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Contents.

(Illustrated articles are marked with an asterisk.)

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 557.

For the Week Ending September 4, 1886.

Price 10 cents. For sale by all newsdealers.

THE WATER SUPPLY OF NEW YORK CITY.

In the SCIENTIFIC AMERICAN SUPPLEMENT of the present week (No. 557), we print an exhaustive review of the plans for the future water supply of this city, from the pen of Mr. R. D. A. Parrott. The Quaker Bridge dam project is discussed very fully on the basis of ascertained facts. The conclusions reached are anything but favorable to the city's prospects.

The Quaker Bridge dam valley seems, from the configuration of the land, quite unfit for the purpose of a reservoir. It has a very slight slope, only twelve feet to the mile. When the dam is overflowing, comparatively little harm may be anticipated from it. But, unfortunately, the records of the past ten years prove that overflowing will be an abnormal state of things, and will only occur during four months of the year. For the remaining eight months, the storage *plus* the flow into the reservoir will be drawn upon. This will occasion fluctuations in the level; and when it is remembered that twelve feet fall of water will expose a riparian area a mile in width of mud, the malaria-generating capacities will be obvious. It is quite within the possibilities that nearly three thousand acres of bottom may be exposed.

This injurious feature does not only affect the country inhabitants, the city is also threatened. Eventually, by its increase of 800 inhabitants a week, the region near the dam will be populated, and its evil influences may spread south and east over future thickly settled streets of the city. The recent injury to contiguous property, due to the lowering of the waters of Lake Mahopac, shows what harm exposed lake or pond bottoms may do.

For eight months, all the water of the shed will be impounded by the dam, and delivered to New York. All the filth of this area is to be drawn into a great pond, and without any purification by aeration is to be husbanded until delivered more or less diluted to the aqueduct. If sanitary science teaches anything, it does affirm that pond water is the worst of natural water supplies, and that a river by aeration due to its flow purifies itself. In the proposed reservoir, we have an exaggerated pond, in which no aeration is possible, and one that by its emanations threatens injury to those near it, and by its water may affect a whole city.

Pumping, as executed in this city by private individuals, represents a great deal of work, or its equivalent, money. But New Yorkers are proverbially patient, and now seem resigned to await the completion of the new dam to secure a flow of water in the upper floors of their buildings. But Mr. Parrott points out that the bottom of the Quaker Bridge dam is only seventy feet above tide water, and that little or no amelioration is to be expected from it. In the dry goods district, from one hundred to one hundred and fifty millions of dollars' worth of property are uninsured, as the risks will not be taken. When the Croton was originally introduced in 1842, rates fell 40 cents on the hundred dollars. Referring to this district alone, is it not public policy to spread the awful risk of a conflagration among insurance companies all over the world, rather than to center it upon a group of representative merchants, now unwillingly their own insurers?

It appears, then, that little amelioration in pressure is to be looked for, and that the supply will not much exceed 250,000,000 gallons a day. At the rate of 100 gallons per head per day, this supply will soon be grown up to. The policy of limiting the supply of water is directed against factories and health. Mr. Parrott advocates a possible supply of 400 million gallons a day at a head of 300 feet. Among the features to be disapproved of in the new structure, he includes the submerging of the Croton dam after its past and possible years of usefulness.

The indictment from chemical and engineering standpoints reads like a sound one, and if unaccompanied by any suggestion for a remedy, would be disheartening. But the feature of the paper lies in a very pregnant suggestion, the utilization of the Catskill Mountains as a watershed. The idea cannot be clearly explained without the map that is printed with the paper. A dam on Esopus Creek, within fifteen miles of the Hudson River, is the starting point. This is 500 feet above tide level, and includes 240 square miles of a mountainous watershed. A tunnel eight miles long will bring in 110 more square miles of watershed, through the Schohaire Creek; another three miles of tunnel will bring in 50 square miles of the Batavia Kill shed; and, finally, a third tunnel, eight miles long, would increase the total area to 530 square miles of the purest watershed this side of the Adirondacks. All this is little over a hundred miles from the city, is on the west side of the Hudson, and could be made tributary to the new aqueduct at comparatively small expense, in proportion to its features of good.

Mr. Parrott calculates that the water will be six degrees cooler than Croton. By the tunnels different sides of mountains will be utilized, so that local thunder storms will all contribute to the supply.

This is the general result of the conclusions derived from the paper we have considered. The subject of expense is taken full cognizance of, but should be the last thing thought of. The health and safety of New York, and the encouragement of its manufacturing interests, rise paramount to any possible expenditure.

SCORING OF GRINDSTONES.

The following item is a recent one, but it is not a new fact:

"An improvement in the driving of grindstones and emery wheels is that by which the wheel is given a reciprocating lateral motion in addition to its rotation. Every one has noticed the advantage of moving a tool from side to side on a grindstone, so as to equalize the attrition on the different parts of the edge. It has now been found that by making the grindstone move laterally, and keeping the tool still, a more perfect result is attained, while the detached particles of steel have an opportunity to drop off the grindstone instead of being crushed into it, and the wear of the stone and the heating of the tool are both greatly diminished."

In file-making establishments the lateral movement of the grindstone is a necessity, else the file blanks would speedily cut the stone into annular channels. In some machine shops, also, provision is made for the same movement. But if this sideways movement is absolutely reciprocal, the stone will be scored as surely as though there was no movement sideways, only the scores will be curved instead of straight. For instance, suppose the shaft of the grindstone has end play enough on its journals to allow of a lateral motion of one inch, and a cam is fixed on the shaft with that amount of throw, a stationary guide on which the cam works to be secured to the frame. It is evident that, when the stone has made one revolution, its periphery will be, in relation to a fixed line on the frame, in exactly the same place as when it started; and, in consequence, if a scoring point was held against the face of the stone, it would make a cut one inch sideways out of a direct line, but meeting, to make a continuous ring, precisely as though the stone had no sideway motion.

In order to prevent this continuous and uniform action, the lateral movement, in relation to the revolution of the stone, must be continually changing. For this purpose, the driving belt should be on a pulley on a short countershaft, on which is also a gear wheel that meshes with another on the shaft of the grindstone. This countershaft is to be attached by boxes to the grindstone frame. The gear on the grindstone shaft should be wide enough on the face to allow the lateral movement of the stone without unmeshing the teeth of the gears. The cam is fixed to the grindstone shaft, and may have its throw either as a raised strip or as a score, to be guided by a holder fixed to the frame; but if the gears have even numbers of teeth—numbers divisible by each other—the uniform scoring cannot be avoided. So, one gear should have an odd tooth—"a hunting tooth," as it is sometimes called—which will insure perpetual change. Thus, if the two gears had respectively 40 teeth and 80 teeth, there would be uniformity of throw; but with 39 teeth and 80 teeth, or with 41 teeth and 80 teeth, uniformity would be impossible. Half an inch is enough of lateral movement to the stone, and the relative sizes of gears are immaterial, so long as their disproportion in number of teeth is observed.

PHOTOGRAPHIC NOTES.

A Miniature Paper Camera.—We have several times alluded to the fact that it was possible to obtain fair negatives by arranging a sensitive dry plate in one end of a suitable box, while in the center of the opposite end was a fine needle hole through a thin piece of metal attached to the outer surface of the box. Practically this idea has just been carried out in a small camera recently put upon the market, which, for its compactness, simplicity, and novelty, will be likely to lead a great many, young and old, into taking up photography as a pastime.

The camera bellows is nothing more than a heavy brown-black paper box made in two folds, the whole when fully extended measuring about three inches. The front portion of the paper bellows is pasted over the edges of a rigid sheet of straw board, cut to the size of the sensitive plate, thereby forming the camera front, and in the center of this is an aperture about a quarter of an inch diameter, covered by a film of ruby and green colored isinglass, pasted on the inner face of the front. A minute needle hole is punctured through the center of the thin isinglass which forms the lens. The aperture is closed on the outside by a gummed paper flap. Cemented to another straw board, forming the back of the camera, is the sensitive dry plate. The back portion of the paper bellows is then pasted over the back of the camera the same as the front. We then have a light-tight paper box, the front provided with a pin hole and the back with a sensitive plate.

When the folds of the paper bellows are pressed inward, making the front and back come together, the thickness of the package does not exceed half an inch, and measures $3\frac{1}{4}$ by $4\frac{1}{4}$. An angle of 100° is included in the picture, and the focus is 3 inches. It will be seen that its compactness makes it very handy to carry. Several cameras can thus be readily taken in one's pocket, since they occupy scarcely any more space than the sensitive dry plate itself.

In making an exposure, the bellows is extended, and the miniature box is set upon a post, chair, or any convenient support, the front being turned toward the object to be taken. The small wafer of paper covering the aperture is turned down and an exposure of from one to two minutes is given, according to the light. Upon its completion, the wafer cap is turned back over the aperture, and the box compressed into its original compact form. The plate may be thus packed away for future development. If it is to be developed at once, the box is removed to the dark room, and the back end carrying the sensitive plate is cut off with a knife. The plate is next easily separated from its paper backing and can be developed in the usual manner with potash and pyro.

The peculiar advantages are that with each plate is furnished its own camera, so that both are always ready for immediate use. No focusing or adjusting is required.

It is expected that the novice will take the plate after exposure to a professional photographer for development and the finishing up of prints. The low price at which the camera is sold complete, ready for use, puts it within the reach of everybody, and we expect it will be the means of educating many who will eventually take up the practice of the art with more expensive apparatus.

Reproduction of Drawings direct with Black Lines on a White Background.—M. Poitevin is said to have been the first to give the details of a practical process for the reproduction directly, without the intervention of a negative, of drawings, maps, positives, etc. Pellet next devised the process of making blue lines in a white ground. A French officer, Lieut.-Col. De Saint-Florent, has lately published in the *Bulletin de la Societe*, which we find translated in the *Photo. News*, an account of some improvements he has made in these processes, accompanied by several useful details.

The first method he speaks of is what is called the powder process, where the positive is reproduced by the use of inert powders.

The paper employed is sensitized on a bath of bichromate of potash.

If albumenized paper is used, it must be laid back down upon a saturated solution of bichromate of potash. If plain paper is employed, it should first be coated with a weak solution of gelatine and water, and when dry sensitized face downward upon a solution of 48 grains of bichromate to one ounce of water.

If the sheet is large, the solution may be applied with a badger brush.

The paper is next dried in the shade, and exposed in a printing frame behind the picture or drawing to be copied. The drawing should be specially prepared with Indian ink having mixed with it a little chrome yellow. The back of the sensitized albumen sheet is now placed in contact with the face of the drawing, and an exposure made to the sun in the usual way. For ordinary tracing linen or thin drawing paper, from three to six minutes will suffice; for an architectural design on thick paper, from twenty to twenty-five minutes.

In case engravings on thick paper are to be copied, the printed side should be laid in contact with the front or glossy side of the sensitized sheet, and an exposure of from ten to fifteen minutes given. It is well to use a special photometer, to determine accurately the right exposures. When taken from the frame, the print should be washed a few moments in ordinary water containing a few drops of ammonia, then dried in the air. If albumen paper is employed, its surface will present a curious condition. The under side of the albumen fiber, in contact with the paper, will be found to be slightly coagulated by the bichromate of potash where the light acted upon it. The reduction by light of the chromic salt has rendered the portions of the surface not protected by the lines of the drawing impervious to water.

In case the exposure has been too short, or ammoniacal albumen used in the preparation of the paper, or if too much water has been added to the ammonia bath, the albumen surface will not be totally impervious to water. It is necessary that these precautions be carefully observed.

The portions protected by the black lines will, even if the albumen is slightly coagulated by the bichromate, be quite permeable to water. In the water bath the albumen thus protected will swell up quite perceptibly.

The print is now dried between blotting pads, when it will be observed that the whites alone, that is, the parts corresponding to the blacks to be reproduced, will possess an adhesive property, and retain the black or any other inert color that may be applied, whether by means of a dabber of cotton or a pointed pencil of cuttlefish bone. The surface is then cleared with a new dabber till the print is as free as possible from the black

The sheet is next immersed briefly in a ten per cent solution of sulphuric acid and water, which transforms the chromic oxide into soluble sulphate, and, at the same time, coagulates the albumen of the black parts. After further washing in three or four changes of water, the ground becomes almost white.

One difficulty to be noted about this process is that it is very hard to obtain absolutely pure whites—the ground is likely to be more or less slightly tinted. On the other hand, the prints are very clear, the lines standing out bold and plain. The process is also very simple and quick, and is valuable in case one has but little time to spare.

The glaze of the albumen may be destroyed by placing the print for ten or fifteen minutes in a solution of caustic soda, followed by careful washing. If the exposure is too short, negatives will be obtained instead of positives.

Direct positives of landscapes strongly illuminated by the sun may be obtained in the camera with exposures varying from thirty to forty-five minutes.

The Freight Brake Tests at Burlington, Iowa.

The tests of freight train brakes, undertaken by the special committee on that subject of the Master Car Builders' Association, began at Burlington, Ia., July 13. They continued through three weeks, and are now completed. Of the five companies which brought their trains to engage in the contest, viz., the American, Eames, Rote, Westinghouse, and Widdifield & Button, the Rote has practically not entered into the contest at all. Preliminary trials on the ground convinced the managers of this company that changes would have to be made in the apparatus before it could accomplish what they had expected of it.

The Widdifield & Button representatives entered into the trial with 25-car trains, but the records made by them on the first 50-car train test in which they took part were not encouraging, and they undertook no others. This brake, like the others of the buffer class, as stated below, failed to hold evenly on the wheels during stops, and showed a lack of power on the grade.

The American Brake Company pluckily took its turns on the programme with 25 and 50-car trains, but every run, especially with long trains, showed that there were imperfections to be overcome before the brake would be satisfactorily adapted to all conditions of railway freight traffic. It must be added that these imperfections seemed to be common to all the independent brakes. With trains of 25 cars, and still more with those of 50 cars, the effort to hold the trains to a moderate speed on a down grade was a practical failure. In a run of this kind with the American brake, in an attempt to hold the train to a speed of 15 miles per hour, down the 55 ft. grade, there was a constant succession of shocks and lurches, much too severe for stock trains.

The buffer brakes clearly failed to exert sufficient braking power on the down grade. The indications are that the retarding force exerted by the locomotive with its driver and tender brakes was very considerable on level track, and that the comparative absence of this help on the grade greatly increased the distance of the stop. If our railways had no grades, or only slight ones, the task of producing a satisfactory buffer brake would be a much easier one than it now is. The American brake certainly made a very good showing in the first three stops of several of the service tests, in spite of the intermittent action of the brakes above referred to, and it is not impossible that the well-known ingenuity of its mechanical superintendent may make it successful.

It appears that the irrepressible "coupler question" is an important element in the brake problem. There seems to be no doubt that the shocks of which we have spoken are largely caused by the cumulative effect of the slack, as the cars are bunched during a stop. In the case of buffer brake systems, when the cars come up against each other as the brakes take effect from the front of the train toward the rear, the result is the releasing of the brakes on the forward portion of the train, which then forges ahead until another compression of the draw-bars again sets them. This alternate slacking and starting forward would sometimes occur a number of times in a single stop, giving a continuous succession of shocks. With continuous brakes there was usually but one bunching of cars, and consequently one shock, though sometimes there would be a second one, far more severe than the first. Tests made with trains so coupled as to reduce the slack to a minimum showed a large decrease of shocks, thus scoring a point for the hook couplers. It is not impossible that much of the imperfection in the working of the buffer brakes may disappear if slack can be eliminated from long and heavy freight trains. The extent to which draw-bars can be compressed also appears to be an item of some importance. There were indications that the trains whose draw-bars were capable of only slight compression did not show as severe shocks as did those which permitted more variation in the space between the cars.

The Westinghouse air brake and the Eames vacuum brake were the only continuous brake systems entered for the tests.

The Westinghouse surpassed all the other competitors in the completeness of the preparations, the perfection of its equipment, and the familiarity of its representatives with their duties. Those upon whom devolved the handling of the brakes had an invaluable practice in all that was required to bring out the full efficiency of the system in all the tests. While it is believed that no train of 50 cars, each loaded with 20 tons, had ever before been handled with this brake, it is in extended use on the freight equipment of many roads, and long and heavy trains are being handled with it every day down the grades of the great mountain and Pacific coast lines. Its representatives, when they began the tests, knew fairly well from actual experience what the system could be depended on to accomplish.

The Eames vacuum brake entered the contest handicapped in more than one respect. It had never been operated on a train of even 25 cars in regular service. Those who handled it had had but slight opportunity to learn those niceties of management by which the difference between a good stop and a bad one is caused. The cars which this company brought to the trials were in some respects inferior to those of the other competitors, especially as regards the draw-bar rigging.

Doubt as to the possibility of controlling loaded trains of 50 cars with continuous brakes need no longer exist. When, on the morning of July 24, the Westinghouse train of 50 cars, each with a 20 ton load, thundered along the course, and swept down the 55 ft. grade, making each stop smoothly, in short distances and practically without shock, the fact that such trains can be handled by continuous brakes in all the exigencies of service was shown for the first time, but it was shown conclusively. The same fact was demonstrated by the Eames vacuum train, which in similar circumstances made in these runs records which fully satisfy all those who are identified with it or interested in its success.

Yet it should be said that it is very doubtful whether the brakes on the rear third of a 50-car train, in either of the two systems, exert much effective retarding force. Although the gauges on the last car always indicated nearly as much air or vacuum pressure as those at the front end, and showed that the brakes were on in from 10 to 14 seconds, other facts lead to the belief that the stops were made before the rear brakes were effectively applied. It was certainly shown that 50-car trains could be well handled if the brakes were cut out of the last 20 cars.

The general facts established by the tests, as regards the systems taking part in them, may be summarized as follows:

1. Continuous brakes, operated by air, can be applied to and released from the wheels of trains of 50 cars with all the promptness required in the service.

2. Brakes operated by compression of the draw-bar may be used with a good degree of success upon trains not exceeding 25 cars, if handled intelligently. To be used on long trains, some device must be contrived by which the brakes will be steadily held to the wheels during the whole stop.

3. In running down grades, the buffer brakes do not show retarding power relatively proportioned to that which they exhibit on level track, or to that shown by the continuous brakes on down grades.

4. The comparatively gradual putting on of the full power of continuous brakes in what are called "service" stops is sufficient to meet all or nearly all the exigencies of service. The records show that these stops, or, at least, many of them, are made in just about the same distance as the corresponding "emergency" stops, while the injurious shocks which accompany the latter are avoided if the brakes are applied with a fair degree of skill.

5. The proper handling of long freight trains with either continuous or buffer brakes requires a coupling device which shall largely decrease the amount of slack caused by the use of the ordinary link and pin. This proposition is, perhaps, not absolutely established by the tests, but its truth is certainly indicated.—*Railway Master Mechanic.*

Mrs. Cleveland, in the Adirondacks, Starts the Machinery of the Minneapolis Exhibition.

The opening of the industrial exhibition at Minneapolis, Minn., Aug. 23, was made somewhat memorable by the fact that the machinery was set in motion by the President's wife from Upper Saranac Lake, in the Adirondacks. All the other arrangements for the purpose having been previously made, direct telegraphic communication was established between the exhibition building and the Minneapolis office of the Western Union Company, thence through Chicago, Cleveland, and New York city, with the country stopping place of the President's party, when, upon a given signal that the circuit was open the whole distance, Mrs. Cleveland pressed a button which set the wheels turning in the exhibition, over a thousand miles distant. The opening of the exhibition was a great success, the ceremonies being participated in by enthusiastic crowds.