THE MANUFACTURE OF INDIA RUBBER.

An industry is easiest created, and progresses best, with cheap raw material and high price of manufactured product; but as processes improve and applications increase, the raw material becomes dearer and the finished goods bring less price. Competition aids to injure the industry when it seeks modes of adulteration or lowering the grade. If consumers know something about the manufacture and about these adulterations, they can aid in keeping up the grade of the product. The india rubber business has rapidly run down. At first the raw material was very cheap, and the product six times as high, weight for weight. Now the finished material sells at about the same price per pound as the main ingredient, often much lower! Unscrupulous makers, knowing that consumers knew nothing about the material or its manufacture, endeavored to keep up the *density* of the products at the expense of their other qualities. Purchasers would have heavy goods, and they got them with a vengeance. The following paragraphs will aid the consumer to distinguish, and the reputable manufacturer to sell, good grades of manufactured caoutchouc.

Caoutchouc is an elastic gum, composed of hydrogen and carbon. It forms as a milky juice, exuding from incisions made in certain varieties of trees growing in nearly all intertropical regions. After partial drying, this juice is sent to us in the shape of pears, balls, slabs, blocks, etc., containing a large proportion of water, and generally much foreign matter, as earth, wood, resin, etc.

Crude caoutchouc comes to our factories in different shapes; each country producing it having its peculiar manner of gathering, drying and shipping.

Our engraving shows the manner of gathering and drying rubber in the province of Pará, in Brazil. The tree is tapped in the morning, and during the day a gill of fluid is received in a clay cup placed at each incision in the trunk; this, when full, is turned into a jar, and is ready to be poured over a pattern of clay or a wooden last covered with clay, the form of which it takes as successive layers are applied. Its drying and hardening are hastened by exposure to the heat and smoke of a fire.

The quality is more variable than the appearance. All india rubber, when perfectly freed from foreign matters, possesses the same physical and chemical properties, but in varying degrees; the prices, on this account, varying even 100 per cent; thus, the price of African gum being unity, that of Pará is 2 and even 2½. The African gums lose much in washing; however, the difference in the loss is far from equaling that in the price.

Completely pure india rubber is solid and white; density 0·925; at our normal temperature (say 15° to 20° C., equal to 59° to 68° Fah.) it has great elasticity, which it loses below 0° C. or above 50° C. (32° and 112° Fah.); freshly cut surfaces rejoin with the greatest ease. It is unalterable by alkalies or strongest acids; however, it is destroyed by boiling nitric or sulphuric acid, or by a cold mixture of these two. It is more or less soluble in turpentine, liquid coal oils, sulphuric ether, bisulphide of carbon, and all fatty bodies.

At first, caoutchouc was manufactured and used in its normal state. It was cut into strips, and threads, and stretched into sheets; with these strips or sheets were made tubes and other similar objects possessing all the above mentioned properties. But despite these advantages, these objects had the undesirable property of hardening with cold and softening with heat, which greatly hindered the employment of caoutchouc; and its use could never have attained a great development if the discovery of "vulcanization" had not opened out new and unexpected avenues.

Normal caoutchouc being very little used in the arts, it is important to study it in the vulcanized condition.

The first process to which all grades of rubber are submitted is washing, generally effected by passing through cast iron rollers, having different speeds, and drenched by a current of water. The difference of speeds produces a tearing of the rubber, and exposes all its particles in succession to the action of the current of water; the impurities adhering are carried away; and instead of sheets having an integral section, there are obtained granulated and flaky strips, very well suited for subsequently drying out not only the washing water but that contained in the gum on its arrival.

Drying is done in chambers heated to 20° to 50° C. (68° to 112° Fah.), according to the gum. The loss from washing and drying (it is very important that the latter be complete) is at least 12 per cent for "dry and fine" Pará gums, 18 to 25 per cent for medium grades, 30 to 48 per cent for inferior grades.

The preparation is continued by grinding and kneading, which can be done by passing the gum alone through powerful crushers, or by passing it, mixed with solvents (as benzine or bisulphide of carbon), through less powerful apparatus.

These grindings and kneadings have a double purpose; they increase the adhesive qualities of the natural gum, and bring it into the semi-pasty state necessary to its rolling out into sheets or its application to fabrics.

The making into sheets is done either by huge calender rolls heated by steam or by spreading or stretching machines.

Sheets of pure rubber or of rubber-coated fabric are the starting point of nearly all manufactured objects, such as vulcanized threads, clothing, belts, hose and tubing, valves, toys, etc. These are vulcanized after being made up, and are then put into the market.

GATHERING AND DRYING RUBBER IN PARA.

If a certain proportion of flowers of sulphur be intimately mixed with well washed, dried, and kneaded rubber, and the mixture be placed under such conditions as to lead to the crystallization of the sulphur, there is effected a complete transformation. The soft and little tenacious product becomes elastic and tenacious; it was adhesive, sticking easily to itself, and dissolving readily in essences, and now it is no longer coherent when freshly cut, and is completely insoluble in all known menstruums. From being hardened by cold and softened by heat, it preserves its elasticity from the lowest temperatures almost to its point of decomposition, or about 180° C. (356° Fah.).

Caoutchouc thus transformed has received the name of "vulcanized" rubber,* and the term vulcanization is applied to the time during which this remarkable change takes place.

Does vulcanizing cause a chemical combination between the sulphur and the caoutchouc, or are the properties which it communicates to the gum simply the result of the interposition and the crystallization of the sulphur in its pores? It seems necessary to suppose both cases in explaining all the facts pending and subsequent to vulcanization.

When the vulcanized objects are not over 0·0015 millimeter in thickness, vulcanization can take place at the same time with the introduction of the sulphur; it sufficing to plunge the objects in a solvent of caoutchouc, susceptible of being mixed with a sulphur compound which decomposes easily and liberates free sulphur, such as a mixture of bichloride of sulphur and sulphide of carbon, or of benzine and bisulphide of hydrogen. During immersion, the solvent swells the rubber and penetrates into its pores, carrying with it the sulphur compound; the object is withdrawn very soon and the solvent evaporated, resulting in the abandonment and crystallization of the sulphur.

Another method consists in exposing the object to be vulcanized in a bath of melted sulphur at about 125° to 150° C. (257° to 302° Fah.). These two processes have the disadvantage of being inapplicable to thick objects; furthermore, their execution is delicate, demanding great skill. They are thus little employed and of insignificant importance compared with that consisting in the introduction of sulphur and mixing it mechanically during the kneading which the gum must undergo in any case. This does not in the least interfere with the making of the sheets or other objects, which are then placed either in a heater tightly closed and kept at a high temperature, by steam or hot air; or in liquid baths at a temperature of 112° C. (say 234° Fah.), the melting point of sulphur.

For a given quantity of caoutchouc there are three variable elements: the quantity of sulphur, the temperature of vulcanization, and its duration.

The action of the sulphur upon the rubber not causing a definite combination (if indeed there be any actual combination), one cannot, in the present state of the art, give precise rules for the relation of these three variables; one can only say, in general terms, that there must be (1) the least possible quantity of sulphur, (2) the temperature be as little as practicable above the melting point of sulphur, and (3) the vulcanization must be as prolonged as practical manufacture permits.

It is no less difficult to point out the characteristics enabling one to recognize, when the operation is concluded, whether the object be well or badly vulcanized. Long experience gives certain indefinable tests or indications; however, although very important, these do not afford the exact certainty which the importance of the subject renders so desirable.

Vulcanizing, the crowning point of the manufacture, is also the most delicate and serious. Done under good conditions, all other things being equal, it gives an object its maximum of good qualities. Badly done, it gives them the same qualities for a short time, after which they quickly disappear; and before long the rubber loses its elasticity, becomes hard and brittle, and cracks and splits with the least little thing. Badly vulcanized rubber goods lose all merchantable value, and are fit only to be ground up and mixed as so much inert matter (often hurtful matter) in other manufactured objects.

The discovery of the influence of sulphur on normal rubber was due to chance, which was also, for a long time, the only guide of the first manufacturers. Afterward, for each kind of rubber, there were combined, in every possible manner, the three variables of sulphur, temperature, and time. Specimens were made and carefully kept and examined after several years, this examination showing what were the combinations best adapted to practical use.

If, on the one hand, one thinks of the numerous grades and qualities of the crude gum, and on the other one figures up all the combinations which can be given to the three variables, one will understand the multiplicity of the preparations of india rubber, and also the secrecy with which the manufacture is still surrounded, each maker naturally guarding the happy combinations which he has discovered.

The gum, during the grindings and kneadings preceding its moulding or spreading, can receive, besides the sulphur necessary to its vulcanization, other and very widely differing additions. The employment of these additions has been caused by the necessities of manufacture and by the aid which adulteration gave in lowering the price.

For the latter purpose, there is generally used old ground up vulcanized rubber. This worthless débris is ground to

* Goodyear at first used the word "metallized."

fine pulp, and can be mixed with normal gum in indefinite proportions. It defies the test of specific gravity and the most minute analysis, and permits the manufacturers to say that they "use only pure rubber;" while it really lowers the elasticity and tenacity of the goods, in proportion as it is used. It has been endeavored to lessen the bad effect of its addition by attempts at devulcanizing it, that is, at multiplying the effect of the sulphur and bringing the material back to the normal state; but notwithstanding the most earnest efforts and researches, the result has not been completely obtained. The gum has been decomposed and then given an adulterant with a value a little greater than purified mineral bitumens; but it has not been devulcanized, and, whatever its condition, the material still remains only the most easily employed adulterant of pure caoutchouc, and consequently the greatest enemy of pure fabrications.

The foreign matters generally employed are earthy or metallic salts. They are either inert, that is, exercising, at the temperature of vulcanizing, no chemical action upon the mixture of sulphur and gum; or they are active, that is, forming sulphides in the pores of the raw goods, and at the temperature named.

Inert materials are introduced either to give colors more pleasing than the natural one (in which case zinc white, lampblack, vermilion, etc., are used), or to reduce the too great elasticity of the pure material (for this purpose powdered chalk, talc, kaolin, etc., answer).

Active materials are to facilitate vulcanization, and are principally employed when the rubber is to be applied to preserve or join tissues. The combination of these active materials with proportions of sulphur and of gum effects in the mass a disengagement of heat, which simplifies the work due to vulcanization and permits of lessening the temperature and duration, which are highly conducive to the longest possible duration of the prepared tissues. Lead salts being cheap, and having a great affinity for sulphur, are given the preference. Lime and calcined magnesia answer well, but can be added in but small proportions, their principal rôle being to prevent the holes or cracks produced by the sulphur vapor in certain combinations containing a large proportion of admixture, or in pure preparations that are too much worked.

There are employed certain undefined polysulphides, so prepared as to contain free sulphur precipitated at the time of their formation. Of these we might mention sulphide of antimony, which gives that preparation of caoutchouc known as mineralized; also the analogous supersulphides of lead. These salts are difficult and expensive to make, and their high price prevents their use in making goods of secondary importance.

ASTRONOMICAL NOTES.

BY BERLIN H. WRIGHT.

PENN YAN, N. Y., Saturday, August 17, 1878.

The following calculations are adapted to the latitude of New York city, and are expressed in true or clock time, being for the date given in the caption when not otherwise stated.

PLANETS.

	H.M.		H.M.
Mercury sets	7 44 eve.	Saturn rises	8 30 eve.
Venus rises	2 56 mo.	Saturn in meridian	2 29 mo.
Jupiter in meridian	10 21 eve.	Neptune rises	9 59 eve.

FIRST MAGNITUDE STARS.

	H.M.		H.M.
Alpheratz rises	6 26 eve.	Regulus	invisible.
Algol (var.) rises	8 06 eve.	Spica sets	8 57 eve.
7 stars (Pleiades) rise	10 26 eve.	Arcturus sets	11 37 eve.
Aldebaran rises	11 45 eve.	Antares sets	10 56 eve.
Capella rises	9 12 eve.	Vega in meridian	8 48 eve.
Rigel rises	1 55 mo.	Altair in meridian	9 59 eve.
Betelgeuse rises	1 41 mo.	Deneb in meridian	10 52 eve.
Sirius rises	3 57 mo.	Fomalhaut rises	9 06 eve.
Procyon rises	3 31 mo.		

REMARKS.

Venus is in the constellation *Gemini*, about 2° from its eastern boundary, and exactly in the earth's path, being at her ascending node. Jupiter is in the head of the Goat; and a line drawn from *a Capricorni* (a quintuple star) through *β Capricorni*, and produced 5°, will pass through Jupiter and form an arc of 8°. A most interesting occurrence may be witnessed by watching Jupiter's satellites on the evening of August 15. At 11h. 23m. evening the fourth satellite appears at Jupiter's eastern limb, having been occulted, continues moving eastward for twenty-seven minutes, and then disappears in Jupiter's shadow, not to emerge until after he has set. At the above mentioned time the first satellite is very near inferior, geocentric conjunction, and is therefore making a transit, having disappeared at 10h. 49m. evening, and reappearing at 1h. 9m. morning, of the 16th; the second is west of Jupiter, and is moving toward the planet; and the third is east about twice the distance of the second, and moving from the planet. With a good telescope the shadow of the first satellite may be seen, as a dark spot, to cross Jupiter's western limb thirty-three minutes after it begins the transit referred to, and to pass off at the east thirty-three minutes after the satellite does. Uranus will be in conjunction with the sun August 22.

The Undeveloped Regions of the Southwest.

An argument for the Texas Pacific Railroad dwells at great length upon the vast extent of territory to be developed by the road. All of Western Texas, all of New Mexico, Arizona, Southern Nevada, Southern Utah, and a large portion of Northwestern Mexico would be tributary to the road, an area of about half a million square miles in extent. The part within our own national bounds is equal in size to Germany and France combined, or enough to make ten States the size of New York, in all of which there is not a single mile of railway. The assertion that there was not enough arable land left in all the region to make a good sized county in Wisconsin was resented as a libel; a large part was unquestionably sterile, yet there remained a very considerable area of the highest fertility. The valleys of New Mexico, Arizona, and the bordering States of Mexico are exceedingly productive, when irrigated or where the supply of moisture is sufficient. The wheat is equal to that of California. Corn is a staple product, and in some parts two crops a year can be grown. Oats, barley, rye, peas, beans, and other food crops grow well and are very productive. According to locality, the peach, nectarine, apricot, plum, pear, and grape do well; oranges, lemons, olives, mangoes, bananas, and pine apples flourish; and sweet potatoes, rice, sugar cane, tobacco, cotton, coffee, cocoa, and indigo grow to perfection. Here too is one of the best wool growing regions of the Union; winter feeding is almost wholly unnecessary, and the pure dry atmosphere forms a perfect indemnity against foot rot and like diseases. The mining interests that would be developed by the road are admittedly very great. Our relations with Mexico and with the Southern Indians would be very much improved by the influence of the road. Areas along the Union Pacific, previously supposed to be beyond redemption, now bear abundant crops; a like effect would follow the building of the Southern road. Already settlements in anticipation have preceded the construction of the road in Texas. Complete it, and intelligence, science, and energy will bring into action dormant power now useless and almost unknown.

New Engineering Inventions.

Henry Exall, of Richmond, Va., has patented an Endless Chain Propeller, in which two endless chain propellers, moving around sprocket wheels, are arranged to run in open channels beneath the boat upon opposite sides of the keel, and propel the boat by securing a decided anchorage in the water. The main points of novelty are in the construction of the chain propellers, each of which is made of rod sections carrying midway between their jointed ends rigid disk paddles, the jointed ends being coupled by a shell which forms with nuts on the ends of the rods a double ball and socket joint, and also affords a hold for the grabs of the sprocket wheel. By inclosing the return chain box and supplying it with suitable pipes the current of air produced therein is utilized for purposes of ventilation. A vessel embodying the improvements is, we are told, being built at Richmond, Va.

John Paul, of La Crosse, Wis., has patented an improved Log Slide or log way employed in a sawmill for drawing up logs. The invention consists in an improved form of the slide and a novel construction of the links of an endless chain serving as a log carrier, whereby the operation of drawing the logs up the slide is greatly facilitated, and the labor considerably lessened.

Edward Huber, John C. Titus, Edward Durfee, and James F. Swinnerton have patented a Portable Engine. The objects of this invention are to lessen the bulk or size and thereby reduce the weight of the engine, as compared with others of its class; also to obviate the danger of injury to flues or flue sheet, and the labor, delay, and expense incident to repair of the same. The engine possesses several other novel features, which cannot be properly described without an engraving.

Charles E. Clark, of Rochester, N. H., has patented an improved Hose Pipe and Nozzle, which is made in straight sections of different diameter, and provided with an inwardly projecting annular edge at the inner end of each section, the object being to reduce the friction between the water and inner surface of the pipe and nozzle by dispensing with tapering surfaces and causing a portion of the water to act as a guide or friction surface for the stream passing through the nozzle.

Walter Dawson, of Scranton, Pa., has patented an improved Feed-water Heater for Locomotives, in which the surplus steam is conducted from the boiler and discharged into the tender through a pipe suitably arranged for the purpose, thereby effecting a considerable economy of fuel by heating the water preparatory to its entering the boiler by means of the surplus steam which is not required for working the engine.

Earthquakes and Eruptions.

The year 1878 has already seen more than its fair share of disastrous earthquakes and similar phenomena. There are slight *tremblements de terre* in one part or another of the earth's surface about once in three days, but it is only occasionally that serious outbursts occur which overwhelm cities, swallow up whole islands, or raise up the bed of the sea from a fathomless depth to a dangerous shoal. During the first half of the present year, however, the intensity of the shocks of earthquake and of volcanic eruptions has undoubtedly been on the increase, and if this continues the thousandth anniversary of the destruction of Herculaneum and Pompeii, which will occur next year, will be celebrated in an appropriate, if an undesirable, manner, by the forces of nature itself. This activity has developed itself since June, 1877.

In the whole of 1877 there occurred, according to the compilations of Professor Fuchs, 109 recorded earthquakes, though from our own observations we believe the number to have been somewhat larger. In the three months of June, July, and August there were only 11 earthquakes; while 34 occurred in September, October, and November, and the rest in the previous six months back to December 1, 1876. As usual, the most violent of these phenomena were those occurring in South America. The damage done to Iquique, Valparaiso, Lima, and other cities by the outbreak of May 9, 1877, was enormous, the vibrations recurring with startling rapidity, and lasting over several days. A few days later a submarine volcanic eruption occurred off the coast of Peru, which also did great damage to shipping. The effects of these disturbances were felt in all parts of the Pacific. During the year, several minor earthquakes, though of unusual intensity for the part of the world in which they were felt, occurred in Europe. Those of April 4, May 2, and October 8 in Switzerland, and of November 1 and 4 and December 22 at Lisbon, were the most alarming. Fortunately, little or no serious damage was done.

The volcanoes of Europe were unusually inactive during the year, but in South America, in Japan, and in the Pacific generally, the year was marked by several very violent volcanic explosions. The frequency with which outbreaks of this nature were observed in the open sea was a peculiarity of the year. Thus in February a very remarkable eruption occurred in the seas surrounding the Sandwich Islands, ten days after a violent outburst of the crater of Mauna Loa, on the mainland of the group, and a few weeks before another most remarkable outflow of lava from the celebrated lava lake of Kilauea. Here vast jets of liquid lava were ejected to a great height through the hard crust of the solidifying lava of the lake, which had lain undisturbed for many years. Much more serious was the eruption of Mount Cotopaxi in June, accompanied by terrible showers of ashes, dust, and mud, which were carried by the wind far and wide over the country, devastating the fair lands and destroying hundreds of lives. The insular volcano of Ooshima, in Japan, broke out in flames and burning lava on January 4, and continued in violent action till the first week in February, causing, in combination with the earthquakes which accompanied it, a disastrous loss of life.

Among the more noteworthy events of the year was the eruption of a new volcano in a district hitherto supposed to be free from volcanic disturbance—namely, on June 11, in a new crater near the Colorado river, California. About the same time an earthquake was felt in Canada. The submergence of several islands in the great archipelago lying between the Malay Peninsula and Australia, the upheaval of new lands in the same district, and the observance of the effects of volcanic phenomena in the deep waters of the South Atlantic, and where the sea is some 20,000 feet deep, would have been sufficient of themselves to mark the past year as an uncommon period of strange volcanic phenomena. As already hinted, however, we believe that the current twelve months will, unless a sudden cessation of activity occurs, prove to be even more prolific of such events than any of its recent predecessors.—*London Times.*

India as a Wheat Producer.

The amount of wheat sent from India to England in 1877 has given rise to the belief that within a few years England would be practically independent of America with regard to this element of her food supply. The Madras *Mail* disputes the proposition, alleging that "the fact is, India exports not because she has a surplus, but because the people are too poor to retain the food now exported. Were the people able to afford it, every pound of grain produced would be eaten. A very large proportion of the inhabitants of this presidency do not know what a really hearty and satisfactory meal is from year's end to year's end. In Madras the cultivators have to pay £4,500,000 annually in the shape of rent, and must sell their grain to get the cash needed to give to the tax-collector. Again, much of the grain exported goes to pay for the scanty clothing of the people, for the cotton fabrics worn are mainly of Lancashire weaving. As regards the wheat trade from the northwest provinces, it is clear that the great export for a time was due to the people parting with their usual reserve. What has been the result? Why, as the effect of the failure of a single harvest, Sir George Couper has had to encounter not merely scarcity, but actual famine."

Labor in Ireland.

The United States Consuls at Dublin and Cork have forwarded to the Department of State specific information with regard to rates of wages in Ireland. The former reports that the skilled mechanic gets per day 6s. 6d., and the unskilled mechanic receives 17s. 6d. per week. Agricultural laborers are paid per day from 1s. 2d. to 2s. 6d. permanent, and from 2s. 6d. to 3s. 6d. in the busy season, the rate of wages varying very much according to locality and season. Near large towns the rate is much higher than in the country districts; also, in spring and harvest the rate is higher than at other seasons.

The Consul at Cork reports that agricultural laborers get 48 cents a day; coal heavers, machinists, gas fitters, and bakers, $1.09; masons, shoemakers, painters, and joiners, $1.21. On public works, laborers earn from 48 to 60 cents a day. On the railways conductors receive $4.88 to $7.29 per week; engineers, $1.21 to $1.70 per day. Last summer the railway employes struck for an advance, but failed. The cost of living to the laborer and the mechanic is about $85 per annum. Trade is much depressed, with many failures. Wages and cost of living have increased about one sixth since 1873.