if it is drawn too soon, a great part of the pulp will be lost, if too late, the whole will be spoiled.

From the steeping vat the liquor is removed to the second vat, called the beater or mortar, when it is found to be impregnated with a very fine and delicate earth, which is the blue substance. To separate this substance from the useless salt of the plant, the contents of the vat are forcibly stirred and beaten for about an hour and a half, after which it looks curdled or as if full of small grains. A quantity of clear lime water is then admitted, when the colouring particles gradually subside to the bottom, and leave the water clear; the agitation of the water is continued, until, by degrees, the tint passes from greenish to deep blue. Should the stirring and beating process be continued too long, the salt, re-acting on the dregs, would cause

a second fermentation. This would alter the dye, spoil its colour, and produce what is called burnt indigo.

After the dye has been left ten or twelve hours to settle, the clear water is gently drawn off through plug holes, fixed for that purpose a few inches from the bottom of the vat. The blue muddy substance that remains at the bottom is then drawn off through a strainer into a third vessel called the settler, when it is again heated to the boiling point, and more thoroughly cleared and freed from water. It is then strained through a sieve of horse hair, called the dripping vat, and put into coarse linen bags, eighteen inches in length and twelve in width, which are hung up in a shady place, that any superfluous water may be thoroughly drained off.

The bags are now tied at the mouth, and transferred to a press, consisting of a box five feet in length, two and a half in width, and two in depth, with apertures at one end for the escape of water. After all these processes, the indigo is a fine, stiff paste, which, being placed upon a plank, is cut with a brass wire into squares of two inches each, and dried in the air on shelves of wicker work. A fine efflorescence soon covers the squares, which is brushed off; but in some place the cakes are fermented by placing them in heaps in a cask, until moisture exudes, after which they are covered with a white meal, and finally packed for exportation.

Another method of preparing the indigo is to dry the croppings in the sun and then to place them in the steeping vat with six times their bulk of water, where

they are stirred for two hours until the floating leaves sink. The fine green liquor is then drawn off into the second vat, and beaten as before.

Impure indigo may be detected by dissolving a little in a glass of water; if pure, it will mix equally with the water; if not, it will separate from the water and settle at the bottom. Indigo may be impure from the following causes. First, from being allowed to remain too long a time in the steeping vat, which will give it a black, dirty hue; secondly, from too little beating, in which case it will have a coarse grain, and a greenish colour; thirdly, from too much beating, which makes it black; fourthly, from want of care in cleansing it from the particles of lime used in the second process, which renders it of a grey colour, and hard.

There are four sorts of indigo; blue, purple, violet, and copper colour. The finest is the blue; but the copper or red indigo is that chiefly used in manufactures.

The indigo grown in Guatemala was at one time considered the best, after which, in importance, ranked that of South America, but East Indian indigo is now preferred to all other.

One of the most valuable properties of indigo is the great facility with which it imparts its colour, becomes soluble so as to allow of its being used for dyeing purposes, and then, by exposure to the air, re-assumes its blue tint and again becomes insoluble.

This chapter may be closed by a short extract detailing the manner in which the American Guatemala Indigo is procured.

"In these beautiful countries, where every estate is from fifteen to twenty leagues in extent, a part of this large space is annually devoted to the culture of indigo. For this purpose, it is sufficient to burn the shrubs which cover the ground, and carelessly to pass the plough once over it. This is done in the month of March, a season when it very seldom rains in these delightful climates. A man on horseback then scatters the seeds of the plants, in the same manner as corn is sown in Europe, after which none pays any attention to this valuable production, till the time of gathering it. From this careless method of cultivation great quantities of indigo are choked by weeds, so that the Spaniards gather less indigo from three or four leagues, than others do from a few acres of ground carefully managed; and this indigo, though superior to any other, is not so perfect as it might be."

LAC.

Lac is a resinous substance produced on the branches of the Indian fig and dhak trees by the puncturing of a little animal called the gum-lac animal. The use of the substance is to cover and protect the young.

The animal is a native of the East Indies, and is found in the greatest abundance on the mountains lying on both sides of the Ganges. It is also found

on the banks of the Godavery chiefly on the northern side. The gradual accumulation of the viscid substance forms complete cells, in each of which is placed an egg. About the middle of March the cells are completely formed, and the insect, after laying her eggs, becomes, in appearance, an oval, smooth bag, without life, and full of a beautiful red liquid. In October and November, about twenty or thirty oval eggs, or rather young grubs, are to be found within the red fluid. The young insects feed on the liquid, and thus acquire a beautiful red colour, so that the branch which bears them appears to be covered with red powder. If not gathered in this state, the young grubs pierce through the viscid cells which enclose them, and fly away. The produce from the tree of the Khosum is said to be superior in quality to that from any other tree, both as regards colouring matter and the gum in which the animal lies imbedded. The cells when gathered take the name of stick-lac. The more thickly the branches are encrusted, the better is the quality of the lac. This lac, when separated from the stick, reduced to a powder, and formed into cakes, is called seed-lac. Lump-lac is the seed-lac freed from impurities by melting over a gentle fire; and finally, shell-lac is the seed-lac further purified and formed into thin layers or cakes, by being passed over a smooth surface of wood.

Lac is used for various purposes. It yields a scarlet dye, the colour of which is less brilliant, but more durable than that afforded by cochineal. It is the principal ingredient in sealing wax and varnish, and

is used also in the process of japanning. For these purposes it is exported to Europe.

Lac is much used by the Hindus for dyeing and varnishing purposes. The dye they obtain by pouring warm water on stick-lac, from which a colouring matter is obtained, which they form into cakes and call lac-dye, lac-lake, or cake-lake. A mixture of lac, alum, and tamarind water is the native dye for silk or cotton cloth of a crimson colour. The Indian lapidaries use gum-lac for the purpose of retaining the hard powders used in cutting and polishing stones.

Even after the extraction of the dye, the gum is not sufficiently pure to be used as varnish, the dark brown hue which it still retains being a drawback to its use. Of late, however, processes have been discovered by which the varnish may be rendered sufficiently pure and as fit for use in the arts as that prepared from any other substance.

The best quality of lac is that procured in Siam; that of Assam ranks next. The stick-lac of Bengal is inferior to these, being scanty in its resinous coating.

SAFFLOWER.

Safflower is an annual plant growing in India, Egypt, America, and the warmer part of Europe. It is produced in some parts of the Concan, and is extensively grown about Bangalore and in Guzerat. That obtained from Bengal is considered superior to all the other

Indian varieties. There are two species of this plant, one having small leaves and an orange flower, the other with larger leaves and a yellow flower.

The flowers are the only parts used in dyeing. They yield two sorts of colouring matter: the first, yellow and of little value; the second, a pink of great delicacy and beauty, but which recommends itself more for its beauty than its durability. The yellow colouring matter is soluble in water, the pink is resinous in its nature, and is best dissolved by the fixed alkalies.

When the flowers are gathered they are placed in a bag and trodden under water to get rid of the yellow colour. They are then placed in a trough with a proportion of soda or other alkali, allowed to soak for some time, and then transferred to a second trough with a perforated bottom, but lined with finely woven cloth. This trough is placed above another unperforated trough, and water being poured into the upper one, a large portion of the colouring matter is disengaged by the alkali and passes into the empty trough below. If lemon juice be added to the dye stuff in the troughs, the colour is raised to a bright cherry red.

In Madras, safflower is used for giving silk and cotton different tints of red, orange, rose, and flesh colour, according as it is combined with alum, potash, tartaric acid, or sulphuric acid.

The mode of dyeing yarn red on the coast of Coromandel is as follows:—The yarn requires to be washed and untwisted first, so that the texture may be as loose

as possible, and that the dyeing ingredients may easily penetrate every part. After being thus prepared, it must be submitted to a process which will enable it to retain the desired colour. The *mordant* is prepared with a *ley* of ashes and water mixed with gingely oil, a soapy fluid, and sheep's dung. With this the yarn is treated until thoroughly impregnated with the mordant. The next step is to impart the colour. For this purpose it is soaked and steeped for several days in infusions of Casah leaves, Chey root, &c., after which it is boiled in the same kind of liquor and then washed, beaten, and dried in the sun.

The sheep's dung and gingely oil appear to be the essential part of the mordant. The dung no doubt communicates some animal matter to the yarn, and the ashes act in a peculiar manner on the oil.

Safflower is a very costly dye, and is used in the preparation of a very delicate and beautiful *rouge*, a powder used to give brilliancy to the complexion. The Mussulmans are particularly fond of this dye in their holiday cloths and turbans.

OILS.

Introduction.—Oil is an inflammable substance, obtained from vegetables and the fat of animals. There are two classes of oils; the fat, unctuous, or fixed oils; and the essential or volatile.

The animal oils or fats may be obtained by boiling, or by expressing certain animal substances. Fats

and oils are either colourless or of a yellow colour, and they may be obtained from vegetables as well as from animals.

The fixed oils of vegetables are obtained from their seeds, and have been probably placed in them for the purpose of assisting germination.

Vegetable oils are obtained by expression, distillation, and infusion. Oils by expression are obtained from the leaves, fruits, barks, and seeds of plant. The following is the method of obtaining oil by expression from seeds.

The seeds are first taken to the crushing mill, and passed betwen iron rollers for the purpose of cracking the shells. After the seeds are crushed, they are collected in a heap and then removed to two revolving vertical mill-stones, between which they undergo a second process of bruising and compression. When the seed is sufficiently bruised it is collected into bags made of hair. These are placed in what is called a wax press, where the oil is expressed. The oil thus obtained is superior to that got by the after-processes. When the seeds are removed from the press, they are in the form of flat cakes, which are broken and reduced to a fine powder. This powder is heated, and on being subjected to a second compression in hair bags, gives oil of the second quality. The use of heat, however, in preparing oils for internal use ought to be avoided, as it is apt to give them a disagreeable rancidness.

The pounded seed or meal is made to undergo a third compression, when a small quantity of inferior

oil is produced; and in some instances, even a fourth compression is resorted to. The cakes are afterwards sold as food for cattle, and for manuring purposes.

Oils obtained by expression should be permitted to clear themselves of dregs, by standing in a cool place for some time.

The essential oils are the odorous principles of herbs and flowers, and are obtained by distillation with an alembic and refrigerator. The alembic is a vessel used for distilling, the refrigerator is placed near the top of the alembic, for the purpose of cooling the condensing vapours. Water must be added to the materials to prevent them from burning, and they are macerated a little time in that water before distillation. The oil separates from the water, and sinks to the bottom or rises to the top, according as the oil undergoing the process is heavier or lighter than water. Some of these essential oils can be produced in very small quantities only, and are exceedingly evanescent; on this account they are very dear, and it is a common practice to adulterate them with cheaper oils, or alcohol. The usual process for obtaining these very evanescent oils is to spread the fresh plant upon layers of cotton, soaked with an inodorous fixed oil. This gradually absorbs the perfume of the flower, and, when saturated with it, the cotton is steeped in alcohol, which abstracts the essential from the fixed oil, and a fragrant essence is thus obtained. The last-mentioned oils are said to be produced by infusion.

There is a certain class of drying oils, such as linseed oil, nut oil, and poppy seed oil, used by artists

who paint in oil colours. Some oils are also used for the various purposes of perfumery, and are valued as retaining the odour of the plant from which they have been distilled.

The principal vegetable oils of commerce are castor oil, oil of cinnamon, cloves, and nutmegs, mace oil, linseed oil, hemp-seed oil, almond oil, palm oil, cocoanut oil, ground-nut oil, olive oil, &c.

Olive Oil.—Of these, olive oil is the one in greatest demand throughout the world. Its consumption is immense, as it is an ingredient in the composition of balsams, ointments, and plaisters. It is used also as an article of food, in the manufacture of wool, and in the fine arts. Asia is the home of the olive, but it is now exclusively cultivated in the warm countries in the south of Europe, on the African coast, and more particularly in Italy and Sicily. The olive oil known as Gallipoil oil, is so called from the place of its exportation, a seaport town in the kingdom of Naples. This kind is in the greatest demand, the best kind of it being known and used as salad oil.

The olive tree begins to bear when it is two years old; but it does not attain maturity till three or four years later. As these trees continue to bear fruit for many years, and even after the trunk has become quite hollow, they are a source of great wealth to the cultivator. A celebrated olive tree at Pescio was said to be 700 years old; but generally they are not considered capable of bearing fruit after a century's growth.

In the case of the olive, the best oil is not obtained from the seed, but from the pulpy part of the fruit. The olives are gathered about the months of November or December. The quality of the olive depends on the nature of the soil in which the tree grows.

Olives are also eaten: they have a bitter, acid taste, and the art of preparing them consists in removing their acidity, while retaining their greenness, and in impregnating them with a brine of aromatic sea salt which gives them an agreeable taste. When olives are perfectly ripe they are eaten with salt, pepper, and oil; but the number consumed in this way is trifling when compared with that used in the manufacture of oil.

The olive branch is the well known emblem of peace, and in connexion with this it is worthy of notice that the olive seems to have followed the progress of civilization from the lands of the East to the sunny shores of Greece and Italy.

OILS IN EXTENSIVE USE IN INDIA.

Cocoa-nut Oil, Lamp Oil, Rape Seed Oil.—The oil obtained from the cocoa-nut is in general use in India for lighting purposes. It is obtained from the kernel or pulp of the cocoa-nut either by expression or decoction. But as this oil is used in large quantities, the former method is the one generally resorted to. The husk of the nut is broken by a blow from a large crooked knife, which exposes the kernel. The kernel is ground in a mill worked by bullocks, but in Colombo steam-power is used for the purpose. The watery part

of the kernel is got rid of by exposure to the sun for a few days, after which the oil becomes in some degree rancid.

The process of obtaining the oil by decoction is thus explained:—

"The fresh kernel is finely rasped. The raspings are then washed with water, which becomes milky, and, by decoction, yields a limpid oil. If the preparation be exposed for a night it separates spontaneously into an oily and watery portion, and the oily portion is purified by a very short boiling. To separate the oil, the operator, who is generally a female, lays the palm of her left hand flat upon the surface of the fluid, and a portion of oil adheres to the hand, which is brushed off into a vessel by the right hand. The oil made in this manner is nearly as colourless as water, and when newly prepared has no offensive odour, though it acquires it on being exposed to the air for a few days."

Cocoa-nut oil is used by the natives of India in a preparation of ointments and plaisters, and for anointing their bodies, and when mixed with resin it forms a substance used for protecting the corks of beer and wine bottles from the ravages of the white ants.

In England (*and other countries of Europe,*) the use of candles and the extensive introduction of gas has made the inhabitants nearly independent of the lamp oils.

A candle may be described as a bundle of twisted cotton fibres, called the wick, thickly coated with tallow

or some preparation of it. Palm oil is extensively used with tallow in the manufacture of candles.

Gas is an inflammable air, which, upon, combustion, affords light and heat, and is found in many parts of the world issuing from the earth. In China, the gas issuing from these natural jets is used in the salt works for evaporating the salt, and also for lighting houses and streets.

The gas used for lighting purposes in England is generally obtained from coal by the application of heat, which drives the gas into large vessels composed of sheet iron, named gasometers. From the gasometer, the gas is distributed through the town in pipes laid under the streets; and introduced into the houses and public buildings by smaller pipes attached to the main conduits.

GINGELY OIL.—The oil known as gingely oil is expressed from the seeds of the plant of that name, and is one of the most valuable of Indian vegetable oils. It has the valuable property of keeping for many years without becoming rancid either in smell, or taste, and it becomes so mild as to be used in the place of salad oil. The plant producing the oil is an annual one, and is in height between two and three feet. The following mode of preparation is given in the Jury Reports of the Madras Exhibition:—

"The method sometimes adopted is that of throwing the fresh seeds, without any cleansing process, into the common mill, and expressing in the usual way. The oil thus becomes mixed with a large portion of

the colouring matter of the epidermis of the seed, and is neither so pleasant to the eye nor so agreeable to the taste as that obtained by first repeatedly washing the seeds in cold water or by boiling them for a short time, until the whole of the reddish brown colouring matter is removed and the seeds become perfectly white. They are then dried in the sun, and the oil is expressed in the usual manner."

There are two varieties of seeds known in commerce, one white and the other black, the latter being regarded as of the finer quality from the fact of its yielding the largest percentage of oil. This sort is sown in May. The white gingely is sown in June, and produces a red seed. The plant resembles the first sort, with the difference that it is a little larger, with a longer leaf, and the flower appears a shade or two different in colour.

From the absence of smell, this oil might be made the medium for extracting the perfume of the jasmine, the camomile, and the yellow rose. The seeds are roasted and ground into meal, and so eaten by the Hindus. The oil is externally used in rheumatism; and in the process of dyeing silk a pale orange colour."

CASTOR OIL.—This oil is extracted by boiling or by crushing in a press the seed of the Palma Christi, an annual plant, growing in tropical countries, and cultivated also in the south of Europe. It varies in size according to the temperature of the climate in which it grows, attaining in India the height of a pretty large tree. The oil which the seeds yield is very nau-

seous, and is much used as an active medicine. The castor oil plant is produced in considerable quantities, in Mysore, and oil is manufactured in large quantities at Amboor, a town on the Palar river west of Madras, situated on the Madras Railway. Formerly the oil intended for medicinal purposes was drawn out by heat, but cold-drawn castor oil is now generally preferred and recommended. Cold-drawn oil is extracted from the seeds by means of a hand-press.

PALM OIL.—This oil is made from the fruit or nuts of the oil palm by boiling them in water, when the oily particles rise to the surface and are skimmed off and strained for use.

This tree grows in most parts of Asia, Africa, and America. The oil is used by the natives as an ingredient in their food, and is said to be very efficacious in the cure of strains and rheumatic ailments.

It forms an important element in candle-making, and for this purpose is imported into Europe from the west coast of Africa. This trade, which is profitable alike to Africa and Great Britain, has also a favourable effect in checking the slave trade, the services of the natives being required at home in the manufacture of the oil.

LINSEED OIL is obtained by expression from linseed, or the seed of flax. It possesses most of the qualities of nut oil, being clean and colourless, and on this account it is extensively used by painters in their art, when they wish to preserve the clearness of their

the colouring matter of the epidermis of the seed, and is neither so pleasant to the eye nor so agreeable to the taste as that obtained by first repeatedly washing the seeds in cold water or by boiling them for a short time, until the whole of the reddish brown colouring matter is removed and the seeds become perfectly white. They are then dried in the sun, and the oil is expressed in the usual manner."

There are two varieties of seeds known in commerce, one white and the other black, the latter being regarded as of the finer quality from the fact of its yielding the largest percentage of oil. This sort is sown in May. The white gingely is sown in June, and produces a red seed. The plant resembles the first sort, with the difference that it is a little larger, with a longer leaf, and the flower appears a shade or two different in colour.

From the absence of smell, this oil might be made the medium for extracting the perfume of the jasmine, the camomile, and the yellow rose. The seeds are roasted and ground into meal, and so eaten by the Hindus. The oil is externally used in rheumatism; and in the process of dyeing silk a pale orange colour."

Castor Oil.—This oil is extracted by boiling or by crushing in a press the seed of the Palma Christi, an annual plant, growing in tropical countries, and cultivated also in the south of Europe. It varies in size according to the temperature of the climate in which it grows, attaining in India the height of a pretty large tree. The oil which the seeds yield is very nauseous, and is much used as an active medicine. The castor oil plant is produced in considerable quantities, in Mysore, and oil is manufactured in large quantities at Amboor, a town on the Palar river west of Madras, situated on the Madras Railway. Formerly the oil intended for medicinal purposes was drawn out by heat, but cold-drawn castor oil is now generally preferred and recommended. Cold-drawn oil is extracted from the seeds by means of a hand-press.

Palm Oil.—This oil is made from the fruit or nuts of the oil palm by boiling them in water, when the oily particles rise to the surface and are skimmed off and strained for use.

This tree grows in most parts of Asia, Africa, and America. The oil is used by the natives as an ingredient in their food, and is said to be very efficacious in the cure of strains and rheumatic ailments.

It forms an important element in candle-making, and for this purpose is imported into Europe from the west coast of Africa. This trade, which is profitable alike to Africa and Great Britain, has also a favourable effect in checking the slave trade, the services of the natives being required at home in the manufacture of the oil.

Linseed Oil is obtained by expression from linseed, or the seed of flax. It possesses most of the qualities of nut oil, being clean and colourless, and on this account it is extensively used by pa in their art, when they wish to preserve the clearness of their

colors. When drawn without the assistance of fire it is much esteemed in medicine.

The oil obtained by the application of heat is of a deeper yellow, and is disagreeable in its odour. The linseed oil made in India has not the full drying properties of that made in Europe. This is caused by the Indian seeds being sown along with mustard seed, the effect of which is a deterioration in the quality of the oil.

WOOD OILS.—This class of oils is obtained for the most part from the Burmese Coast and the Straits. They are procured by tapping certain trees. A large notch is cut in the trunk of the tree near the ground, and upon heat being applied to the incision, the liquid begins to ooze out. These oils are chiefly used as a natural varnish, either alone, or in combination with colours. They are also used as a substitute for tar in painting the seams of ships, and for preserving timber from the attacks of the white ants. Large quantities of this wood-oil are exported from Moulmein to Europe, where from its medicinal properties it has become a new drug in trade. These oils are much used in India for painting ships and houses.

PALMYRA TREE.

There is no natural object which sooner arrests the attention of the Western traveller in Eastern lands than this tree. He has read of it in the poetry of his childhood, and 'the feathery palm tree,' with its

lofty crest mingles in the dreams of the youth, longing for the light of some fairer land than his own. Nor are these trees less remarkable for the many useful purposes they serve than for their beauty.

The principal species of palms are the Date Palm in Arabia and Africa, the Oil Palm in the west of Africa, the Cocoa-nut Palm in India and its islands, together with the Betel-nut palmyra and Taliput palms; while the Sago, the Ejoo, and the Betel-nut palms flourish in the moist warm climate of the Malayan Peninsula and the Indian Archipelago.

Although the palm tree is the child of the tropics, a few species extend to higher latitudes, the dwarf palm, a native of the north of Africa, being found growing in the south of Europe. The date palm, too, is found growing there in some favoured spots, but it attains its highest perfection in the hot and dry soils of Africa and Arabia. It furnishes a pleasant food for the inhabitants of those countries, and is an important article of commerce. The date palm is the palm tree of Scripture, and though it grows well in India its fruit is not edible, but a tree which resembles it much, called Khujjoor, is found in every part of the country, in Madras, Mysore, the North West Provinces, Bengal, and the Punjab. The juice of this tree is distilled and yields *arrack*.

It is remarkable that this tree is often to be found apparently growing out of the centre of the banian tree. This has been well explained by Dr. Roxburgh:—

"The seed of the banian tree having been eaten by

birds, is by them frequently deposited in the moist upper parts of the leaves and spathes of the Palmyra tree, where it germinates and soon sends down its descending roots or shoots, which entirely encircle the palm in course of time; till, at last, all that is seen of the palm are bunches of leaves at the top of the trunk of the banian tree, out of which the palm appears to be growing, though this latter is actually older, with its roots fixed in the ground."

Palmyra is the name applied by Europeans to the *tar* of India. It is found in all parts of India, occasionally as far north as the thirtieth parallel of latitude. This tree is stated to be the largest palm on the Madras coast, and it seems to thrive equally well in all soils and situations.

COCOA-NUT TREE.

The Cocoa-nut tree is a species of the Palm. Its trunk resembles a slender column, and rises to a height of from thirty to sixty feet: it is crowned at the summit with a dozen or fourteen straight and tapering leaves, about fourteen feet long and three in breadth; amidst these hangs the fruit.

The trunk generally inclines to one side, and this inclination is probably caused by the weight of the nuts the tree sustains when young. The cocoa-nut tree is of the shape of an Apothecary's pestle, being of an equal thickness at the top and bottom, but tapering

from both ends towards the middle. Its colour is a pale brown throughout, and its trunk is somewhat smooth. The nuts hang at the top of the trunk in clusters of from five to fifteen in a bunch, and in good soils a tree may produce from eight to twelve bunches, thus yielding from eighty to a hundred nuts annually. The flowers proceed from within a large pointed spathe which opens on the under-side. Surrounding the base of each leaf-stalk is a substance resembling coarse cloth, which falls off before the leaf is fully grown. In wet seasons the tree blossoms every five or six weeks, so that there are generally fresh flowers and ripe nuts on the tree at the same time.

This tree is supposed to be a native of the Maldives and some desert islands of the East Indies; but it is found in all parts of the tropics, and especially in the neighbourhood of the sea growing within reach of salt water and establishing itself upon reefs and sand banks as soon as they emerge from the ocean.

The external rind of the cocoa-nut, which is smooth and approaching a triangular form, is succeeded by a fibrous shell of considerable thickness having three holes at the base, each closed by a black membrane. These holes or scars are intended as a passage through the shell of the nut for the germinating embryo, which otherwise would be unable to force a passage through the hard shell, but as only one embryo arrives at perfection, it happens that only one scar has to fulfil its destined purpose. That one is known by its being easily pierced; the others are hard like the rest of the shell. The inside of this shell is lined with a

kernel or pulp about half an inch in thickness, as white as snow, and containing a cool, refreshing liquor, much used by the natives. From this kernel the oil is extracted.

Uses.—The great variety of uses to which the cocoa-nut tree is applicable, and of commercial value of some of its products, render it peculiarly interesting in an industrial point of view. It affords the Hindus food, clothing, and means of shelter. The kernel of the nut supplies an agreeable and nutritious kind of food. The young leaves are occasionally used as vegetables, and the roots are sometimes used by the natives as a substitute for the areca nut. The woody shells are used in the manufacture of cups, ladles, and other domestic utensils, and, when tipped with silver and carved on the outside, form ornamental drinking cups, sugar cans, and baskets. Cocoanut oil is one of the best known products of this palm, and is extensively used in Europe in the manufacture of candles. In the east it is employed as lamp oil, and when mixed with aromatic oils, such as sandal-wood and jasmine, it is employed for anointing the body.

By soaking the *fibre of the palm* in water, it becomes soft, and can be manufactured into sail cloth and twisted into a cordage named *coir*, which surpasses in durability that made from hemp, being pliable, smooth, strong, and elastic, and not liable to rot from sea water. Coir is much used in India, instead of hair, for mattresses, cushions, and pillows.

It also produces a downy fibre of a more delicate nature, which is used to stop bleeding from wounds.

The leaves may be formed into baskets, brooms, nets, mats, sacks; and, when plaited together, they form an excellent thatch for houses, and a shelter for young plants from the scorching rays of the sun. Sometimes buckets are made of the leaves so closely woven that they serve to draw water from deep wells. The hard woody trunk of the tree is employed in the manufacture of drums, boats, posts and rafters for houses, and the centre rib of the leaf is used as an oar.

The young leaves of palm trees have a yellow colour and a fine smooth texture like satin. This latter property makes them a substitute for writing paper, the writing instrument used being an iron pencil. In writing, the leaf is held flat in the left hand. Instead of moving the hand from left to right, the native, when writing in this way, moves the leaf from right to left, by a motion of the thumb, and the letters are rapidly formed as the leaf passes under the point of the pencil.

When the cocoa-nut tree is burned, there remains a large quantity of potash which is used as a substitute for soap.

If the buds of the flowers be cut off before they are perfectly unfolded, a white juice begins to flow from the wound. This juice is collected in an earthen vessel, and fermenting on exposure to the air, becomes spirituous, and forms the intoxicating liquor called toddy. When this liquor is distilled it yields a spirit called *arrack*, which is about the same strength as brandy. Toddy juice makes good vinegar when it is allowed to turn sour: and when boiled with quicklime it yields a kind of sugar called *jaggery*. In the Malay language, this jaggery

is called *goola*, or *goora*. The Sanscrit word *goor* signifies sweet, the superlative of this word *soo goor* is supposed by some to be the origin of the word sugar.

When this jaggery is mixed with lime, the composition forms a powerful cement, which resists moisture, endures great solar heat, and will take a fine polish, resembling white marble. This cement is called chunam, and is much used in Madras and other parts of India for covering the tops of houses, floors, and columns.

The name Cocoa is supposed to be a contraction of the Portuguese word *macaco*, a monkey, and to have been given from the resemblance betwen the end of the shell where the three black spots are found, and the face of the monkey.

Cocoa-nuts are taken to Europe not so much for their value as for their use on boardship in closely wedging casks and other packages to prevent them from rolling about. Their freight, therefore, costs nothing.

OTHER PALMS.—There is another species of palm known in Malabar, as *Evanpannah*, and in the Telugu country as *Jeroogoo*.

The natives cultivate the palm for the sake of the sugar and toddy which are produced from it. The pith is equal to the best sago, and is made into bread and gruel. It is stated that the trunk of this palm is the favourite food of elephants. The fruit, which is about the size of a plum, has a thin yellow rind

very bitter to the taste, and producing a burning sensation on the tongue.

The Ejoo palm is celebrated as being of all vegetables the least liable to decay. On this account it is of great value to the natives of the country where it is indigenous. It is equally elastic with coir, more serviceable, and it floats on the surface of the water. The fibres are universally employed in the manufacture of cables, rigging for vessels, and cordage. These fibres possess remarkable tenacity and durability, and do not suffer from being exposed to wet.

Some of the other palms are the Betel nut or Areca palm and the Talipot palm. Of the leaves of the latter the natives make hats and umbrellas. The areca palm is to be found in all parts of India, and is in appearance perhaps the most graceful of the Indian palms. It yields the betel nut, which, when mixed with chunam, is chewed with the leaf of the betel pepper. In Travancore the trunk is used for spear handles. This tree produces fruit when it is five years old, and will continue to bear for twenty-five years.

TEAK WOOD.

Teak wood or Tick wood is the produce of a tree growing both in this country and in Further India. In India, it is found on the banks of the Godavery above Rajahmundry, on the banks of the Taptee, and

in Malabar, Mysore, Concan, and Bundlekund. This tree is the most esteemed of the Indian forest trees for strength and durability.

The teak is a large tree growing straight and lofty, with an ash-coloured and scaly bark. The flowers are numerous, small and white, and flourish in June and August. On the Coromandel Coast, the tree flowers in June and July, and the seeds ripen in September and October.

In Bundlekund, it is a very moderately sized tree. It grows best by the side of rivers, and is generally found, not scattered among other trees, but growing in detached clumps. The teak tree, during the first eight or ten years, shoots up very rapidly to the height of twelve or fifteen feet, after which its growth is uncommonly slow. Teak grown on the mountains takes a longer time to come to maturity than that grown in the low grounds; but it is considered superior in strength and durability. The Malabar teak is reckoned the best.

This is the only Indian wood which can be advantageously employed in the building of ships; for the indigenous wood of this country, with this exception, is scarcely fitted for the Indian seas. Being an expensive timber, it cannot easily be used for ordinary purpose in any other countries than those to which it is indigenous, but the importance to India of such wood is every year increasing, and will continue to do so as the demand for timber on Indian Railways and for other engineering purposes increases. The teak possesses the necessary properties for these uses, as the

wood is light and easily worked, and is strong and durable, though porous, and requires little seasoning. It is not liable to decay from exposure to the weather, and is able to withstand the ravages of insects, to which wood of all kinds is so much exposed in a tropical climate.

Teak wood is employed in the construction of vessels both at Madras and Bombay. The tree must be of the age of sixty or eighty years before it has attained sufficient maturity to be used in ship-building. After the straightest pieces have been selected by the ship-builder, the crooked pieces, called shin logs, are used for many useful purposes. A valuable quality of teak is that it is not apt to shrink: and it is the best wood for house-building, as from its oily nature it resists the attacks of the white ants.

The following is a description of the method of preparing the timber:—

"On the opening of the season, the tree is sawed through above the roots, and left in that state for a time to absorb the sap, then felled to the ground and trimmed into shape; here it is sometimes left one or two seasons, otherwise it is at once dragged by elephants to the banks of rivers and finally floated down to the sea by the first freshes. In Malabar, the timber merchants who purchase the trees have them felled and conveyed to the adjacent streams, down which they are taken to the market on the coast, where an inland duty of five per cent. is levied. From the depôt the Bombay or foreign merchant exports it, at an

enormous profit to the coast dealers. The value of the exports of teak wood from the Madras Presidency in four years ending in 1856, amounted to Rupees 8,45,842 chiefly to Bombay, the Arabian Gulf, and Scinde."

The largest quantities of teak are obtained from Pegu. This probably arises from the facility which the river transit affords for bringing the wood to the sea coast. The principal depôt for Godavery teak is Coringa, where many vessels are built. A great quantity is brought from Nagpore to Masulipatam.

From the leaves of the teak a purple color can be extracted, which is used as a dye for silk and cotton cloths; the tender leaves are eaten; also a syrup is made from them. Certain preparations of the young leaves and flowers are said to be efficacious as medicine and ointment in dropsy and some other diseases. Teak produces a good oil, which is sometimes used with paint instead of linseed oil; it also makes an excellent varnish for paint or wood.

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TAMARIND TREE.

Tamarinds are the fruit of the Indian date tree, called in Tamil 'Puli maram.' The tamarind tree is a native of both Indies, of America, Arabia, and Egypt. It is a lofty tree with spreading crooked branches and graceful foliage of a light colour; its blossom is yellow veined with red. The fruit is a pod

of a roundish compressed form, from three to five inches long, the external part of which is very brittle. The pod contains two, three, or four seeds, enclosed in a dark, pulpy, acidulous matter, from which a wholesome and refreshing liquor is prepared.

There are several varieties of tamarinds, such as the red tamarind, the sweet tamarind obtained from Persia, the dark tamarind of the Eastern islands, and the common or green tamarind produced throughout India. The red coloured tamarinds of India are found in Guzerat, at Kheir on the Godavery, at Punderpoor on the Seena, and there are four trees in Madras. It is the best of the three Indian varieties. The tree generally flowers in May, and the fruit is ripe during the cold season from December to February.

The fruit of the East Indian tamarind is more esteemed than that of the West Indian, and has a greater length of pod. Before the tamarinds are exported, the fruit is taken out of the pod, cleared from the shelly fragments, and placed in layers in casks. Those which are the produce of the West Indies are preserved in syrup. The East Indian tamarinds are commonly exported without the admixture.

Uses.—The fruit is employed both in food and medicine, and is used for abating thirst and heat in various inflammatory diseases.

In hot countries the tamarind is valued as a refreshing fruit, and when steeped in water forms a cooling beverage, called sherbet; it is also used as an ingredient in curries, to which it communicates a sharp flavour.

In times of scarcity the poor eat the tamarind stones; after being roasted and soaked for a few hours in water the dark outer skin comes off, they are then ground into flour and boiled or fried.

The tamarind tree is one of the largest and most beautiful in Southern India. The timber is firm, hard, and heavy, and useful for building. The wood is very durable and beautifully veined. In Madras, the wood is used for cotton screws, &c., and oil mills are generally made of short pieces of it. Tamarinds are used in preserving fish, which is hence called tamarind fish.

The natives have a prejudice against sleeping under the tamarind tree, as they imagine that the acid damp which it gives forth is prejudicial and liable to affect the health. This belief may arise from the fact that many plants will not grow under its shade; but this remark does not apply to all herbs and shrubs.

The Manilla tamarind was introduced into the East Indies from Mexico by the Spaniards. It forms a valuable plant for hedges, and is to be found along the line of Railway.

SANDAL WOOD TREE. (Tamil CHANDANUM.)

This is a small tree growing from twenty to twenty-five feet high and having numerous branches. It is found in Southern India, growing in Mysore, Coromandel, and Malabar. The Chinese get their sandal wood from

Timor, the Sandwich and Tijee Islands. White and yellow sandal wood are both the produce of the same tree, the last being the inner part; and, where nearest the root, it is very hard and fragrant. The white sandal wood is coated with a thick compact bark, the wood is hard and heavy and nearly inodorous, having a slightly bitter taste. The yellow or citron sandal wood is either straight, or twisted, lighter than water about the trunk, but heavier near the roots.

Another species of this tree is the red sandal wood. The wood, as its name indicates, is dark red, it is also close grained and capable of taking a fair polish. It sinks in water The red sandal wood is used chiefly by dyers and colour manufacturers. The red colouring matter appears to be of a resinous quality.

When the tree is about nine inches in diameter at the root, it is cut down, cleared of its bark, and cut into logs. These logs are buried for six months, in order that the white ants may clear off the outer wood. This they effectually do without injuring the heart of the tree, which is the only valuable part. The best wood is of a fair deep brown colour and highly perfumed.

The art of carving in sandal wood is much practised by the natives of India and China, and the various articles of ornamental furniture made by them from this wood are deservedly held in high estimation.

In India, sandal wood is burnt as a perfume in temples and in private houses, and in funeral ceremo-

nies. When reduced to a powder, it is made into a composition for marking the forehead. The native doctors of India esteem this powder as a medicine, which, from its cooling, sedative qualities, they prescribe in fevers and other complaints. The natives use it in bathing the body; and when mixed with cocoa-nut water, it allays thirst. The powder is also used to allay the irritations of mosquito bites, and eruptions on the skin.

The Mahomedans and others express an oil from the wood, which they value highly as a perfume. This oil is made principally on the Malabar Coast, whence it is taken to Bombay and exported to England, China, Arabia, and the Persian Gulf. Calcutta obtains her supply chiefly from Malabar. European perfumers make use of the oil, and in India it is extensively used in the adulteration of attar of roses.

Large quantities of red sandal wood are exported from Madras, to which place it is brought from the low hills near Pulicat.

[BAMBOO. (Tamil MONGIL.)

This cane is the largest kind of reed or grass, and multiplies very much by its root, from which springs a branchy tuft. It is the only kind of grass that attains the size of a tree, growing sometimes to the height of sixty or seventy feet.

It has an erect, jointed stem, hollow between the joints, where strong partitions cross the inside, and bending at the summit. When in flower, the cane is without leaves, but the extremities are covered with flowers. It is found in most of the forests of the Indian peninsula, and flourishes from March to May. There are about twenty different species of bamboo known to botanists, and these have been arranged into three classes: two classes of Asiatic bamboos differing in the flower, and the American bamboo.

Like the palm, these trees form one of the peculiar as well as most striking features of oriental scenery. The tall bending stems and the light green foliage arrest the eye, as they appear in clumps throughout the forests of the Indian peninsula. Nor is the bamboo more remarkable for its beauty, than for the many uses to which it may be made subservient. With the exception of the cocoa-nut tree, no vegetable is more valuable to the natives of hot countries than the bamboo; from it they make almost every thing they require. The following summary will show the various uses to which the bamboo is applied:—

"The purposes to which different species of bamboo are applied are so numerous, that it would be difficult to point out an object in which strength and elasticity are requisite, and for which lightness is no objection, to which the stems are not adapted in the countries where they grow. The young tender shoots of some species are eaten. The full grown stems, while green, are cut into pieces and used for carrying flowers, as

'they keep damp and so preserve the freshness of the flowers; when ripe and hard, they are converted into bows, arrows, and quivers, lance-shafts, the masts of vessels, bed posts, walking sticks, and the poles of palanquins; they also form floors and supporters of bridges, and are applied to a variety of similar purposes. In a growing state, the spiny kinds are formed into stockades, which are impenetrable except to artillery. By notching the sides of bamboos, the Malays make wonderfully light scaling ladders, which can be conveyed with facility when heavier machines could not be transported. Bruised and crushed in water, the leaves and stems form Chinese paper. The leaves of a small species are the material used by the Chinese for the lining of their tea chests. Cut into lengths, and with the partitions knocked out, they form durable water pipes. Slit into strips they form a most durable material for weaving into mats, baskets, window blinds, and even the sails of boats. Of bamboos are made the posts and frames of the roofs of huts, scaffoldings for buildings, rafts, masts, yards, oars, and spars. It is used for building bridges across creeks, for fences, as a lever for irrigation, for flag poles, and many other minor purposes. Finally the larger and thicker truncheons are exquisitely carved by the Chinese into beautiful ornaments."

The species of bamboo growing in Bengal is said to form an impenetrable thicket, as the stems are closely crowded, and armed with strong sharp spikes. A staff of this bamboo must be placed in the hands of every young Brahmin when he is invested with the sacred

thread, otherwise they say the ceremony cannot be performed.

Large quantities of bamboo are annually exported to Europe.

THE BANIAN TREE. (Tamil ALA MARAM.)

The Banian tree has wide spreading branches, and is remarkable, as every one knows, for the singular property of letting a gummy kind of root fall from its branches. When these descending branches reach the ground they take root and form natural supports to the large branches of the parent stem; and several of these extending and increasing from year to year, form a vast assemblage of pillar-like stems, and cover a considerable area round the original trunk.

> "Branching so broad and long that in the ground
> The bending twigs take root and daughters grow
> About the mother tree a pillared shade
> High over-arched with echoing walks between."

Many instances are on record of the immense extent of some of these trees which form so peculiar a feature in an oriental landscape. One tree of the kind near Fort St. David was computed to cover nearly 1,700 yards. Colonel Sykes mentions one at Mhow 100 feet high, with 68 stems descending from the branches, the principal trunk being more than twenty-five feet from the ground to the lowest branches, and eight or nine feet in diameter.

Travellers in this country have described banian trees as large enough to form a shelter for a regiment of cavalry, and how they have formed a natural canopy for public meetings and other assemblages.

Lady Falkland thus describes a banian tree at Wace, which covers a space of ground between three and four acres:—

"Under this magnificent tree, I remained some hours. The shade was so complete that I could sit in the middle of the day without any covering on my head. There were countless avenues or rather aisles like those of a church, the pale grey stems being the columns, which, as the sun fell on them, glittered in parts like silver, and here and there were little recesses, like chapels, where the roots from the boughs formed themselves into delicate clustering pillars, up and down which little squirrels were chasing each other, while large monkeys were jumping from bough to bough, the boughs cracking and creaking as if both monkeys and boughs would fall on my head. The tree looks at a distance like a closely-planted clump of trees; but in every other respect seen from underneath it is beautiful, whether in the heat of noon-day or in the dark night, when the servants and camp followers have lighted their watch fires in its lofty aisles, or perhaps most of all when a bright moonlight struggles through some of the few openings in the leafy canopy."

The wood is light and porous, and, therefore, of little value as timber. An infusion of the bark is said

to be a good tonic. The white glutinous juice which exudes from the stems is applied as a remedy for toothache and to the soles of the feet when they have become cracked or inflamed. Birdlime is also manufactured from this juice, and the Brahmins use the leaves as plates to eat off. If the seeds drop into the leaves of the Palmyra tree, the roots grow downward embracing the trunk in their descent, until by degrees they envelope every part except the top, so that the head of the Palmyra is seen emerging from the trunk of the banyan as if it grew from it. These the Hindus regard with reverence, and call them holy marriages.

MANGO TREE.

The Mango tree yields one of the most grateful fruits of India. It grows to a great size, and has an erect trunk, and dark coloured cracked bark. The wood is of a whitish or dull grey colour, porous, yet pretty durable if kept dry. The flowers are numerous, small sized, and of a yellow colour. This tree is common throughout India, and is cultivated in great abundance about Bangalore. In cultivated varieties of the mango, the fruit is sweet, richly flavoured, juicy, and free from fibres; but in neglected trees, the fruit produced has been often aptly described as nothing better than a mixture of *tow* and *turpentine*. The tree is generally raised from seeds, but the best mode to obtain the finer varieties is by grafting and propagating by cuttings.

The kernel contains much nourishment, but is never used for food except in a time of famine, when it is cooked in the steam of water and used as an article of diet by the poorer classes.

In the pulp of the fruit there is secreted sugar, gum, citric, and gallic acid. If the fruit be cut with a knife, a stain will immediately appear on the blade. The stain indicates the presence of the acid.

The wood of the mango is one of those used by the Hindus for burning corpses, and is reckoned sacred for that purpose. The natives use the twigs as tooth cleaners, and the stalk sometimes supplies the place of betel. When an incision is made in the bark, a soft brownish resin issues from it, which is mixed with lime juice or oil and used medicinally. Infusions of the bark and of the young leaves are prescribed by native practitioners as a cure for disease of the skin, and when taken internally as a remedy for affections of the chest and bilious complaints. The unripe fruit is much used in tarts, preserves, and pickles.

JACKFRUIT TREE.

The Jackfruit tree is a fine shady tree of quick growth, producing a nourishing fruit, which is a favourite article of food with the natives of India. There are several varieties of this tree, but that called the *honey jack* is the sweetest and best. In Travancore,

this tree yields an annual tax to the Sircar. The word Jack is a corruption of the Sanskrit word *Tchacka*, the name given to the fruit of the tree. It was planted by the roadsides in some parts of Mysore by order of Tippoo for the use of his soldiers on their marches.

THE BLACKWOOD TREE.

The Blackwood is a magnificent tree growing in the forests of Southern India and elsewhere. It is common in the Hyderabad territory, and is brought down to Masulipatam in brinjarries. The wood of this tree is much used for furniture, and when it is well polished it rivals *rosewood* in the beauty of its appearance; indeed, blackwood is often sold as rosewood. The root of the tree is used in medicine, and a fixed oil is procured from the seeds, which is said to be efficacious in the case of cutaneous diseases.

India abounds in many other trees and creepers which grow wild in the open country. Not a few of these supply medicines, as camphor, castor oil, aloes, &c., while others yield resins, gums, and varnish. The yellow flowers of the sweet scented gum arabic tree are seen scattered in profusion throughout the woods and plains, as also two kinds of acacias, and other flowering plants. Plaintains or bananas, guavas, custard apples, oranges, limes, and citrons, are in general use. Figs are not so common; the best grow at Poona. Grapes are plentiful as a garden fruit, but are not cultivated for

wine, while pine apples are reared everywhere and are found growing wild in the woods of Pegu.

FIBROUS PLANTS.

FLAX.—Fibrous plants are numerous throughout India, the chief being flax, jute, cotton, hemp, cocoa, palm, &c. Until late years the flax and hemp plants were cultivated for the seed alone, and their fibres were considered of no value; while in Europe they are cultivated chiefly for the sake of the fibre. In India, the hemp plant has hitherto been esteemed for the intoxicating secretion in its leaves, and the flax plants for the oil in the seeds.

Flax is an annual plant, with a slender hollow stem and a small blue flower. The bark consists of fibres, like those of the hemp, which are manufactured into linen, lace, and canvas. The flax plant is cultivated on the Neilgherries, in the Sangor and Nerbudda territories, and at Burdwan and Jubbulpore. Such portions of land as are annually fertilized by the overflowing of rivers, are the best adapted for the cultivation of flax. When the plant attains a sufficient height to cover the ground, dry weather becomes comparatively harmless, but occasional showers materially assist growth. The proper time to sow the seed is in autumn from October to November, according to the nature of the soil.

The first step in the preparation of flax is pulling

up the stalks by the roots and steeping them in stagnant pools. The fermentation which ensues separates the bark or flaxy substance from the seed-pods, after which the stalks are spread thinly on the ground, when they exhale a very disagreeable and pernicious odour. To save the seeds, the pods are put in heaps to ferment, and then dried slowly in the sun that they may get ripe. After the stalks have lain some time on the ground, they are beaten with a mallet, which loosens the fibres—these are then *dressed*, that is, drawn through a comb with coarse, iron teeth, and afterwards through one with fine teeth. The refuse is called 'tow,' and is used to make packing cloths and to caulk ships.

The dressed flax is next spun into *yarn* and then converted into *thread*. Weaving into linen cloth is the final process. The art of weaving spread from the East to the West, where, however, the former rude processes have been superseded by machinery. In a piece of plain cloth, the threads which proceed in the direction of the length are called the 'warp,' the threads which run in the direction of the breadth are called the 'weft' or 'woof.'

Flax is much cultivated in Egypt, especially on the Delta, and near Damietta. Egyptian flax is soft and good, but not better than European.

The frequent mention of fine linen in Scripture, and the evidence that is afforded by the unrolling of Egyptian mummies, that the fine linen of Egypt was actually woven from flax, shew that the same plant which

we now employ, furnished one of the most ancient manufactures known. The fineness of some of this linen, compared with what is woven in Egypt at the present day, also shows that the ancients had attained a high degree of skill.

Much attention has lately been paid to the cultivation of the flax plant in India for the sake of the fibres, and although the experiments hitherto made have not in every case met with that success which was anticipated, yet there seems little reason to doubt that further experience will show the cultivation of flax to be as profitable in India as it is in Europe; while European cultivators must eventually supersede the ryots, whose obstinate prejudices against the introduction of novelty is fatal to any improvement at their hands.

HEMP.

The common Hemp plant is an annual from four to six feet high. It has an erect, tough, and strong stem with green branches and sharply serrated leaflets, tapering to a long smooth point. The stalk consists chiefly of a tissue of fibres, joined together by a soft substance which easily rots. The leaves yield a strong smell, which is apt to produce intoxication.

The hemp plant is grown in almost all parts of Europe, but especially in Russia, Italy, and England.

In Russia, it forms one of the principal articles of commerce.

Some of the plants are flower-bearing, some fruit-bearing, the former being taller and more slender, and having finer and more elastic fibres than the latter. It is a remarkable property of this crop, that it requires no weeding, but, on the contrary, thrives best on a rank, weedy soil. Birds are very fond of the seed.

The flower-bearing plant being first ready is first pulled. When pulled, the leaves, flowers, and roots are cut off, and the stalks tied up in bundles. The next process is *rotting* in water for the purpose of dissolving the vegetable glue which holds the fibres together. This practice of *rotting* is generally considered injurious to the hemp, though it is extensively practised. After fermentation, the stalks are dried in the sun, in ovens, or in warm rooms, and then beaten in order to loosen the bark from the fibres. It is then treated in the same way as flax.

There are other species of hemp besides the common hemp plant. Of these, the sunn hemp of India has lately obtained considerable notoriety. The sunn fibre, called in Tamil 'wuckoo nar,' is a very different one from that of common hemp. The plant is from four to five feet high, with yellow flowers; and it is now extensively cultivated for the sake of its fibres in many parts of India, especially in Mysore, Rajahmundry, and throughout the Deccan. In some places, the fibre is known as Madras hemp, or Indian hemp, but the latter appellation is incorrect. The mode of preparation differs from that of other fibres, the plants being pulled

up by the root, and not cut, and the fibres separated by the hand instead of by a machine.

In the Madras territory, the seed is sown towards the close of the rains in October and November. A strong clayey soil suits it best. The soil is raked over the seed with the Hindu harrow, and no further care is necessary. In February or March, soon after the flowers drop, and before the seeds are ripe, the plant is pulled up by the roots, half dried in the sun, tied in bunches, and steeped in water.

In India, the fibres are used for fishing nets, cordage, canvass, paper, and gunny bags. The latter name is derived from the word '*goni*,' the native name for the fibre on the Coromandel Coast. The word canvass is derived from *cannabis*, the Latin name of the plant.

The disadvantages in the use of the sunn fibre are not so much owing to a want of requisite strength in the raw fibre as to want of care in the curing and dressing. All that is necessary to bring this hemp to a state of perfection, is European superintendence in its growth and manufacture.

The Orientals prepare from hemp an intoxicating liquor called *bang*, which serves both in India and Egypt as a substitute for malt liquors.

Jute is another species of hemp, extensively cultivated in Bengal, which is used in the manufacture of packing cloth and other coarse fabrics.

THE COTTON PLANT.

Cotton is a substance which is cellular in structure, it would therefore be incorrect to give it a place among the fibrous plants were it not that it is useful in the manufacture of those articles which are generally made from fibrous plants.

The cotton plant is indigenous to both the East and West Indies. There are many varieties of the plant yielding cotton fit for manufactures. These have been divided into:—

1. The American cotton, which has a hairy stalk two or three feet high.

2. The Barbadoes shrubby cotton, having a shrubby branching stalk, four or five feet high. This species must not be confounded with the cotton *tree* of the American and West Indian forests.

3. The Tree-cotton, which has an upright woody stalk of great height. The silky fibres of this species have not yet been made suitable for manufactures, but they are useful in stuffing cushions, &c.

4. The common herbaceous cotton, which creeps along the ground, and has either yellow or dark purple flowers; succeeded by oval pods, filled with seeds and cotton wool.

The last species is the most generally cultivated, and is considered the most valuable.

The prevalent practice in cultivation.—The seed is sown in rows five feet apart, each row having its seeds

planted in holes eighteen inches apart and with several seeds planted in each hole. The land is kept well weeded, and when the plants come up the weakest are drawn out, leaving two or three strong plants in each hole. A few months later they are again thinned and topped to the extent of an inch or two: this checks the upward growth and promotes the development of side branches.

When the pods arrive at maturity, they burst open and disclose a ball of white or yellowish down, enclosing and intermixed with the seeds. At this time the crop has a very beautiful appearance, the fine dark green of the leaf contrasting strikingly with the brilliancy of the cotton.

The prevalent practice in the cultivation of cotton is to prepare the ground by repeated ploughing after the first rains have loosened the surface. In some districts the sowing begins with the setting in of the petty monsoon in July; in others, not till October or November, when the first burst of the north-east monsoon is past. From five to seven months after the harvest begins, and lasts from one to two months.

In most parts of the country, it is the native practice to sow grain among the cotton plants, it being thought that this practice does not injure the crops. In the Vizagapatam district, the annual cotton plants are pruned when they are about three months old, but the branches of the perennial sort are cut down nearly to the ground in the second and third years, and the produce is said to amount to forty-six maunds of seed cotton per acre, a crop nearly equal to the best American.

One of the principal defects in Indian cotton cultivation, is the neglect to change the seeds from time to time; it being a well known fact that great advantage results from the introduction of new seed, or by an interchange of seed between different districts.

When the cotton is ripe, it is gathered by women and young persons in bags or baskets suspended from the shoulders. It is better that the cotton should be gathered without the outer husk, which breaks into small pieces and becomes so mixed up with the cotton that it cannot easily be picked out afterwards. The crop is liable to be damaged by wet seasons, which induce diseases called *blight* and *gangrene*. It is apt to suffer also from the ravages of insects, such as the cotton bug and the cotton caterpillar. Sometimes the cotton adheres firmly to the seeds, at other times it parts easily from them; in some sorts it is long, in others comparatively short, giving rise to the commercial names of *long staple* and *short staple*.

The parts of India where cotton is chiefly grown are Guzerat, the Southern Maharatta countries, Concan, Berar, Canara, and Malabar. The quantity exported from the Madras side of the Peninsula has not been great, although it is cultivated in the Bellary, Cuddapah, Salem, Coimbatore, Tinnevelly, Madura, Trichinopoly, and Tanjore districts. The difficulty of transit to the coast increases the price and so reduces the quantity exported; but much has been done recently, both to increase the quantity of cotton grown and to improve the roads, and there has been a steady increase in the quantity of cotton which finds its way to England.

Much diversity of opinion exists as to the best soi and climate for the growth of cotton, but as it is found adapting itself to every variety of climate and soil, an attempt to specify the particular amount of dryness or moisture necessary to ensure perfection in the crop, would be superfluous. It would appear that an arid climate is most favourable for the growth of the plant. In the southern parts of India between 8° and 10° of North Latitude, there is a hot arid climate resembling that of Egypt, and this district produces the best quality of cotton and senna.

The opinion seems general that the neighbourhood of the sea is favourable to the growth of cotton, and it is well known that the best and largest crops have invariably been obtained from island plantations, or those in the vicinity of the sea on the mainland. The American sea-island cotton, which is cultivated on the low sandy islands from Charleston to Savannah, has long been celebrated for its long fibre and silky texture. In the Madras territories two varieties of the cotton plant are cultivated, which require very different soils. One is an annual plant called in Tamil '*oopum parooty*,' the other is a perennial plant called '*nadum parooty*.' The first comes to perfection only in the black adhesive soil known as *black cotton ground*; the other requires a light, loose soil.

"As flax is characteristic of Egypt and the hemps of Europe, so cotton may truly be designated as belonging to India. Long before history can furnish any authentic account of this valuable product, its uses must have been known to the inhabitants of this

country, and their wants supplied from time immemorial by the growth of a fleecy-like substance, covering the seeds of a plant, raised more perhaps by the bounty of Providence than the labour of mankind."

Recently, owing to the great demand for cotton in Great Britain, the supply from the East has not been equal to the demand, and consequently the British market looks to America for an increased supply. By the stoppage of the American crop during the war between North and South, great injury was inflicted upon the trade in the United Kingdom, many thousands of people were thrown out of employment, and much misery ensued.

On this account, British manufacturers anxiously looked to their own colonies in Hindustan, Australia, and the West Indies for a supply, and urged upon Government the necessity for promoting the cultivation of cotton by every proper encouragement. And it is to be remembered that the greater the quantity of cotton India can supply England with, the greater will be the advantage to both countries.

TOBACCO.

The Tobacco plant is a native of America, and was first introduced into Europe by the Spaniards, who found it growing near Tabasco, a province of Yucatan on the Gulf of Mexico, whence it derives its name. When the plant was introduced into France, the French named it Nicotiana, from Nicot, their Ambassador at the Court of Lisbon, who brought some from Spain. The

celebrated Sir W. Raleigh gets the credit of having been the first to introduce it into England, about 1585.

Tobacco is cultivated in the East, in the Northern and Western Provinces, and on the banks of the Godavery and Mahanuddy rivers, where its cultivation is rapidly increasing. The Lunka cheroots, which are made from the last-mentioned growth, are considered superior to any others made in the East Indies.

The East Indian Tobacco has a weaker flavour than that grown in America, probably from a deficiency of skill on the part of the curers.

The Portuguese and Dutch settlers first introduced tobacco into the East Indian Islands about the beginning of the 17th century.

There are two species of tobacco cultivated for common use, viz., the Oronakoe and the sweet-scented, the difference consisting in the figure of the leaf—that of the former being shorter and broader than that of the latter. The Oronakoe is principally used for smoking; and the sweet-scented for snuff.

Tobacco is an annual herbaceous plant having a thick stem, varying in height from five to nine feet, and a handsome foliage. The stalk near the root is upwards of an inch in diameter, and is surrounded by a hairy clammy substance, of a greenish yellow colour. The leaves are of a light green, changing to yellow with their growth rising from the stem at distances of two or three inches from one another. They are oblong and spear-shaped, the largest near the root are about twenty inches long, the others decrease in size

as they ascend, till they become about ten inches long and five broad.

The flowers grow in clusters from the extremity of the stem and branches, they are yellow externally, and of a delicate red colour inclining to pale purple within the edges. The flowers are succeeded by brown kidney-shaped pods, each pod containing about a thousand very small seeds.

The cultivation and preparation of tobacco are very similar in all parts of the world where it is produced. It thrives best in a warm, rich soil; and the variations in the quality are caused by the varieties of soil in which it is grown. The seed is sown in beds or patches of earth prepared for it, and so situated that it may be easily watered. Tobacco is sown in March or early in April, and in a month's time it has four or five leaves, when it is fit for transplanting. The time selected for transplanting should be when the ground is well softened with rain, so that the roots of the plant may come away easily from the soil. The plants being removed to a field, the soil of which has been well broken up by the hoe, the labourer then forms hillocks of earth, by drawing the soil around his leg to the height of the knee. These hillocks are formed in lines at a distance of three or four feet from one another, and in each of them a single plant is placed. When the plants have risen to the height of two feet, the branches on which the flowers are produced begin to appear, the plants are then topped, that is, the extremity of the stalk is nipped off, to prevent its growing higher.

Were the stalks to continue growing, the leaves would be drained of much of their nutriment.

When the tobacco is fit for gathering, the leaves become rough and spotted with yellow on the raised parts. The plant must then be cut down as close to the root as possible, and left exposed to the rays of the sun for some hours. This exposure deprives the leaves of their brittleness, after which they become pliant and more easily handled. The plants are now left in heaps to ferment. This is called sweating the tobacco, and the longer the plants lie, the darker in colour is the tobacco. The plants are then conveyed to godowns open at the side, called curing-houses, and hung in pairs upon poles for the purpose of being cured. In about a month, the leaves are dried, when they are taken from the poles, arranged in heaps, and pressed with logs of wood, thus undergoing a second process of sweating, and a slight fermentation. The leaves are then tied up in small bundles, technically called *hands*, and kept in a cellar, or other damp place, ready for sale.

Tobacco is packed for exportation in hogsheads from thirty to thirty-two inches in diameter, and considerable pressure is necessary in packing to prevent moisture from penetrating. These casks will contain about 1,000 lbs. of tobacco.

The tobacco grown in the East Indies is principally intended for native consumption, very little being exported. A peculiar arrangement in the cultivation of East Indian tobacco affords evidence that the plant is a native of cooler regions than the island of the

East. The plant requires to be first raised from seed upon the cooler mountainous tracts of the islands, whence it is transplanted to the lowlands. The plants would degenerate if the seed were sown and the plants reared in the hotter districts.

Tobacco grows in all warm and temperate climates, but it succeeds better in some situations than in others. The islands of the New World at an early period attended to the cultivation of tobacco, but their production has been by degrees superseded by finer quality in all the islands except Cuba, which produces the tobacco of the far-famed Havannah cigar.

Of the tobacco grown in the East, that of Luzon is most valued. When compared with the supply from other countries, the quantity grown in the East is small, and its quality is, on the whole, inferior to that raised in Maryland and Virginia, the former province producing tobacco principally for smoking, the latter for snuff.

There is a part of Tanjore, famous for the growth of tobacco. This place is called சுவாமிமலை (religous jungle.) The story is, that when Rama came there, he saw many hermits, hence the name. Tobacco is also cultivated in Trichinopoly and Masulipatam, and it is grown very generally in small quantities for domestic use.

COTTON MANUFACTURE.

The fabrics made from Cotton are probably more various and numerous than those made from any other material. They comprehend stuffs of all degrees of fineness, from the transparent muslin of a robe, to the thick plush and warm bed quilt. Cotton forms the clothing of the immense population of India, but it is not more valuable to the Indian than to the European nations. It is used in a thousand different ways, for carpets, tents, pillows, screens, curtains; and, in India, cotton ropes are used for the rigging of ships, and many domestic purposes.

The Hindu woman first cards her cotton with a bone, she then separates the seeds by means of a small iron roller worked backwards and forwards on a flat board. An equally small bow is used for bringing it to the state of a downy fleece, which is then made up into small rolls, about the thickness of a man's thumb, to be held in the hand during the process of spinning, in which they are twisted and drawn out so as to form threads or yarn, and then sent to the weaver.

The apparatus required for spinning consists of a delicate iron spindle, having a small ball of clay attached to it, in order to give a sufficient weight in turning; and, imbedded in a little clay, is a piece of hard shell on which the spindle turns without much friction. A moist air and a moderate temperature are found to be best suited for this fine spinning, it is, therefore, practised early in the morning, and in the evening, and sometimes in moist cool places under ground, or over a shallow vessel of water, the evaporation from which imparts the necessary degree of moisture, and makes the cotton hold together, so that the spinner can draw out the threads to the greatest degree of fineness. The Indian spinning wheel is looked on with contempt by those who look to the polish rather than the fitness of the tool, but it has been proved that in no other way can such satisfactory results be attained as by closely imitating the Indian model.

It is probable that cotton clothes more people in the world than any other substance. Its peculiar advantage besides cheapness, is the combination of warmth with lightness, whence it is fitted for a great variety of climates. The vast extension of the cotton manufacture in England, and the expense of hand labour in that country, have caused the preparatory operations just described to be performed by a system of complex machinery, the inventions of the late Sir Richard Arkwright, Hargreave, and others. Were it not for these inventions, it would have been impossible for European artizans to compete successfully with the spinners and weavers of India. But these inventions counteract the effect of a low rate of wages in India, and England is thus enabled to export vast quantities of cotton and muslin goods instead of importing them.

Carding consists in brushing the cotton with coarse wire brushes until the fibres are all arranged in one direction, when it is formed into soft fleecy rolls about a

foot long, in which state the cotton is ready for the spinning wheel.

The preparation of yarn for the weaver was formerly a domestic employment common to all ranks of the people of England, a fact which the word *Spinster* for an unmarried female denotes.

The distaff and spindle were the earliest instruments employed. The distaff was a stick or reed three feet long, with a fork near the top, on which the carded cotton was wound. It was held under the left arm, and the fibres of cotton were drawn from it and twisted spirally by the action of the thumb and forefinger of the right hand. The spindle was a reed scarcely a foot long, on which the thread was wound; at the top was a slit for thread, and at the other end a wheel to steady it. The thread being attached to the spindle, was drawn from the distaff till the spindle touched the ground, when a *length* was said to be spun, and the spinster, winding it up on the spindle and securing it firmly in the slit, proceeded to spin another length, so forming a continuous thread. The use of the spindle and distaff was superseded in England by the spinning wheel about the reign of Henry the Eighth. We are indebted to Hargreave for the invention of a carding machine and the spinning jenny. The great advantage of the last-mentioned invention over the spinning wheel was, that it permitted of many threads being spun at once. The new instrument first contained eight spindles, but afterwards as many as eighty, so that it soon superseded the old spinning wheel.

But there was another genius at work who was soon to produce more powerful machinery, and such as would throw into the shade all previous inventions. This was Richard Arkwright, the great inventor of the *Cotton Spinning Machine*, who was a barber, till he was thirty years of age, in his native town of Preston in Lancashire.

The characteristic quality of this man's mind was not deep thinking, so much as tenacity of purpose and long patience. He abandoned every employment to perfect his idea of a roller spinning machine, it was not until Arkwright's spinning frame was brought into successful operation, that the cotton yarn produced by this invention was found to be sufficiently strong to be used as a warp, for which purpose linen yarn had been previously employed.

By a perfectly original contrivance, Samuel Crompton combined the rolling spinning of Arkwright with the jenny spinning of Hargreave; this invention was called the *mull jenny*, and by it, yarns fine enough for muslins were spun.

The yarn is next formed into banks, then slightly twisted, folded, and put up into bundles by an ingenious invention called a *bundling machine*. Sometimes fine yarns are disfigured by loose divergent threads. These are removed without injury to the yarn by passing the yarn rapidly through the flame of a gas jet, when the loose threads are burnt off and the yarn becomes improved both in appearance and value. When two or three single yarns are twisted together, they

form various kinds of threads, such as bobbin, net, lace, stocking thread, and sewing thread.

Weaving is the art of twisting or combining threads or yarns or strips of different materials so as to form a kind of cloth. This art had its origin in the necessities of man's nature; the rudest nations have practised it and continue to practise it, and the most refined nations have received from the rudest the principles of the art, on which they have engrafted many improvements in details and machinery.

The Egyptians were celebrated at an early period for their woven materials, specimens of which are still to be seen in the linen cloths in which they were accustomed to wrap their mummies.

The ancient mode of weaving among Oriental nations is illustrated by the loom of the modern Hindu weaver. It consists of two bamboo rollers, one for the warp, the other for the woof, and a pair of healds for parting the latter. The shuttle is similar to a large needle. The weaver erects his rude apparatus under the shade of a tree, forms his seat by digging a hole in which are placed the treadles; he stretches the warp by fastening in the turf two bamboo rollers at proper distances apart, he attaches the treadles to a branch of a tree or to a bamboo rod extended between two trees; he inserts the great toe of each foot into a loop which serves for a treadle, and thus raising the alternate threads of the warp, he draws the weft, and strikes it close up to the web with his long shuttle. The warp is previously dressed by

means of rice water. The weaver is assisted by a winder, whose duty is to supply *weft* and mend broken threads. The method of warping is to fix sticks in the ground at certain distances and to lead round them the yarn previously wound upon pieces of split bamboo attached to a centre stick held in the hand.

The act of weaving gradually spread from the East to the West. It was long a mechanical problem to construct a machine which would repeat with precision the somewhat complicated motion required in weaving, that is, alternately depressing the treadles; 2nd, throwing the shuttle between the alternate threads from right to left and from left to right; 3rd, to drive up each thread of the waft close to the web with the batten; 4th, to unwind the warp from the warp-beam, and 5th, to wind the woven fabric on the cloth-roller. There is also a 6th action generally introduced, viz., an arrangement for stopping the loom if a thread breaks, or when the shuttle sticks in its course through the thread or when the yarn in the shuttle is run out. Dr. Cartwright, in 1785, was the first to weave by means of machinery, and to him the world is indebted for the power loom which, by the help of steam-power, performs the various distinct actions we have mentioned. Power-looms are usually contained in one large room or shed in the ground floor of the mill. They are attended by women and girls. One woman and a girl can attend to four looms, or one woman unassisted, can attend to two.

There are different varieties of weaving, such as muslin, twill, velvet, plain, check, and pattern or figure-

weaving. These varieties are obtained either by altering the number and arrangement of the healds, by using yarns of different degrees of fineness, or by introducing at regular intervals different colours of thread. The Jacquard loom permits of *figure-weaving* in silk, worsted, or muslin, and its function is to raise the warp threads, in the order and number required for the pattern, for the passage of the shuttle.

MUSLIN.—A kind of cloth called muslin, in French *mouseline*, derives its name from Moussul, near Bagdad, from which place such fabrics were first imported into Europe. Until the early part of the present century, all the muslin used in Europe was of Indian manufacture. Some of these, from the incomparable manual dexterity and patience of the workman, though made with very simple machinery, equal, if they do not surpass, in beauty and fineness any thing of European manufacture. Some of the muslin of India, and especially those of Dacca, are of the most astonishing degree of fineness so as to justify their poetical description as "webs of woven wind." Such, however, has been the result of the mechanical invention of England in this branch of industry, that, not only are muslins of British manufacture now used universally in Europe, to the exclusion of those woven in India, but large quantities are exported to all parts of the world, and find their way even into the interior of India.

Dacca cotton is a variety principally found in Bengal, which furnishes that exceedingly fine cotton employed in manufacturing the delicate and beautiful muslins just spoken of. The Berar cotton is another variety from which the northern Circar cloth is made. Since this district has come under British rule, it promises to be one of the most fertile and valuable cotton districts in the whole continent of India.

SILK.

Silk is a very soft, fine, bright thread, the work of an insect called the *silk-worm*.

The art of rearing silk-worms for the sake of the thread spun from them, appears to have had its origin in China, and the discovery of the use to which the cocoon of the silk-worm might be applied is attributed to a Chinese empress who lived about 2,640 years before the Christian era.

As the silk-worm is a native of China, the culture of it was confined in ancient times entirely to that country, and in such importance was the silk manufacture held, that the very people and their country were named in ancient writings, Seres and Serica, from the Chinese word *Se* which signifies *Silk*. So little was known to the western nations of antiquity about the rearing of this insect, that Dyonisius, an ancient geographer, when he visited the East in the first years of the Christian era, speaks of it as a precious web, finer than that of the spider, combed by the natives from flowers and spun into rich garments at a great price.

The web of the silk worm is an oval ball, called a cocoon, varying in colour from light straw to deep yellow, and consisting of a single thread, wound round and round, so as to make a close and impenetrable covering. This thread is so very fine that an unravelled cocoon, the size of a pigeon's egg, will measure seven hundred or a thousand feet.

In their native countries, the silk worms form their cocoons upon the mulberry tree itself, "where they shine like golden fruits amid the leaves," but in cold climates, and even in the warmest climates of Europe, the inclemency of the season at which the worms are hatched, does not permit of their being reared in the open air. On this account, they are kept in warm but airy rooms, and supplied with mulberry leaves till fully grown.

While they are in the caterpillar state, they change their skins several times, and many die under this operation. When they become full of silky matter, they acquire a yellowish tinge and cease to eat. Twigs are then placed before them on a state of wicker work, and on these they immediately begin to form the web.

The regular time required for hatching is nine days, except in the cold and hot weather, when it generally takes twelve or fifteen. The insect contained in the cocoon from which the silk is wound, must be destroyed before it makes its exit, otherwise the aperture left by it as it issues forth spoils the cocoon.

A downy substance called *floss* must be removed from the outside of th cocoons, after which they are

thrown into warm water to separate the silk from the glutinous particles which caused the threads to adhere, and the ends of the thread being found, several are joined together and wound in a single thread upon a reel. The smallest number of cocoons that can be used together in winding, in order that these united fibres may form one thread, is three. This is the silk in its natural state, to which the name of raw silk has been given. The next operation is that of clearing and freeing the threads from *nibs* and uneven threads, after which it is worked into threads of different degrees of fineness according to the sort required. In this state, it is called *thrown silk*, and is ready for weaving into various fabrics either at the common loom or the Jacquard loom. It also forms yarn or thread for hosiery and gloves, and also sewing or knitting silk. The floss silk and the refuse of the throwing process are worked into yarns of coarser fabrics, such as shawls and cheap bandanas.

In plain silk-weaving, the process is much the same as in weaving woollen or linen cloth, but the weaver is assisted by a machine for the even distribution of the warp, which frequently consists of eight thousand separate threads in a breadth of twenty inches. By this invention, patterns are easily formed upon the silk, to produce which, by other means, would require the greatest skill and the most painful labour. The Jacquard loom is so called from its inventor, a weaver of Lyons.

The excellence of silk as a material for clothing consists in its strength, lightness, lustre, and readiness in taking dyes. In short, silk bears the same relation to other clothing materials, that gold does to other metals.

There are various varieties of silk goods, the principal being satin, brocade, damask, and velvet. These varieties are obtained either by making the silk undergo some peculiar process, or by a difference of mechanical arrangement in the loom, such as using different shuttles with threads of various substances.

The production of raw silk is extending in British India, and the quality has for some years been gradually improving, so that there is every prospect of the English market being supplied exclusively with silk from British India, as labour is not only cheaper in India than in Europe, but a greater number of crops can be obtained in the year. At the present time there is a large export of silk from China to England and France.

The advantage attending the rearing of the silk-worm in the more elevated districts of India, are now generally recognized, and silk is produced to some extent in Mysore, Cuddapah, Pondicherry, and various parts of the Deccan. The cultivation of silk-worms is supposed to have been introduced into Mysore by Tippoo Sultan, but it does not appear to have made much progress until the government of the country fell into the hands of the British.

At the present time there is a considerable consumption of raw silk in Bangalore and Mysore for the manufacture of silk-shawls, handkerchiefs, and native cloths. Owing to the nature of the climate, the mulberry is in constant vegetation, so that even six crops of leaves may be obtained in the year without injury

to the trees. In Italy, where silk is the grand source of wealth, the trees have only one crop of leaves in the year. The worm, too, thrives remarkably well in the Deccan, the eggs from which it proceeds are here hatched all the year round, by the heat of the climate alone.

The silk produced in India is of a superior quality, and realizes a high price in England. The quantity, however, is small, and the culture and management of the worms so expensive, that little profit remains to the planter.

The Tassah silk manufacture is carried on at Mahdapore near the Godavery, but the cloths are very inferior to those of the same kind which are manufactured in Lower Bengal. This silk is made into scarfs, punchees, and sarees, at several towns of the Circar of Warungal. It is much used for ladies' and children's dresses, and in most parts of India, is worn by the natives during certain ceremonies, and while bathing.

Woollen Cloths.—Wool is the fleecy covering of the sheep, and, like the hair of horses and cattle, completes its growth in one year, then falls off and is succeeded by a fresh growth. Wool differs from hair in this particular, that whereas hairs are commonly of the same thickness in every part, wool is generally thicker at the points than at the roots. The whole of the wool shorn from one animal is called a fleece.

Wools are distinguished by the length of the staple and by the fineness of their threads. As an article of commerce it is of great importance, hence much attention has been paid to the rearing of sheep in all

civilised parts of the world. The fleece of the S[illegible] sheep is considered particularly fine, and the [illegible] made from it is known as merino. Wool is lar[illegible] imported into Bombay from the Persian Gulf, K[illegible] mehee, and Cutch, and is re-exported to England.

The table lands of the peninsula of India, commencing with the Neilgherries, and proceeding along Mysore to the Deccan, Candeish, and Guzerat, present large tracts of country with a climate favourable and abundant pastures for sheep. If from thence, we proceed in a northern direction passing Marwar, Malwa, and Rajpootna, to the district of Hurriana and the province of Delhi, we shall see immense herds of cattle and numerous flocks of sheep. These sheep supply the wool used by the natives of India for blankets, or cumblies, as they are generally called. Upon the southern side of the Himalaya mountains, a breed of sheep is reared, from which the natives of that part of India manufacture their clothing. The goats on the northern side of these mountains in Thibet, have long shaggy hair with a fine down underneath. Here also is found the goat from whose wool the far famed Cashmere shawls are made. These shawls are esteemed on account of their extreme softness, bliancy, and elegance, but as the process of weavi them is very slow, the shawls are very costly.

In Coimbatore and Baramahal, good ewes are to be obtained, but Jaulnah and Beder are considered the best places whence to obtain the white woolled sheep. At Bangalore and the Neilgherries successful experiments have been made by crossing the white woolled sheep

of the country with Saxony, Merino, and South Downs, and the results are stated to be satisfactory, both as to the quality and quantity of wool. Hoonsoor has become celebrated for its white and coloured blankets of various degrees of fineness. The native weavers there produce a very good description of blankets in imitation of English articles. Felted blankets and cloaks have been manufactured from the Mysore wool, but this is generally coarse, and little used, except for the native loom. Bangalore and Tanjore are both famous for the manufacture of carpets.

Woollen Cloths.—The mode of manufacturing cumblies in Mysore, and, indeed, in all parts of the country, is as follows. The wool is cleaned, carded, and spun, and being put into the loom, is rubbed over with a mass, made of boiled kernels of tamarinds, beaten into powder. After this the cumblies are woven in the usual way, a common one being woven in six or eight days.

As woollen clothing is not suited to the climate of Hindustan, there is little use made of woollen fabrics of a superior quality.

In the manufacture of woollen cloth, the fibres are first picked, cleaned, and combed out, then spun into threads called yarn, and afterwards woven into cloth by the loom. It would be difficult to give, within the compass of a lesson, details of the modes of manufacture of the various descriptions of goods in which wool is employed. The mixture of woollen with worsted yarns, or either of those with cotton or silk,

were found, which are supposed, from the appearance of the cities, to have been manufactured 1,000 years before the Christian era. In the tombs of Thebes, the potter's art is represented in all stages. The mixing of the clay was effected by kneading with the feet, after which a mass of convenient size was formed by the hand, placed upon a wheel of very simple construction turned by the hand. During its revolution, the forms of the vessel were made out with the finger, the handles were afterwards affixed, the vessels placed upon planks to dry, then carefully arranged on trays and carried to the oven to be baked. Ornamental designs were traced upon them with a wooden or metal instrument previous to baking.

From what has been said, it will be evident that pottery is not liable to decay from the effects of time. Hence the art is valuable in an historical and antiquarian point of view, as handing down to us records of the manners and customs of early nations, in a state of preservation unattainable in wood or metal.

Till lately, very little seems to have been known about Indian pottery, and the general impression seems to have been that it was always of a hemispherical shape, as being most convenient for carrying on the head. But it is now understood that Indian pottery is not only varied in shape, but distinguished by the elegance and gracefulness of its forms, so as to rival the celebrated Etruscan vase.* Some of it is remarkable also for its extreme thinness and lightness, which is the more surprising as the native potters of India do not appear to use the turning lathe to give a finish to the articles.

* The Etruscan is an elaborate and delicate vase attributed to the Greek potters of the Isle of Samos.

This beauty of form is chiefly seen in the pottery of Sewair near Patna, Azimghur, Ahmedabad, Mirzapore, and Moradabad.

Uses.—The earliest use of pottery, as its name indicates,* was doubtless that of drinking vessels, but there was also a religious employment assigned to earthen vessels, which has been the means of preserving them for the inspection of after-generations. In vases of baked earth, the ashes of the dead were frequently deposited, and even where the practice of burning the dead was not followed, still various earthen vessels have been found, placed at the hands and feet of the skeleton and sometimes hanging on pegs along the sides of the tomb.

Porcelain differs from pottery in being formed of a finer kind of clay; and consequently in every kind of pottery and porcelain, are silica† and alumen‡ but when a third ingredient is added having alkaline § properties, such as lime or magnesia, a change is

* From the Latin *Poto*, I drink.

† Silex, flint.

‡ Alumen, a kind of mineral acid.

§ Alkali, a substance which, when mixed with an acid, produces fermentation.

effected and a vitrified body* produced, resembling many natural gems both in density and liability to fracture. This has obtained the name of porcelain. Some derive the word from *porcellana*, the Portuguese fine drinking cup, others from an Italian word signifying a shell possessing a hard, glassy exterior. The latter is considered the more probable derivation.

The Chinese appear to have been acquainted with the art of making porcelain as early as a hundred years before the Christian era, and at last 1,250 years before its manufacture was attempted in Europe. It was long supposed that the fine clay required for the production of Chinese porcelain was peculiar to that country, and that any attempt at imitation in other countries would prove useless. So exclusively were the Chinese the manufacturers of this article, that it is universally known by the name of the country where it was made; but the beauty of porcelain led to many attempts at imitation, and we owe the production of the celebrated Dresden and Sevres China of Europe, to a fortunate discovery of a native of Saxony named Böttger, who had long been engaged in the attempt to manufacture an imitation of the Chinese porcelain. A traveller called Schnorr was struck with the appearance of a white earth near Schneeburg, and collected some of it, thinking it might be used as a substitute for hair powder. The only drawback was that the powder made from it was very heavy. Böttger remarked the increased weight of his wig, and no

* Vitrify, to become like glass.

sooner discovered that the new powder was an earthy substance, than he at once saw in it the long sought-for material for the manufacture of porcelain; and he found that it made a porcelain as white as China. We are indebted to Bernard Pallissey, a Frenchman, for the discovery of the art of making glazes for the finer descriptions of pottery. He was in every respect a remarkable man, having endured unwonted privations for many years in prosecuting his labours; and, after he had acquired fame and fortune, he died at last in a prison, rather than deny his adherence to the Protestant faith.

The manufacture of porcelain in England has not been so successful as that of earthenware.

The Potteries of Staffordshire turn out the well-known Wedgewood ware, so called from the valuable improvements in the manufacture introduced by Josiah Wedgewood.

Owing to its resistance to the action of acids, this ware is much used for mortars required in the laboratories of chemists.

The cheapness, beauty, and convenience of English ware, have made it so common that, in travelling from Paris to St. Petersburg, from Amsterdam to the furthest part of Sweden, or from Dunkirk to the extremity of the south of France, one is served at every inn upon English ware. Spain, Portugal, and Italy are supplied with it, and large quantities find their way both to India and America.

The materials for the manufacture of earthenware

are reduced to the consistency of cream to ensure the perfect mixture of all the ingredients. The basis of the composition is a clay from Devonshire or Dorsetshire, to which is added ground flint with a small quantity of ground white granite. These ingredients being mixed in proper proportions and once or twice passed through very fine sieves, the mass is placed with water in a boiler, and boiled until it has attained a proper consistency for working. Those articles which are not fashioned by the hand, and turned on a wheel, are made in moulds of gypsum, the pores of which absorb the moisture of the clay, so that the casts shrink, and are easily loosened from the mould.

After the vessels have been thus shaped, they are placed in separate clay cases which are then put in a furnace, closely bricked up, and subjected to a [illegible] heat for sixty hours. This process is called *fi[illegible]*. When the ware is withdrawn from the furnace, it is in that state which is known by the name of *biscuit*. Vessels for common use undergo no further treatment, but ornamental ware has still to be printed and glazed. The patterns and coloured figures are put on while the ware is in the biscuit state. The glaze consists of the ingredients of some kind of glass melted in a furnace and reduced to powder, which is stirred up in water, and the articles to be glazed are dipped into this preparation, and again baked for forty hours. It should be mentioned that the addition of the opaque powder which forms the glaze conceals the pattern at first, but after the second baking, the glaze becomes *transparent*, and the pattern is visible.

Painting on porcelain and earthenware is done with a camel hair pencil and the colours used in enamel painting.

LEATHER.

Leather is the tanned skin or hide of animals. Two objects are attained by tanning, 1st, the leather is preserved from rotting, 2nd, it is rendered impervious to wet. The hide or skin of an animal consists of three parts, the cuticle which is covered with hair or wool, below which is the reticulated or net-like tissue, and lastly the true skin which is in contact with the flesh. The last is the only part which can be tanned, so that it is necessary to get rid of the two former before the conversion into leather can be commenced.

The hides of cows, oxen, and horses, are chiefly used for shoes. Calves' skin is thinner than cows', and is made into vellum and used for book-binding, saddles, harness, &c. Sheeps' skins are also used for book-binding, for gloves, for dyed leather used in covering writing tables, chairs, sofas, and linings for carriages: and are made into parchment. The skin of kids, goats, and doe, are useful in the manufacture of gloves and shoes. The chief supply of the best kid is obtained from Switzerland and Tuscany, and is used in the manufacture of the finest white and coloured gloves. Chamois leather is the skin of the mountain goat dressed in oil. Other sorts of skins used for various purposes are—dog skin, chiefly for gloves,

seal skin for covering boxes, and hog skin for the best saddles.

The first operation of the tanner is to cleanse the hides from all extraneous filth. The hair is next removed, either by steeping the hides for a short time in a mixture of lime and water, or by rolling them up close, and piling them in heaps, when they quickly begin to heat and putrify. The hair being then loosened is scraped off, and the tanner proceeds to the operation called *fleshing*, which consists of a further scraping with a particular kind of knife contrived for the purpose, and cutting away the jagged extremities.

The raw leather is then put into an alkali, or dilution of sulphuric acid, in order to discharge the oil and render its pores more capable of imbibing the ooze. The oil being sufficiently discharged, the leather is ready for the *ooze* or liquor in the tanning vat.

The skins are first thrown into pits, whence they are taken up from time to time and allowed to drain. The hides are next placed carefully in vats, where they are spread out smooth, and between every two some powdered bark is sprinkled. When the vat has been thus filled, the ooze has a preparation of bark and water, is poured on; and a little bark is sprinkled over all. When the ooze has completely saturated the mass, the tanning is finished. The hides are then hung up in airy rooms to dry thoroughly.

Such is the general process for tanning calf skins and the lighter sort of hides; but the large, thick, heavy

hides, of which the strongest kind of sole leather is made, require to have their pores more thoroughly opened before the ooze can sufficiently penetrate them. For this purpose, after the hides have been rotted by being piled together in heaps and well soaked in an alkali, they are thrown into a sour liquor generally brewed from rye; effervescence ensues, and the pores of the leather open. The hides are then put into the pits and afterwards removed to the vats, where they remain for about two years before they are perfectly tanned.

The subsequent operation of *currying* renders the leather pliable and more waterproof. Under this head is included the process of *waxing*, which consists in laying on the colour or blacking which is composed of oil, lamp black, and tallow, rubbed in with a hair brush.

Tan is the bark of the oak, and it possesses a remarkable degree of astringency; it consequently contracts the pores of the leather and renders it impervious to wet. *Tannin*, as the substance which effects the tanning is called, may be obtained from many other vegetable productions besides oak bark. Pure tannin is most frequently obtained for chemical purposes from *nut-galls*, but it may be procured also from the horse-chestnut and other trees.

The vast number of barks and other astringents useful for tanning purposes within the tropics are comparatively unknown in Europe, although they might be obtained in large quantities at a trifling cost. The

plants of the mangrove tribe and other allied species have frequently an astringent bark which is used for tanning and dyeing. This tree is very common in tropical countries, where it forms dense thickets on the muddy banks of rivers and on the sea shore. And its bark is said to be superior to that of the oak for tanning, completing in six weeks an operation which the oak bark takes six months to perform, and the leather tanned from the former is said to be more durable than any other.

Myrabalams, or the kernels of the nut of several East Indian trees, also yield *tannin*.

The Tenasserim Provinces are rich in materials for tanning. The bark of several species of mangrove growing there, the fruit of the sea-cocoa-nut, and the peel of a species of ebony, all abound in tannin.

The manufacture of leather in Great Britain ranks next to those of cotton and wool, being about equal in importance to that of iron. There is a large and constantly increasing demand for leather as an article of clothing, for the construction of various engines and machines, and other manufactures previously noticed in this lesson.

The manufacture of leather in India has up to this time been far from satisfactory, although there is no want of hides or tanning materials. The raw hides are steeped in vats for four or five weeks in a strong pickle of salt and water, from ten to fifteen hides being placed in each vat. At this time a quart or pint of the juice of the milk-bush is thrown in. This

juice contains a considerable quantity of gum and has the property of rendering leather waterproof and cords elastic. The Morocco leather manufactured at Hurryhur is treated with salt and a mixture of water and the milk of wild cotton; when the cuticle or outer skin has become decomposed, and the hair removed, it is placed in a decoction of mangrove, babul, or other tanning bark. After the skins have been some time in this, they are taken out and sewed up so as to form sacks, and then suspended from the roof of the building and filled with fresh tanning solution. When the process is completed, they are taken down, the stitches cut, and the skins are dried. The leather is soft and flexible, and looks tolerably well; but it resists the rain indifferently and is easily penetrated by wet, and during the south-west monsoon it becomes as moist and flexible as paper dipped in water. When set aside, it becomes mouldy and easily rots. The leather made at Bangalore is considered very inferior.

PAPER.

In early times, the materials used for writing on were chiefly such as required only a little mechanical fashioning to make them suitable for that purpose. Characters were engraven on flat stones made smooth, or were impressed on clay, afterwards hardened by the sun or fire. Thin tablets of wood covered with wax, and plates of ivory and of metal, have also been used. The skins and intestines of animals under the

name of parchment, have also been made suitable for writing on, but a more convenient material was afforded by the leaves of some species of trees. The use of these, although continued in other parts of the world, was discontinued in Europe after the introduction of papyrus and parchment.

At a remote period, a species of paper was manufactured in Egypt, from the papyrus, a reed which grew freely on the banks of the Nile.

It is interesting to see the way in which many of our words connected with books keep in memory facts connected with early writing. We talk of the *leaves* of a book, because people once wrote on *leaves* of trees, as they do now indeed in this country. From *papyrus* we get the word *paper*. So from the Saxon word *boc*, meaning the bark of the beech tree, which that people wrote on, the word *book* is derived. *Volume* comes from *volumen*, the roll into which written skins were rolled; and a collection of books, or the place where they are kept, is designated a *library*, as the Roman name for a book was *liber*.

The Chinese are generally acknowledged to have been the first who made paper from *pulp*, and to have practised the art as far back as 2,000 years ago. The Arabs are sometimes supposed to have learned the art from the Chinese, but it is more probable that they acquired it from the Hindus, as the Arabs translated many of their works and adopted much of their science. These Arabs are further said to have introduced the

art of making paper from cotton into Spain in the ninth or tenth century.

In the fourteenth century, paper made from cotton was almost entirely superseded in Europe by paper made from hemp and linen rags.

At one time it was thought that the supply of linen rags must soon fail, and various researches were made to find substitutes. This led to the discovery that paper of various qualities may be formed from the barks of many trees, from the stalks of nettles, thistles, cabbages, and even from potatoes, wood shavings, and saw dust. The Chinese employ a vast variety of fibrous substances for this manufacture, and apply paper to a variety of uses little thought of in other countries.

They make up an infinite variety of kinds of paper from the coarse, heavy, half-inch thick touch paper for retaining a slow enduring fire, to the beautiful so-called India paper suited for our finest proof engravings. In the tea-chests, there is a lavish use of many thicknesses of paper. If a hut or a boat is leaky overhead, the bed is protected by a large sheet of oiled paper. If a shop-keeper wants to tie up a parcel, he seizes a piece of tough paper, and by rolling it on his thigh, at once converts it into a strong pack thread. Even patches on a torn sail are at times made of tough paper. It is the cheapest of materials in daily use, and the manufacturers are very numerous. They make their paper of rice-straw, of young bamboos, of different fibres, and of the bark of the paper mulberry.

The process of manufacture adopted by the Chinese is the following. The small branches of a tree resembling the mulberry are cut in lengths of three feet and boiled in an alkaline mixture in order to loosen the inner rind or bark, which is then peeled off and dried for use. When a sufficient quantity of bark is thus obtained, it is again softened, steeped in water, and the outer parts scraped off as useless. The rest is again boiled in an alkali and stirred until the bark separates into distinct fibres; it is then placed in a pan and worked by the hand in a stream of water till the mass becomes soft and pulpy, when it is spread out on a table and beaten with a mallet. Thus prepared, it is transferred to a tub, into which is admitted an infusion of rice and a root called *oreny*, and after being stirred and well mixed, it is removed to a larger vessel to admit of moulds being dipped into it. These moulds are made of bulrushes cut into narrow strips and mounted in a frame, and as the paper is moulded, the sheets are placed on a table covered with a double mat, and laid one above another, but separated by a small piece of reed which is serviceable afterwards for lifting the leaves one from another. Each heap is covered with a board and weight to press out the water, after which the sheets are lifted singly by means of the projecting reeds, and placed in the sun to dry. The Chinese manufactured paper also from rags, silk, hemp, and cotton as early as the second century of the Christian era.

Although the Hindus long used the leaves of the Talipat palm and the Palmyra for writing on with a

style or metal pencil, yet the manufacture of paper from *pulp* is an ancient one in India. Considerable quantities of paper are made in India in the present day, but it is generally of a bad quality. Small paper manufactories are scattered throughout most parts of the country. At Singapore, it is manufactured from jute; and in Behar and other parts of India, from the sunn fibre. There are also manufactories in Western India at Ahmedabad, Surat, Aurungabad, Charwar, and Kolapore. In these manufactories, the pulp is formed of old grain bags of the sunn fibre. Good paper is made at Combaconum and at Perralore a few miles from Madras. When paper is made for the use of royalty, grains of gold dust are mixed with the pulp, and thus become spread over the surface of the paper.

The manufacture of paper from linen rags became general in France, Italy, and Spain, in the fourteenth century. Paper was first made in Germany in 1390, and in England in 1450.

Process of Manufacture.—Rags of all colours are separated and sorted according to their quality, cut into pieces, thoroughly washed, and, by the application of chloride of lime, deprived of their colour and rendered of the purest white. The rags are then subjected to the action of a revolving cylinder fixed in water, till they are reduced to a soft pulp. The pulp is now ready to be made into paper, which is done either by moulds, as already described, or by a machine.

A workman of France made the first attempt to produce paper in a continuous web, the details of the

machinery being perfected in England. The chief advantages of the paper-making machine are that paper can be made of any size that is practically required, and with a degree of rapidity far surpassing the old method. By the new process, as much as twenty-five square feet can be made in a minute.

In making paper by a machine the pulp is made to flow from the vat upon a wire frame or sifter which moves rapidly up and down so as to force the fine filaments of the pulp through the wire, whilst it retains any knots or other unsuitable matter. Having passed through a sifter, the pulp flows over a ledge in a regular and even stream and is received upon an endless web of wire gauze, which presents an uninterrupted surface of five or six feet long. The wire web moves forward, and the pulp is allowed to flow with such a motion as to determine the thickness of the paper. At the same time a shaking motion is given to the wire web which assists to spread the pulp evenly, and also facilitates the separation of the water which passes through the wire. Straps prevent the pulp from flowing over the sides. The pulp, which is now solid, is pressed by a roller covered with felt, and is then taken up by an endless web of felt, which forms an inclined plane and absorbs a further portion of moisture. The pulp is now seized by a pair of rollers between which it is pressed whence it passes to another inclined plane, which conducts it to a new set of pressing rollers. The pulp is now paper, and requires only drying and smoothing. To effect these objects the paper is passed over the polished surface of a cylinder heated by steam, thence to a second, and afterwards to a third hotter than the first two. It is then pressed between a woollen cloth and the cylinder, and lastly conducted to a reel on which it is wound, perfectly dry and smooth, and ready to be cut into sheets for use.

In order to give writing paper a gloss, it is dipped two or three times into a tub of *size*, made from skins and other animal substances. This prevents the ink from spreading through the fibres, hence blotting paper is never *sized*.

Machines for cutting the paper into sheets of any size have been invented by different persons. After the paper is cut, it is counted or *told* into *quires* of 24 sheets and folded, then put up into reams of 20 quires, when it is ready for sale.

GLASS.

Glass is said to have been discovered by some Syrian merchants, who, driven by stress of weather on the shores of Palestine near Mount Carmel, in the absence of other fuel, placed their pots upon some masses of *nitrum* or *soda*, a cargo of which they had on board. The nitrum being fused by the heat, and mingling with the sand, produced a transparent stream of glass. The Sidonians in the neighbourhood improved upon the discovery and practised the new art with great success.

On some of the Egyptian monuments the art of glass-blowing is represented, and the accompanying hieroglyphics prove that the art was practised before the exodus of the children of Israel from that land, nearly 3,500 years ago. The glass-blowers of Alexandria were at an early period celebrated for their skill and ingenuity, and ornaments of glass have been found among the ruins of Herculaneum and Pompeii. The Jews appear to have carried with them from Egypt a knowledge of the art, and the Greeks and Romans, who successively conquered that country, seem to have acquired the art from the same source.

Venice was the first state which discovered the art of making glass sufficiently cheap to allow of its general introduction. The Bohemians also rivalled the Venetians in this art, and ornaments of Bohemian glass are still much prized.

The term *glass* in its widest sense is applied to those mineral substances which liquify and become transparent on the application of heat, and remain transparent on cooling. The base of all glass is silex or flint. This is combined with an alkali and exposed to the action of intense heat, which causes the substances to melt and unite. Silica is found in great abundance in rocks and stones; it is the principal ingredient in flint, agate, rock crystal, and quartz. When subjected to intense heat, it acts the part of a powerful acid, and, combined with bases, forms solid compounds termed *silicates*. These silicates alone are insufficient to form glass, but by a judicious mixture of metallic silicates with a certain amount of potash

and soda, or both, glass may be formed. The potash and soda render the glass easy of fusion. A few ounces of black oxyde of manganese is usually added to the materials for making flint glass, as this, acting chemically with the silicic acid, cleanses the mixture and makes the glass colourless.

There are three kinds of furnaces used in the preparation of glass, one to prepare the *frit*, a second to work the glass, and a third to anneal it. The frit or batch is prepared by carefully mixing the materials and sifting them through coarse sieves. They are then put into pots of clay and conveyed to the second furnace where they are burned or calcined for a sufficient time when they are ready for the operation of *blowing*.

So great are the ductility, flexibility, and plasticity of glass developed by heat, that it can be blown, moulded, turned, and cut with scissors into any shape. It may be blown so thin as to float upon the air, and its ductility is such that the fine filaments of glass can be worked into silk and other fabrics with beautiful effect. The blowing tube is of iron, from four to five feet in length, with a bore of from one-third of an inch to an inch in diameter. It is smaller at the end which is applied to the mouth of the blower than at the other end which gathers the metal. This blowing tube is heated and inserted into the pot of melted glass; by rapidly turning the tube the workman gathers up as much as he requires round the bottom, and then by blowing through the tube he forms the glass into any article he wishes to make.

The *annealing furnace* is intended to cool the glass very gradually after it has been shaped and finished. For this purpose the articles are put into a tray waiting to receive them as soon as they are formed, being removed from the blowing tube by a slight but smart blow. The furnace is so arranged that the part where the articles are first placed is of almost the same temperature as the newly formed articles; and as the tray containing these is moved along it comes into a very gradually decreasing temperature, until at last it reaches the end when the tray is removed into the open air. Did the glass not undergo this annealing or gradually cooling process, the articles manufactured from it would be too brittle for use and liable to fracture at the slightest touch. The hotter the goods enter the furnace, the better. The annealing lasts from six to sixty hours, according to the weight of the articles undergoing the process.

The simple glasses are *crown glass*, and *bottle* glass. The glass commonly used for window panes is a silicate of soda and lime. Crown glass is manufactured in the form of flat discs or tables 52 inches in diameter. Plate glass differs little from crown glass, but being used principally for windows and mirrors it must be as transparent and colourless as possible, with no waves in the glass to produce [illegible]. These qualities can be secured only by [illegible] the material.

The art of casting plate glass, which [illegible] to the modern plate glass of [illegible], was discovered at Paris in 1688.

Bottle glass is the coarsest kind manufactured. A wine bottle is formed in a cast-iron or brass mould, the mark of which is very prominent in some bottles. Bottles containing a fermenting wine, such as champagne, require to be very strong. The wine growers of champagne lose 15, 20, and even 30 per cent. of bottles of wine from bursting by internal pressure.

Before the invention of glass, thin leaves of mica were used for windows.

The science of optics owes much to the invention of glass. Optical glasses must be very carefully made, requiring the same density and composition throughout the whole mass. This has been always very difficult to obtain, the best flint glass being liable to undulation, which refract and disperse the rays of light. Minute bubbles called *seeds* are sometimes to be found in glass and *knobs*, or opaque particles of earthy matter from the furnace. The method of making optical glasses is still a secret confined to the few persons who carry on the manufacture.

NATURAL PHENOMENA.

The Atmosphere.—The word atmosphere is derived from two Greek words, signifying a sphere of vapour or gases, and is applied to that fluid usually called *air*, which surrounds the earth on every side, and which accompanies that body in its daily revolution on its own axis, and its annual revolution round the sun. It is supposed that the Sun, Venus,

Mars, Jupiter, and Saturn, have each of them their own atmosphere, and that the Moon has none. The atmosphere is so thin and clear that it appears to our senses to possess no weight, although it really exercises a pressure of about *fifteen pounds* on every square inch of the earth's surface. By calculating the number of square inches on the surface of the body of a man of ordinary stature, and multiplying the number by *fifteen*, we may therefore ascertain the number of pounds of pressure which his body sustains from the atmosphere. This will be found to amount to no less than 33,000 lbs., or about 15 tons; but as this enormous weight presses equally on all parts of the body and in all directions, no one part of the body is incommoded by the weight. The air then is as truly a substantial body as water or earth, but of less density.

The atmosphere that surrounds the earth is supposed to be about forty or fifty miles in height, always becoming rarer as the elevation from the surface of the earth increases. This increase in density near the earth arises from the pressure of the higher portions of the air upon the lower, just as the lower parts of a haystack will be closer and denser than the upper from the pressure of the parts above.

The atmosphere consists of three gases combined in different proportions, viz., one part of the gas called oxygen to four of nitrogen, and a small quantity of carbonic acid gas. By evaporation of the waters on the surface of the earth, there is also always present in the atmosphere a portion of aqueous vapour which gives rain and dew that fructify the earth.

One great use of the atmosphere is to sustain animal and vegetable life. Animals inhale the gases which form the atmosphere through the lungs, vegetables absorb them through small pores. If a number of people were confined for a length of time in a room of limited dimensions, difficulty of breathing would be experienced. The cause of this is, that the oxygen of the air, the portion suited to sustain animal life, is soon exhausted, and the air of the room becomes overcharged with carbonic acid gas, which is injurious to life and health. This exhaustion of the life-sustaining element would have proved destructive of animal life had not Providence supplied a remedy. Those parts of the air which are injurious to animals are beneficial to vegetables. The latter absorb the carbonic acid gas refused by animals, and, after exposure to the rays of the sun, emit oxygen, so that a constant balance is preserved in nature, and the air is kept in a state of continual freshness.

Air is elastic, that is, it may be condensed by compression, and when the pressure is removed it again expands so as to fill the space it before occupied.

The other properties of air besides elasticity are expansiveness and weight. It is also invisible, transparent, and subtile, and it is owing to some of these properties that currents of air called winds are produced.

The air is necessary for several purposes, besides the support of animal and vegetable life. Were it not for this agent, we should see none of those varieties of colour which refresh the eye, nor would

any sound be heard, for sound is produced by percussions or strokes upon the air which set it in motion so that it affects the membrane of the ear, whence an impression of sound is conveyed to the brain.

Any substance which is specifically lighter than air will rise through that fluid till it attains a height where the specific gravity of both is equal. If, then, we fill a thin silken bag with a gas called hydrogen, which is lighter than common air, it will ascend if the bag and the gas contained in it are not heavier than the quantity of common air which the bag displaces. On this principle balloons are constructed.

WINDS.—Wind is the air in a state of motion. This motion of the air originates from a variety of causes, the principal of which appears to be heat. When air becomes heated or rarefied, it has a tendency to ascend on account of its greater lightness, and the vacant space which it leaves is immediately filled by a rush of cold air. This process may be observed if we throw open the door of a room the temperature of which has for some time been very warm. On applying a light to the bottom of the door, the flame will be blown inwards, by the cool air rushing in; if to the top, the flame will be blown outwards by the heated air rushing out. In the same way, the air in the tropical regions, which becomes rarefied by the intense heat of the sun, expands, becomes lighter, and ascends into a higher region, and the vacuum which it leaves is filled up by a rush of cold winds from the cooler regions near the poles, while the heated air which has

ascended flows towards the poles, becomes cool, and, in its turn, displaces the rarefied air at the equator.

TRADE WINDS.—As the atmosphere accompanies the earth in its revolution on its own axis, the air of the equator has a much greater degree of velocity than the air at the poles. And the air which rushes in from high latitudes towards the tropics does not acquire the velocity which the earth has at and about the equator, so that the earth seems, as it were, to glide away, and the winds stay behind; and, instead of being north and south winds, as they would be did the earth not revolve, they acquire an easterly direction or become north-east and south-east winds. These winds blow for months in one direction at the speed of from ten to twenty miles an hour. They are known as *trade winds*, because the mariners of the Atlantic and Pacific Oceans take advantage of them in their voyages.

* MONSOONS.—Monsoons, or shifting trade winds, are merely the trade winds modified by the position of the sun at certain seasons, with reference to certain large masses of land lying within the tropics. The English word *monsoon* is derived from the Malay *mooseem*, signifying a season; hence the term 'monsoon,' or season wind. The monsoons blow with the greatest regularity between Hindustan and the eastern coast of Africa. When the sun is south of the equator, from

* The word 'Monsoon' as here used denotes the wind; as used colloquially in Madras it refers only to the heavy falls of rain attendant on the setting in of the monsoon proper.

October to April, a north-east monsoon prevails; but when the sun is north of the equator, from April to October, a south-western current is established. When the sun passes the equator, and the monsoons are changing their direction, variable winds or tempests generally occur, a disturbance which is called by seamen the "breaking up of the monsoon."

The theory of the monsoons is as follows:—

When the sun has great northern declination, the peninsula of Hindustan, the north of India, and China, being strongly heated, the quick moving air of the equator rushes to the northward, to fill up the slower moving space, where the air has become rarefied, and this new supply of air having not only rapid velocity towards the east, but also a motion from the south produces the south-west monsoon in the Indain Ocean, in the Bay of Bengal, and the China Sea. When the sun, on the other hand, has great southern declination, the same seas are occupied by air, which, coming from regions beyond the northern tropic, has less easterly velocity than the space it is drawn into. This gives the air an easterly direction, which, combined with its proper motion towards the equator from the north, produces the north east monsoon.

In addition to the grand effects of the trades and the monsoons, the heating action of the sun produces a *diurnal* interchange of air in some parts of the world, in what are called *land and sea breezes*. The ocean is but little affected by sudden changes of temperature, such as are produced by the succession of day and night, and it participates only to a certain extent in the

alternating temperatures of the seasons. Such changes become equalized over large tracts of salt water, and serve to temper the rigours of climate on coasts and in islands. The land, on the contrary, becomes rapidly heated by the sun, and is rapidly cooled in its absence. Thus, the great continents act as heaters and coolers of the atmosphere, and produce those changes in the aerial currents already noticed; and not only continents, but islands of moderate size, produce the daily alteration of land and sea breezes, so refreshing upon the coasts of hot climates. During the day the land becomes much more heated by the sun than does the adjacent water, and, consequently, the air resting upon the land is much more heated and rarefied than that upon the water. The cooler and denser air, therefore, flows from the water towards the land constituting the *sea breeze*, and, displacing the warmer and lighter air over the land, forces it into a higher region, along which it flows in an upper current to seaward. At night a contrary effect takes place. After sunset the land cools much more rapidly than the water, and the air over the shore becoming cooler, and consequently heavier than that over the sea, flows towards it, and forms the *land breeze*.

The phenomena of land and sea-breezes may be well illustrated by a simple experiment. Fill a large dish with cold water, and place in the middle of it a saucer full of warm water; let the dish represent the ocean, and the saucer an island heated by the sun, and rarefying the air above it; blow out a wax taper, and if the air of the room be still, on applying it successively to

every side of the saucer, the smoke will be seen moving towards it and rising over it, thus indicating the course of the air from sea to land. On reversing the experiment, by filling the saucer with cold water, and the dish with warm, the land breeze will be shown by holding the smoking wick over the edge of the saucer; the smoke will then be wafted to the warmer air over the dish.

Rotatory disturbances in the air display a variety of phenomena which have been distinguished by various names, such as *whirlwind*, *water-spout*, *sand-spout*, *sand pillar*, *tornado*, *white squall*, *pampero*, &c. These terms have been applied to rotatory storms of small extent. The *hurricanes* of the West Indies and the *typhoons* of the Indian seas are whirls of greatly increased extent, often extending from one to four or five hundred miles in diameter, and consisting of a revolving movement propagated from place to place, not by bodily transfer of the whole mass of air which at any moment constitutes the hurricane from one geographical point to another, but by every part of the atmosphere in its track receiving from that before it and transmitting to that after it this revolving movement.

It was formerly supposed, when accounts of hurricanes were received, as occurring at different islands on various dates, with marked differences also in the direction of the wind, that those violent storms were rectilinear in their course, and that such accounts related in most cases to different storms. Their true nature was first clearly established by Mr. Redfield of

New York, and afterwards by Lieutenant-Colonel Reid, Governor of Barbadoes, by constructing charts on a large scale of some of the most remarkable hurricanes on record. In this way a single storm was traced successively from one island or locality to another, and the direction of the wind at any one point or place was found to have no connection with the general progress or direction of the storm. For example, one of the tracks thus laid down is that of the memorable gale of August 1830, which, passing close by the Windward Islands, visited St. Thomas's on the 12th; was near Turk's islands on the 13th; at the Bahamas on the 15th; along the coast of Georgia and the Carolinas on the 16th; off Virginia, Maryland, New Jersey, and New York on the 17th; off Georgie's bank and Cape Sable on the 18th; and over the Porpoise and Newfoundland banks on the 19th of the same month, having occupied about seven days in its ascertained course from near the Windward Islands, a distance of more than 3,000 miles, the rate of its progress being equal to 18 miles an hour. Now the actual velocity of the wind in its rotatory movement is probably five times greater than this rate of progress, which would be equal in a rectilinear course to about 15,000 miles; but the whole length of the track does not exceed 3,000 miles: we thus have strong evidence of the rotatory nature of these storms; for, if the wind move 90 miles an hour, and the whirls or eddies which constitute the storm move in a body, at the rate of only 18 miles an hour, it is clear that the motion of the wind must be in circles. It is curious also that these storms in a direction contrary to the sun's apparent daily motion; and, therefore, in the Northern

hemisphere, contrary to the motion of the hands of a watch, but similar to that motion in the Southern hemisphere, a result which would naturally be expected from their common origin, just as two wheels set in motion by anything passing between them must necessarily turn in contrary directions. The general progress of these storms is always away from the equator, and therefore reversed in the two hemispheres; but in both they have first a westward motion, until they escape the influence of the easterly trade winds, when they turn round in a hyperbolic curve and are drifted eastward by the prevailing westerly winds of each temperate zone. Throughout their course they increase in size, but diminish in intensity, until they are lost in the winds of high latitudes, the variable and fluctuating nature of which they greatly increase.

Sir John Herschel explains the origin of one of these rotatory storms by supposing a column of air, intensely heated at a particular point of the intertropical plains of America, to rise bodily from the lower stratum of the atmosphere with sufficient ascensional force to carry it into the upper current, but retaining the full westerly energy which it has derived from the earth's rotation. Now, nothing is more likely than that a [illegible] in its course should thus be produced, and that the portion thus driven upwards should, on its return, strike down far below, into the lower current. All the conditions necessary for a rotatory storm would then arise. A mass of air animated with immense velocity, has to force its way through an atmosphere either at rest or moving in a contrary direction—a state of things which in the

movements of fluids, is invariably accompanied with vortices on one or both sides of the moving mass, which continue to subsist and to wander over great tracts long after the original impulse is withdrawn. In such vortices the motions of translation and rotation may have any proportion; but the former is usually slow compared with the latter. An illustration of this kind may be witnessed at a mill-dam when the sluice is closed so as to allow the water to escape at some small hole. A funnel-shaped depression will appear on the surface, in which air descends, often to the actual hole of escape, though that is many feet below the surface, but often also as an interrupted column. All the movements of a rotatory storm are here represented by the revolving fluid. So long as the hole is kept open it retains a fixed position, at least at the lower extremity, fluctuating only by a bend of the column. But if the hole be closed, it immediately begins to wander, continuing often a long time, but gradually retreating upwards.

Volcanoes.

Volcanoes are mountains having openings or craters at the top. These craters are the vents of subterranean fire, from which issues burning matter or lava, together with stones, ashes, and mud. Volcanoes are so termed from the heathen deity Vulcan, the mythical god of fire, who was supposed by the ancient Greeks to reside under Mount Ætna, engaged in forging thunderbolts for Jupiter.

Volcanic eruptions are generally preceded by certain

peculiar phenomena, such as a densely close atmosphere, and great stillness of the air; a low rumbling subterranean noise is then heard, followed by columns of thick smoke and showers of stones, issuing from the crater, the stones being projected to an immense distance with a thundering noise.

Earthquakes are those violent up-heavings and rockings of the earth which generally precede the eruption of a neighbouring volcano. When these are felt at short distances from the seat of volcanic action, they are accompanied by fissures or chasms in the earth. Another kind of earthquake shakes extensive tracts of country, but is unaccompanied by these openings of the earth, and followed by less dreadful consequences.

Those volcanic mountains which have ceased to throw out lava, are called extinct volcanoes; those which have done so within the memory of man are named active volcanoes.

The first shock of an earthquake is generally the most severe, the following ones gradually decreasing in force. The single shocks of an earthquake last from a few seconds to two or three minutes. In Europe, the active volcanoes are those of Ætna in Sicily, Stromboli in the Lipari Islands, Vesuvius in the Neapolitan tract, and Hecla in Iceland.

In Africa, the volcanic district is found chiefly in the islands, the most celebrated volcano being the Peak of Teneriffe in the Canaries.

The volcanic district of the new world is principally on the west of the continent, along the line of the rocky mountains and the Andes.

The northern extremity of the volcanic region of America is continued into Asia by the Peninsula of Alaska and the Aleutian Islands. The line of volcanoes extends through Kamschatka by the Kulu Islands into Japan, and is thence prolonged by the Philippine Islands through the Moluccas and the Sunda Islands into the Bay of Bengal, and northward along the entire coast of Arracan and Chittagong. In the line just traced the most active volcanoes in the world are found.

Earthquakes are of rare occurrence in the Peninsula of India, south of 15° of Latitude, though they are sometimes felt across the north of Nellore by Ongole into Kurnool.

The only authentic account recorded of any earthquake on the coasts of India from Bombay to Calcutta is that of the eruption at Pondicherry in July 1757. Fires were seen from Pondicherry to break out on the surface of the sea three or four leagues from shore, throwing up pumice stone and combustible matter, accompanied with a noise like thunder or the roar of artillery. An island about a league in length and the same in breadth appeared above the waves with a cone in its centre. Vast quantities of fish were found on the surface of the sea, killed by the eruption, and the sea for several days afterwards was covered with pumice stone, so that vessels had difficulty in making their way through the water, while they ran the risk of being burned by the showers of hot ashes with which the air was darkened. The island speedily subsided again.

The earthquake of 1819 in Cutch, elevated the

Ulla-Bund a mound 70 miles in length, 16 miles in breadth, and 10 feet high; sank the Runn of Cutch; and created a salt marsh 2,000 miles in area; laid the cities of Ahmedabad and Bhooj partially in ruins, and more or less injured every building in the province. In 1755, the town of Lisbon was completely destroyed by an earthquake the most destructive that ever occurred in Europe. It is said that thirty thousand persons perished by it. Another celebrated earthquake, accompanied by an eruption of Mount Vesuvius, happened about A. D. 72, in the reign of the Roman Emperor Titus, by which the cities of Herculaneum and Pompeii were buried in the mass of burning lava that issued from the volcano.

Uses of Volcanoes.—As the ingredients of which the earth is composed are deposited in layers one above another, it would be impossible, in most instances, to reach any of the lower rocks in their natural position, and render them available for the use of man. But by volcanic action, the different strata of rocks and earths have been heaved up into sloping positions, so that strata originally deep in the bowels of the earth are brought near the surface, and sometimes exposed in clifts to the air. Volcanoes are also a useful provision as the safety valves or chimneys by which elastic matters are permitted to discharge themselves without causing too great a strain on the surface of the earth.

ELECTRICITY AND THE ELECTRIC TELEGRAPH.

The English word 'Electricity' is derived from a Greek work signifying amber. In early times it was observed that amber when rubbed acquired the power of attracting light bodies, such as hair and feathers. At a more recent period, it was discovered that glass and wax or any resinous substance acquired the same property, and emitted a bright sparkling fluid. This has been called the Electric fluid.

Electricity, like heat, appears to pervade all substances. If we excite a piece of glass or a stick of sealing wax, by rubbing it on a piece of woollen cloth and put it near any light substance, say a ball of pith, the following phenomena will take place. The excited glass, on being brought near the ball, will attract it, and on removing the glass, and again advancing it to the ball, the ball will be repelled. The same thing will take place if we substitute wax for glass. But if, when the ball is electrified by the glass, we then apply the wax, the ball, instead of being repelled, is attracted; and so also when the ball has been electrified by the wax, the glass, instead of repelling, attracts it. Hence we see that the electricity produced by glass, differs from that produced by resinous bodies; the former is called vitreous or positive electricity, the latter, resinous or negative electricity. When any substance is charged with more than its natural quantity of electricity, it is said to be negatively electrified. Those substances that are capable of receiving more than their ordinary share of electricity, as, for instance, glass, wax, amber, dry air,

feathers, silk, cotton, wool, are called electrics. They are also called non-conductors of electricity, because, although they are themselves capable of producing electricity, they do not convey it from one body to another. Another class of substances is called non-electrics, because they do not exhibit electricity when rubbed. The principal of these are the metals, and all fluids except oil and dry air. These are also named conductors of electricity, because they have the power of conveying it from one substance to another. Although this distinction is generally made, it is very probable that all substances are more or less conductors of electricity; and for the words conductors and non-conductors, might be substituted, quick conductors and slow conductors.

The immense velocity possessed by electricity, and its instantaneous arrival at different parts of a metallic tube however long, has suggested the idea of employing it in conveying signals from one part of a country to another. For this purpose, iron wire is laid down between two places, and the electric signal which is communicated at one end of the wire is conveyed to the other in an instant of time.

This invention has been named the Electric Telegraph. The word telegraph is derived from the Greek *tele*, at a distance, and *grapho*, I write.

The essential parts of an electric telegraph are three in number, viz., the battery, the wire, and the instrument. The electrical power is derived from the battery; the wire is the channel or path which conveys the electrical force from the battery to the required

point; by the instrument the signals are made or the words printed.

The simplest form of battery is a water-tight box or trough partitioned into cells by pairs of zinc and copper plates, so arranged that the copper plate of one pair and the zinc of the next are on opposite sides of the same cells. These cells are filled either with a diluted acid or a solution of some salt which acts chemically on the zinc.

Attached to the single plates at the ends of the battery are screws called poles, and to these are joined wires which connect the battery with the instrument, or one battery with the next, when more than one battery is used.

The wires which transmit the electric force from the battery are suspended on posts of wood along the lines of route, by means of rings or tubes of glass, earthenware, or porcelain. These substances are preferred because they are non-conductors, and so do not allow any portion of the electric current to escape. These insulators must be protected from rain, because, if water wets the surface of glass or porcelain, it loses its non-conducting property and a portion of the electric current would escape along the posts to the ground. For the same reason, when the wires are conducted through damp tunnels or places where they are liable to be exposed to wet and damp, they cannot be suspended in the usual way, but are preserved in a coating of gutta percha or some other material impervious to wet.

Besides frictional electricity, there is voltaic or galvanic electricity; and the introduction of Volta's battery constituted a most important epoch in electrical applications, as producing those electrical phenomena arising from the chemical agency of certain metals with different fluids. The agent itself is denominated galvanism, from its discoverer Galvani. The action of the electric current so produced upon a magnetized needle was next discovered. It was then suggested that this needle might be made by the galvanic current to give signals at a distance. At first, a number of needles were required. These were placed near to, and parallel with, the wire, so as to be influenced by the electric current passing through it. Each needle represented a certain letter, and the movement of any needle by the electric current showed that the letter for which that needle stood was to be taken as part of a communication or telegraphic message.

Telegraphic instruments are varied in form and in their modes of working. The one formerly in general use was called the *Indicator* telegraph, in which the signals were given by the movement either to right or left of a pointer or indicator, acted on by an electric current passing through a coil of wire. For instance, one movement of the needle to the right may indicate *a*, two to the right *b*, and so on, to the first half of the alphabet; again, one movement to the left may indicate *m*, two movements of the needle in the same direction *n*, and so on to the end. Recently, however, this has been superseded by the *printing* instrument; which, instead of indicating the letters of a word,

prints the words themselves; but the description of this would be too lengthy for insertion.

Telegraphic wires are not now confined to land. The immense advantage it would be to connect different countries and continents by sub-marine telegraphs becoming apparent, many attempts have been made to submerge wires at the bottom of the ocean. The principal difficulty to be overcome in this attempt is to prevent the sunken wire from being injured by rocks, ships' anchors, and the action of currents and tides. For this purpose it is usual to encase the wire in gutta percha and then surround this with a very strong and durable cable formed like a rope, only of twisted wire instead of coir or hemp.

A telegraphic wire connects Ceylon and India which works well. There is also a telegraphic line from Calcutta to Madras, and between Madras, Bombay, and Calcutta, but owing to the nature of the country through which it passes, and especially from the powerful action of atmospheric electricity in stormy weather, these lines are often out of working order. The continents of Europe and America are connected by two cables which span the Atlantic.

By means of a cable along the Persian Gulf there is now almost daily communication between India and England, the route being from Bombay to Kurrachee, thence to Bushire, up the Gulf, across Turkish territory into Europe; while in Europe there are various lines leading to London. The continent of India, under the able direction of Sir R. O'Shaughnessy, appears to be well supplied with electric telegraphs.

That gentleman, writing before the late mutinies, which caused much destruction to telegraphic lines, says, "The telegraph lines constructed under my direction during the two preceding years extended in unbroken range from Saugor light house, at the mouth of the Hooghly, to Peshawur, beyond the Indus, viâ Calcutta, Benares, Cawnpore, Agra, Delhi, and Lahore. From Agra the line stretched south to Gwalior, Indore, and Bombay; and from Bombay traversed the Deccan, viâ Poona, Belgaum, and Bellary, to Bangalore and Madras. Lastly, from Bangalore, a line ran south to Mysore and the Neilgherry Mountains." It is stated that in October 1858, there were open and in working order7, 155 miles of electric telegraph in India; and the distance has since been increased, especially by the telegraph which is laid down on the railways, and which is the property of the companies. The other lines belong to Government.

STEAM AND THE STEAM ENGINE.

By the application of heat, water may be converted into aqueous vapour or steam, in which state it occupies more than 1,700 times its former space. Steam is transparent and colourless, and when it first issues from a vessel of boiling water it is invisible, but it becomes visible on contact with the cooler air which condenses the moisture and makes it like a cloud. The elastic force of the vapour arising from water boiling in an uncovered vessel is equal in pressure to the air, viz., 15 lbs. on every square inch of surface, but

when water is boiled in a close vessel, such as a steam boiler, where the steam is not permitted to escape, the force goes on gradually increasing, and unless an opening is made in the boiler it must eventually burst with a loud explosion. It is this elastic force of steam which acts in the steam-engine, and which, mismanaged, causes the many fearful accidents from the bursting of steam boilers.

Steam is now an indispensable agent in the arts and manufactures, and it has accomplished a complete revolution in the modes of sea and land travel.

The production of the steam engine is undoubtedly one of the greatest triumphs of modern science. The name of Watt is inseparably connected with the steam engine, as it is to him and others who followed in his steps that the world is indebted for the successful application of steam power to the purposes of navigation and inland communication. The elastic force of steam has been already mentioned. In order to measure the elastic pressure of steam in a boiler, a bent tube called a barometer guage is used. This tube is open at both ends, which are curved upwards, one end communicating with the interior of the boiler, the other end being left exposed to the air. In the bend of the tube and rising a short way up the branches is placed a quantity of mercury, to prevent any communication between the air without, and the steam within the boiler. If then the steam in the boiler be equal in elastic force to the external air, the pressure on the mercury will be the same on both sides, and the mercury will be

when the piston is at the highest point of its stroke, suppose this arrangement reversed, that is, E to be opened to the boiler and F not; then the steam rushing in above the piston will drive it downward, and the steam which is below the piston will escape through F either into the outer air or into a vessel provided for the purpose, it being so contrived that the arrangement which opens E to the boiler cuts off the communication of F. If this alternate opening of the pipes be effected by some contrivance, it is manifest that we shall obtain a continuous oscillating motion of the piston C.

The contrivances for the alternate opening of the pipes are various; in the figure we have represented a simple and common one. G is a steam-tight box which is made to slide up and down by means of the rod GH; the magnitude of this box or slide is such that when one pipe is just covered the other is just uncovered, and while one of the steam-pipes, as F in the figure, is uncovered by it, the other (E) communicates through it with the vent pipe K. If then the rod HG has exactly the reverse motion of the rod CD, so that one shall rise when the other falls, it is evident that what was required will be done.

It is clear that the pressure on the piston throughout the stroke will not be uniform, because, with one of the pipes E, F, is being shut and the other opened, they will both be partially open, and consequently there will be an influx of steam both above and below the piston; in fact, at the middle of the stroke there will be as much steam pressure on one side of the piston as on

the other. This difficulty is obviated by the use of a *fly-wheel*, which is a large heavy wheel turned by the rod CD, and which by its momentum carries the machine past the half stroke and also tends to equalize the motion throughout.

The manner in which CD is connected with the fly-wheel, and the motion of the rod HG produced by an eccentric crank on the axis of the fly-wheel, we shall not here describe.

The steam, when allowed to escape from the cylinder, through the pipe K, may be permitted either to escape into the outer air, or else to flow into a closed vessel in which it is condensed, and the water formed by it pumped up again into the boiler to be re-converted into steam.

In the former case, the pressure of the atmosphere is allowed to act on the piston, and must be overcome by the greater pressure of the steam on the opposite side: hence, in order to produce a given effect, the elastic force of the steam, and consequently the quantity of fuel employed, must be much greater in this case than when the steam is allowed to escape into a condenser; engines on the former construction are called *High Pressure*, on the latter, *Low Pressure* engines.

The high pressure engine has also this disadvantage, that the interior of the cylinder is cooled by being open to the atmosphere, and consequently when the steam is again admitted some portion is condensed and rendered ineffective.

It is usual to cut off the steam before the piston has attained to the end of its stroke, and to allow the stroke to be completed by the elastic force of the steam already injected; by this arrangement not only is less steam required, but also the motion is more uniform.

An earlier and imperfect form of the steam-engine was the *atmospheric* engine, in which the piston was driven up by steam, and a vacuum having been produced below it by an injection of cold water, the piston was driven down by the atmospheric pressure above. The capital defect of this construction is, that the cylinder must be cooled down at every stroke, and consequently when the steam is again admitted a very large quantity is condensed, and there is an immense waste of fuel. This construction has consequently almost entirely disappeared."

LOCOMOTIVE STEAM ENGINE.

Of all the uses to which steam has been put, none is of greater importance than its application to locomotion. For this reason a sketch of the principal features of the Locomotive or Railway Engine will prove both interesting and instructive.

The Locomotive Engine consists of a strong cast iron frame, supported upon six wheels, the two larger ones being named the driving wheels. On this frame rests a boiler of a cylindrical form, made of plates of wrought iron rivetted together, and covered with a wooden casing to check radiation, and thus economize the heat. In front of this boiler is a chimney, and attached to the other end is a furnace having a grating at the bottom for the reception of fuel. This furnace consists of a conical iron box with double sides and top, enclosing within them a layer of water about three inches thick. The smoke and hot air from the fire enter a number of small tubes which

pass along the lower part of the boiler towards the chimney. By this arrangement, the smoke and hot air from the furnace are made useful in heating the water in the boiler, and promoting the rapid generation of steam. From the boiler, the steam passes into the cylinder which is placed near the bottom of the chimney, and in this cylinder, as already described, works the piston.

The lower end of the piston rod communicates motion to one angle of a piece of iron machinery of a triangular form, which moves upon a hinge at one of the opposite angles. The remaining angle of the triangle is attached to a rod, which, by means of a crank, works the wheels of the carriage. The motion of the triangle converts the perpendincular movement of the piston rod into a horizontal one of the rod which works the wheels.

In all steam carriages, either for railroads or common roads, and in almost all steam-boats, there are two distinct engines working two cranks on the main axles, which bear the driving wheels in carriages, and paddle wheels in vessels. The chief object of this is, to obviate a defect in the crank. When a crank with its rod revolves, there are two points in its revolution where neither pushing nor pulling will tend to make it revolve. These points are called the *dead points*, past which the crank is carried simply by its momentum. When, therefore, two cranks are placed on the same axle, they are set at right angles to each other, so that the *weak* or *dead points* of the one may correspond with the strongest points of the other. To

accommodate them to this arrangement, one engine is always half a stroke later than the other, so that there is no danger of both the cranks arriving at once at the dead point. Were they to do so, not only would the motion be uneven, but the cranks would probably be broken off short.

The engine driver has the power of altering the course of the steam, and thus reversing the action of the engine, and consequently of the wheels, so as to move the engine backwards and forwards at pleasure. The engine driver performs this operation and many others by means of handles extending to the back of the engine where he is situated.

Attached to the engine is a carriage called a *tender*, which contains the water and fuel, and the water conveyed to the boiler by means of a pump worked by a part of the machinery connected with the engine.

THE RAILWAY.

A Railway is a road having a smooth and solid foundation upon which are laid down rails of wood or iron in two narrow tracts, along which the wheels of a carriage roll with ease and velocity. The term railway is applied to such road, whether the carriages be drawn by steam power or horse power. Railroads were in use long before steam power was applied to the purposes of locomotion, and they were originally employed for the purpose of conveying coal from the mouth of the coal-pit to the nearest depôt or place of shipment.

The success which had attended the invention of the steam boat, suggested the idea of employing steam in impelling carriages on land. But before this power could be successfully applied to land travel, a particular kind of road was necessary, and such as should be free from all the obstructions of the common road. A perfect railway should be upon one uniform level from end to end, but the irregularities of the earth's surface resulting from the presence of hills and valleys, rivers and canals, and the difference in the level of the places between which the railroad runs, in most instances renders the formation of such a line an impossibility.

When a railway is projected between two towns, a careful survey of the intervening country takes place, the geological structure of that part of the country is investigated, the elevations and depressions of the land are calculated by competent persons, and, from the data thus obtained, the civil engineer can determine how far the proposed road will require to deviate from a direct line between the two places, and the number of ascending and descending inclinations which will be necessary, or, in other words, what will be the curves and gradients in the line of road.

The lateral deviation from a straight line in a railway must be made in curves of considerable length, short curves not being compatible with the form of the wheels of the carriage, or the rates of railway speed. The deviations from the horizontal level form the inclinations or gradients of the railroad. The works necessary to get rid of these gradients, and to

form a railway, independent of the laying down of rails are tunnelling, excavations, embankments, and masonry for bridges, viaducts, and other erections.

The most formidable of these works is tunnelling. Tunnels are arched openings passing under a hill or elevated country, which happens to lie in the line of railway. They are avoided as much as possible from the great time and expense they involve. Cuttings are made instead of tunnels when the railway passes through ground not so high as to necessitate a tunnel. The depth of cuttings is sometimes as much as sixty or seventy feet, and occasionally even more.

Embankments are the artificial ridges of earth formed to support the railway or a higher level than the natural surface of the ground. The earth for the purpose is generally obtained from the cuttings on the same line, so that an engineer always endeavours to have an embankment and a cutting going on at the same time. Embankments ought to be provided with strong parapets to prevent the train from falling over in the event of its running off the line.

Bridges are required when the railway crosses rivers, and sometimes at the intersections of roads.

Viaducts are necessary to cross valleys at an elevation higher than could be conveniently obtained by an embankment, and also for entering and passing through towns. They are usually built of stone or brick, sometimes of wood or iron. The inclinations of the earth or rocks that form the sides of both embankments and cuttings are of material importance, and these must be determined by the height and the nature of

the material excavated, the less solid the material, the greater being the slope necessary. In passing through rock or chalk cliffs, the excavations may have steep sides. The banks of the railway must be preserved with great care; for this purpose spade cuttings should be made in the form of the letter V for the draining of water, as the giving way of many earthworks is to be traced to the want of good drainage. The banks should also be covered with turf or sown with grass to give them greater stability and prevent them from slipping. The railway should also be properly fenced in with some of the ordinary kinds of fencing, or with stone walls, to prevent people or cattle from straying on to the line. The timber of the sandal or bamboo tree is generally used for the purpose in Indian Railways.

When the embankments, bridges, viaducts, and other works mentioned have been completed, the *permanent way* is then constructed. This is done by spreading over the road a layer of broken stone. In this ballast, as it is called, the sleepers are embedded. The ballasting is generally from 18 to 24 inches in thickness, and consists of a mixture of chalk and flint or gravel and broken sandstone. The drainage of the permanent way must also be carefully attended to.

In the earlier railways, when waggons were drawn by horse power, wooden rails were invariably used. This kind of railway continued in use for 150 years, and no change was made upon the roads till the introduction of cast iron plates upon the wooden rails. These again gave place to rails made entirely of

cast iron, and afterwards of malleable iron as being more durable though not so cheap. When iron rails were substituted for wooden ones, the resistance of the wheels to the surface of the rail was much lessened, and in descending inclines a species of crooked lever known as a break was attached to the wheel, by which the driver could regulate the speed of the waggon. Double, or self-acting, inclined planes were also common, by which the surplus force of gravity which one carriage acquired in descending impelled another carriage up the ascending plane. The rails are cast in lengths of 15 feet, and the ends are so made as to lap over one another. These ends fit into a cavity in a cast iron chair or pedestal which is fastened down to a block of stone or wood termed a sleeper, which is embedded in the road. The *guage* or width between the rails is of great importance, as on it depends to a great extent the kind of locomotive to be used, the size of the passenger carriages, the bulk of merchandize and goods to be conveyed, the steadiness of the motion, and the safety and facility of passing round curves at a high rate of speed. It has also an influence on the quantity of land required for the line, on the width of bridges, tunnels, viaducts, and embankments. In England, there are guages of two widths termed "the broad guage," and "the narrow guage." The former is that of the Great Weste. Railway which extends from London to Exeter, but "the narrow guage" is now preferred and adopted in all new lines. In India, a guage is adopted called "the Indian guage" of a medium width between those of the two English guages.

Contrivances for conducting engines and carriages

rom one line of rail to another are required in a variety f situations. These are termed *switches* and *turn-tables*. Switches are moveable rails placed at the points where wo tracks of rail fall into one, and adjusted so as to guide vehicles from one track to the other, as required. Turn-tables are used at stations for the purpose of conveying a single carriage from one line of rail to another. The carriage is pushed on to a circular platform, the rails of which correspond with those of the railroad. The platform is then wheeled round upon a pivot in the centre till its rails upon which the carriage rests correspond with the other line of rails to which the carriage is then moved.

The wheels of the carriage are made with a projecting rim called a flange, which, by coming in contact with the sides of the rail, prevents the carriage from running off the track. One flange on each wheel is sufficient for this purpose. The carriages and waggons employed are very strongly built and of large size in order to resist the great shocks to which they are constantly exposed. They are built low, and the great weight of the wheels and axles and framing prevents them from overturning easily. The carriages are linked together by a screw termed a *coupler* and two strong chains; these last, however, hanging loosely, being called into use only when the coupler breaks. Injury from concussion is prevented by contrivances called *buffers*, which are attached to the springs of the carriages. These buffers being of the same width and height in all the carriages, they must come in contact, when, in consequence of a sudden stoppage, the carriages

are liable to run into one another, and the elast
the springs on which the buffers are fixed prev
great shock to the carriages or passengers.

At important points on the line and at the t
of the railway, stations are built. The train on n
a station previously lessens its speed gradually
it is stopped at a platform of stone or wood, on
the passengers descend from the carriages. I
station are the booking offices, refreshment room
waiting rooms, and at large stations are erected
for carriages, luggage, and parcels, and shops f
repair of engines and carriages.

It is difficult to estimate what may ultimately
the effects of railroads upon civilization. But
do know even now, that they are of the greatest
vantage to commerce and agriculture, opening up n
channels of industry, commerce, and wealth—that t
are the best safeguards against insurrection; and t
enemies of caste and custom.

Looking at them in a commercial point of view, th
bring within reach the production of places hither
inaccessible, and introduce into the market produc
which before were valueless from the want of mea
of transport, thus becoming the source of wealth a
prosperity to individuals. They are the best safeguard
to countries against internal insurrection or extern
aggression, as by this means, news of disturbance
attack can be rapidly conveyed from one part o
country to another, measures of defence taken, a
an overwhelming force concentrated on a requis
spot in an incredibly short space of time.

They make travelling easy, and facilitate the means of communication between different countries. By travel we increase our knowledge, and are enabled to throw off the narrow-mindedness and self-conceit of the man who has seen nothing beyong his native village, and divest ourselves of those prejudices which we are apt to form against those whose manners and customs and institutions differ from our own. Travelling tends to explode that selfish and superficial philosophy which teaches man to confine himself within the horizon of his birth-place, and to regard as barbarian in comparison with himself the rest of the world.