ust commenced, is most important, for they are the real sources of the characteristic products of the country; the region bordering the main trunk yields scarcely anything. On the Tocantins a steamer goes once a month to Cametá; once a month (during high water) to Baiao and to the first falls. Almost the only trade on this river is in Brazil nuts. The Xingu has one occasional steamer going just above Souzil for rubber, of which the annual product is five or six thousand arrobas. The Tapajos has a monthly steamer as far as Itaituba (175 miles) leaving Santarem the 28th, and bringing down rubber, salsaparilla, tobacco, farina, cacao, coffee, copaiba, pepper, nuts, pirarucú, pitch, hides, lumber and limestone. The annual amount of the Topajos cacao is is 100,000 arrobas, rubber the same, pirarucú 50,000 arrobas, salsaparilla 1,000 arrobas, nuts 40,000 bushels, hides 20,000. A steamer leaves Manaos for San Antonio, on the Madeira, the 27th of each month, and oftener when there is a cargo.

PRESENT AND PROSPECTIVE COMMERCE.

At present the trade on this chief tributary is inconsiderable, its value, in 1872, amounting to only $279,312. The exports consist of rubber (about 25,000 arrobas), hides, tallow, quina, copaiba, cacao, nuts, fish, tobacco (of superior quality for pipes), and salsaparilla. But the moment the railway around the falls is finished, a magnificent country will roll its wealth down the Madeira. Above the falls are the cities of Exaltocion, Trinidad, Santa Cruz, Oruro, Cochabamba and La Paz; there is the Bene valley, famous for its gold, silver, tin, copper, lead and mercury mines; and from the banks of the Marmorá will be exported, as soon as an outlet can be made, cinchona bark, rubber, coffee, cacao, salsaparilla, tobacco, farina, cotton, llama and alpaca wool, cattle and hides. At present, cattle can be bought there at $7 a head; cinchona, $45 a quintal; cacao, $1.50 an arroba; sugar, $1 an arroba.

On the Rio Negro a steamer makes six trips a year as far as Santa Isabel (546 miles) for piassába and salsaparilla. The value of the trade on this tributary, in 1872, was $62,586; it is now on the increase. The rich cacao and coffee, once raised in this region, is no longer cultivated; and no one can be found to cut the celebrated moira pinima—the most beautiful wood in the world. Not a stick can be found for sale in the city of Manaos; while everybody confesses that there is an abundance of it up the Negro, especially on its branch, the Branco, near the boundary line of Guiana. A regular monthly steamer (and often an extra one) goes up the Purús, one thousand miles to Hyutanahau, bringing down rubber, copaiba, salsaparilla, nuts, turtle oil and fish. The commerce on this river is rapidly increasing. Its value in 1872 was $627,602. There are more inhabitants along the banks of the Purús than on any other tributary.* There is a monthly steamer, likewise, on the Juruá, ascending to Marary (five hundred miles), and the trade is similar to that on the Purús. The Peruvian steamers, plying between Lonto and Yurimagnos, takes up dry goods and hardware in exchange for Moyabamba hats and salsaparilla. Her rate down stream is eighteen miles an hour and from ten to twelve up, while the Brazilian steamers descend at the rate of twelve or fifteen miles an hour, but make only eight up stream.

Such is this great fluvial highway, as thus far developed. Unless checked by blind legislation, the commerce of the Amazons, leavened by Anglo-Saxon capital and Anglo-Saxon enterprise, is destined to assume proportions commensurate with the magnitude of the river. JAMES ORTON.

*The latest intelligence contradicts the report of Mr. Piper's massacre, and announces that he has found gold in abundance.

NOTE ON AN ELECTRO-DYNAMIC EXPERIMENT.

BY MM. GASTON PLANTE AND ALF. MAUDET-BREGUET.

In charging a secondary couple of leaden plates with the magneto-electric machine of Gramme, we have observed a phenomenon which affords quite a curious example of the reciprocal transformation of mechanical power into electricity, and of electricity into mechanical power.

The machine of Gramme possessing, as is well known, the remarkable property of furnishing currents influenced in the same direction, the secondary couple is charged by the aid of this machine as if under the influence of a voltaic pile, and enables us to obtain, at the end of a few moments, by a successive chemical action accumulated upon a large surface, temporary effects of an intensity superior to those which the machine produces in a continuous manner. It is easy to verify this, either by the incandescence of a thread of platinum, or by any other physical action. But if, instead of thus discharging the secondary couple, it is left in communication with the machine, and if we cease to make it revolve, if we even stop it entirely, by opposing a sufficient resistance, it will immediately be observed to put itself in motion again under the influence of the secondary couple which it has just charged, not in a contrary direction, but in the same direction as the motion with which it was animated, while charging the secondary couple.

The velocity is less, it is true, than that which is given to it in order to develope electricity, but it is still sufficiently great, and the rotation may be prolonged two or three minutes, that is, during the time employed by the secondary couple to discharge itself. The dynamo-electric machine operates in this case as an electro-magnetic motive power, and the secondary couple gives back to it, under the same form, the power which it has stored up. Electricity serves only, as it were, as the intermediate machinery in this communication and restoration of motion.

If we measure the forces called into play, we can plainly ascertain that this restoration is not complete on account of the loss inevitable in every transformation. But as the measure of the product of the secondary couple, effected by one of us in a previous experiment conducted after another method, has demonstrated that this couple was a good receiver of the electric force, it is probable that one would find here, all the circumstances being the same, only a trifling waste in the transformation.

The direction of the rotatory motion communicated to the machine by the discharge of the secondary couple is, we have said, the same as that in which the machine was turned in charging the couple. Now if the machine in turning in a certain direction has charged this couple, it is difficult to conceive, at first view, that under the influence of the discharge of the couple it turns still in the same direction; for it must then tend to recharge the secondary couple, so that the latter would be discharged and charged at the same time.

Nothing seems more paradoxical. Nevertheless the fact is easily proved, and is very simply explained in the following manner: If we consider in the first place the direction of the current furnished by the machine, that of the current given back by the secondary couple (which is the reverse of the preceding), and if we take into account the actions resulting, we confess that, according to the laws of induction and of electro-dynamics, the rotating ought indeed to act in the direction indicated by experience. If we observe, on the other hand, that the secondary couple, once charged, has a temporary intensity superior to that of the machine, that is, that it can furnish in a given time, by means of the accumulation which takes place, a quantity of electricity superior to that which the machine would produce during the same time, we understand that it could overcome or surmount the feebler intensity which the machine tends to develope by its rotation even under the influence of the discharge of the secondary couple.

The motion then takes place by virtue of a difference of intensity between the current furnished by the secondary couple and that which the machine would tend to develope by the simple fact of its rotation. Thus is explained, according to us, this apparent paradox of electro-dynamics. We will add that the experiment can be easily repeated, with the smallest as with the largest models of Gramme's machine.

On the Manufacture of Ether.

O. Süffenguth states that the best method of making large quantities of ether is by the continuous process. A retort, containing a mixture of nine parts sulphuric acid of 66° B. and five parts 90 per cent alcohol, is heated to 284° Fah. and alcohol allowed to flow in continuously to keep the mixture at a constant level. Heretofore a direct fire has been applied under the copper or iron retort; but owing to the inflammability and volatility of the ether, this is evidently dangerous; and moreover, the direct fire soon destroys the retort, or at least dissolves the leaden lining. This is now entirely avoided by the use of superheated, high pressure steam for heating the retort. Even though this method is rather more expensive, it prevents igniting and exploding the ether vapor, which quite compensates for the cost. Another advantage is the ease with which a constant temperature is maintained by regulating the pressure, so that the operation is no longer dependent upon the care and experience of the workmen.

Various materials have been used for the retort or still; sometimes copper alone, sometimes copper lined with lead, and also iron lined with lead. Experience has proved that the last named is not only the cheapest but will last the longest. If the operation is carefully conducted, 66 per cent of ether of a specific gravity of 0·730 will be obtained. Half a pound of sulphuric acid makes 100 pounds of ether, and the apparatus is so constructed that it can be refilled without interrupting the operation. Great attention to the regulation of the temperature and to the flowing in of the alcohol are the principal conditions for obtaining a large yield.

The crude ether thus obtained is freed from the acid dissolved in it and washed, after which it is rectified in a suitable apparatus. Attempts have been made to rectify it in the process of its manufacture, by conducting the ether vapor into a vessel with double walls, the space between the walls being filled with water at a temperature of 35° C. (95° Fah.) Here the water and alcohol are condensed, while the ether passes up into a second vessel filled with pieces of quick lime of the size of a man's fist, which take up the sulphurous acid. It is now warmed and enters from beneath into a cylinder holding a leaden basket of dried wood charcoal, or alternate layers of charcoal and pieces of coke soaked in a solution of soda and well dried. From here it is conducted through a cooler into the receiver. This continuous rectification is more difficult and requires greater attention on the part of the workmen than where the purification is a separate operation, first on account of the continual regulation of the temperature in the different parts of the apparatus, and secondly because the lime sometimes stops up the tube or is carried off in the vapor. The operation never goes on regularly nor is the product always pure. It seems to be better, in practice, to keep separate the two operations of making and of purifying the ether.

Bees as Architects.

Now we exercise a patient observation on Nature, analyzing, investigating, calculating, and combining our facts, and say coolly with Professor Haughton, "bees construct the largest amount of cell with the smallest amount of material;" or with Quatrefages, "their instinct is certainly the most developed of all living creatures with the exception of ants." "The hexagons and rhomboids of bee architecture show the proper proportions, between the length and breadth of the cell, which will save most wax, as is found by the closest mathematical investigation," says another great authority. Man is obliged to use all sorts of engines for measurement—angles, rules, plumb lines—to produce his buildings, and guide his hand; the bee executes her work immediately from her mind, without instruments or tools of any kind. "She has successfully solved a problem in higher mathematics, which the discovery of the differential calculus, a century and a half ago, alone enables us to solves at all without the greatest difficulty." "The inclination of the planes of the cell is always just, so that, if the surfaces on which she works are unequal, still the axis running through its inequalities is in the true direction, and the junction of the two axes forms the angle 60° as accurately as if there were none." The manner in which she adapts her work to the requirements of the moment and the place is marvelous. A center comb burdened with honey was seen by Huber and others to have broken away from its place, and to be leaning against the next so as to prevent the passage of the bees. As it was October, and the bees could get no fresh material, they immediately gnawed away wax from the older structure, with which they made two horizontal bridges to keep the comb in its place, and then fastened it above and at the sides, with all sorts of irregular pillars, joists, and buttresses; after which they removed so much of the lower cells and honey, which blocked the way, as to leave the necessary thoroughfares to different parts of the hive, showing design, sagacity, and resource. Huber mentions how they will find out a mistake in their work, and remedy it. Certain pieces of wood had been fastened by him inside a glass hive, to receive the foundation of combs. These had been placed too close to allow of the customary passages. The bees at first built on, not perceiving the defect, but soon changed their lines so as to give the proper distance, though they were obliged to curve the combs out of all usual form. Huber then tried the experiment another way. He glazed the floor as well as the roof of the hive. The bees cannot make their work adhere to glass, and they began to built horizontally from side to side; he interposed other plates of glass in different directions, and they curved their combs into the strangest shapes, in order to make them reach the wooden supports. He says that this proceeding denoted more than instinct, as glass was not a substance against which bees could be warned by Nature, and that they changed the direction of the work before reaching the glass, at the distance precisely suitable for making the necessary turns—enlarging the cells on the outer side greatly, and on the inner side diminishing them proportionately. As different insects were working on the different sides, there must have been some means of communicating the proportion to be observed; while the bottom being common to both sets of cells, the difficulty of thus regularly varying their dimensions must have been great indeed. The diameter of the cells also varies according to the grubs to be bred in them. Those for males have the same six sides, with three lozenges at bottom, as those for workers, and the angles are the same; but the diameter of the first is $3\frac{1}{4}$ lines—that for the workers only $2\frac{2}{5}$. When changing from one size, to another, they will make several rows of cells intermediate in size, gradually increasing or diminishing, as required. When there is a great abundance of honey, they will increase both the diameter and the depth of their cells, which are found sometimes as much as an inch and a half in depth.—*Good Words.*

Enameled Iron.

M. Peligot has made a report, to the Society for the Encouragement of Industry, on the enameled wrought and cast iron work introduced by M. Paris about twenty-five years ago, and for which the Society have awarded him two medals. According to the report in question, the enamel used is a true transparent glass which allows the color of the iron to show through, very tenacious, having the same power of dilatation as iron, and capable of resisting powerful acids. The ordinary white enameled ware of Paris generally contains lead, and often in large proportions, and is liable to be attacked by even very weak acids. M. Paris' ware has been employed for many purposes: cast iron vases for gardens decorated in imitation of old Rouen ware have been exposed to all weathers without suffering any injury; a chimney in enameled plate iron was set up at the Mazas prison in 1849; the doors of the gold assay furnace in the laboratory of the Paris mint are of the same, and have borne the effect of nitrous vapors since 1850; in 1866 this enameled iron was selected for street names and house number plates, in several districts of Paris, and the report states that, while other manufacturers make enameled ware of the same appearance as that of M. Paris, the latter has shown its superiority in resisting the effects of time.

Specimens of new applications, lately introduced by M. Paris, were presented to the Society, and included chairs, tables, and stools for gardens, enameled on sheet iron and mounted on castings; and stands for dishes, decanters, etc., made in imitation of ancient earthenware, but presenting the superior advantage of bearing heat well.

ACTION OF NITRIC ACID ON CHROMATE OF LEAD.—On treating chromate of lead with about double its weight of nitric acid, a solution of chromic acid is obtained, according to M. E. Duvillier, containing but two per cent of oxide of lead. It is considered that the nitric acid decomposes the chromate of lead into chromic acid and nitrate of lead, which precipitates itself on boiling in presence of the excess of nitric acid employed.