was at its height, trains were run on regular schedule time, fifty three-car trains daily each way, carrying from one to three hundred passengers per trip. The regular time taken for the run was three minutes, but special trips were made in two and three-quarter minutes each, including starting and stopping. The daily consumption of coal in performing this service was but half a ton. The great economy of this method of traction is also evidenced by the smoothness with which the cars run, and the entire absence of side motion and vibration, there being no striking and grinding of the wheel flanges upon the rails, as is common on double-track roads. From a seat in the top part of the tender, where one could observe how the trolley wheels followed the guide rail, it was noticed that frequently, for considerable distances, these wheels did not touch the guide rail at all on either side, and when they did approach and bear upon the guide rail it was with a gently swaying movement, indicating no expenditure of power at this point, and apparently having no effect upon the motion of the car. This was, of course, to be expected, in this system of locomotion, when a high speed is attained, and it is upon this point that the claim is made by the advocates of such systems, that in this way only is it possible to obtain greatly increased speeds on railways with the present styles of motors.

Hydrogen and Oxygen Produced by Electricity

In a paper recently read before the Société Française de Physique Commander Renard described his investigations on the electrolysis of water on a commercial scale, which he commenced as far back as December, 1887. Taking the counter E.M.F. at one and five-tenths volt, and the total plant efficiency at only 50 per cent, thirty-five and three-tenths cubic feet (one cubic meter) of hydrogen can be produced for every ten horse-power hours; and taking the coal consumption at two and two-tenths pounds (one kilogramme) per horse-power hour, the cost of fuel for every thousand cubic feet at atmospheric pressure of the mixed gases comes out in France at between 32 cents and $1.20, according to the price of coal. To make the electrolytic production of these gases a commercial possibility it is necessary to avoid the use of costly platinum electrodes and of air-tight partitions for collecting the gases. Commander Renard employs an alkaline electrolyte (caustic soda, thirteen per cent solution) and is therefore able to substitute cheap cast iron electrodes for platinum. As to the vessels for the collection of the gases, he finds that so long as they have a *capillary reaction* Δ equal to a few centimeters of water, the hydrogen and oxygen do not mix. Commander Renard employs porous pots of asbestos fiber, which are able to withstand a pressure of from thirty to fifty cms. of water without permitting the passage of the gases. The actual commercial apparatus used at the Chalais works is as follows: A large cylinder of common sheet iron serves at the same time as the containing vessel for the electrolyte and as the negative electrode. The positive electrode is a perforated iron tube, fixed on to an insulated lid, which fits hermetically on to the top of the containing vessel. This electrode is surrounded by a large asbestos bag. Two voltmeters of this kind have been in continuous work at Chalais for some six months, and at the end of this period both the electrodes and the asbestos bag were in perfect condition. The gases given off are pure, and there is no ozone. According to Commander Renard, a battery of thirty-six large voltmeters could generate about 200 cubic feet of hydrogen and 100 cubic feet of oxygen per hour, which could be compressed to a pressure of from 120 to 200 atmospheres in steel tubes, and utilized for therapeutic, laboratory, metallurgical, and other purposes. The *total* cost of these gases, ready for use in steel bottles at a pressure of 120 atmospheres, when produced on a sufficiently large scale, is estimated at from $2.92 to $3.54 per thousand cubic feet.

Electrical Welding of Wheels and Rails.

An invention is now undergoing investigation which promises the improvement of railway traffic. The invention consists of a small dynamo and an auxiliary engine placed upon the locomotive in such a way as to be easily operated, furnishing a current of small force but large quantity, which is made to pass from one pole of the dynamo to one pair of driving wheels, thence along the rail to the other pair of driving wheels, thence to the other pole of the dynamo, thus forming a traveling circuit, moving at all times with the locomotive. By means of this current an incipient weld is caused between the wheels and rails at the point of contact, preventing the slipping of wheels. The working model of the device shows an increase of 400 per cent in the hauling power of the locomotive. The model without the application of the current would not mount a grade of fifteen per cent, but when the current was applied, it mounted a grade of thirty-five per cent. A locomotive is now being equipped with the invention to test it on the Baltimore and Ohio Railway.

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THE CELEBRATION OF THE BEGINNING OF THE SECOND CENTURY OF THE AMERICAN PATENT SYSTEM.

The coming month is to witness the celebration of the Beginning of the Second Century of the American Patent System. On April 8, 9, and 10, a grand convention of all who appreciate the value of the American patent system is called to meet at Washington, D. C. The programme, lists of committees, names of speakers and subjects of their addresses have been published. The occasion is an impressive one; the *personnel* of the meeting, it is not too much to say, seems to rise to the occasion. Without the encouragement of the patent system the inventors of America would never have worked as they have in the past. With no statutory right to the fruits of their intellectual toil they would never have appeared on the scene as the moving force in so many parts of the commercial, agricultural, and mechanical world. The gathering at Washington of the leading scientific and mechanical workers of the age and race, the oral exposition of the law and statistics of invention, of the science and practice of invention and of its specific applications, the interesting collections in science and art, and the historical models of inventions which will be produced, all co-operate to give the occasion an importance not exceeded in the case of any convention ever held in Washington.

Our views on the maintenance of the rights of the inventor and on the preservation of the force of the Patent Statutes are known, and have often been recorded. In this convention, to include the best minds of the day among its active participators, we recognize a tribute to the inventor and an auxiliary in the defense of his rights. The voices and opinions of the old-time federal judges, upholding the dignity of the inventor and his vital importance to America, will be re-echoed in no uncertain tones during the three days of commemoration. A chance will be afforded our legislators to hear the just views of the nation's thinkers upon the patent system. A barrier will be opposed to future attacks upon it, and the moral force of the convention will be great and lasting.

The first public meeting, on the afternoon of April 8, is to be presided over by the President of the United States, and on the evening of the same day the second public meeting is to be held under the chairmanship of Hon. John W. Noble, Secretary of the Interior. Two public meetings are called for the afternoon and evening of April 9, presided over respectively by Hon. Frederick Fraley, LL.D., president of the National Board of Trade, and Prof. S. P. Langley, LL.D., Secretary of the Smithsonian Institution. The final public meeting is to be held on the evening of April 10, to be presided over by Prof. Alexander Graham Bell.

The list of speakers and the subjects of their orations indicate the work of these public meetings, and give its character. Dr. John S. Billings, a scientist of international reputation, is to treat of "Invention and Discovery in the Field of Medicine, Surgery, and Sanitation." Judge Samuel Blatchford, of the United States Supreme Court, perhaps the leading judicial exponent of patent law, is to speak on the subject of "A Century of Patent Law." The Hon. Benjamin Butterworth, formerly Commissioner of Patents, now of the United States House of Representatives, is to treat the material development of the country as affected by invention. The "New South," as an outgrowth of invention and of the American patent law, is to be the subject of an address by Senator John W. Daniel, of Virginia. The Commissioner of Patents, Hon. Charles Eliot Mitchell, is to speak on the "Birth and Growth of the American Patent System," and the copyright system in similar aspects is to be treated by Hon. A. R. Spofford, Librarian United States Congress. Among the other distinguished speakers may be mentioned Professor Robert H. Thurston, Director of the Sibley College of Cornell University. He has chosen for subject "The Inventors of the Steam Engine." Much of his own work has been devoted to the theory of the heat engine in all its forms, and his theme seems peculiarly suited to his record.

The above is a very incomplete outline of the work before the convention, for besides the five public meetings and the numerous addresses, of which but a small part have been alluded to, there will be many other attractions. A special reception to inventors and manufacturers, and to ladies who accompany them, is to be held at the Patent Office on April 8, from 9 to 11:30 P. M. The guests are to be received by Secretary Noble and Commissioner Mitchell. Anniversary Day is the name given to April 10. On this date, over a century ago, General Washington, as President of the United States, signed the first American Patent Law, entitled "An Act to Promote the Progress of the Useful Arts." In commemoration of this act, at 10 A. M., on April 10, an excursion to Washington's old home and burial place, Mount Vernon, will take place. Here J. M. Toner, M.D., will deliver an address on the first president as an inventor and promoter of improvements.

In connection with the celebration, the director of the National Museum has consented to furnish space for a loan exhibition of relics, old models, and ancient patents. J. Elfreth Watkins as secretary of the executive committee has issued a request for the contribution of such articles from the citizens at large. Any one possessing such objects of interest should at once communicate with the secretary with a view to their exhibition.

The most permanent and lasting action has yet to be spoken of. It is proposed to hold meetings on the afternoon of April 7 and on the mornings of the succeeding days to organize the National Association of Inventors and Manufacturers. At these meetings addresses from representatives of the above branches of work are expected. This organization, if successful, may have far-reaching results, and in any case will serve to perpetuate the memory of what will, we believe, obtain recognition as one of the most important and significant conventions ever held in the national capital.

POSITION OF THE PLANETS IN APRIL.

URANUS

is morning star until the 19th, when he becomes evening star. He holds the place of honor on the April record, for his opposition to the sun takes place on the 19th, at 1 h. P. M. He is then on the meridian at midnight, at his nearest point to the earth, and in the best position for observation. He will be found about 8° east of Spica, retrograding or moving westward. He is visible to the naked eye as a faint star of the sixth magnitude. In the telescope he appears as a small disk, of a delicate sea-green color.

The moon is in conjunction with Uranus on the 23d, at 1 h. 26 m. P. M., being 2° 46′ north.

The right ascension of Uranus on the 1st is 13 h. 53 m., his declination is 10° 59′ south, his diameter is 3″.8, and he is in the constellation Virgo.

Uranus rises on the 1st at 7 h. 47 m. P. M. On the 30th he sets at 4 h. 30 m. A. M.

JUPITER

is morning star, and is joint actor with Venus in the most interesting event of the month. The regal planets are in conjunction on the 7th, at 4 h. 25 m. P. M. Jupiter is then only 13′ north of Venus, the space intervening between them being a little more than one-third of the diameter of the moon. Both planets are invisible at the time of conjunction, but will not be far apart on the morning of the 8th, rising about 4 o'clock, nearly an hour and a half before the sun. Jupiter is west of Venus, is receding from the sun, and approaching the earth, and when the month closes will rise more than two hours before the sun. Early risers who command a view of the southeast horizon will behold a charming celestial picture.

The moon is in conjunction with Jupiter on the 5th, at 5 h. 39 m. P. M., being 4° 34′ south.

The right ascension of Jupiter on the 1st is 22 h. 31 m., his declination is 10° 17′ south, his diameter is 32″.6, and he is in the constellation Aquarius.

Jupiter rises on the 1st at 4 h. 22 m. A. M. On the 30th he rises at 2 h. 42 m. A. M.

VENUS

is morning star. After her conjunction with Jupiter on the 7th there is nothing to vary the even tenor of her course as she draws nearer to the sun, rising later, lessening in size, and diminishing in luster. She is not half as brilliant as she was in January, her light number decreasing from 218 in January to 91 on the 1st. The illuminated portion of her disk increases during the month from 0·698 to 0·791.

The waning moon is in conjunction with Venus on the 5th, at 2 h. 32 m. P. M., being 4° 51′ south.

The right ascension of Venus on the 1st is 22 h. 12 m., her declination is 11° 31′ south, her diameter is 16″.4, and she is in the constellation Aquarius.

Venus rises on the 1st at 4 h. 7 m. A. M. On the 30th she rises at 3 h. 38 m. A. M.

MERCURY

is evening star. He reaches his greatest eastern elongation on the 19th, at 3 h. A.M., and is 20° 1′ east of the sun. The conditions at that time are most favorable for observation with the naked eye, and careful observers will be sure to find him, for he is in high northern declination, and sets about an hour and three-quarters after the sun. He must be looked for in the northwest, about three-quarters of an hour after sunset, a few degrees southwest of the Pleiades. If the sky be cloudless and the atmosphere pure, he will surely be found, shining with fitful brilliancy on the twilight sky.

The slender crescent moon, when one day old, is in conjunction with Mercury on the 9th, at 6 h. 14 m. P. M., being 4° 37′ south.

The right ascension of Mercury on the 1st is 1 h. 17 m., his declination is 8° 16′ north, his diameter is 5″.4, and he is in the constellation Pisces.

Mercury sets on the 1st at 7 h. 3 m. P. M. On the 30th he sets at 7 h. 59 m. P. M.

SATURN

is evening star. He reaches the meridian on the 1st at 10 h. 15 m. P. M., and still continues in most favorable conditions for telescopic observation. He is moving westward, and, in telescopes of low power, his rings no longer look like rings, but resemble lines of light passing through the center of the planet, and extending from each side.

The moon is in conjunction with Saturn on the 19th, at 0 h. 33 m. P. M., being 3° 16′ north.

The right ascension of Saturn on the 1st is 10 h. 56 m., his declination is 9° 11′ north, his diameter is 18″.4, and he is in the constellation Leo.

Saturn sets on the 1st at 4 h. 45 m. A. M. On the 30th he sets at 2 h. 46 m. A. M.

MARS

is evening star. He is in conjunction with Neptune on the 28th at 11 h. 26 m. A. M., Mars being 2° 17′ north.

The right ascension of Mars on the 1st is 2 h. 58 m., his declination is 17° 22′ north, his diameter is 4″.6, and he is in the constellation Aries.

Mars sets on the 1st at 9 h. 18 m. P. M. On the 30th he sets at 9 h. 7 m. P. M.

NEPTUNE

is evening star. His right ascension is 4 h. 12 m., his declination is 19° 31′ north, his diameter is 2″.5, and he is in the constellation Taurus.

Neptune sets on the 1st at 10 h. 44 m. P. M. On the 30th he sets at 8 h. 51 m. P. M.

Mercury, Neptune, Mars, Saturn, and Uranus are evening stars at the close of the month. Jupiter and Venus are morning stars.

How to Mount Maps and Drawings.

A short time since, in the "Query" column of your paper, I noticed an inquiry in regard to the best method of mounting drawings, etc., on cloth. The answer you gave, while correct, so far as it goes, is apt to mislead a novice, and will not give the most satisfactory results.

To begin with, a paste of good quality is required. When paste is made at home, trouble often arises from scorching, or from the addition of too much water. Thoroughly made paste, when spread on paper, will not strike through, but will remain on the surface, like butter on a piece of bread. To enable the paste to keep for several months in a cool place, add dissolved alum as a preservative, in the proportion of a tablespoonful of pulverized alum in two quarts of warm or hot water.

Put the water in a tin pail that will hold six or eight quarts, as the flour, of which the paste is made, expands greatly while it is boiling. *As soon as the water has cooled*, stir in good rye or wheat flour until the liquid has the consistency of cream. Beat thoroughly with a paddle-shaped stick, and see that every lump is crushed before placing the vessel over the fire. Care should be exercised to have the water cool before adding the flour, otherwise the paste will be lumpy.

To prevent scorching the paste, place on the fire a pot or kettle partly filled with water, and set the pail containing the paste materials in the water, permitting the bottom to rest on a few large pebbles to prevent excessive heat. Of course, a "farina kettle," or "double boiler," is better, and will be less troublesome to handle, but the "ruling element" of the kitchen will not always permit its use. Add a teaspoonful of powdered resin, a few cloves tied in a cloth, so that they will flavor and not discolor the paste, let it cook until it assumes the consistency of "mush," then, if any lumps appear, strain through a sieve. Keep in a tight jar, and if it becomes too thick after standing, put the quantity required in a suitable dish, and thin by adding cold water and stirring thoroughly.

So much for the paste. Now let us proceed to the mounting. Cut the cloth from one to two inches larger all around than the drawing or paper to be mounted. Lay it on a drawing board or table, dampen well with a sponge, stretch lightly, and tack down; use small tacks, and place them four or five inches apart, or closer, if necessary.

Leave it for a moment, and while its surface is evaporating and absorbing the surplus dampness, lay the drawing, map, or paper to be mounted face downward on another table, and dampen the back with a wet sponge. Returning to the cloth, with a brush (a large, round fine-haired paint brush is best) lay the paste on evenly and smoothly, and then, after the surface is well covered, take the brush and BEAT *the paste* thoroughly into the pores of the cloth. After this is done, smooth the surface nicely.

Take up the paper by the corners, and, if the thickness of the paper seems to require it, apply the sponge again. The paper should be *limp, but not wet.* If it is not well prepared, my experience has been that the surface will "blister," particularly on large drawings, for the paste adheres much better to a damp surface than to a dry one.

At this stage it is best to obtain some assistance. Have your assistant grasp two of the corners of the drawing or paper while you manage the others, holding the paper suspended horizontally a few inches above the cloth. When it is in the right position place your end on the paste-covered cloth, while your assistant still holds his end up. Place a piece of clean paper on top to prevent smearing the sheet, and with the hands brush quickly from the middle of the end toward both sides, working constantly toward your assistant as he slowly lowers the paper to the cloth. Rapid manipulation is necessary to insure perfect contact and a smooth surface.

Should any "blisters" develop, rub them briskly with the bone handle of an eraser or any similar substance. Small undulations will disappear when the cloth dries. Stand the board aside with the cloth tacked to it, and allow to dry thoroughly, then cut off as required.

Ordinary bleached cotton cloth or sheeting makes a good backing for small sheets, while large ones are best mounted on a heavy grade of unbleached material. These directions are general, and have been found to work well in practice. Individual experience can alone, however, determine many of the details.

Other paste than that described may be used if desired, though it is doubted whether a better can be obtained. Should any of your readers know of a better method, many, including the undersigned, would doubtless be glad to hear of it. CHAS. L. BAILEY.

Washington, March 9, 1891.

The Water Beetle.

Lately I kept for a few days for inspection that very beautiful insect the water beetle. The specimen was large and splendidly colored, gold banded, and displaying brilliant iris hues on its legs. I placed it in a glass jar of water. On the surface of the water some leaves were laid. On one side of the jar, at the bottom, was pasted a square of paper, and to the shelter of this the beetle often retired. It seemed to take the greatest delight in darting, swimming, and diving, rising from the bottom of the jar to the top of the water by long, vigorous strokes of its hind legs. Then joining its second pair of legs before it, like a swimmer's hands, and stretching the hind pair out nearly together, it would dive to the bottom. It slept hanging head downward under the leaves, with the tip of the body above the water to secure air.

It showed the pleasure of a child in "blowing bubbles." Rising to the surface, it would put the tip of its body above the water, part the elytra, and take in air; then, closing its case, it would dive to the bottom, stand on its head, emit the air bubble by bubble until it was exhausted, and come up for a new supply. It seemed to need the daily renewal of the water in the jar. When it was hungry, or the water was not fresh enough, it became dull and sulky, and hid behind the paper. After the beetle had fasted twenty-four hours, I laid on the top of the water a wasp, a mosquito, a blue bottle fly, and a common fly, all dead. The beetle, being at the bottom of the jar, did not seem to see or smell these insects. Rising presently, he came up against the mosquito, seized the body in his jaws, and sucked it dry with one pull. He then found the blue bottle, carried it down to the shelter of the paper, trussed it neatly, cutting off the wings, legs, and head, and letting them float to the surface. He then held the body in his hands, or short front feet, pressed to his jaws, and sucked it dry. After this he rose to the surface, found the other fly, and served it in the same fashion. Next he found the wasp, a large one. Carrying this below, as he had the flies, he clipped off the wings and legs, but took the precaution to suck the head and thorax before turning them adrift. He also grasped the body in his hands, pressed the part that had been cut from the thorax to his mouth, and holding it exactly as if drinking out of a bottle, he drained it dry.

I found that he could eat all the time, except when he was asleep or playing, and his activity was in proportion to the quantity of his food. Cooked meat he would none of. Raw beef he did not greatly like, but raw veal he prized even above wasps and blue bottles. I cut an ounce of raw veal into dice, and dropped it in the bottom of the jar in a heap. He did not seem to see or smell it, but after a while happened to dive into it. He appeared to be full of joy at the discovery. One fragment after another he took in his hands, held it closely to his jaws, and sucked it dry by strong pulls. At each pull I could mark the receding red juice of the meat. When the veal was reduced to a pale fiber, he let it go and took a fresh bit. He always retired to the shelter of the paper to eat, with the sole exception of the mouthful he made of the mosquito. Like the King of Dahomey, he would not eat in public. —*Julia McNair Wright, in Science.*

Engineers Must Study.

A few years ago, says the *Stationary Engineer*, no one dreamed that in so short a time the electric light would become a regular part of the equipment of mills and factories. It was only when the dynamo found its place in the engine room and the incandescent light sparkled in the shops and workrooms that the engineer found anything of special interest to him in the study of electricity. Now he must study it whether he will or no, and though the knowledge he most requires must be of a practical nature, he must have a goodly amount of theoretical or "book" information in order to understand what he is doing.