temperature, the shorter are the oscillations. Here are some of the figures: Selenium, 3·7, lead, 3·3, zinc, 3·5, silver, 3·8, copper, 3·4, gold, 3·4, iron, 3·3, platinum, 3·6. These numbers are evidently near enough together to warrant the statement that the law of constancy is here verified with conditions of exactness comparable to those which Dulong and Petit declared satisfactory in their researches on specific heats.

RECENT MECHANICAL INVENTIONS.

A machine for laying bands or stripes of color around broom handles, which does its work rapidly and neatly, has been patented by Mr. Solomon Lang, of Schenectady, N. Y. The machine is fitted to carry two handles and two sets of striping brushes, which act alternately, so that while one handle is being striped the other may be removed and replaced by another.

Messrs. A. H. Simms, of Nixburg, and J. L. Porter, of Rockport, Ala., have patented an improved rope measuring machine. It consists in the arrangement of a measuring wheel provided with an alarm device for indicating its revolutions, and in a semicircular receptacle for containing the rope to be measured.

Mr. John G. Meeker, of Danbury, Conn., has patented an improved machine for filling and hardening hat bodies and other fabrics. The invention consists in forming ribs of hempen rope upon the opposite working faces of the filling roll and apron of a machine for fitting and hardening hat bodies.

American Hardware in British Colonies.

The *Ironmonger* continues to lecture the English manufacturers for their apathy in not bestirring themselves to prevent the introduction of American manufactures into the British colonies.

There would appear to be much reason, says the editor, for fearing that English manufacturers are not even yet fully alive to the extent and nature of the competition they have to meet and fight. Through our own columns, for instance, attention has repeatedly been called to the subject, and we have been careful to give, from time to time, the latest and most authentic information obtainable. It has been shown more than once that our colonists in Australia, New Zealand, the Cape, and elsewhere are rapidly developing an amount of business in American hardware which was not even contemplated half a dozen years ago. They are well and attentively served by the manufacturers of the United States, and appear to be disposed to transfer to them many of their commissions. They tell us directly, or indirectly, that they are more thoroughly satisfied by their new providers than by our own traders, and we cannot blame them, therefore, if they continue to divert their favors into transatlantic channels. They would, and do, prefer to have English made goods of all kinds, but they find that the patterns, finish, and packing of the Americans are frequently so superior that they are literally compelled to cease doing business with us. In not a few instances they still send their indents to England, but they specify American goods, and decline to be put off with any others. They are, as our correspondent tells us, often charged nothing for packages, and have everything so carefully wrapped up or boxed, marked, and labeled, that they find far less trouble in retailing the goods than those sent to them from this country. We have before remarked that there is not the slightest reason why this state of things should continue. We are able to compete successfully with the whole of the outside world, either as regards quality, quantity, or price, and it ought not to be publicly stated that we do not do so. We have every advantage on our side, and it is nothing less than a notorious scandal if we neglect our opportunities any longer. As a nation we are compelled to manufacture, and inasmuch as we produce immensely in excess of our internal consuming powers we must continue to export the surplus. It is, therefore, not merely our interest, but an absolute necessity, that we should consult the tastes and requirements of our customers, and by the exercise of enterprise, tact, and progressive tendencies, keep ourselves in that foremost position we have so long held. The time for apathy, indifference, and adherence to obsolete patterns or practices has gone by, never to return. The recognition and full appreciation of these facts ought to be sufficient to put our manufacturers and merchants on their mettle to such an extent as to render the continuance and repetition of these complaints impossible and unnecessary.

Copper and Iron Lightning Conductors.

What should be the relative sectional areas of lightning rods in order that neither metal should be more liable to fusion by the passage of an electrical discharge through it than the other? Mr. R. S. Brough (whose recent death in India we regret to announce) has answered this question in the May number of the *Philosophical Magazine*. The relation usually given—viz., that an iron rod should have four times the sectional area of the copper rod—is based on the fact that copper conducts electricity six times as well as iron, while the melting point of iron is about 50 per cent higher than that of copper, and $\frac{6}{1·5} = 4$. This simple treatment is incomplete, because it neglects the following important factors: (1) The influence of the rise of temperature in increasing the electrical resistance of the metal; (2) the difference between the specific heats of the copper and iron; and (3) the fact that the iron rod being made several times more massive than the copper rod, it will require a proportionally greater quantity of heat to increase its temperature. Taking these considerations into account, Mr. Brough finds that the sectional area of an iron rod should be to the sectional area of a copper rod in the ratio of 8 to 3. For the same efficiency iron rods are therefore cheaper than copper rods.

PREVENTIVE FOR SLIPPING BELTS.

Mechanical engineers and users of machinery know only too well that all belts slip more or less, thereby occasioning a loss of both power and motion as well as the wearing of the belt. Several remedies have been suggested and tried such as the application of rosin and other adhesive substances to the belt or pulley, but none of them, so far as we are aware, with the exception of the device shown in the accompanying engraving, have proved of any practical value. In fact the application of adhesive substances is

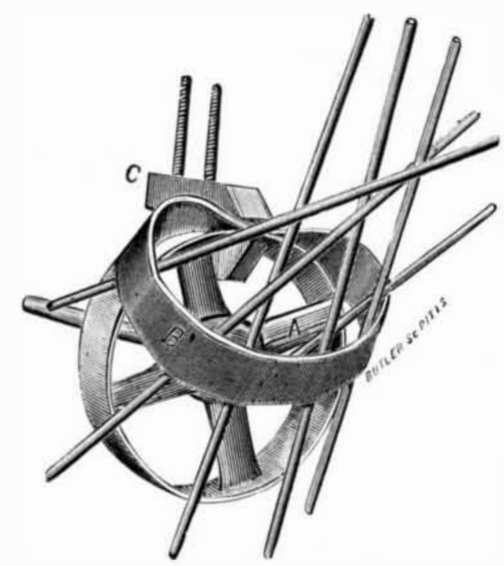

Fig. 1.—SUTTON'S PATENT PULLEY COVER.

productive of a direct loss of power, and injury to the belt. To secure the required amount of friction by tightening the belt brings greater pressure and consequent friction upon the journals and increases the strain and wear on the belt.

The pulley cover shown in the engravings is designed to obviate all of these difficulties and greatly increase the transmitting capacity of both belt and pulley. It is simply a flat endless band of elastic rubber and canvas, made about one inch to the foot shorter than the circumference of the pulley, with the inside face unvulcanized. It is stretched around the pulley and cemented fast.

The manner of applying the cover is shown in the engravings. After cleaning the pulley the cover is clamped to the upper part of the pulley by means of an ordinary hand screw, then a number of rods are inserted in the cover and placed against the rim of the pulley, as shown in Fig. 1. Three or more men, taking one rod in each hand, stretch the covering outward and place it on the pulley, as shown in Fig. 2; then all of the rods but one are removed, and the

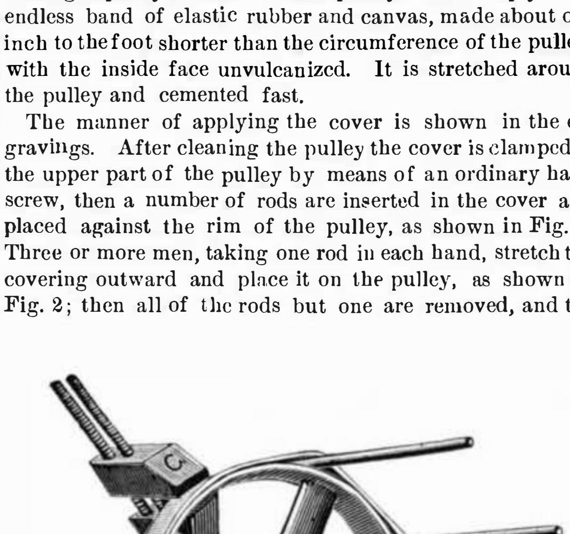

Fig. 2.—PULLEY COVER.

hand screw is taken off; cement is placed between the cover and the pulley as the remaining rod is rolled around the pulley under the cover. When all sides of the pulley have been cemented the rod is removed, and the cement is allowed to dry.

The manufacturers assert that this cover effects a great saving in power, and that a pulley having this cover applied has at least double the capacity of a plain pulley of the same dimensions.

Further particulars may be obtained from Joseph Woodward, room 11, 55 Liberty street, New York (P. O. box 3419).

The Nature of Plastic Substances.

At a recent meeting of the Philadelphia Academy of Natural Sciences, Dr. Koenig referred to a statement made by him some time ago when speaking of the composition of the so-called mountain soap of California, that the plastic components thereof are not crystallized substances. As this was contrary to the opinion held by certain authorities on such matters, he had been led to give the subject further consideration, and he was now prepared to sustain his original assertion, although it was at first based simply upon analogy. He believed that in the inorganic, as in the organic kingdom, no plastic substance is crystallized. The substances pholerite and necrite, which have indeed the same quantitative and qualitative composition as the plastic kaolinite, are indeed crystalline, but these are simply cases of polymerism. In the course of his investigations on the nature of clays he had studied the sediment thrown down by slightly turbid river water. If portions of this substance be again dissolved and the redeposit examined under microscope, it will be found to present the appearance of starch. The granules are transparent, and may be examined by polarized light, when it will be found that they are not at all crystallized. Further investigations of the subject are promised.

Emigration to the United States.

Probably from its comparative nearness, and the social and personal freedom it promises, as well as from the fact that so many of the working classes have "some friend or brother there," emigration to the Transatlantic Republic has always been much in excess of that to our own colonies, even to the adjacent Dominion. But for some years there has been a great commercial depression in the United States as in the United Kingdom, and during the past quinquennial period as much slackness in emigration as in everything else. The turn of the tide has, however, come at last, and it is doubtless a sign that a decided improvement has set in over the water. Both from the Clyde and Mersey, as well as from other less important havens, flocks of emigrants are leaving these shores. Nearly 11,000 persons left Liverpool to go into voluntary exile last month, of whom 8,931 were bound to the United States, 1,723 to British North America, and only 48 to Australia, 6,015 altogether over those of March, and 4,090 over the corresponding month of last year; while during the present May there is every prospect of numbers leaving several thousands in excess of the corresponding month for many years past. Of the April emigrants, 5,348 were English, 1,546 Irish, and only 58 Scotch.—*Iron.*

Phosphorescent Photographs.

To Mr. Woodbury's inventive ingenuity we owe this plan, which has been tested, and is a practical success. The method he employs is known as the "dusting-on" process. It consists in coating a plate with a preparation of dextrine, honey, and bichromate of ammonia, which, exposed under a negative, becomes hardened, where it is subjected to the action of light, through the transparent parts of the negative, remaining tacky where it is protected from the action of light by the denser parts of the negative. After exposure under a negative, the film, as it will be seen, is tacky in the lights of the picture, but hard and dry where light has acted on the shadows. The lights are therefore adhesive and tacky, retaining any fine powder which is dusted in or rubbed into the moist surface. At this point comes in the essential novelty. The powder to be used must be a phosphorescent substance. One of the best known and available is sulphide of calcium. A powder of this substance is applied to the image formed on the adhesive film, and sticks to it in due gradation of the tackiness, as regulated by the action of light which passed through the negative. An image of sulphide of calcium is thus formed, which, the powder being nearly white, is scarcely visible by daylight, but if the image be submitted for a time to sunlight, or bright daylight, or brilliant artificial light, and then taken into the dark, presents a luminous picture, somewhat startling, indeed, in the case of a portrait.

A variety of substances possess this phosphorescent quality: sulphides of barium, calcium, and strontium displaying it in the most marked degree; fluorspar, carbonate of lime, pearls, diamonds, phosphate of lime, arseniate of lime, and other substances, all showing in their degree this capacity of absorbing light and radiating it in the dark. The Bologna stone, consisting of sulphide of barium, displays this property in a marked degree. The old Italian cobbler to whom tradition assigns the discovery of the property of this stone, and its use to astonish his friends and neighbors, prepared it by heating red hot with charcoal a piece of sulphate of baryta, found plentifully in the neighborhood of Bologna. Sulphate of baryta made into a firm paste with gum, or with flour and water, and calcined, will produce the substance. It should be kept sealed in a stoppered bottle.

The phosphorescent property has been utilized in America for the production of luminous clock and watch faces, which readily show the hour in the dark. Professor Morton, in the SCIENTIFIC AMERICAN, points out the possibility of superseding gas or other incandescent substances as means of illumination by having the walls of a room treated with a phosphorescent substance, which might absorb sufficient light during the day to serve for illumination at night. Dr. Phipson points out that a whitewashed cottage exposed during the day to strong sunlight sometimes shines at night with a brilliant phosphorescent light; pure lime or a mixture of lime and nitrate of lime possessing the property in question. The substance used in preparing luminous clock faces is sulphide of calcium, sometimes known as Canton's phosphorus, Canton having prepared it by heating a mixture of three parts of calcined oyster shells with one part of sulphur to an intense heat for an hour. It may also be formed by heating gypsum with charcoal. The most refrangible or actinic rays are most active in producing this phosphorescence, or fluorescence.

Mr. Woodbury, so far as we know, is the first to give this property a practical purpose in photography. He applies the sulphide of calcium in powder to the image formed by light on a surface possessing an elective degree of tackiness, and the image being so formed and submitted to the action of sunlight, or even a good artificial light, presents a luminous picture in the dark. Used with judgment, such portraits may be found very interesting, while, perhaps, nothing could be more ghastly than the unexpected presentment of such a portrait of a deceased friend.

To those of our readers who may desire to study the question of phosphorescence generally in connection with this subject, we cannot recommend any better assistance than the very interesting work on "Phosphorescence, or the Emission of Light by Minerals, Plants, and Man," issued by Dr. Phipson a few years ago.—*Photographic News.*

PRACTICAL DIVISIBILITY OF THE ELECTRIC LIGHT.

[*Continued from first page.*]

A single electric lamp placed near the current generator supplies light for a building or a street. This lamp is surrounded by a system of lenses and reflectors forming a chamber of light, as represented in Figs. 2 and 3. These lenses concentrate the whole of the light into as many beams of parallel rays as there are faces in the chamber. In this form the light may be projected through long distances. The intensity of the light when not condensed is inversely proportional to the square of the distance from the source of light, but when the light is projected in parallel rays and is prevented from radiating, its intensity remains unchanged, except perhaps a small loss by the absorption of the atmosphere.

From every face of the chamber of light a box or pipe projects, which incloses the light beam. These pipes are laid along the streets, as seen at T in the larger engraving, and they are placed along the walls and floors of the building.

At every side street a smaller pipe branches out of the main one, and at their junction there is a reflector, which, by its size and position, will divert into the side street any desired percentage of the entire light. By means of this device every street in a city may be provided with one or more pipes carrying a certain amount of light that is always controllable by merely changing the position of the reflectors. This arrangement may be compared to valves and water gates of a system of water distribution.

Service pipes lead from the street pipes to the lamp posts and to the buildings, and at the intersection of the service pipes with the street mains there is a reflector, the size of which will determine and control the amount of light supplied by the service pipe.

The larger engraving shows, at T, the street main pipe and light beam, A. B is a reflector or totally refracting prism, which sends a portion of the main beam of light into the service pipe, B C, which, in the present case, supplies both the street lamp and the building. Another reflector or prism, *b*, bends a portion of the supply beam upward into the lamp post; this vertical beam strikes a reflector of suitable shape, which diffuses the light as may be required, the manner of diffusion depending of course on the form of the reflector.

The horizontal light beam, B C, reaches the vertical supply pipe, C F, laid along the wall of the building, and the reflector at the juncture of these two pipes bends the beam upward.

At D, E, F, there are other reflectors, each of which, according to their size and position, will bend horizontally the amount of light required for each floor. These smaller beams are projected through pipes laid along the floor joists. The horizontal beam, D *d*, is partly intersected by a reflector at *f*, which bends downward a portion of the beam which enters the room below through a diffusing lens (shown in detail in Figs. 4 and 5), called by the inventors a secondary lens, which sheds the light in any predetermined direction, according to the shape and curvature of the lens. The remaining portion of the beam passes on to illuminate other rooms, including the hall above, which receives its portion from a reflector at *d*.

The arrangement just described is duplicated on the other floors and modified to conform to the varying requirements of the different stories.

When it is desired to distribute light to rooms not in line with the main pipes, a double reflector may be used to divide the principal beam into two lateral ones, which will illuminate two or more adjoining rooms.

It will thus be seen that all of the rooms in a building may by illuminated by a single beam, and that the light may be divided without material loss. The reflector, B, controls the supply of light for the entire building, and the amount of light may be regulated or it may be shut off altogether by moving the reflector. In like manner the reflectors, D E, will control the light for their respective floors. If they are stationary the percentage of light for each floor will be constant, but if either of them is arranged to slide into and out of the light tube, it will vary the amount of light supplied to the corresponding floor at the expense of the other floor. The light in any of the rooms may be increased or diminished in a similar way. The reflectors are sometimes arranged to slide laterally, so as to increase the light or decrease it to a mere glimmer, or even shut it off altogether without affecting the light supply of the other rooms. In the left hand rooms there are at *m m' m''* cords or handles connected by cords or wires to the prisms or reflectors, which, being pulled or turned more or less, will slide the prisms or reflectors; in this way the light may be perfectly controlled with less effort than is required to turn a gas key.

The secondary lenses, which are shown in detail in Figs. 4 and 5, are made movable, and a set of two or more of them is supplied to every room. These lenses are moved by the cord, P, which is connected with one of the handles, *m*. By moving the handle either of the lenses may be brought into line with the beam of light. These lenses will diverge the light more or less according to their curvature, so as to illuminate a part or all of the floor, or the entire floor and as much of the walls as may seem desirable.

The lenses, in addition to the sliding motion, have a swinging motion, by means of which the light may be projected in any required direction, rendering it unnecessary to place the table exactly under the lens. The inventors state that these lenses will answer for all household purposes, and that by means of lenses of different kinds a very wide range may be given to this system of lighting; for example, if a condensing lens is employed the light will be concentrated at a single point, so that it may be used to advantage by the microscopist. If no lens is employed the beam of parallel rays may be used in the magic lantern and in other apparatus for projection. It may also be employed in philosophical experiments, in medical examinations, and surgical operations. There are many branches of industry, now requiring daylight, which could be conducted in the night by means of the condensed light.

Another advantage in this system is that the color of the light, as well as its intensity, may be readily modified by means of colored glass slides. This is especially convenient in photography, where lights of different colors and of differing actinic power are required. This feature will also render the light valuable in treating ophthalmic diseases at home and in hospitals. There are many uses to which this system of lighting seems adapted, which, for want of space, cannot be mentioned.

As to economical advantages it will be noticed that regulators or lamps are entirely dispensed with, and that attendance is consequently not required.

Another important feature is that a large generator of electricity may be employed, thereby greatly reducing the cost of the production of the electrical current. The loss consequent upon the use of electrical conductors is entirely avoided, as the single lamp needed is located near the generator, permitting of the use of a short and thick conductor having practically no electrical resistance.

A great advantage in having only a single lamp for a large system is that a vacuum may be maintained in the chamber of light without difficulty, thereby preventing the rapid combustion of the carbon, which always occurs when the electric arc is maintained in air. The cost of the carbons, as well as the labor of replacing them, which, in the ordinary electric regulators, is something considerable, is entirely avoided.

Besides being adapted to the illumination of large and small areas, this system of lighting appears peculiarly suited to certain applications for which other lights are totally unfit; for example, mines may be safely illuminated without fear of explosion and without increasing the temperature or vitiating the air. In warehouses, storerooms, powder works and magazines, chemical factories, and the like, this system can be used with perfect safety. It is also adapted to the illumination of railroad tunnels and similar places.

Messrs. Molera & Cebrian exhibit some very flattering figures based upon an expenditure of twenty horse power, which, as we have already learned, is not sufficient to obtain the most advantageous results. They claim that they are able to produce by their system 195 lights per horse power giving a light equivalent to 1,958 candles, and that the cost of lighting is less than one twentieth the cost of gas.

The lamp used in connection with this system is so clearly represented in the engraving as to require little explanation. Fig. 2 is a perspective view, and Fig. 3 is a vertical section.

Chamber G, before referred to as the chamber of light, is surrounded on the sides and top by lenses, L. At the bottom there is a concave reflector, H, and at the center two carbon rods converge. These rods are supported by pistons or floats in inclined tubes, J, which are connected at their lower ends by a horizontal tube communicating with the spring acted bellows or cylinder, K. The tension of the spring that draws the top of the bellows down, may be changed by revolving the small windlass, S.

The top of the bellows is iron, and above it is supported an electro-magnet, which is in the electrical circuit. The carbons pass between conducting surfaces, and are also in the electrical circuit. The tubes, J, as well as the horizontal tube and the bellows, are filled with a suitable liquid. As the current passes from one carbon point to another the core of the electro-magnet becomes magnetized and attracts the head of the bellows with more or less force, maintaining a uniform light by governing the distance between the carbons by displacing the liquid in the tubes and throwing the pistons or floats up or down, according to the strength of the current.

Should the current cease the spring draws down the head of the bellows and the points of the carbons touch. When the current is too strong, the top of the bellows is attracted upward, and the carbons separate.

Rats in Brazil.

Mr. Orville A. Derby contributes to the *Rio News* some interesting information on the plague of rats in Brazil. From time to time in all parts of Brazil the plantations are subject to the depredations of armies of rats that issue from the forests and consume everything edible that comes in their way. During a recent excursion in the province of Paraná Mr. Derby found an almost universal lack of corn throughout the province, due to such invasion of rats, by which almost the entire crop of last year had been destroyed. This invasion, or plague as it is called, is said to occur at intervals of about thirty years, and to be simultaneous with the drying of the *taquara*, or bamboo, which everywhere abounds in the Brazilian forests. The popular explanation is that every cane of bamboo sprouts with a grub, the germ of a rat, within it, and that when the bamboo ripens and dies the germ becomes a fully developed rat and comes out to prey on the plantations.

An educated and observant Englishman, Mr. Herbert H. Mercer, who has resided a number of years in the province and had an opportunity of studying the phenomenon, furnished Mr. Derby the following rational and curious explanation: The bamboo arrives at maturity, flowers, and seeds at intervals of several years, which doubtless vary with the different species. The period for the species most abundant in Paraná is thirty years. The process, instead of being simultaneous, occupies about five years, a few of the canes going to seed the first year, an increased number the second, and so on progressively, till finally the remaining and larger portion of the canes seed at the same time. Each cane bears about a peck of edible seed, resembling rice, which is very fat and nourishing, and is often eaten by the Indians. The quantity produced is enormous, and large areas are often covered to a depth of five or six inches. After seeding the cane dies, breaks off at the root, and falls to the ground, the process of decay being hastened by the borings of larvæ which live upon the bamboo and appear to be particularly abundant at seeding time. These larvæ have doubtless given rise to the story of the grub developing into a rat. New canes spring up from the seed, but require seven or eight years to become fit for use, and thirty to reach maturity.

With this sudden and constantly increasing supply of nourishing food for a period of five years, the rats and mice, both of native and imported species, increase extraordinarily in numbers. The fecundity of these animals is well known, and the result after four or five years of an unusual and constantly increasing supply of excellent food and in the absence of enemies of equal fecundity, can readily be imagined. The last of the crop of seed being mature and fallen to the ground, the first rain causes it to decay in the space of a very few days. The rats, suddenly deprived of food, commence to migrate, invading the plantations and houses and consuming everything that does not happen to be repugnant to the not very fastidious palate of a famishing rodent. If this happens at the time of corn planting, the seed is consumed as fast as it can be put into the ground. Mr. Mercer, who plants annually about fifty acres of corn, replanted six times last year, and finally gave up in despair. The mandioca is dug up; the rice crop, if it happens to be newly sown or in seed, is consumed, as is also everything in the houses in the way of provisions and leather, if not carefully guarded in tin trunks.

A Permanent Exhibition in Boston.

It is reported that the New England Manufacturers' and Mechanics' Institute is completing the erection of a suitable building for the permanent exhibition of the industrial products of New England, with stated fairs and special exhibitions. The proposition is to make each exhibitor pay a small rental for the space occupied, and to distribute the interest in the undertaking as widely as possible throughout New England, the shares being put at twenty-five dollars, and no one man allowed to take over four shares. A fair will be held as soon as a place and funds are secured, and thereafter annually, beginning the first Wednesday of September.

When America was Named.

The Lenox Library, in this city, is very rich in old books, many of them relating to the discovery of America. Among these is the "Cosmographiæ Introductio" of Hylacomylus, printed in 1507, in which the name of America was first suggested for this continent. "Hylacomylus" was the Hellenized form of the name of Martin Waltzmüller, a professor in the gymnasium of St. Die, in Lorraine. In this "Cosmographiæ Introductio," on the fifteenth leaf, appears the suggestion which named the continent, of which the following is a translation: "But now that those regions have been more extensively described and another fourth part has been discovered by Americus (as will appear in the sequel) I do not see why it should not be named America, that is the land of Americus, after its discoverer, Americus; a man of sagacious mind, since both Europe and Asia took their names from women." The popularity of this early geography led to the immediate adoption of its author's suggestion, and the new continent was called America by other writers.

CURE FOR HICCOUGH.—Under this title Dr. Grellet, of Vichy, states that he has never failed in immediately relieving hiccough, *i. e.*, not dependent upon any appreciable morbid condition, by administering a lump of sugar imbibed with vinegar.—*Revue Medicale.*