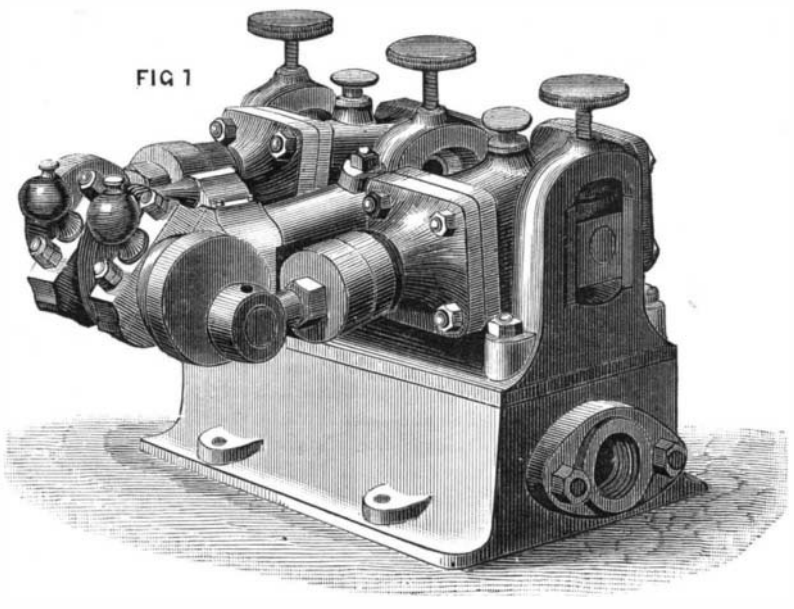
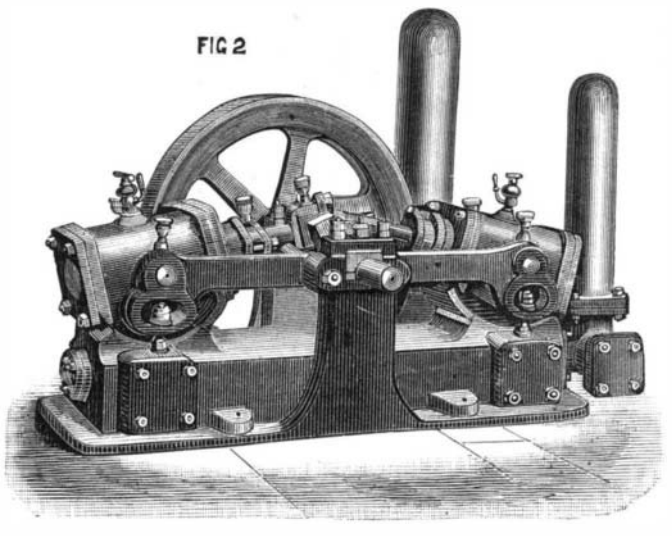
of recent experiments in Europe, that animal or vegetable oil when mixed with a mineral oil would undergo spontaneous combustion. It was found that cottonseed oil would take fire even when mixed with 25 per cent of petroleum oil. But it was ascertained beyond a doubt that even 10 per cent of mineral oil mixed with an animal or vegetable oil went far to prevent combustion. Professor Ordway described some experiments in other directions, but explained that they would have to be continued before definite deductions could be made. In connection with the tests of the flashing point, experiments had been made with ten specimens of kerosene oil bought at different stores in Boston. The flashing point should be at 130° Fahrenheit. Downer's kerosene was found to be good at 134, but the other specimens flashed respectively at 84, 80, 81, 117, 79, 73, 125, 79, 80, 84 degrees. The professor was of the opinion that it was time for somebody to look after the kerosene oil sold and used in Boston, when out of ten specimens bought at random only one was fit to use with safety. He remarked the fact that oils bought under the same name, from the same manufacturer and at the same price, differed very much in quality. Another remarkable circumstance was that some oils which flashed at a low point were high priced, and *vice versa*. Closing, the professor recommended that manufacturers of oil should be aroused to a greater sense of their responsibility.

HYDRAULIC MOTORS AT THE PARIS EXHIBITION.

M. A. Schmid had at the Paris Exhibition several applications of his patent hydraulic motor or pump, which is figured in *Engineering* as below. Its specialty lies in the manner in which the distribution of the water before and behind the piston is effected by means of the oscillating cylinder. The sectional areas of the inlet and outlet pipes are very large in proportion to the area of the piston, by which means the passage of the water is in no way restricted, and the constant pressure and absence of shock produce a more even action of the engine. It can be applied wherever there is sufficient height of water, or can be driven by steam; can be used as a motor or as a pump, or, as shown in Fig. 2, can be combined into both. When used as a motor the motion is forwards, the admission from either side, and the exit below; as a pump the motion is reversed, the admission of water or suction is from below, and the exit or pressure is on either side. Air vessels are used with the pumps. When this motor is used in the combined form, as a direct acting steam pump, both piston rods are coupled to the same crank axle. In the one exhibited the diameter of the cylinder is 6 inches, and the length of stroke 8 inches, and with a speed of 90 revolutions it delivers 110 gallons per minute. Another application of the same principle of construction is shown as a hydromotor, which consists of two of the hydraulic motors coupled together and driven by the pressure of the fluid passing through them. The oscillating cylinders are kept watertight up to the faces of the valve ports by adjustable screws, whose tension naturally depends on the pressure with which the fluid is actuated. The advantages claimed for the motor are that its speed depends entirely on the quantity of the water passing through it, and that the variations through leakage, etc., are less than in any other, the results given from numerous experiments conducted by Messrs. Sulzer Brothers, of Winterthur, giving an average discrepancy of not more than 1·72 per cent. All the above machines were shown in motion, as well as some well constructed air pumps for compressed air and vacuum, and a small engine on the same principle for working sewing machines.





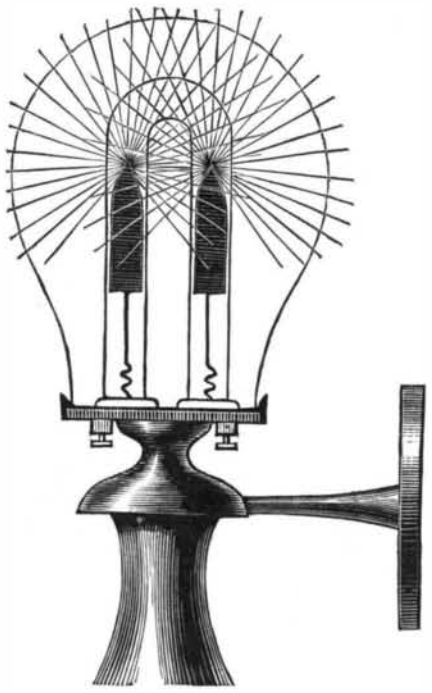
NEW HYDRAULIC MOTOR.

Another Mountain Railroad.

A railway up Vesuvius is to be constructed within the next few months, if the threatened eruption does not interfere with the present plans. A London contemporary states that there will be a double line of rails laid on an iron framework, supported by iron pillars, on which will run eight small carriages, drawn by a wire rope instead of the usual locomotive, and so arranged that four will be making the ascent as the four others descend. These carriages will hold four persons apiece, and will be kept some two hundred yards apart, while strong automatic brakes are to be fitted, so as to stop the carriages immediately if the rope should break. The line will be somewhat over half a mile long, and the gradients very steep—1 in 2.

BURNER FOR ELECTRIC LIGHT.

The annexed engraving shows a sketch of a new burner for the electric light. It consists of a glass tube, one half inch inside and about ten inches long, which is bent to the



FAHRIG'S BURNER FOR ELECTRIC LIGHT.

shape shown, both arms as close as possible together. A small hole is drilled in the top of the bent tube to insert two pieces of wire, No. 30 platinum. Length of platinum wire one inch and three quarters inside each arm of the tube. Two carbon pencils, well fitted to the tube and one inch and a half long, connected on the flat end to a copper wire of No. 12 thickness, are now inserted into the tubes, the points toward the platinum wires, leaving one quarter inch space between the carbon points and the ends of wires. The tube is now warmed, and the air expelled, and quickly sealed and cemented with any fire resisting cement. The two platinum wires are one pole, the two carbon wires the other pole, to be attached to the battery or magneto-machine power. The light so obtained is very brilliant, steady, and clear, having many advantages over the two-point carbon burner, and dispenses with the costly regulator. How far the success of the new burner can be estimated is not known, and must be proved by longer experiments; but as at present it is worthy of adoption and improving in this direction. A bell-shaped globe is better than a round one.—*F. E. Fahrig, in English Mechanic.*

Preservation of Iron.

In 1877 Professor Barff, of London, first reported on some experiments made by him in regard to bronzing iron by the action of steam. The metal is by the process covered with a layer of magnetic oxide, adhering firmly and affording protection against the influences of the atmosphere.

According to M. Krafft, C.E., in *Annales des Ponts*, etc., M. Bourdon, captain of artillery, stationed at the government factories at Tulle, France, has now tried a similar process to bronze all kinds of arms. He inclosed the articles to be bronzed in a cylinder closed at both ends by riveted plates, into one of which the steam supply pipe ended, while the other was supplied with three openings. Into one of the latter a thermometer was fitted; the second one is supplied with a stopcock through which to allow the water condensed to run off. This must be done frequently, as the steam must be as dry as possible. The third opening is taken up by an escape valve for the steam.

The most favorable conditions for success are the following: The pressure must amount to two or two and a half atmospheres, the temperature must be from 330° to 340° C., and five hours of time must be allowed for the completion of the operation. Thus a covering of a greenish black color is obtained which adheres firmly and is perfectly stable.

It must be remarked that the cylinder is placed in a sort of oven, maintaining its shell at 500° C. The thermometer plunged in the steam of the interior with its registered part protruding so as to allow observations, however, only showed 340°. If the current of steam is stopped, the thermometer will almost instantly rise to 500°.

The bronzing was thus a perfect success; care must, however, be taken that no parts of the articles are soldered together by tin solder, as the latter melts at 228° C. Even if the connection remains intact, there will always be a few minute globules of solder detached and stains caused. Copper must be used instead.

In further following up his experiments, Captain Bourdon conceived the idea of replacing the steam by hot air. He proceeded as follows: A coil of pipe communicating at one end with the open air ascends gradually through a reservoir heated to 120° C., from whence it enters the cylinder in which the articles to be operated upon are inclosed. This cylinder is identical with that used for steam. The escape valve leads into a tank with water, permitting a better regulation of the air current. This must pass very slowly. The interior pressure is but a little above one atmosphere, as the apparatus communicates with the open air.

The temperature of the air in the cylinder is 280° C.; the time consumed, five hours. A layer of 0·05mm. thickness was obtained, resisting the action of 00 emery paper and left unaffected by diluted sulphuric acid. The layer possessed a fine greenish black color.

To insure perfect success the articles must be suspended perfectly free. After removing them from the apparatus they are rubbed with a greasy cloth; stains, if any should be present, are removed with emery paper or iron dust.

It has been found that with an elevation of temperature under pressure of one atmosphere a very thick layer is obtained, which, however, scales off easily. The adherence is, therefore, a question of temperature and not of pressure, as was formerly supposed.

Those pieces bronzed by hot air were for one month exposed to the weather without being attacked in the least. On removal of the exterior black rind a gray layer is discovered below the same, which to some extent becomes rusty on exposure. The rust, however, does not adhere as on metallic iron, but is easily removed by scraping with a piece of wood. This fact also applies to articles bronzed by steam.

It will be seen that bronzing by air is applicable to industrial purposes; for instance, to the preservation of the interior surface of marine boilers, steam pipes, etc.

Last June Captain Bourdon tried the process on 400 rifle barrels at once. Similar trials have since been made, showing the practicability of using it on a large scale. The principal point is to obtain a current of air sufficiently abundant to secure a proper thickness of the layer, but of a circulation slow enough to allow the air to act on the iron. The French Government has already adopted the process at some of its arsenal manufactories; for instance, at St. Etienne and Chatelerault.

GUTTA PERCHA cuttings are very useful for the laboratory. By dissolving them in benzole and adding a little carmine or any other pigment, a solution is obtained which when brushed on the cork and neck of a bottle forms a tight fitting cap, impenetrable to air, dampness, alcohol and acids, and can be taken off without difficulty.—*Deutsche Photographen Zeitung.*

New and Stale Bread.

The nature of the difference between new and stale bread is far from being known. It is only lately that the celebrated French chemist, Boussingault, instituted an inquiry into it, from which it results that the difference is not the consequence of desiccation, but solely of the cooling of the bread. If we take fresh bread into the cellar or into any place where it cannot dry, the inner part of the loaf, it is true, is found to be crummy, but the crust has become soft and is no longer brittle. If stale bread is taken back into the oven again, it assumes all the qualities of fresh baked bread, although in the hot oven it must undoubtedly have lost part of its moisture. M. Boussingault has made a fresh loaf of bread the subject of minute investigation, and the results are anything but uninteresting.

He took a round loaf, one foot in diameter and six inches thick, and plunged a thermometer into it three inches deep immediately on being taken out of the oven. When the thermometer was taken out it was found to indicate 78° Réaumur (207·50 Fah.). This might well appear surprising, seeing that the oven was heated to 240° R. But we must consider that in the inside of the loaf, on account of the water with which the dough has been mixed, the temperature cannot rise above boiling heat, that is, 80° R. (212° Fah.), as long as the bread has not lost all its water and become perfectly dry; but it takes a long time to come to that on account of the protective thick crust. The loaf was then taken into a room heated to 150° R., the temperature of the air. At this time it weighed 7½ lbs. In twelve hours the temperature of the loaf sank to 19°, in 24 hours to 15°, and in 36 hours to 14°. In the first 48 hours it had only lost 2 ounces in weight, which, in a loaf of such a size and weight, must be considered an insignificant loss. When after 6 days the loaf was again put into the oven, and the thermometer indicated that its temperature had again risen to 55° R., it was cut and found to be as fresh and to possess the same qualities as if had been taken out of the oven for the first time; but it had lost now not merely 2 ounces, but 12 ounces in weight. M. Boussingault now made separate experiments with slices of the loaf, and also with the crumb, all of which showed precisely the same results, so that it may be considered fully established that stale is distinguished from new bread less by containing a smaller quantity of water than by a peculiarly altered molecular condition, which begins to manifest itself in the process of cooling, which continues to develop itself more and more, and lasts as long as the temperature remains essentially unchanged, but is annulled the moment the temperature has reached a certain height. The molecular condition is the form and the union of the smallest parts dependent upon it; it decidedly indicates a mechanical relation which undergoes changes in consequence of chemical processes. It is this mechanical relation also which makes the difference dietetically between new and stale bread. New bread, in its smallest parts, is so soft, clammy, flexible, and glutinous (in consequence of the starch, during the process of fermenting and baking, being changed into mucilaginous dextrine), that by mastication it is with greater difficulty separated and reduced to small pieces, and in its smallest parts is less under the influence of the saliva and digestive juices. It consequently forms itself into hard balls by careless and hasty mastication and deglutition, becomes coated over by saliva and slime, and in this state enters the stomach. The gastric juice being unable to penetrate such hard masses, and being scarcely able even to act upon the surface of them, they frequently remain in the stomach unchanged, and, like foreign bodies, irritate and incommode it, inducing every species of suffering—oppression of the stomach, pain in the chest, disturbed circulation of the blood, congestions and pains in the head, irritation of the brain and inflammation, apoplectic attacks, cramp, and delirium.—*The Miller*.

Leather from Sheep Stomachs.

Among the recent patents is one issued to Edward Tivet, of Philadelphia, for a process of treating sheep stomachs, by which means a light and serviceable leather is produced particularly adapted for purses, bags, and other similar articles, as the leather produced by it is in the form of sacks or pouches.

The following is the process: Take the stomach proper of the sheep, in the state in which it comes from the animal, the gut and ligaments being previously or subsequently severed, and empty it, and, while it is yet fresh, remove by a dull scraper the softest or least adherent layers of the external covering or serous surface, thus leaving the firmest part of the peritoneal or serous surface adhering to the muscular or middle membranes. The stomach is now turned inside out and brushed, so as to remove the mucous surface, thus leaving only the muscular tunic or middle membranes, covered on the outside by the portion of the serous membrane that remains, the result whereof is a thin white integument, presenting on the inside a multitude of *papillæ*, intimately adhering to it, which integument is to be treated so as to be preserved and its pliability retained. This may be accomplished by any known process of tawing or tanning, some glycerine being used for keeping the pelt in a suitable state of moisture. Among these processes the following may be mentioned. For tawing about ten pounds of the prepared integuments, form a paste of one half pound of alum dissolved in one half gallon of water, one and a half pound of best wheat flour, the yelks of one dozen eggs, and five ounces of pure concentrated glycerine, more or less, all well mixed together.

The integuments are placed in the paste, and permitted to remain therein for about one day, after which they are wrung out and hung up to partially dry, are then stretched to shape, and a small quantity of linseed oil rubbed over the muscular surface of the integuments, which are then permitted to dry to the full extent.

If desired, dye stuff may be advantageously applied to the integuments prior to the treatment with the paste.

A NOVEL EGG OPENER.

For almost every operation in the shop or household there are devices which not only save labor, but accomplish results more satisfactorily. The simple device shown in the accompanying engraving is one of those useful things that

Fig. 1.

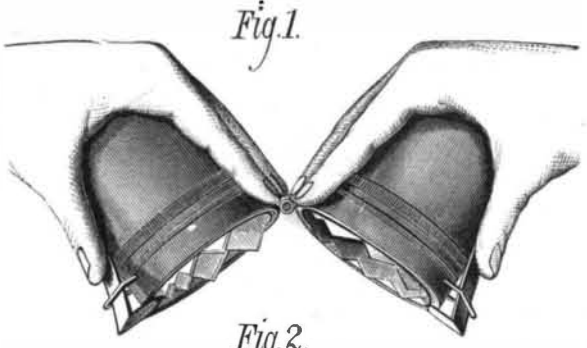
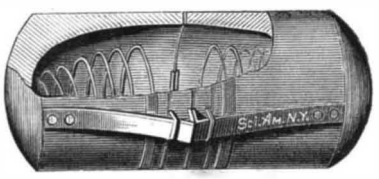


Fig. 2.



EGG OPENER.

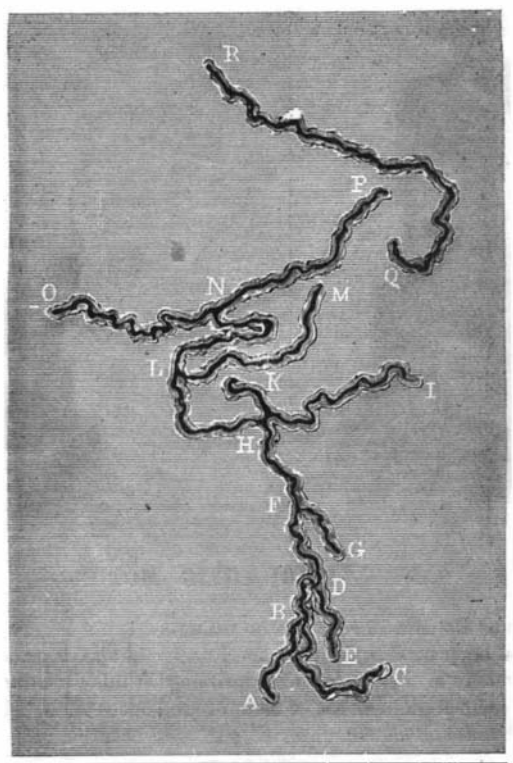
eventually finds its way into almost every house. It consists of two cups hinged together at one side, and each having at the opposite side a flat spring, the end of which is bent inward. Each cup contains a conical spiral spring for holding the egg in a central position when the device is shut.

The egg is inclosed in the cups, when the two flat springs are pressed inward so as to break the shell, after which, and while the springs are still pressed, the cups are opened, separating the shell and discharging the contents thereof. Upon releasing the flat springs the shell is thrown out by the spiral springs.

This device was recently patented by Mr. G. W. H. Kry, of Brooklyn (E. D.), N. Y.

ARTIFICIAL BALL LIGHTING.

The mica plate condensers which enter into the construction of Planté's rheostatic machine (*Comptes Rendus*, vol. lxxxv.) are sometimes pierced, when the plates of mica are too thin, under the action of a current from 800 secondary couples, the same as the glass of a Leyden jar too strongly



PATH OF ELECTRIC SPARK OVER A SHEET OF MICA.

charged by an electric machine. This accident has given M. Planté the occasion to observe a very curious fact, which consists in the slow and progressive movement of the electric spark. One of these condensers being placed upon an isolated metallic plate, in connection with one of the poles of the secondary battery, and the upper armature being touched with the other pole, a spark bursts forth upon some point of the surface of the too thin condenser, forming a fissure in advance of it. This spark then begins to move in the form of a very brilliantly luminous little globule, accompanied by a peculiar rustling sound, and slowly traces, on the tin foil of the condenser, a deep sinuous and irregular furrow. The annexed engraving gives a faithful representation of a part of the surface of a condenser on which the phenomenon has taken place. The spark appears at first at A, soon ramifies to B, then to C, then disappears to immediately reappear at the point, B, with such rapidity, and in such an inappreciable interval of time, that it seems to have made a leap. It directs itself afterward toward D, where it forms a new ramification, which ends at E, reappears at D, continues its course toward F, and so on. Sometimes (as in the present case) the spark shows itself anew further off at a point, Q, detached from the principal furrow, to end afterward at R, and the phenomenon only ceases when the sheet of mica no longer presents a portion thin enough to be traversed. In other cases, the spark remains for some time stationary around the same point; at other times, again, one of the branches elongates out of all proportion, and describes over the whole surface figures analogous to those on a geographical map. It should be understood that a tube of water is interposed in the circuit of the secondary battery, for the purpose of avoiding too intense calorific effects, and the deflagration of the whole condenser. During the progress of the phenomena, it cannot be foreseen through what points the spark will pass, and nothing is more strange than the movement of this dazzling little globule, which is seen slowly making its way and choosing the points toward which it is to direct itself according to the greater or less resistance of the different points of the isolating plate. The condenser is found to be cut through in the pathway of the spark, and the melted tin forms a double row of beads along the edges of the consumed mica. It is a sort of Voltaic arch produced successively at the expense of the material of the condenser, as in the electric candles of M. Jablochkoff; but the mica here contributes more to the brilliancy of the globule than does the incandescence of the metal, producing (like quartz and the silicates) electrosilicic light. This experiment may throw a new light on the phenomena of "ball lightning." It confirms the opinion already expressed on this subject by M. Du Moncel, in 1857, as well as certain views since proposed by M. Planté, and based on other experiments. It results from what has been said that, at the point where lightning of this kind manifests itself, there must very likely be formed the elements of a condenser, in which a powerfully electrified column of moist air plays the part of upper armature, the soil that of the lower armature, and the layer of interposed air that of the isolating plate. Here the spark is doubtless a globule of matter in fusion, of a different nature from that which constitutes the balls of lightning. But M. Planté has already shown, too, that there may be obtained, with dynamic electricity at a high tension, globular electric flames formed solely of the elements of the air and gases from the vapor of water, rarefied and incandescent; and that these globules naturally followed the movements impressed on the electrode under the conductive surface.

It only remains to show now that, were luminous electric globules formed of another matter, they might move spontaneously and slowly, even when the electrode remains immovable.

The experiment just described puts this fact in evidence, and appears to be of a nature to explain particularly the slow and capricious movement of ball lightning.

New Sources of Rubber.

The director of Kew Gardens (Eng.) has given much attention to the matter of extending the sources whence this valuable product is obtained. In his annual report he states that though a large proportion of the young plants of the Para rubber (*Hevea Brazilien sis*) brought to Kew failed to thrive, seeds and plants of the Ceara rubber have been obtained, and a considerable stock successfully raised. Para rubber plants have been transmitted to Calcutta for distribution to Assam and Burmah, where, it seems, they are now doing well. Favorable reports have also been received from Singapore, where it is said that, judging from the progress the plants have made, the climate is evidently suited for their growth. The same may be said of Ceylon, whence the superintendent of the government gardens reports that cuttings of *Hevea* strike readily, as well as those of *Castilloa* and the Ceara plant.

In Jamaica, also, the plants of *Hevea* are doing well. The propagation of the Central American rubber plant (*Castilloa elastica*) is still being proceeded with at Kew, and during the past year plants of this species were sent to Liberia, Mauritius, Singapore, and Ceylon. The Ceara rubber, owing to its totally different habit from that of the other two species, will, it is thought, prove to be best fitted for cultivation in Bengal and the drier parts of India.

Regarding new sources of India rubber, reference is made to a creeping Burmese plant, the *Chavannesia esculenta*, which was first noticed so long back as 1860, and again made the subject of a pamphlet published in India in 1874. The plant is there stated to be one "for whose extermination in the teak tracts an annual budget provision is made." From Fiji samples of rubber were received at Kew, which were reported as "a strong, elastic, pure rubber, of the same character as the higher grades of African rubber." This rubber would seem to be the produce of a plant closely allied to *Tabernæmontana pacifica* or from *Alstonia plumosa*, both of which appear to yield caoutchouc in Fiji, and both of which belong to the same natural order Apocynaceæ. Regarding the rubber producing plants of the east and west coasts of Africa, which are referred to as species of *Landolphia*, also belonging to the same natural family as the pre-