

canal begins, the bottom is 24.488 feet below datum. The entire descent would be sufficient to send a very rapid current through it, but at Lockport controlling works are established, consisting of gates or movable dams, by which the flow of water from the canal into the Des Plaines River beyond it is controlled. Thus the course of the Chicago River, whose waters now run to the lake, will be reversed; the lake will in the future run into the Chicago River and down the canal, and the outflow will be regulated by a dam at Lockport in the distance.

The Des Plaines River, whose stream is subject to the widest fluctuation, has also been taken care of. Accordingly, diversion works, as they are termed, are established, one of our smaller views showing the work in progress upon them, to keep the water out of the canal. Thirteen miles of new river channel were excavated parallel with the main drainage canal, nineteen miles of levee were built between river and canal for the same purpose, while at the head of the river diversion a spillway is to be built for letting surplus water run back into the lake, as arrangements have not yet been made to carry the entire flow of the river with that of the canal to the city of Joliet below Lockport. It will thus be seen how very perfect the whole system is.

Looking at the bird's eye view, the terminus of the canal marks Lockport. Below Lockport the sinuous river can be traced to Joliet. This portion is a relatively steep declivity, involving a fall of some 42 feet in a distance of $4\frac{1}{2}$ miles. Lockport, therefore, is the critical point; the raising or lowering of the control gate a few inches means an immense difference to the flow through the canal. Up to the limit of the canal's capacity the level of the great lakes rests in the hands of the engineer.

It is not only as a drainage canal that the work is being prosecuted. The Chicago people fondly hope that it will eventually be a fully developed ship canal, and some believe it possible that communication with the ocean may be made by it. Our view of the canal as completed, with a railroad on the bank, the steamship and steam barge running through it, gives an idea of what it will be like when finished. The other view shows operations incident to the excavation. Its estimated costs exceeds \$21,000,000, and some eighteen months from to-day it is hoped it will be completed. A number of very different types of excavating machines were employed with various success upon different sections of the canal, as these involved the best appliances that could be devised for the purpose. A special study of them is highly interesting, and for such purpose our readers are strongly recommended to the issue of this paper of October 20, 1894, the one already alluded to.

Birds and the Farmer.

Dr. C. Hart Merriam, chief of the division of ornithology of the Agricultural Department, has just made a report on the results of his examination of the contents of the stomachs of hawks, owls, crows, blackbirds, and other North American birds that are supposed to be the enemies of farmers. He shows that the popular notions about hawks and birds, for the slaughter of which many States gave bounties, are altogether erroneous. Ninety-five per cent of their food was found to be field mice, grasshoppers, crickets, etc., which were infinitely more injurious to farm crops than they. The charge against crows is that they eat corn and destroy eggs, poultry, and wild birds. Examination shows that they eat noxious insects and destructive animals, and that although 25 per cent of their food is corn, it is mostly waste corn picked up in the fall and winter. With regard to eggs, it was found that the shells were eaten to a very limited extent for the lime. Crows eat also ants, beetles, caterpillars, bugs, flies, grubs, etc., which do much damage. The cuckoos are also found to be very useful birds. —Rochester Herald.

A Model Suburb.

Since January, 1893, up to date there have been over 2,000 houses built in San Francisco, of which it is estimated 15 per cent have been erected in Richmond. Miles and miles of streets have been graded and sewered. A scientific system of sewerage, with proper outlet to the bay, has been laid down, and to-day, it is said, Richmond is the only properly sewered district in the city. It also enjoys excellent transportation facilities, and when the Sutro road is completed and the Geary Street line continued it will, with those roads now running through the district, be ahead in this respect also. Salt water mains have been laid in the district for private baths, flushing sewers, sprinkling streets and putting out fires, for which purposes it is superior to fresh water. The Spring Valley mains give an abundant supply of good fresh water. The location, scenery and shelter are unsurpassed. Its closeness to the park and bay, coupled with the advantages enumerated above, make Richmond, with its magnificent marine views, a favored locality for building homes. —Daily Call.

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THE ELECTRIFICATION OF THE AIR BY RAIN DROPS AND WAVES.

As the earth rotates on its axis it is in constant receipt of energy from the sun, which energy manifests itself in the production of the tides, of the winds and in the maintenance of the existing temperature. As the earth rotates, the great tide disturbances go round and round it, acting as a drag upon its motion, so that it is easy to see how its rotation is being resisted by the lines of gravitational force, much as a plate of metal is retarded when rotated in a strong magnetic field. The sun, expending its energy in the evaporation of water, released again from the upper regions of the air as rain, and in producing winds which form waves upon the ocean, produces electrical disturbances which have recently been investigated by Lord Kelvin and others, with quite curious results.

A recent paper by Lord Kelvin, communicated to the Philosophical Society of Glasgow, has brought forward two very curious incidents of the electrification of air by rain drops and by waves on the sea. By investigation with apparatus adapted for the purpose, it was found that if a drop of water falls through air a slight electrification of the air is produced undoubtedly, but if the drop is checked in its fall, striking about a solid body or upon a liquid surface, such as that of water, the air is much more strongly electrified, the point of electrification being the place where the water drop strikes. This is not all; experiments were made with salt and fresh water, and it was found that if a drop of fresh water strikes a surface of salt water or a solid body, the air becomes negatively electrified, while if salt water is used of sufficient saltiness, the air will be positively electrified.

On the earth many examples of such impact exist; fresh water cascades present them; the waves of the sea, of fresh water lakes and the falling of rain are all instances. When the ocean is calm and rain falls upon it the air is at once negatively electrified, and may be raised many volts in potential. Again, in a dry wind, when the waves are constantly breaking, the impact of salt water against salt water produces positive electrification.

Sir William Thomson believes that the positive electrification of the waves by self-impact is much greater in amount than the negative electrification by rainfall. The positively electrified air also finds its way more quickly to great heights than does the negatively electrified, the greater part of which, he says, may be quickly lost into the sea. Thus we have conferred upon the mighty ocean the attributes of a gigantic electric machine, and just as with the old time plate machine one or the other kind of electricity is generated according to whether its rubber or prime conductor is grounded, so the ocean in a rain storm is a generator of negative electricity and in a wind storm is a generator of positive electricity. In some of his experiments on the seashore, Lord Kelvin found that the east wind at Arran gave strong positive electricity. This he attributed to the fact that in such a wind, even if gentle, countless waves were breaking all over twelve nautical miles of water lying to the eastward of that shore. If this is so other winds should produce positive electrification at places whose exposure is different from that at Arran.

In our this week's SUPPLEMENT we give Lord Kelvin's paper in full.

SUPREMACY OF THE SEA.

Supremacy at sea, whether in the commercial or the warlike sense, has always been a source of pride for the nation possessing it. England in the old days of the walls of oak and muzzle-loading cannon mounted in great broadsides of two and three tiers high was willing to sacrifice anything and everything to win victories at sea. A people boastful of their freedom submitted to the atrocities of the press-gang simply on the plea that his majesty's ships must have men. On board of the ships relentless discipline combined with the frightful sanitary condition of the overcrowded vessels, bringing about virulent ship fever, made life afloat an absolute horror. Smollett, Douglas Jerrold, Defoe and others have pictured old time life at sea. Dibdin wrote his spirited lyrics in praise of the sailor's life under the inspiration, it is alleged, of the English government, who wished to do away with the dislike for naval service which had naturally pervaded the people. The United States, progressive in everything, unfortunately inherited English methods, and imported some of the worst elements of old time discipline into her navy. While the older country was proclaiming that a slave who touched its soil became a freeman, while in the United States the slave States were held up to reprobation because of their treatment of the negro, merciless flogging prevailed in the navies of both countries, and the press laws made service in the English navy a virtual slavery.

The gradual march of reform has ameliorated these matters. Corporal punishment at sea is practically abolished, and many humanitarian associations and enactments have for their object the amelioration of the condition of the sailor. The old spirit survives, and the merchant and naval marine are objects of

solicitude and pride for every nation. Years ago the English, striving with bulldog pertinacity for the mastery of the sea, found themselves surpassed by other nations in the building of sailing ships. The fastest ships in the British navy were often captured ones which had been launched at French dockyards. In this country the American fore-and-afters won high reputation, and the name of Baltimore clipper is a matter of history. These vessels outpointed all other sea-going ships. Ever since the days of Peter the Great, of Russia, men had been striving to force ships to windward, and every degree of pointing gained meant a great deal in the days preceding steam. As long as it was a question of sailing ships, America and France were most successful in their models, and we were active competitors for the carrying trade of the world. The wharves of our seaboard cities were described as appearing like forests of masts.

Now steam rules supreme. Enormous foreign capital is invested in steam vessels, and the United States has taken an inferior position in ocean commerce, and the forests of masts have departed. English tramp ships pervade the whole water area of the globe, and English liners connect the British Islands with every part of the globe. The government of England, directly or indirectly, subsidizes many of these lines, and their stockholders are content with smaller dividends than perhaps would be acceptable here. The price paid for modern supremacy is a high one. A few years suffice for the fastest ships to be outclassed by newer ones, but at an immense expense in the consumption of fuel. The race across the ocean is run now by mechanical force and skill rather than by fine models.

When this paper reaches our readers, the St. Louis will have finished her first voyage across the ocean. American in design and appearance, commanded by officers who are at least citizens of the United States in the legal sense, the ship will carry the American flag into Southampton under auspices pleasing to the American patriot. As such a person looks back on America's record in the steam marine, he can but hope that the American Line will have a better fate than has been accorded to some of the other American Atlantic steamship lines, its predecessors.

The St. Louis is built for transatlantic service. In one week, probably, she will reach Southampton, and there, within about three days, she will be discharged, coaled, reloaded, and on her voyage back, arriving in New York in time to start on her third trip within three weeks from the date of her first voyage. No ship of war can do this. In case of war, ships like the St. Louis will do work that no other type of vessel can accomplish, and such ships can only be the product of such service. The commercial and naval necessities of the country require that every possible encouragement should be extended toward the building of many other vessels such as the St. Louis.

Southampton should not be the only European port to see our flag floating over a ship of American materials and American build. If proper encouragement were given, all the principal ports of the world might renew their acquaintance with a once familiar, now seldom seen object, the American flag over an American deck.

How Diamonds, Rubies and Sapphires are now Floated to Prove their Genuineness.

Mr. Arthur Chamberlin, in the Mineral Collector, says: An accurate scientific method has at last been discovered, whereby precious stones may be distinguished from the fraudulent gems which are now so numerous manufactured in the laboratories of Paris and other Continental cities. This is by testing them for their specific gravity, but not by the scales occasionally used for large stones, and which, however delicate, are unreliable.

The new means of detection of bogus gems is simple and ingenious, and is likely to be widely adopted in the jewelry trade. It is the chemist who has added this knowledge to the lapidary's art. Several liquids have been discovered, which are more than three and one-half times as dense as water, and in which, therefore, the amethyst, the beryl and other light stones will actually float.

The most useful of these liquids is methylene iodide, which has a specific gravity of 3.3, and in which the tourmaline readily floats. Moreover, it is not corrosive or in any way dangerous. It being impossible for the lapidary to prepare a number of liquids each having the specific gravity of a different gem stone, the methylene iodide is easily diluted by adding benzene to it. Each drop of benzene added makes the liquid less dense, and so it may be used to separate the tourmaline and all the lighter gem stones from each other.

If it be doubtful whether a certain gem be an aquamarine or a chrysoberyl, all that is necessary is to place it in a tube of the liquid, together with a small fragment of true aquamarine to serve as an index. If it be a chrysoberyl, which has a specific gravity of 3.6, it will sink like lead. If it be an aquamarine, which has a specific gravity of 2.7, it will float. If the liquid

be then stirred and diluted until the index fragment is exactly suspended, the gem also will neither float nor sink, but will remain poised beside it. This method may be adopted with all of the lighter stones.

But for heavier gems, like the carbuncle, the jargon, the sapphire, the ruby, the spinal, the topaz and the diamond, a different liquid is necessary. This has lately been discovered by the Dutch mineralogist Retgers. He has found a colorless solid compound which melts at a temperature far below that of boiling water to a clear liquid five times as dense as water, and therefore sufficiently dense to float any known precious stone. This compound is the double nitrate of silver and thallium.

Its most remarkable property is, that it will mix in any desired proportion with warm water, so that by dilution the specific gravity may be easily reduced. This fused mass may be reduced in density by adding water, drop by drop, so as to suspend in succession carbuncle, sapphire, ruby and diamond.

These tests of precious stones may be made in a few minutes, and are absolutely reliable, as all stones of the same nature have the same specific gravity. None of the bogus rubies or diamonds have the same weight as those they are made to imitate.

Voting by Machinery.

The days of ballot box stuffing and other modes of cheating at elections appear to be numbered. Inventive genius has provided machinery that will not lie and will not allow deception at the polls. The New York Herald says:

A vote by machinery is the latest luxury indulged in by Westchester County. The city of Mount Vernon tried the experiment recently and pronounced it very good. The voter touches the button and the machine does the rest. Though not a machine in the political sense, this ingenious contrivance runs the voter to suit itself. Any man yielding himself to its insidious advances must vote willynilly or be forever shut out from the gracious sunlight. How this is will appear later on. At all events, the voters of Mount Vernon are mightily pleased with the results achieved.

One of the many beauties of voting by machine is that the eager citizen is not obliged to wait very long for results. The polls in Mount Vernon, for example, closed at nine o'clock at night, and a little more than a quarter of an hour later the full and accurate results of the election were announced in extra editions of the local press. No more anxious waiting about bulletin boards for the community that votes by machine! As soon almost as the last voter has ceased his pressure upon the magic button the result of the day's balloting is known beyond any question.

The Myers ballot machine, which was used so successfully in the above election, is so simple in device as to be easily and immediately comprehended. It consists of a sheet steel cabinet five feet square and seven feet high, which is lighted inside by a lamp, gas or electricity. The cabinet has two doors, an entrance and an exit door. After he has been duly scrutinized by the inspectors of election, the voter is allowed to enter the booth or cabinet by the entrance door, which closes behind him, automatically locking itself.

As soon as he has recovered from the shock of this sudden and rather awful imprisonment in a chamber of steel, the voter is able to realize what is expected of him. He finds himself confronted with vertical columns in colors, divided into as many spaces as there are candidates to be voted for. To the right of each name is a little knob which he must press in order to register his vote. Candidates of the democratic party are printed upon a yellow background, candidates on the republican ticket upon a red background, prohibition ticket candidates upon a blue background, and questions to be voted upon a white background.

The voter presses the knob at the right of the name of the candidate for whom he wishes to cast his ballot, and this vote is instantly registered in another compartment of the booth, which, at the opening of the polls, has been locked under seal by the inspectors of election. It is to be observed that all the names of candidates for the same office are printed in the same line, so that a vote for one of them, by a pressure of the knob opposite the name, locks the knobs opposite the other names, so that they cannot be used until the voter leaves the box. The voter, by pressing the knobs in succession, as his political allegiance dictates, votes either a straight or split ticket as he desires. He then passes out through the exit door, which is immediately and automatically locked behind him. The entrance door to the booth will not open until the exit door, which releases the voter, has closed and locked after him.

One of the beauties of the machine is that it shuts down with hard mechanical precision upon attempts at repeating. As soon as a man has voted and retired from the booth by the first exit door the knobs opposite the names of the candidates are automatically locked, so that they cannot be made to register a vote. The springs which lock up the knobs are not released until the citizen passes through the second exit door and out into the polling place. As the outer exit door

closes, the entrance door opens of itself, and the machine is ready for another voter.

This is a quick method of casting a ballot, and the law therefore has placed the time in which a voter should finish up his work at one minute. As soon as the polls are closed, the private compartment in which the registration of the votes has been going on is unlocked, and the figures are copied off and footed up in a very few minutes. The saving of time in the matter of securing complete and accurate returns can be easily appreciated. It is estimated that, even in densely populated districts, returns, which under the old system would require hours of figuring to complete, would be ready for promulgation in a very few minutes.

The colored columns containing the names of candidates bear this caption in each case: "Democratic Ballot—The ballot and counting knob supports are Yellow. Republican Ballot—The ballot and counting knob supports are Red. Prohibition Ballot—The ballot and counting knob supports are Blue."

The ballot machine can supply six party columns for thirty-five knobs in each column, or a total of 210 knobs. The Presidential electors are all voted for by the use of one knob; therefore, in the State of New York the machine has capacity to vote for seventy candidates for each party, or 420 candidates in all.

On all offices where only one is to be elected, voting for any one automatically locks the other two. The voter has, in all cases, freedom of choice to cast only one vote each for as many candidates as are to be elected. It is the claim of the inventors that any illiterate or even a blind voter can vote a straight or mixed ticket, or a part ticket, without assistance.

The following extracts from Chapter 127 of the Laws of 1892 provide for the use of the Myers Automatic Ballot Cabinet in town elections:

"Section 1. Hereafter, within this State, any town may, by a majority vote of the town board, . . . determine upon, purchase and order the use of one or more of Myers Automatic Ballot Cabinets, . . . for the purpose of voting for the officers to be elected at such election, and for registering and counting the ballots cast thereat.

"Section 2. The ballot by which the elector chooses or votes there [here, the reader will notice, the voter votes by ballot described precisely like the present ballot, and that he counts by a knob] in said Myers Automatic Ballot Cabinet shall be in secret, and shall be a cardboard or paper ticket, which shall contain written or printed, or partly written or partly printed, the names of the persons for whom the elector intends to vote, and shall designate the office to which each person so named is intended by him to be chosen, and shall not contain any other printed or written device or distinguishing mark, excepting a heading or caption of its political or party designation, of not exceeding five words, and may be of different colors, and contain index hands pointing toward the knobs by which the elector counts and registers his ballot. . . .

"Section 3. At the close of the polls at such election at which such ballot cabinet shall be used, the canvassers shall proceed to ascertain publicly the total number of ballots cast for each candidate for each office, as registered and declared by such ballot cabinet register, and such ascertainment of the results shall be deemed to be the canvassing of the votes cast at such election."

The city of Mount Vernon is so well satisfied with machine voting that its voters declare that they will never again use any other system.

Electric Illuminating of our Men-of-War.

The navy department has arranged for spectacular displays by the American war ships at Kiel, which can hardly fail to create a sensation. Admiral Kirkland's four ships will be especially well equipped for displays at night. Each is provided with two or more powerful search lights, and each will be resplendent with thousands of incandescent lights. As a special decoration, each will carry before and around the pilot house an immense shield representing the American coat of arms, the red and white bars and the stars on a blue background being reproduced by electric lamps.

The name of each ship will be brilliantly displayed in large electric letters running around the stern. In addition to these two special features, incandescent lights will be strung along each vessel's stem and stern from the water to the deck and along the deck rail from end to end, on both sides. Lights will be placed along the water line on each side, just high enough to be out of the swash, thus outlining the hull. More lights will be strung up the masts and down the side stays, and up and down and around the tops of the smokestacks. The lights will be set three feet apart and at a distance will appear to be unbroken lines. There will be about 2,000 of these electric lights on the New York and about 1,500 on each of the other three ships. The finest display on the vessels will be the electric shield, which will be sixteen feet high and extend back on each side of the pilot house twenty-four feet.