

soon as the operator at the table finds, by the motion of the alidades, that the ship under observation is directly over a torpedo, he will be able to fire the latter and blow the enemy up. During this time the two observers at A_1 and A_2 have only to keep their telescopes directed upon the vessel that it has been agreed upon to watch.

In order to obtain a parallelism between the motion of the alidades and that of the corresponding telescopes, the winch of each of the latter, while putting its instrument in motion, also sets in motion a Siemens double-T armature electro-magnetic machine. One of the wires of the armature of this machine, connected to the frame, is always in communication with the ground at E_1 (if we consider, for example, the telescope to the left), and the other ends in a spring that alternately touches two contacts. One of these contacts communicates with the wire, L_1 , and the other with the wire, L_2 , so that, when the machine is revolving, the currents are sent alternately into L_1 and L_2 . These two latter wires end in a system of electro-magnets, M_1 , provided with a polarized armature. The motions of the latter act, through an anchor escapement, upon a system of wheels. An axle, set in motion by the latter, revolves one way or the other, according to the direction of the telescope's motions. This axle is provided with an endless screw that gears with a toothed sector, and the latter controls the rotatory axis of the alidade. The elements of the toothed wheels and the number of revolutions of the armature for a given displacement of the telescope being properly calculated, it will be seen that the alidade will be able to follow all the movements of the latter.

When it is desired to place one of the telescopes in a given position (its position of zero, for example), without acting on the alidade, it may be done by acting directly on the telescope itself without the intermedium of the winch. For such purpose it is necessary to interrupt communication with the mechanism by pressing on the button, g . If the telescope be turned to one side or the other of its normal position, in making it describe an angle of 90° , it will abut against stops, and these two positions will permit of determining the direction of the base.

The alidades themselves are provided with a button which disengages the toothed sector from the endless screw, and permits of their being turned to a mark made on the table. A regulating screw permits of this operation being performed very accurately. In what precedes, we have supposed a case in which the movable point is viewed by two observers, and in which the table, TT , is stationed at a place distant from them. In certain cases only two stations are employed. One of the telescopes is then placed over its alidade and moves with it; and the apparatus thus comprehends only a system of synchronous movements.

This telemeter was one of the first that was tried in our military ports, and gave therein most satisfactory results. The maneuver of the winch, however, requires a certain amount of stress, and in order that the sending of the currents shall be regular, the operator must turn it very uniformly. This is a slight difficulty that has led to the use of piles, instead of the magneto-electric machine, in the apparatus employed in France. With such substitution there is need of nothing more than a movable contact that requires no exertion, and that may be guided by the telescope itself. —*La Lumière Electrique*.

PHYSICS WITHOUT APPARATUS.

Experiment in Static Electricity.—Take a pipe—a common clay one costing one cent—and balance it carefully on the edge of a goblet, so that it will oscillate freely at the least



CLAY PIPE ATTRACTED BY AN ELECTRIFIED GOBLET.

touch, like the beam of a scales. This being done, say to your audience: "Here is a pipe placed on the edge of a goblet; now the question is to make it fall without touching it, without blowing against it, without touching the glass, without agitating the air with a fan, and without moving the supporting table."

The problem thus proposed may be solved by means of electricity. Take a goblet like the one that supports the pipe, and rub it briskly against your coatsleeve, so as to electrify the glass through friction. Having done this, bring the goblet to within about a centimeter of the pipe stem. The latter will then be seen to be strongly attracted, and will follow the glass around and finally fall from its support.

This curious experiment is a pretty variation of the electric pendulum; and it shows that pipe-clay—a very bad conductor of electricity—favors very well the attraction of an electrified body.

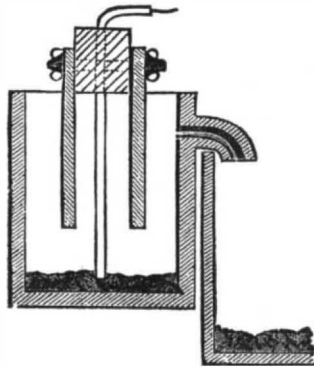
Tumblers or goblets are to be found in every house, and a clay pipe is easily procured anywhere. So it would be difficult to produce manifestations of electricity more easily and at less expense than by the means here described. —*La Nature*.

THE CASCADE BATTERY.*

By F. HIGGINS.

THE battery which I have brought here to-night to introduce to your notice is of the circulating kind, in which the alimentary fluid employed passes from cell to cell by gravitation, and maintains the action of the battery as long as it continues to flow. It cannot, of course, compare with such abundant sources of electricity as dynamo-electric machines driven by steam power, but for purposes in which a current of somewhat greater volume and constancy than that furnished by the ordinary voltaic batteries is required, it will, I believe, be found in some cases useful. A single fluid is employed, and each cell is provided with an overflow spout.

The cells are arranged upon steps, in order that the liquid may flow from the cell on the topmost step through each successive cell by gravitation [specimen cells were on the table before the audience] to the reservoir at the bottom. The top and the bottom reservoirs are of equal capacity, and are fitted with taps. The topmost tap is used to regulate the flow of the solution, and the bottom one to draw it off. In each cell two carbon plates are suspended above a quantity of fragments of amalgamated zinc. The following is a sectional drawing of the arrangement of the cell:



A copper wire passes down to the bottom of the cell and makes connection with the mercury; this wire is covered with gutta-percha, except where immersed in the mercury. The pores of the carbon plates are filled with paraffin wax. This battery was first employed for the purpose of utilizing waste solution from bichromate batteries, a great quantity of which is thrown away before having been completely exhausted. This waste is unavoidable, in consequence of the impossibility of permitting such batteries, when employed for telegraphic purposes, to run until complete exhaustion or reduction of the solutions has been effected; therefore some valuable chemicals have to be sacrificed to insure constancy in working. The fragments of zinc in this cell were also the remains of amalgamated zinc plates from the bichromate batteries, and the mercury which is employed for securing good metallic connection is soon augmented by that remaining after the dissolution of the zinc. It will therefore be seen that not only the solution, but also the zinc and mercury remnants of bichromate batteries are utilized, and at the same time a considerable quantity of electricity is generated. The cells are seven inches deep and six inches wide, outside, and contain about a quart of solution in addition to the plates. The battery which I employ regularly, consisting of 18 cells, is at present working nine permanent current Morse circuits, which previously required 250 telegraphic Daniell cells to produce the same effect, and is capable of working at least ten times the number of circuits which I have mentioned; but as we do not happen to have any more of such permanent current Morse circuits, we are unable to make all the use possible of the capabilities of the battery. The potential of one cell is from 1.9 to 2 volts with strong solution, and the internal resistance varies from 0.108 to 0.170 of an ohm with cells of the size described. In order to test the constancy of the battery, a red heat was maintained in a platinum-iridium wire by the current for six weeks, both day and night.

The absence or exhaustion of the zinc in any one cell in a battery is indicated by the appearance of a red insoluble chromic salt of mercury, in a finely divided state, floating in the faulty cell. It is then necessary to drop in some pieces of zinc. The state of the zinc supply may also be ascertained at any time by feeling about in the cells with a stick. When not required, the battery may be washed by simply charging the top reservoir with water, and leaving it to circulate in the usual manner, or the solution may be withdrawn from each cell by a siphon. A very small flow of the solution is sufficient to maintain the required current for telegraphic working, but if the flow be stopped altogether for a few hours, no difference is observed in the current, although when the current is required to be maintained in a conductor of a few ohms resistance, as in heating a platinum wire, it is necessary that the circulation be maintained [heating a piece of platinum ribbon]. The battery furnishing the current for producing the effect you now see is of five cells, and as that number is reduced down to two, you see a glow still appears in the platinum. The platinum strip employed was 5 inches long and $\frac{1}{8}$ inch wide, its resistance being 0.42 ohm, cold. That gives an idea of the volume of current flowing. I have twelve electro-magnets in printing instruments joined up on the table, and [joining up the battery] you see that the two cells are sufficient to work them. The twelve electro-magnets are being worked (by the two cells) in multiple arc at the same time. The current from the cells which heated the platinum wire is amply sufficient to magnetize a Thomson recorder. I have maintained five inches of platinum ribbon in a red hot state for two hours, in order to make sure that the battery I was about to bring before you was in good order. The cost of working such a battery when waste solution cannot be obtained, and it is necessary to use specially prepared bichromate solution, is about $\frac{2}{3}$ d. per cell per day, with a current constantly active in a Thomson recorder circuit, or a resistance of $1\frac{1}{2}$ ohms per cell; but if only occasionally used, the same quantity of solution will last several weeks.

A comparison of this with another form of constant battery, the Daniell, as used in telegraphy, shows that six of these cells, with a total electromotive force of 12 volts and an internal resistance of 0.84 of an ohm, cannot be replaced by less than 71 batteries of 10 cells each, connected in multiple arc, or for quantity. This result, however large it may appear, is considerably below that which may be

* Lately read before the Society of Telegraph Engineers and Electricians.

obtained when working telegraphic lines. A current of 0.02 weber, or ampère, will work an ordinary sounder or direct writing Morse circuit; the cascade battery is capable of working 100 such circuits at the same time, while the combined resistance of that number of lines would not be below that in which it is found that the battery is constant in action.

Objection may be made to the arrangement of the battery on the score of waste of zinc by local action, because of the electro-positive metal being exposed to the chromic liquid; but if the battery be out of action and the circulation stopped, the zinc amalgam is protected by the immobility of the liquid and the formation of a dense layer of sulphate of zinc on its surface. When in action, that effect is neutralized from the fact that carbon in chromic acid is more highly electro-negative than the chromate of mercury formed upon the zinc amalgam, and which appears to be the cause of the dissolution of the zinc even when amalgamated in the presence of chromic acid. The solution may be repeatedly passed through the battery until the absence of the characteristic warmth of color of chromic acid indicates its complete exhaustion. During a description before the Society of thermo-electric batteries some time ago, Mr. Preece mentioned that five of the thermopiles which were being tried at the Post-Office were doing the work of 2,535 of the battery cells previously employed. Thirty of the cascade cells would have about the same potential as five such thermopiles, but would supply three and a half times the current, and be capable of doing the work of 8,872 cells if employed upon the universal battery system in the same manner as the thermo batteries referred to.

Although this battery will do all that is required for a Thomson recorder or a similar instrument much more cheaply in this country than the tray battery, and with half the number of cells, I do not think it would be the case in distant countries, on account of the difficulty and cost of transport. A solid compound of chromic and sulphuric acids could be manufactured which would overcome this difficulty, if permanent magnetic fields for submarine telegraphic instruments continue to be produced by electric vortices. In conclusion, and to enable comparisons to be made, I may mention that the work this battery is capable of performing is 732,482 foot pounds, at a total cost of 1s. 6d.

[FROM THE SCHOOL JOURNAL.]

PERFECTLY LOVELY PHILOSOPHY.

CHARACTERS: Laura and Isabel, dressed very stylishly, both with hats on. Enter hand in hand.
—*Laura*. My dear Isabel, I was so afraid you would not come. I waited at that horrid station a full half hour for you. I went there early on purpose, so as to be sure not to miss you.

—*Isabel*. Oh, you sweet girl!
—*L.* Now, sit right down; you must be tired. Just lay your hat there on the table, and we'll begin to visit right off. (*Both lay their hats on the table and stand near by.*)
—*I.* And how have you been all the ages since we were together at Boston?

—*L.* Oh, well, dear; those were sweet old school days, weren't they. How are you enjoying yourself now? You wrote that you were taking lessons in philosophy. Tell me how you like it. Is it real sweet?

—*I.* Oh, those I took in the winter were perfectly lovely! It was about science, you know, and all of us just doted on science.

—*L.* It must have been nice. What was it about?
—*I.* It was about molecules as much as anything else, and molecules are just too awfully nice for anything. If there's anything I really enjoy, it's molecules.

—*L.* Oh, tell me about them, dear. What are molecules?
—*I.* They are little wee things, and it takes ever so many of them, you know. They are so sweet! Do you know, there isn't anything but that's got a molecule in it. And the professors are so lovely! They explained everything so beautifully.

—*L.* Oh, how I'd like to have been there!
—*I.* You'd have enjoyed it ever so much. They teach protoplasm, too, and if there's one thing that is too sweetly divine, it's protoplasm. I really don't know which I like best, protoplasm or molecules.

—*L.* Tell me about protoplasm. I know I should adore it!
—*I.* Deed you would. It's just too sweet to live. You know it's about how things get started, or something of that kind. You ought to have heard the professors tell about it. Oh, dear! (*Wipes her eyes with handkerchief.*) The first time he explained about protoplasm there wasn't a dry eye in the room. We all named our hats after the professors. This is a Darwinian hat. You see the ribbon is drawn over the crown this way (*takes hat and illustrates*), and caught with a buckle and bunch of flowers. Then you turn up the side with a spray of forget-me-nots.

—*L.* Oh, how utterly sweet! Do tell me some more of science. I adore it already.

—*I.* Do you, dear? Well, I almost forgot about differentiation. I am really and truly positively in love with differentiation. It's different from molecules and protoplasm, but it's every bit as nice. And our professor! You should hear him enthuse about it; he's perfectly bound up in it. This is a differentiation scarf—they've just come out. All the girls wear them—just on account of the interest we take in differentiation.

—*L.* What is it, anyway?
—*I.* Mull trimmed with Languedoc lace, but—
—*L.* I don't mean that—the other.
—*I.* Oh, differentiation! That's just sweet. It's got something to do with species. And we learn all about ascidians, too. They are the divinest things! If I only had an ascidian of my own! I wouldn't ask anything else in the world.

—*L.* What do they look like, dear? Did you ever see one?

—*I.* Oh, no; nobody ever did but the poor dear professors; but they're something like an oyster with a reticule hung on its belt. I think they are just too lovely for anything.

—*L.* Did you learn anything else besides?
—*I.* Oh, yes. We studied common philosophy, and logic, and metaphysics, and a lot of those ordinary things, but the girls didn't care anything about those. We were just in ecstasies over differentiations, and molecules, and the professor, and protoplasm, and ascidians. I don't see why they put in those common branches; we couldn't hardly endure them.

—*L.* (*Sighs.*) Do you believe they'll have a course like that next year?

—*I.* I think may be they will.