the joints being filled in carefully with smaller rock and cement. The rock is blasted from a neighboring quarry and brought to the dam by a railroad which runs across the north end of the dam below the wall of the temporary channel (see Fig. 2). Here the skips are picked up by a cableway, which stretches across the valley, carried over to the desired spot and lowered. The rock is then picked up and placed in position by derricks, of which a great number are scattered over the work. Some idea of the magnitude of the work may be gained when it is stated that the booms of the derricks, shown on the foundations in Fig. 7, are 50 feet long. In this general view of the foundations the level of the crest of the finished dam is indicated by a cross on the side of the hill.

The general appearance and cross section of the finished dam is shown in Fig. 6. It consists of three distinct portions. The first 400 feet on the south side of the valley is an earth dam, with an interior masonry core wall. Next to this is the masonry dam, 650 feet in length, which extends to within 200 feet of the north side of the valley. Here it bends sharply to the right and runs back up the valley parallel to the contours of the hillside for about 1,000 feet, finally turning into a junction with the hill. This last portion is the spillway or overflow. At the upper end the latter is comparatively narrow and shallow, but it widens and grows deeper toward the dam proper, of which it is really a prolongation. Its downstream face is formed in a series of large steps as shown in Fig. 6. The spillway is given these generous proportions with a view to accommodate any possible flood that might descend upon the lake. The Croton Lake will be only one of a series of smaller reservoirs scattered higher up in the hills. If any one of these should break, the Croton spillway could safely accommodate the sudden rush of water.

The upstream face of the masonry dam will be approximately vertical, but the other face will run back with a sharp inclination, rounding up to the perpendicular at the coping. The excavated material on the up and down stream sides will be filled in against the dam up to the original level of the river bed, and the two faces of the dam above this level will be finished in facing stone masonry in horizontal courses, laid everywhere at right angles to the face of the dam. It is interesting to note that the pressure of this great wall of masonry on the foundations is 18 tons per square foot.

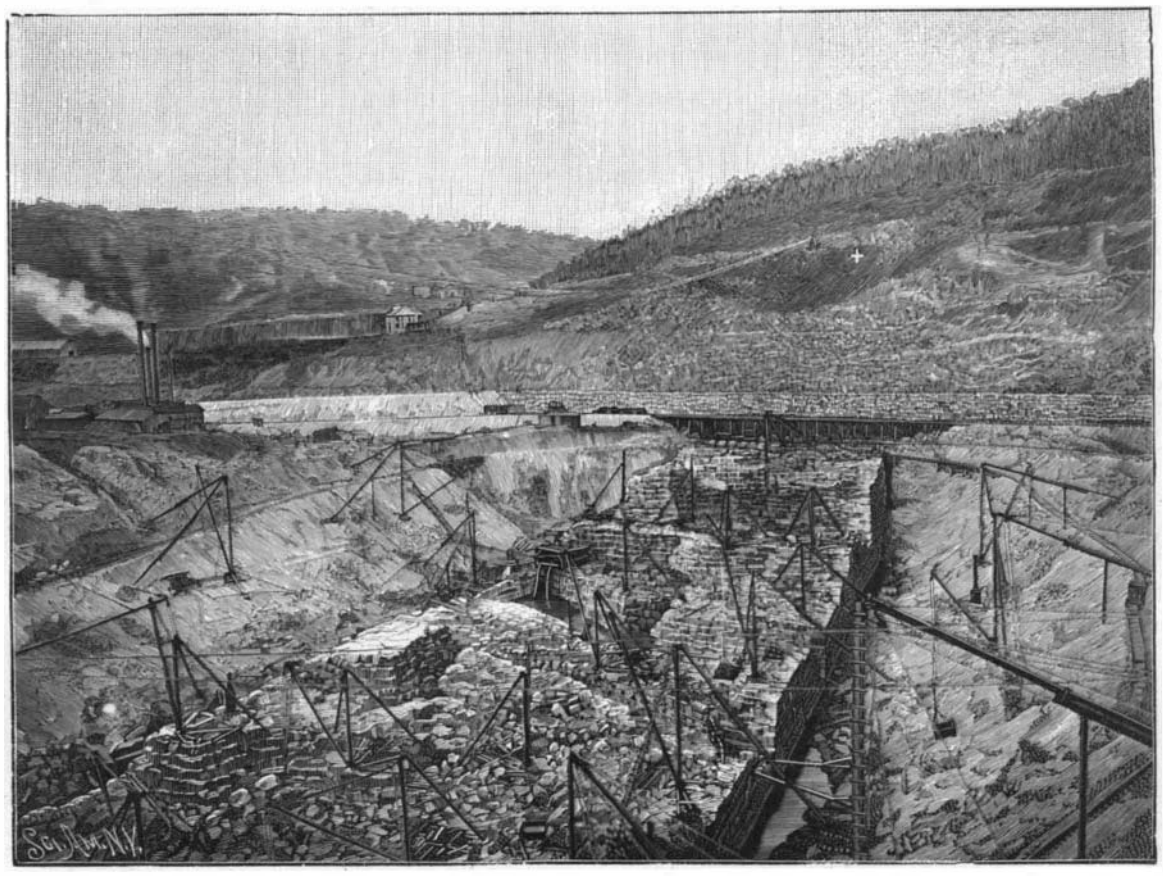
The earth dam is laid in 6 inch layers, from which all large stores are removed. Each layer is rolled with a grooved roller and watered. The water forms a bond and the roller packs the whole mass firmly together. The dead weight of the earth backing affords the necessary stability to resist the thrust of the water, the center core of masonry serving merely to render the dam watertight. This masonry core extends from the great masonry dam to the south side of the valley, and like it extends to solid rock both below the bed of the river and at the side of the hill. It is 18 feet thick at the bottom, 6 feet thick at the top, and its greatest height is about 230 feet. The downstream slope of the earth dam is sodded and the upstream slope is paved.

Along the crest of the dam extends an ornamental driveway which is carried across the spillway by a handsome steel bridge. The driveway is 18 feet wide, with a margin on each side for the necessary railing and coping, and the architectural appearance of the masonry dam is improved by an ornamental line of arches at the coping.

At the extreme north end of the dam will be built a blow-off gate house, for emptying the reservoir, should occasion necessitate it. It will be built out from the dam on the upstream side (see Fig. 6), its dimensions at the top being 35½ by 37 feet. The water will be blown off through three 48-inch pipes, which will lead through the masonry of the dam and discharge into the bed of the river. When the new aqueduct, which runs in a direct line and chiefly in tunnel from the old reservoir to New York, was built, it was provided with a gate house which is arranged so that it can take water from the new reservoir and lead it direct to New York by the new aqueduct. The old aqueduct runs down the south side of the valley from the old Croton dam and intersects the earth dam. At the point of intersection a gate house will be built whose intake will lead water from the lake at various elevations.

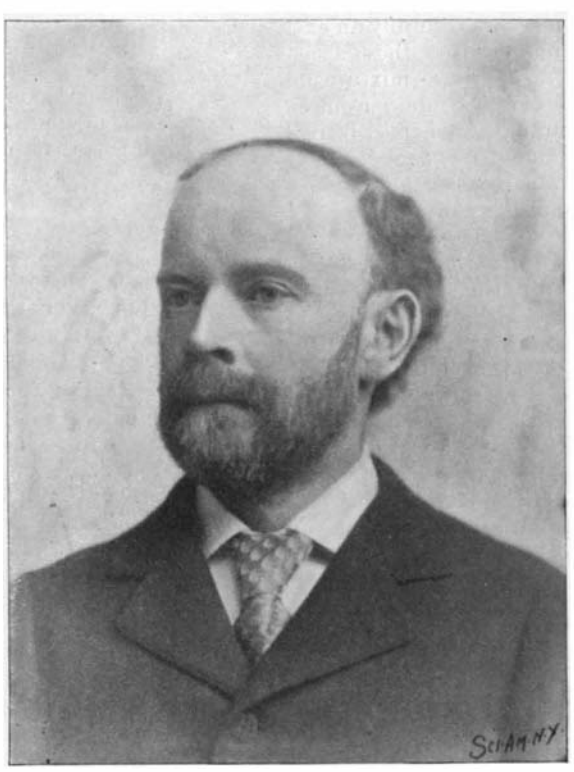
The crest of the Croton dam, 3¼ miles upstream, is 30 feet lower than the crest of the new dam. Hence, when the new reservoir is filled, the level of the lake will be 30 feet above the crest of the old structure The total water area will be about 8 square miles and the lake will extend as far as Croton Falls, fifteen miles up the valley.

The plans of this great work were drawn up by Chief Engineer Fteley, the recently elected President of the American Society of Civil Engineers, and the construction is being carried out under the immediate supervision of Divisional Engineer C. S. Gowan.

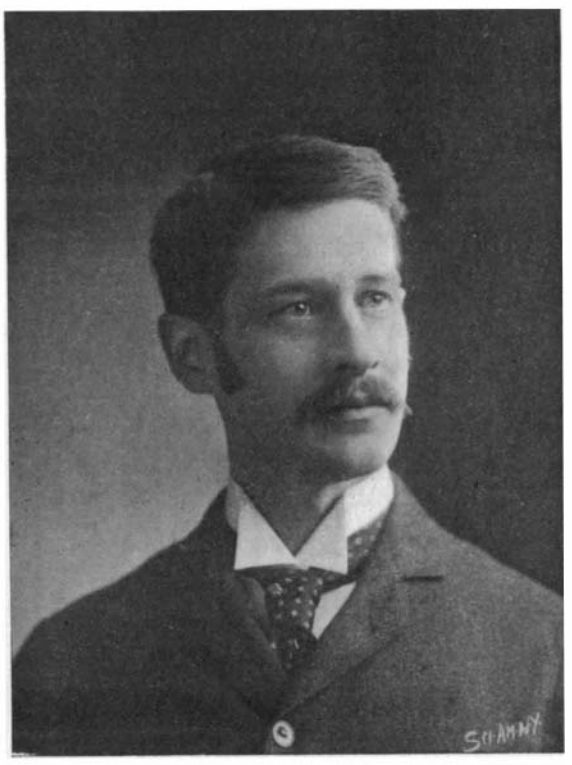


**7.—GENERAL VIEW OF DAM FOUNDATIONS, SHOWING TEMPORARY CHANNEL AROUND NORTH END OF DAM.**

Cross on hillside marks level of crest of dam.



**HON. CHARLES H. DUELL, COMMISSIONER OF PATENTS.**



**JUDGE A. P. GREELEY, ASSISTANT COMMISSIONER OF PATENTS.**

**HON. CHARLES H. DUELL, COMMISSIONER OF PATENTS.**

The United States Patent Office has been again favored with a Commissioner of known ability and probity. There is hardly a public man in the official life of Washington who is charged with more responsibility than the Commissioner, on whom rests the conservation of great interests. It is requisite that the incumbent of this office shall have a competent knowledge of practice before the Patent Office and be a lawyer as well. Mr. Charles H. Duell, of Syracuse, New York, who has been appointed by the President, admirably fulfills both of these qualifications. He has long ranked high as a practitioner in patent cases before the courts and he probably has few equals in this specialty. His practice has been extensive and has covered a great number of cases. He has attained a large degree of success, having had many cases where the interests involved were of large import. These he has handled with skill and prudence.

The appointment will probably mean a considerable financial sacrifice, as it will interrupt a lucrative practice and the position of honor to which he has been appointed is inadequately paid. Mr. Duell's appointment will be received with general public favor and it is considered one of the most fortunate of President McKinley's nominations. The new Commissioner was a candidate at the beginning of President McKinley's administration, but the latter wished to appoint his old personal friend, Congressman Butterworth. The death of Mr. Butterworth gave the President the opportunity of recognizing Mr. Duell's candidacy by nominating him.

Mr. Duell was born at Cortland, N. Y., in 1850; his father, R. Holland Duell, was four times sent to Congress, and in 1875 he was appointed Commissioner of Patents, which office he held for two years. Mr. C. H. Duell received a preliminary education in the Cortland Normal School; he then entered Hamilton College, from which he graduated in 1871. He was an honor man in his class and took several prizes. He has held some political offices honorably and acceptably to his constituents.

The inventors of the United States may feel sure that their interests will be looked after in a conscientious manner both in Congress and in the administration of the Patent Office.

**JUDGE ARTHUR P. GREELEY.**

The duties of the Commissioner of Patents are severe, and each new incumbent of the office must spend a considerable length of time in mastering the detail of the office. The manifold duties of the position render it essential that the Assistant Commissioner shall be thoroughly conversant with the administrative and judicial features of so great an establishment, so that he will be properly equipped to assist the Commissioner and take his place in the absence of his chief. In these respects the present incumbent, Judge Arthur P. Greeley, is well equipped for the responsible position of Assistant Commissioner of Patents.

Mr. Greeley is a graduate of Dartmouth College, in the class of 1883. He is a lawyer by profession, having been graduated from the law school of the Columbian University of Washington in the class of 1887, taking the post-graduate course at the same school the following year. The next year, 1888, he was admitted to practice in the District of Columbia.

In July, 1884, he entered the Patent Office as a fourth assistant examiner, as a result of his standing in the

first examination for appointment to the Patent Office held under the present civil service law. Was promoted through the successive grades of third, second and first assistant and principal examiner solely on merit as the result of standing in competitive examinations held in the office.

As an assistant examiner he served in the division of metal working B and electricity B, in the latter division having charge of the class of electric railways.

On appointment as principal examiner in July, 1891, he was assigned to a newly formed division comprising packing and storing vessels, advertising, etc. He was transferred in 1894 to the division of instruments of precision, and while in charge of this division for a number of months, acted also as examiner of trade marks.

From 1891 to 1893 he was a member of the committee having in charge the preparation, arrangement and installation of the exhibit of the Patent Office at the Chicago World's Fair, which involved an extended consideration of the development of nearly every important art represented in the Patent Office. He was also a member of the committee having charge of the preparation and installation of the Patent Office exhibit at Atlanta.

He is one of the first under the present civil service law to be appointed and advanced through the successive grades and to receive a presidential appointment on merit solely.

The value of the civil service requirements as applied to the United States Patent Office is illustrated by the appointment on April 1, 1895, of Mr. Greeley, of Concord, New Hampshire, a Republican in politics, by President Cleveland, as an examiner-in chief in the Patent Office. The appointment was based simply on the merit and ability which he had displayed in the previous positions he had held and demonstrated better than anything else could the practical application of civil service principles. During the summer of 1897 he conducted an investigation into abuses of Patent Office practice in a masterly and effective way, displaying judicial ability of a high order.

During the illness of Mr. Butterworth, Judge Greeley had entire charge of affairs, and conducted them with marked ability. With the conduct of the Patent Office in the hands of such men as Mr. Duell, the Commissioner, and Judge Greeley, his assistant, the inventor will know that his interests will be carefully safeguarded.

### Acetylene Explosions.

Developments have been somewhat retarded with this new and we must admit excellent illuminant, by the various accidents which have occurred at various times, and under certain conditions. It must be remembered that acetylene is an inflammable hydrocarbon gas, and possesses, by reason of its combustible properties alone, certain properties common to all gases of this series or mixtures of the same. Explosions of illuminating coal gas are common and many of our coal mine disasters are due to the explosion of mine gases; similarly vapors of benzine, dust from mills, factories or coal breakers occasionally inflame and explode under certain conditions. Therefore, the simple fact itself is not an exclusive property of acetylene, but rather that belonging to all combustible material under certain well defined conditions.

The condition referred to is, that sufficient oxygen shall be present and intimately mixed with the gas or finely divided combustible to produce and support combustion after spontaneous or purposive ignition has taken place. Usually this oxygen is supplied by the air; and, therefore, certain definite mixtures of air with various gases are explosive, the latter term indicating that combustion takes place more or less instantly, thereby generating a considerable amount of heat, which, imparted to the gases of combustion, expand instantly and tend to increase in volume to such an extent as to burst the confining vessel or do other serious damage. Thus if we have acetylene confined in a small gas holder such as accompanies some generators, or in the generating vessel itself, it is harmless so long as it is not mixed with air, but as soon as any vent or cover is opened admitting oxygen, the mixture is liable to detonation when an open flame is brought in contact with it. And thus was caused all the explosions of non-liquefied acetylene gas which we have any know ledge of. Carbide is of such good quality that there never will be sufficient phosphorus in the gas to cause spontaneous combustion upon the admission of air to it, and should such a gas be made, it would have such an evil smell that the carbide would be rejected; for the odor of acetylene is due to the phosphureted and sulphureted hydrogen it contains. These impurities exist primarily in the lime and carbon used to make the carbide in the electric furnace.

Let us now take a brief survey of some of the principal accidents that have occurred. In France there have been a number of minor explosions. While brazing a generator which they believed perfectly free from gas, some workmen of Paris were seriously injured, as the vessel was but partially empty and contained the requisite air and gas mixture. At Fecamp a similar accident was caused by a workman soldering a gas holder without taking the trouble to empty it. A café was destroyed at Lyons by a violent explosion due to the carelessness of a boy who had neglected to close a valve on the generator, thus allowing the gas to escape into the room during the night, all ready mixed for ignition by a candle in the morning. At Milan a foolhardy inventor looked for a leak in his apparatus with a lighted candle—and found it, but was dangerously wounded in doing so. While attempting to solder a generator containing a mixture of gas and air, two workmen of Chateauroux were wounded by the resulting explosion. Again, near Toulouse, a tinsmith and his helper were endeavoring to make a generator work, and by their recklessness of consequences caused an explosion which killed both. At Compiegne, in a generator factory, while a generator was being tested, the foreman left the shop for a moment, advising his helper not to approach it with a light. He was scarcely gone before the inquisitive workman lit a candle and approached the apparatus (the bell of which had been removed), and was killed by being struck on the head by a flying fragment. At the restaurant of M. Marignac, at Portet, in Haute-Garonne, the proprietor and another man attempted to clean a generator which had just been installed. He was removing the cover when an explosion occurred, injuring him seriously about the body and legs, while his friend had his right leg maimed.

Another phase of these explosions appears in an explosion at the shop of M. Caron, a bicycle manufacturer of Paris. He sold carbide to supply the acetylene lamps of wheelmen. This carbide was shipped in hermetically sealed tin cans in wood cases, having the top soldered on. While attempting to open this can in the usual way by using a hot soldering iron, he found it was not hot enough and carelessly used the flame of a plumber's lamp instead. The solder melted, but there had been enough moisture in the air inclosed with the carbide to generate some acetylene gas, and this was ignited by the flame of the plumber's lamp. A detonation followed, and M. Caron, who was sitting on the can, was burned about the upper part of his body and his workman was hurt by flying pieces of the can about the head and chest. Although this differs from the other explosions slightly, the cause is the same—applying a flame or incandescent body to a mixture of gas and air. All could have been avoided by ordinary precautions.

In Germany we find similar accidents and in England in less degree. In the United States there are a few examples of note. At Rochester, while working about the safety valve of a galvanized iron gas holder, the experimenter was dangerously injured and a bystander narrowly escaped. It is said that the injured man was bending over the gas holder and was attempting to pull it out, evidently drawing air in at the same time and forming an explosive mixture. The room was dark and a gas jet was burning above the apparatus, the cause of an explosion thus being not difficult to trace. Similarly, at Wilmington, a boy was temporarily left in charge of a generator, and, finding the gas light growing dim, attempted to operate the apparatus. He is supposed to have opened the generator by unscrewing the cover, and to have taken a candle to examine its interior to see where the trouble was. Naturally an explosion followed. It is thus apparent that these accidents were caused by igniting an explosive mixture of acetylene and air, which mixture may contain from 3 to 50 per cent of acetylene, the maximum effect being obtained between 12 and 20 per cent. The range with coal gas is less, beginning at about 8 per cent of gas, and the explosive intensity is not so great.

Acetylene should not be kept under a pressure of more than about 25 pounds per square inch gage pressure, and compressing directly in the generator has been found dangerous, as the temperature generated is liable to cause decomposition; just as acetylene under low pressure has its one great element of danger—explosive mixtures of air and gas—so compressed or liquefied acetylene has its bete noir—temperature.

Liquefied acetylene expands remarkably under the effects of temperature, about one atmosphere (15·4 pounds per square inch) for a rise in temperature of about 2° Fah. Consequently, the heat does not have to be very great to cause the pressure in the storage flask to exceed its strength, and it bursts. The liquid at once expands into gas, and expands still further if it comes in contact with fire, or explodes with tremendous violence, if allowed to mix with air before ignition. New Haven the past year witnessed a very destructive explosion of a flask of liquefied acetylene. The evidence indicated that there was a leak in the valve of the flask caused by a fracture, and that the escaping acetylene was ignited by a match or candle used to test the regulators. The escape of gas was evidently larger than ordinary, causing a large development of flame, which heated the flask up to bursting point, and the shop was demolished by the resulting explosion. At Paris an explosion occurred in the laboratory of Prof. Pictet of a similar cylinder, due to improper handling by an employé.

About a month ago the works of the United States Liquefied Acetylene Company, of Jersey City, were demolished completely by exploding cylinders of liquefied acetylene. Although the coroner's report has not as yet been issued, the evidence seems to point to the fact that a flame was seen in the room before the explosion, apparently coming from a cylinder which had been partly filled with acetylene and blown out again to remove any air that may have been contained. This escaping gas must consequently have been ignited somehow, although the witnesses who could have told how were killed by the explosion. It must be remembered that acetylene gas is readily ignited by a spark, a lighted cigar or pipe, a red hot coal or similar incandescent body, and that carelessness or ignorance of these conditions evidently has caused many accidents. After the first cylinder exploded, the burning gas generated such a high heat that the score of other filled cylinders exploded like a pack of gigantic fire crackers. A boiler was projected through the air to a distance of 200 yards, and earth tremors were felt as far as Staten Island.

These explosions, all of which were more or less disastrous, must one and all be traced to carelessness. A careful man does not go into a cellar in which there is a leaking illuminating gas pipe, carrying a lighted candle; neither does he tumble a can of nitroglycerine off a wagon or throw a lighted cigar into a keg of powder. With the same degree of carefulness, he will not approach a mixture of air and acetylene with a lighted lamp or cigar, nor will he place a flask of liquefied acetylene where any escaping gas will be ignited or the flask itself unduly heated.

A great deal of groundless fear has been induced by the above disasters. As a consequence we still hear about acetylide of copper, although experience and experiment have not corroborated the oft-repeated warnings against it. Similarly phosphureted hydrogen has caused much disquietude, but thus far no harm has been traced to this substance. However, when the carbide is unusually impure, the gas will have a very decided fœtid garlic odor, and the products of combustion, when not permitted to escape, may cause discomfort while breathing it. American carbide is quite free from this defect, and owing to the small consumption of this gas (one-half cubic foot for a twenty-five candle powerlight as compared with five cubic feet of illuminating coal gas), the formation of vitiated air is slow in comparison. When breathed it is not so poisonous as coal gas. And we may safely state that, if we observe the two necessary precautions of low temperature and keeping an open flame away from the generators and gas holders, this gas is perfectly safe to use.

Therefore, generators should be located in well ventilated places, preferably out of doors, and should be opened for filling and cleaning only by daylight. Liquefied acetylene is scarcely a safe form to use this gas in, as the pressure necessary for liquefaction is at least sixty-eight atmospheres—a pressure that in itself is dangerous and admits of no defective apparatus. Acetone as a solvent has not as yet received sufficient application to judge of its possibilities.

### Miscellaneous Notes and Receipts.

**Cleaning Lenses.**—For cleaning optical lenses the Allgem. I. f. Uhrmacherkunst recommends vegetable pith. For this purpose the medulla of rushes, elders, or sun flowers is cut out, the pieces dried and pasted singly alongside of one another upon a piece of cork, whereby a brush-like apparatus is obtained which is passed over the surface of the lens. For very small lenses pointed pieces of elder pith are employed. To dip dirty and greasy lenses into oil of turpentine or ether and rubbing them with a linen rag, as proposed by the above journal, seems hazardous, because the Canada balsam with which the lenses are cemented for the purpose of achromatizing might become dissolved. One had better carefully wipe off the lenses with a soft linen rag dipped in oil of turpentine, etc.

**To Render Fabrics Fireproof.**—16 pounds pure ammonium sulphate, 5 pounds pure ammonium carbonate, 6 pounds boracic acid, 4 pounds pure borax, 4 pounds starch or $\frac{4}{5}$ pound dextrine or gelatine, 200 pounds water. Into this liquid the fabrics are dipped at 86° F., so that they are well saturated; then they are wrung out lightly and sufficiently dried for ironing. The quantity of the starch or the dextrine and gelatine may be changed according to the degree of stiffness the stuffs are to possess. One quart of the liquid will impregnate about fifteen square yards of stuff.—Färber Zeitung.

**Weatherproof Coating for Diaphanies.**—For producing this weatherproof coating proceed as follows: Unite by shaking 100 parts absolute alcohol and 2 to 3 parts of thick turpentine and after the latter has dissolved add about 5 parts of camphor. Now add about 10 parts of pyroxylin which has been moistened with a mixture of 10 parts of glacial acetic acid and methylic alcohol and soaked lightly into the above described solution. The whole is allowed to settle in the warm, whereby the parts of water which are contained in the ready product can separate out. The supernatant liquid is ready for use. A picture provided with this coating is said to be impervious to all influences of the weather and to be able to even withstand slight mechanical actions.