Railroads of the United States.

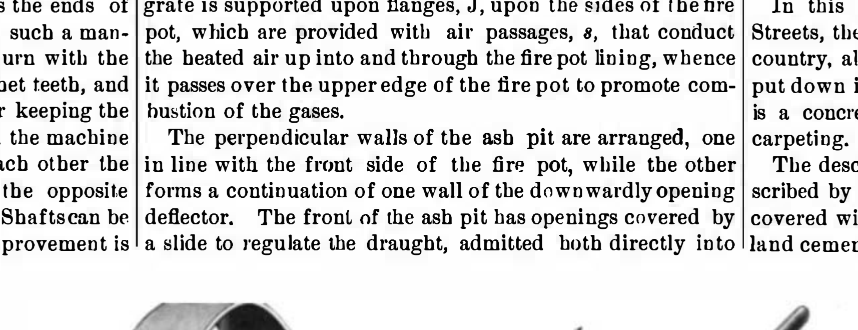
The seventeenth annual issue of "Poor's Railroad Manual," which has just appeared, fully maintains the high reputation heretofore attained by this publication. It is a complete compendium of information touching the railroads of the United States, giving their length, equipment, share capital, funded and floating debts, cost of roads and equipment, traffic operations, earnings and payments, etc. All who have investments in such property, or who think of thus employing their means, cannot fail to do so with a better understanding after looking over the facts presented in this volume.

There were 6,753 miles of railroad built in the United States in 1883, making a total length of 121,592 miles of road built up to the 1st of January last. We have nearly half the railroad mileage of the world, Germany, Great Britain, France, Russia, and Austria following next in order, but the length of our railroads considerably exceeds that of all the European lines combined. The total amount of liabilities of our railroads, on account of stock and debts, is now $7,495,471,311, an enormous amount, certainly; but it appears that their net earnings for 1883 were 4·49 per cent, which is an extremely good average showing, when it is remembered how largely their stocks and bonds have been watered. The "Manual" estimates the actual cost of these railroads at only about one-half of the amount of their funded and floating debts, and that they are thus really paying an annual interest equal to 9 per cent of their cost.

The railroad freight transported in 1883 amounted to 400,453,439 tons, the value of which, at only $25 to the ton, would have exceeded $10,000,000,000. The total length of all tracks was 149,183 miles, of which 78,491 miles were laid with steel rails. The number of locomotive engines employed was 23,823; of freight cars, 748,661; of passenger cars, 17,899; of baggage, mail, and express cars, 5,948.

MEANS FOR TRANSMITTING MOTION.

The object of an invention recently patented by Mr. W. A. Rollins, of Wyattville, County of Surrey, England, is to provide a device for transmitting motion from one part of machinery to another, in one direction, in such a manner that the parts can be revolved independently in the reverse direction. The independent shafts, A, are each formed with an enlargement, B, on the end surface of which are ratchet teeth. These enlargements project into the tubular ends of squared hollow bosses, *c*, projecting from the opposite sides of a wheel, D, held betweens the ends of the shafts. In each boss is held a block, E, in such a manner that it can slide longitudinally, but must turn with the boss. On the outer end of each block are ratchet teeth, and between the blocks and wheel are springs for keeping the blocks engaged with the enlargements. When the machine is moved so that the teeth will engage with each other the wheel, D, will revolve, but when moved in the opposite direction the teeth will slide past each other. Shafts can be coupled in a similar manner, and when this improvement is applied to tricycles the running wheels are operated from the middle wheel, the other parts remaining unchanged. Fig. 3 is a cross section through *x x*, and Fig. 4 a section through *y y*. In addition to simplicity and cheapness of construction, this arrangement admits of perfectly plain drive wheels being used in mowing machines, thus avoiding the expense of making a geared driving wheel and the necessity of replacing this expensive wheel entire if a cog in it gets broken. The clogging by grass, dirt, etc., in the gearing of the drive wheel is entirely obviated in this device. It is not contemplated to alter, further than this, the systems now in use, but to apply this arrangement to existing machines. Further particulars may be obtained from Messrs. Seely & Howell, of 14 Stone Street, New York City.



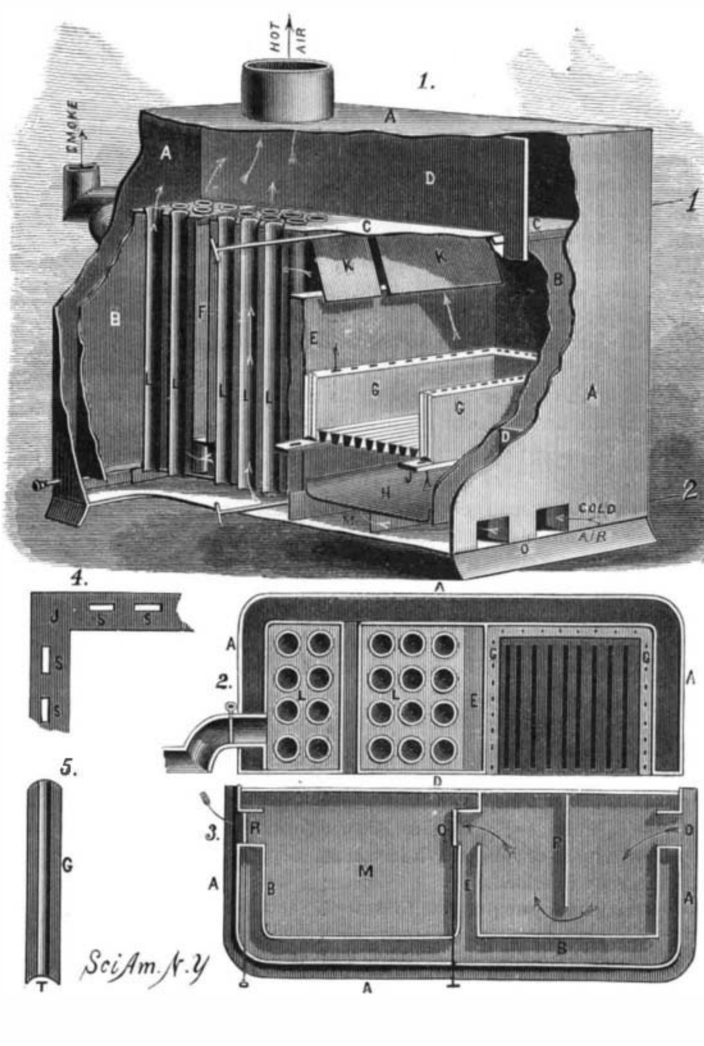
ROLLINS' DEVICE FOR TRANSMITTING MOTION.

Dry Batteries.

MM. Becquerel and Onimus have been experimenting on dry batteries. Many have endeavored to obtain a dry cell by mixing sand with chlorhydrate of ammonia. The two above mentioned obtained a modification of this process by mixing plaster with the exciting liquid, and then allowing it to solidify. As this plan can only be adopted with those cells which work only when the circuit is closed, the chlorhydrate of ammonia and chloride of zinc cells are the only ones that can be used to any advantage. Instead of using plaster only, MM. Becquerel and Onimus sometimes mix peroxide of manganese or sesquioxide of iron with it. In these cases the E.M F is slightly greater. When the battery has run down, all that is required is to moisten with more exciting liquid. The quantity of exciting liquid being a minimum, the total electrical energy is also a minimum.—*The Electrician.*

HOT AIR FURNACE.

The main object of the invention herewith illustrated is to provide an economic and effective heating furnace. Fig. 1 is a perspective view with parts broken away to show the interior; Figs. 2 and 3 are horizontal half sections, the first being above the grate, and the second showing the air passage under the ash pit; Figs. 4 and 5 are details. The fire chamber has an extended area of grate surface to permit the building of a thin fire, and at the same time secure the requisite amount of heat with an ordinary draught. The grate is supported upon flanges, J, upon the sides of the fire pot, which are provided with air passages, *s*, that conduct the heated air up into and through the fire pot lining, whence it passes over the upper edge of the fire pot to promote combustion of the gases.



TRAVIS' HOT AIR FURNACE.

The perpendicular walls of the ash pit are arranged, one in line with the front side of the fire pot, while the other forms a continuation of one wall of the downwardly opening deflector. The front of the ash pit has openings covered by a slide to regulate the draught, admitted both directly into or above the fire pot as occasion may require; by this means the exact amount of air necessary for the consumption of the gases from the fuel in combustion can be obtained. The bottom of the ash pit is made of a thin metal plate, H, that forms the upper wall of an air passage, the bottom of which is formed by the bottom plate of the furnace. Air entering through the two openings, *o*, is affected by the heat of the thin bottom plate of the ash pit. The air passage is divided about centrally by a partition, D, and has two openings at its front and two at its rear, the latter admitting the air to the compartments of the heater. Placed at right angles to the partition, D, are deflectors, P, which cause the air to travel over the greatest possible space. A valve is arranged behind each of the openings, Q, and a valve is hung in each of the two openings, R, in the rear part of the heater, one on each side of the partition. The former admit or cut off hot air from the rear part of the passage, while the latter admit or cut off cold air from the rear part of the passage.

The fire brick lining, G, composed of sections fitting in the sides and ends of the fire chamber, is formed with vertical channels passing through from top to bottom. The channels terminate in a recess made in the lower end of the lining. This recess permits the air to pass up through the channels in the lining to the chamber above the fire pot.

The air is isolated from contact with the walls of the furnace, and, being heated, the combustion of the gases is more surely effected. The crown sheet, C, made in separately removable sections of cast iron, is fitted upon the fire chamber and extended to the rear. The air chamber and deflector, E, forms the fire back of the pot, and between its upper end and the crown sheet is an opening for the passage of the products of combustion. The lower end of this chamber opens into an air inlet under the ash pit, and its sides into a surrounding air chamber.

The upper end and sides of a second air chamber, F, placed midway between that just described and the end of the furnace, open into the surrounding air chamber, while its lower end is a little distance from the furnace bottom. Passing through the crown plate and the lower plate is a series of air tubes, L, whose upper ends are flanged, in order that they may be supported without the use of rivets or similar fastenings.

A hot air chamber surrounds the fire chamber and the case inclosing the tubes and deflectors. The entire heater, save the fire chamber, is divided longitudinally by a vertical partition into two equal compartments of about equal size. Two dampers, K, are hung so as to be operated independently from the outside. Similar dampers are arranged in the smoke pipe. Either compartment is readily accessible to permit separate cleaning, the purpose being to permit the cleaning of the heater without extinguishing the fire. Heat is conducted from the heater through a pipe at the top.

Further information regarding this invention may be obtained by addressing either Mr. J. Travis or Mr. J. W. Travis, 104 Franklin Street, Chicago, Ill.

The Kerr Wood Pavement.

In this city, on Fifth Avenue, between 32d and 33d Streets, there is being laid a pavement which is new to this country, although some 500,000 square yards of it have been put down in Paris, and 800,000 in London. In principle it is a concrete pavement covered with a wooden cushon or carpeting.

The description of the process by which it is laid is described by *Engineering News* as follows: The roadbed is first covered with a 6 inch coating of concrete composed of Portland cement and broken stone, finishing off with a top dressing of Portland cement and fine gravel or sand. Upon this are laid blocks of common red pine of the size commonly used in Nicholson pavement. Between these blocks are left spaces of about one-third of an inch wide into which is poured bitumen or asphalt for an inch in depth. This fastens them to the foundation of concrete and to one another. After this has set, the crevices are filled completely with Portland cement, and the whole is covered with fine sharp gravel, which is ground into the pores of the wood and forms a protective coating. The wooden blocks are previously treated with creosote to protect them from decay and to prevent them from swelling when wet. A space of 3 inches is also left between the wooden blocks and the curbing on each side as a species of expansion joint.

The actual first cost of this pavement is somewhat more than that of Belgian blocks, but the plan upon which it has been put down in Paris is that known as the annuity system, in which the company contracts to lay the pavement and keep it in repair for eighteen years for an annuity of about one dollar per square meter. This annuity was computed on a basis which should render the expense to the city one-half the cost of maintaining a pavement for the eighteen years previous to the contract.

In this connection we give the statistics compiled by Col. Haywood, the London engineer in charge of street construction, in regard to the security of footing afforded by different kinds of pavement. As a result of observations extending over sixty days he found that a horse would travel 117 miles on asphalt, 134 on stone, and 446 on wood pavement before falling, and that falls occurring on wood pavement were by far the least serious.

American Enterprise Abroad.

Manufacturers in this country, while fully alive to supplying the home market, fertile in expedients to meet or anticipate demands, have much to learn from European manufacturers in the way of building up foreign trade. Let a demand for manufactured goods, especially for machinery, develop itself anywhere, and the representatives of English and French houses will be found on the ground industriously working up the business. They appreciate, instinctively, that trade will not look after them, that they must seek the trade, and, what is to the point, they thoroughly understand the advantages of being first in the field. In respect to guiding trade in desired directions, aggressiveness is absolutely essential; custom—habit—is a thing not easily changed, and those who commence buying goods of some particular manufacture are not easily turned in other directions. It is this quality of aggressiveness that American machinery manufacturers, when it comes to looking for foreign custom, lack. Sitting quietly at home, depending on the good quality or even cheapness of products, will not answer the purpose in such cases. The matter must be brought personally and persistently before desired customers—something that American manufacturers are not backward in in regard to home trade, but seem to fail to appreciate the greater necessity for in foreign trade.

European countries have one advantage in respect to foreign trade not possessed by this country, viz.: the lower rates of wages prevailing there operate to induce European engineers and mechanics to accept situations in countries in process of mechanical development that would not be accepted by Americans, and the preferences and influences of those accepting such situations are naturally in favor of trade with the countries from which they come. This has been found in many instances to have had considerable effect against American enterprise abroad; but, after all, this is at the most only a hinderance. Notwithstanding this and perhaps some other advantages possessed by European countries, there are unimproved opportunities for introducing American machinery abroad that require only persistent effort to yield good results.—*Chicago Journal of Commerce.*

Railway Patents.

Mr. Geo. F. Frelinghuysen, in the *American Railroad Journal*, takes to task the patentees of railroad improvements for charging railroad officials with illiberality toward inventors in refusing to adopt their inventions as soon as presented to the railroad officials' consideration. Mr. Frelinghuysen says:

The inventors and patentees who are doubtless much disappointed that they are not immediately besieged by the railroad officials for the privilege of placing the devices disclosed in their last patent on all the railroads of the United States, should remember that letters patent are not granted as rewards to the favorites, as used to be the case, but are simply a grant of security for their inventions; and that the value of the patent depends on the value of the invention which the patent covers and the business ability and perseverance of the patentee. The general misunderstanding in this regard leads many to follow after a shadow which they feel confident will give them fortune when it is once embodied in a patent. That patents have, and doubtless will be the means of securing great riches, is not my purpose to dispute, but I insist that in order to be of any value they must discover a new and useful device, which is largely needed, or for which a large demand can be created, and must then be managed and pushed with business ability.

Inventions in railway appliances differ from most other inventions, in that it is impossible for the inventor to make any experimental trials of his invention, as few persons have private railways or influence sufficient to gain permission to make the trial, even at their own expense, which is ordinarily heavy, and beyond the means of the inventor. This leads them to apply for and obtain patents for their inventions before testing them, which latter would in many cases have been sufficient to convince them of the impracticability of the devices patented.

The railroad world was not long in taking up the automatic couplings, the air brake, interlocking switches, and improved frogs, not to mention the fish joints, heavy steel rails, and stone ballast. The trouble with the railway patents lies more in the poverty of invention shown by the patentees than in any lack of desire on the part of the managements for improvements, or disposition to rob the inventors of the fruit of their labor. An examination of some of the patents shows clearly that the invention is made for the sake of obtaining a patent, instead of the patent being obtained to secure the invention. This is such a prostitution of the Patent Act that there can be little wonder and less pity that the patentees do not reap rich rewards therefrom. There is plenty of chance left for these inventive beings to reap a rich reward if they will only patent an invention instead of inventing a patent.

The couplings are not perfect; the brakes are not always to be relied on; air brakes will not " let go " quickly enough, and sometimes not at all, until the valve is opened by hand, and hand brakes are too slow, and expose the brakeman in case of accident.

There is no way of taking on coal without stopping. The heating appliances for cars are very imperfect; the ventilating arrangements, especially in cold weather, might be deemed not to exist, so far are they from being perfect. There are plenty of ways of roasting one's feet and having a draught about the head, or freezing the feet and heating the head, but to make a pure, warm, evenly distributed atmosphere in a car is unknown, or at least unpracticed.

The tracks, rail joints, switches, frogs, ties, and ballast; taking on and putting off baggage; storing and selling tickets; accommodating, assorting, and directing passengers; receiving, handling, and delivering freight in packages or in bulk, are all subjects capable of improvements, which would appeal to the pocket of the "soulless corporations," and be of advantage to the successful inventor, and a benefit to the public.

There is no use of trying to invent the Westinghouse brake again, nor the old-fashioned coupler, neither can the Miller coupler be revived, nor the Jennings appropriated.

The numerous railway patents which never see the light of even an experimental use can only have the effect of discouraging those who see them, from trying to make advances in the same branch. Those who have *inventions* may be sure of having them appreciated, notwithstanding the contrary experience of the many patentees.

Remember that a patent only gives an exclusive right. It simply excludes all others from using the thing patented without paying or arranging with the patentee for so doing, and must be without value, the *Journal* adds, unless the thing patented is such that others will elect to use it, and pay the license fee or royalties for the privilege.

Insoluble Soap.

The term soap commonly designates a product prepared by the action of caustic alkalies—potassium or sodium caustic—upon fats, fatty oils, and resin, *e. g.*, tallow, lard, whale, palm, olive, cocoanut, linseed, cottonseed oil, and colophony. It as been shown by the experiments of Chevreul relative to the chemical nature of fats, that they are composed of oleic, palmitic, and stearic acid, and glycerine as the basic constituent; hence, fats are natural products to which chemistry the term salt applies. By substituting alkali for glycerine in fats, soap is produced; the process of substitution is called saponification. When sodium caustic is employed as substituting agent, sodium soap—castile soap—is produced; potassium caustic forms also soaps which are of a more or less jelly-like consistency; while glycerine becomes liberated.

It is not our purpose to describe the process for making ordinary soap, but to study the condition which causes the formation of insoluble soap; and we shall also notice that not sufficient attention as been paid to the importance of these latter preparations in diverse branches of practical art. Alkali soap is soluble in water and a few other liquids; all other soaps are insoluble. This insolubility is turned to advantage, and becomes the very principle of chemical processes. When a small quantity of an aqueous soap solution is added to water which contains carbonate of lime, the characteristic property of the solution becomes destroyed, it has ceased to impart to the water the tendency of lather; a further addition of the solution will ultimately transfer to the water the property of forming a lather when agitated. The cause of this deportment has to be ascribed to the presence of lime, which transforms the alkali soap into an insoluble calcium soap.

Upon this fact is based the determination of the hardness of water by means of an alcoholic or aqueous soap solution; and it is also evident that the use of such water for washing purposes involves a loss on soap. A similar result is obtained when water contains other metallic salts; the presence of magnesium sulphate causes the formation of insoluble magnesium soap, copper sulphate precipitates insoluble copper soap and sodium or potassium sulphate. Thus, an insoluble soap is produced when a solution of the respective metallic salts is introduced into a soap solution.

Insoluble soaps constitute the essential part of paints. When zinc oxide is used with oil as paint, the formation of a waterproof coating depends on the production of an insoluble zinc soap; and in all paints and varnishes containing metallic oxides or metallic salts such a process takes place. In medicine insoluble soaps are called plasters, *e g.*, lead plaster. The most valuable property of these preparations is their impenetrability for water. When casts of gypsum are covered with dust it is quite difficult to cleanse them, yet when the surface of such casts is impregnated with stearic acid they have the appearance of meerschaum, and are not affected when washed with water. Another product of saponification, which gives to casts of gypsum, when applied as a coating, a beautiful green, bronze-like color, is prepared by introducing copper and ferrosulphate into an aqueous soap soution; the precipitate, consisting of a mixture of iron and copper soap, is mixed with litharge and wax.

Of all metallic oxides for the preparation of insoluble soaps, alumina is the most valuable; it possesses a great affinity for organic fiber, and thus becomes a suitable medium for fixing dyes upon cotton goods. The fiber, being impregnated with aluminum acetate as mordant, is steeped into a dyebath and is immediately coated with an insoluble lake, or when introduced into a soap solution becomes covered with an insoluble aluminum soap, which also fills up the pores of the fiber. By this process the fabric has acquired the property of being waterproof. It has been suggested some years ago to increase the durability of railroad ties and wood in general by impregnation with aluminum oleate. It suffices to impregnate the wood with aluminum acetate, and then immerse it in a soap solution; by repeating this procedure the desired result will be obtained. Such a process is employed in the manufacture of sized paper; the material of which the paper is made is soaked with a solution of wax, resin, or oil soap, and then treated with a solution of aluminum sulphate; in this manner insoluble aluminum oleate is produced upon the fiber. Zinc sulphate is often used as a substitute for aluminum sulphate.

Though common writing paper being not quite waterproof, yet, by comparing it with unsized paper, it is not difficult to conceive that the impermeability of unsized paper for liquids will depend on the formation of insoluble soap.—*Industrie Zeitung.*

An Electric Torpedo Boat.

Professor Tuck's electric submarine torpedo boat looks at a little distance very much as if it had been constructed by laying a large row boat, upside down, on top of another large row boat, fastening it there, and painting them both sea green. The shell is of iron, however. The boat is thirty feet long. It is ballasted with lead, so as to sink to the water's edge, and its displacement is twenty tons.

In the center of what may be called the deck is sunk a well hole. By a simple air lock arrangement it affords a passage between the interior and the exterior of the vessel, even when the vessel is wholly under water. It is also the captain's look out station, and is capped with a dome of heavy glass, so that if he chooses he can exclude the water and stand in the pit with his head and shoulders above the top of the boat, or he can leave the glass off and stand there in a diving suit. Close to his hand is a signaling steering apparatus, which transmits his orders to the helmsman down below. The boat has three rudders, one an ordinary vertical rudder at the stern, and the other two horizontal blades on the port and starboard quarters. These last help to govern the boat's movements up and down. To sink her, water is pumped into her compartments; to raise her, air is pumped in, and the water is forced out. Compressed air is stored aboard in six inch pipes. There is also an apparatus for reoxygenating air that has already been breathed. Moreover, there is a simple arrangement by which the ends of two rubber tubes can be floated up to the surface of the water and opened to the supply of fresh air up there.

An electric motor, driven by force from storage batteries, runs the propeller. The interior, which is arranged for a crew of four or five men, is lighted by incandescent lamps. An indicator shows the distance of the boat beneath the surface. The estimated speed of the boat under water is eight knots.

The torpedoes are to be carried outside the vessel, one at the prow and one at the stern. They are to be held there in iron cylindrical sheaths by electro magnets, which will release them when the current is cut off. They are ballasted with cork, and after placing one of them the torpedo boat retires to a distance, unreeling as it goes two wires, by which, at a proper distance, the torpedo is fired.

The lead ballast proved insufficient to sink the boat below the water. On a recent trial near the Delamater iron works, this city, a crew of three men went aboard her, and, with Mr. John Rice as captain, a test was made of the electric engine. It drove the boat several miles up and down the river at a speed of ten knots, says the New York *Sun* She answered her rudder well. She will soon be tried under water.

Waterproof Varnish for Paper.

Says the *Photo. News:* In very many cases waterproof varnishes are useful, and among their uses may be mentioned their application to laboratory labels and their use for the fixing of drawings.

There are many such varnishes, but, according to our own experience, one of the best is a thin solution of gutta percha in benzole, and such a varnish may be made by dissolving one or two parts of fine gutta percha foil in a hundred parts of benzol. The heat of a water bath serves to make the gutta percha dissolve tolerably quickly, but if it is necessary to have the preparation at once, the gutta percha may be dissolved in a little chloroform, and this is then mixed with the required bulk of benzole. Paper which has been coated with this varnish can be easily written, drawn, or painted upon; and it must be remembered that the gutta percha varnish does not make the paper transparent or spotted. It is known that gutta percha slowly oxidizes in the air, and becomes converted into a brittle resin; but this oxidation product is itself a waterproofing agent.

Alcoholic solutions of resins tend to make papers more or less transparent, but the following varnish, prepared with acetone, is not subject to this drawback.

One part of dammar is dissolved in six parts of acetone, the materials being allowed to digest together for some weeks; the clear liquid is now decanted off, and mixed with its own volume of plain collodion.

Another method of making a waterproof varnish for paper consists in digesting 30 parts of white shellac with 300 parts of ether, and then agitating the solution with 15 parts of finely powdered white lead; on filtering the solution, it will be found that the white lead has been very effectual in clarifying the solution.

The above resinous varnish gives more luster than the gutta percha varnish, but the latter gives far more flexibility, a considerable advantage in many cases.

Not only silver prints, but also collotypes, and often photo-mechanical impressions, may often be advantageously treated with one of the above varnishes; and it must not be forgotten that anything which protects a silver print against damp serves to diminish the tendency to fading.