the gas may even be stronger than in the liquid, the polarization currents might escape observation.

With regard to the positive part of the discharge it will be sufficient here to mention that stratifications are principally observed in mixtures of gases or in compound gases, and that in the intervals between two stratifications the discharge is very likely carried as through the dark space at the negative electrode, while in the stratifications recombination of the decomposed atoms takes place.

An interesting law has been proved by Hittorf and E. Wiedemann in the case of the unstratified discharge. Hittorf shows that the fall of potential is the same in the positive part for the same tube whatever the current. This means that the energy dissipated is proportional to the current, and not to the square of the current, as in a liquid. In the latter form the proposition had previously been proved by E. Wiedemann, who has shown that the total quantity of heat generated is proportional to the total quantity of electricity which has passed through the tube, whether in a few strong sparks or many weaker ones.

These experiments seem to point to the fact that once the original velocity of the particles at the regular pole has been reduced, the velocity becomes independent of the strength of the current, that is to say, that in the positive part of the current greater intensity only means a greater number of particles taking place in the discharge.

The paper also contains spectroscopic evidence as to the state of dissociation in a vacuum tube, especially in the negative glow.

The question as to how the electricity passes from the electrode to the gas is not discussed, nor is it possible at present to decide, should the theory prove true, whether the polarity of the atoms in the molecule depends on the way in which these are combined, or whether that atom takes positive polarity which happens to be nearest the negative electrode as the molecule approaches it.

In conclusion some novel influence of the magnet on the negative glow is described, and it is shown that two different effects have to be clearly distinguished. The first in an effect of the magnet on the discharge when that discharge is established, and has been sufficiently well investigated. But the second effect depends on the question from what part of the negative electrode the discharge sets out. With respect to this question we meet with many contradictory and inaccurate statements. If at any place the magnet tends to throw the glow together the temperature will be raised, and owing to this fact the current will be strengthened, which again raises the temperature. It may thus happen that a slight cause can induce the current to pass almost exclusively from one part of the negative electrode. For a detailed description the reader is referred to the paper itself and the illustrations accompanying it.

THE ELECTRIC CONDUCTIVITY OF METALS AND THEIR ALLOYS.

MR. LAZARE WEILLER, who has been making some extended researches at the Breguet and Angouleme works regarding the behavior of different metals and their alloys when used for transmitting electricity, has recently presented a resumé of his results to the International Society of Electricians.

The experiments were made with bars of metal which were cast especially for the purpose, which had a diameter of about thirteen millimeters and which were cut so as to render the grain of the fracture apparent, and then drawn out into a wire if the metal permitted it. In the following table of conductivities drawn up by Mr. Weiller, pure copper and pure silver are taken as standards of comparison.

Pure silver	100
Pure copper	100
Telegraphic silica bronze	98
Alloy of copper and silver, 50%	86·65
Pure gold	78
Pure aluminum	54·2
Telephonic silica-bronze	35
Pure zinc	29·9
Telegraphic phosphor-bronze	29
Alloy of gold and silver, 50%	16·12
Swedish iron	16
Pure Banca tin	15·45
Aluminum bronze, 10%	12·6
Siemens steel	12
Pure platinum	10·6
Pure lead	8·88
Pure nickel	7·89
Antimony	3·88

These conductivities are established from a comparison with that of a wire of pure silver 1 mm. in diameter, which at 0° C. possesses a resistance of 19·37 ohms per kilometer. It follows from these figures that chemically pure silver and copper are the best conductors of electricity. Of course, the use of silver for conducting lines and electric apparatus is out of the question, but the same is not the case with copper, the price of which is sufficiently low to allow it to be employed in industrial applications. The purity of copper has considerable influence upon its conductivity, as may be seen from the following data given by Mr. Preece, in regard to the variations of such conductivity following the improvements that have been introduced into the manufacture of the metal:

Cables	Years.	Conductivity.
Dover-Calais	1851	42 per cent.
Port Patrick and Donaghadee	1852	46 "
Transatlantic	1856	50 "
Red Sea	1857	75 "
Malta and Alexandria	1861	87 "
Persian Gulf	1863	89 "
Transatlantic	1865	96 "
Irish Sea	1883	97·9 "
Pure copper		100 "

—*Chronique Industrielle.*

THE STANDARD OF LIGHT ADOPTED BY THE PARIS CONFERENCE.

THE International Conference lately held at Paris adopted as a standard of light the amount emitted by one square centimeter of melting platinum at the point of solidification. Werner Siemens points out that the practical determination of this unit is beset with difficulties, since platinum at the melting point readily takes up foreign substances which change this melting point. He therefore recommends the use of the following apparatus, which, however, determines the light given out by the platinum at the point of melting and not at the point of solidification. With pure platinum, however, the difference is very small. The method is based upon the melting of a very thin plate of platinum by a current of electricity.

The platinum is inclosed in a metallic case provided with a hole 0·1 square centimeter in section, which is immediately over the melted platinum. The sides of this hole are conical, and the platinum foil extends beyond the hole in every direction. At the instant of the melting of the foil a quantity of light equal to 0·1 of the standard is emitted from the hole.

By suitable modification of the strength of the electrical current the melting of the platinum can be delayed until the proper moment of comparison with another light has arrived. Preliminary measurements with this apparatus show that the light emitted from the hole at the point of melting of the platinum is about 1·5 times the English standard candle.—*Ann. der Physik und Chemie*, 1884.

A MODIFICATION OF HUGHES' MAGNETIC BALANCE.

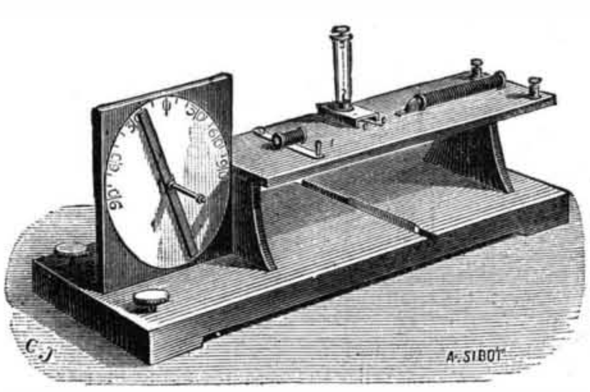
THE annexed figure represents Hughes' magnetic balance modified according to the following suggestions of Prof. S. P. Thompson:

1. The compensator should be fixed in such a way as to revolve against a vertical circle placed at right angles with the magnetic meridian, with its center on a level with the indicating needle, and magnetically to the east or west of the latter. In this position the magnetic force of the compensator has no resultant in the magnetic meridian at the point where the needle is placed. Consequently the sensitiveness of the latter is the same in all the positions that it may occupy in its own plane.

2. A small magnet, placed magnetically north and south of the indicating needle, is employed for rendering the latter astatic to the degree desired.

3. The compensator is so placed that the distance between its center and that of the needle is about 4·6 times half of the space between its poles. If the compensator is not a very thick, flat, and straight magnet, we may suppose, approximately, that the distance of the poles from the ends is one-tenth of the total length, so that a selection of a distance equal to five times half the space between the ends of the magnet cannot give rise to much error. This granted, we may safely suppose that in all positions of the compensator within 55° of each side of zero the magnetic force that it will exert upon the pole of the needle will be about 2 per cent., proportional to the degrees of the scale that the compensator has traversed, and proportional to 1 per cent. for angles under 45°. There will be no need, then, of a special table of graduations for all those practical cases in view of which the magnetic balance was invented.

4. As it is impossible to obtain a vast field of compensation for large and small magnetic forces by diminishing or



MODIFICATION OF HUGHES' MAGNETIC BALANCE.

increasing the distance between the compensator and the needle, I propose to attain such a result by placing over the compensator a second magnet that is capable of revolving around the same axis and that has the same length. In an analogous way, a third magnet may be added for increasing the magnetic momentum of the compensator.

5. As the use of a very small needle is accompanied with less sensitiveness in the indications, I propose to substitute a needle of the type called unipolar, that is to say, having one pole fixed in the axis of revolution, so that a single pole is caused to revolve around the suspension axis. A steel needle, 5 cm. in length, is bent at right angles at 1·5 cm. from its extremity, and the silk suspension thread is attached to the bent end. A counterpoise is added behind, and another small weight is placed beneath upon a brass wire attached immediately under the center of suspension. The sole effective pole of this needle is in the axial line of the balance, at the same level as the center of the compensator.—*La Lumière Electrique.*

THE DAKOTA TIN DEPOSIT.

IF the reports of the recent discoveries of tin at the Black Hills, in Dakota, are of a reliable character, as they certainly appear to be, the United States is destined to become the leading tin producer of the world.

The world's production of this metal last year amounted to 45,770 tons, about one-third of which was consumed in the United States. The countries which produce tin are those bordering on the straits of Malacca, in the East Indies, Australia, and the Cornwall district in England. All the tin consumed in this country has been imported almost wholly from England and English colonies, but the recent discovery in the Black Hills will, if the statements made are correct, revolutionize the trade. According to Professor Bailey, the deposits there are so vast as to be able to supply the whole world for centuries.

The center of the district, which covers an area of twelve miles by seven or eight, is Harney Peak. The tin-bearing rock can be quarried from the surface instead of being followed underground, and he claims to have seen veins of it of more than fifty feet in width which will average much better than the Cornish veins, where the ore has to be raised from a great depth at a heavy cost. Of the stream tin which can be obtained by sluicing, and which will yield about fifty per cent. of pure tin, he speaks as follows:

"The stream tin alone is so abundant that all the companies that could possibly work it could go on for 20 years without exhausting it. Yet this is but the waste, you might say, of the main deposit—the mere scraps that water and frost have detached, a little bit at a time from the great mass and source of the ore, which is Harney Peak, itself more than a mile high, and the surrounding tin-bearing rock, which, as I have already said, extends for miles. It is impossible to imagine this great body of ore ever being exhausted. As to profit, the richness of the ore compared with that of any other tin-bearing district of the world settles that conclusively."

THE FIRST DISCOVERY

Of this deposit was made in the Etta mine, in Harney range, about the first of June, 1883, since which time discovery has been made at several localities of tin stone, the most important being that of Nigger Hill. Mr. Chapman, one of the owners of this mine, furnishes the following facts to a correspondent of the *Mining Review*:

The mineral was first noticed by Mr. Box, who, upon being shown a piece of heavy black rock taken from the gravel of the creek, announced the fact that it was tin. Search was at once instituted for the ledge which had afforded such an abundance of the ore in the shape of stream tin, and which had been the bane of the miners ever since placer mining had been inaugurated in the gulch, its high specific gravity rendering it almost impossible to save fine gold in sluicing or washing without amalgamation.

The stream tin is found usually as sand or small pebbles, though larger pieces have been found. One piece exhibited by Mr. Chapman weighs seventy-two ounces. The search for the ledge resulted in the discovery of a large vein, averaging over 100 feet in width, which has been traced for a distance of four miles. The inclosing rock of all the ore I have seen is orthoclase, the cassiterite being scattered irregularly through the mass in minute grains and crystals of considerable size. The country rock, through which the vein passes, from the description of Mr. Chapman I should judge to be a syenitic gneiss.

A large number of claims have been located on the vein, prominent among which are the Michigan, Lily, Rough and Ready, and Giant. A curious fact has been demonstrated on one portion of the lead: the tin-bearing rock comes to an abrupt termination and its place is taken by gold-bearing quartz, which continues for about 500 feet, when the tin ore as suddenly makes its reappearance, and, as far as is known, continues uninterruptedly. A shaft has been sunk to a depth of thirty feet on the gold-bearing portion of the ledge, which prospects well. A tunnel which was run to tap the vein on the Giant, after being driven a distance of 250 feet and cutting several seams of ore—all of which, I believe, carry tin—encountered a vein, into which the tunnel has been extended 100 feet, the face still being in ore carrying tin.

The miners have made rude tests of their rock by pulverizing and concentrating by washing; the concentrated ore then being smelted in a blacksmith's forge, the results invariably being good. In one instance, 40 pounds of rock was reduced to 10 pounds, and a bar of metallic tin, weighing one pound, smelted from it. The process, being rude, was necessarily very imperfect; as cassiterite carries about 78 per cent. of tin, the result should certainly have been more than 25 per cent. The main chain of mountains, constituting the axis of the uplift of the Black Hills, has a general trend northwesterly and southeasterly, and as the tin mines of Nigger Hill are located near the northern extremity of these mountains, and the mines of Harney near the southern end, it is reasonable to expect that other tin veins will be discovered along this range; indeed, tin has been discovered several miles north of Harney. Considerable development may be looked for in these mines during the coming summer.

[THE MICROSCOPE.]

A PECULIAR DUST IN SNOW.

IN February, 1884, a peculiar sediment was accidentally discovered in snow water at St. Joseph, Mo. Dr. H. Christopher needing some pure water for chemical purposes, melted some apparently clean snow, and called my attention to the above-mentioned deposit. Afterward a fine, feathery snow fell upon a coating of sleet and ice, which covered the surrounding country for hundreds of miles. Upon melting this surface snow, the water was found to contain the same unusual sediment. As the entire adjacent country, and the sand bars of the Missouri River, were covered with ice, it seemed remarkable to find this substance in snow falling upon it. Accordingly this dust was treated with chlorohydric acid, and heated on platinum foil at a red heat to eliminate any carbon or accidental organic matter. Upon washing it in a test tube, it was found to be so minute that portions of it required hours to settle to the bottom. Thinking it might possibly be of local origin, samples were gathered from different parts of the city, and from the country far from habitations. Some were treated as above, and some simply dried.

Its behavior under chemical examination convinced us of its silicious nature. It was then submitted to microscopical examination, and found to consist of flat plates and sharp angled fragments, transparent vitreous pieces, some brownish semi-transparent particles, jet black sharp-pointed pieces, and needle-like spicules. However, every piece, fragment or minute needle, showed a clean-cut, sharply defined margin, and no rounded masses with worn sides were found. After a careful examination it was considered volcanic dust. It was compared with sand from Coney Island, Lake Erie, the Mammoth Cave, and the Missouri River. These various sands were much coarser, appearing as rounded masses, destitute of the clean-cut edges of the snow sand. So great was the difference no one could confound the two. In order to guard against self-deception, thinking it might be ashes from anthracite fires, or dust from foundries and blast furnaces, they were obtained, and found to present an altogether different appearance.

Some of the snow sediment was given to different observers, with no hint as to its character or origin. They called it volcanic dust. Thus we were gradually forced to the belief in the volcanic origin of the specimens.

In order to pursue the matter further, samples were secured on the Atlantic coast from snow falling with the wind from the East, which would presumably give snow free from dust and sediment, having drifted in from air over the ocean. Sediment was also received from Utah snow. All these presented an appearance identical with that obtained in Missouri. A little later it was compared with volcanic matter from Vesuvius, and a striking similarity was at once apparent. The question naturally arises, Whence came this strange visitor? Is it cosmic or meteoric dust which the earth in its orbit has encountered? In former years observers have collected, in uninhabited countries, quantities of dust which was considered meteoric, and is described as "little rounded particles of metallic compounds, unlike anything the earth is known to produce, and strikingly like what meteors of that size would be." That is decidedly unlike the snow sediment.

For another reason this snow sand could scarce be cosmic dust ejected from some planet, as such action could not be vigorous enough to throw such minute particles beyond the attraction of the place of their origin; particles so small, no matter how forcibly ejected, could not escape the attraction of gravity forcing them back to their home.

It will be remembered that on August 26, 1883, one of the most tremendous convulsions known to history wrought immense havoc in Java. Large tracts of country were wrecked, and from Krakatoa tons upon tons of volcanic dust, to say nothing of more bulky material, were ejected with inconceivable force, which coupled with the mighty up-draught of the eruption must have carried the fine particles almost to the confines of our atmosphere. Having once attained a great altitude, borne by the ever-present air-currents, they would drift for months, and in a comparatively short time encircle the earth, and if they were of the same electrical sign as the earth, for instance, both electro negative, the repellent action of this subtle agent would prevent their rapid precipitation. Experiments have proved this, and heretofore volcanic dust has been known to remain aloft a long time. Shortly after this eruption at the Straits of Sunda, colored suns and strange, glowing sunsets startled the inhabitants of comparative neighboring countries by their wierd appearance. These sunsets gradually spread over the earth, and were noticed in this country first in the latter part of November, and during the winter were at their height.

These reflections could not have been caused by the vapor of water, for reasons we will not stop to discuss, but must have come from finely divided solid matter.

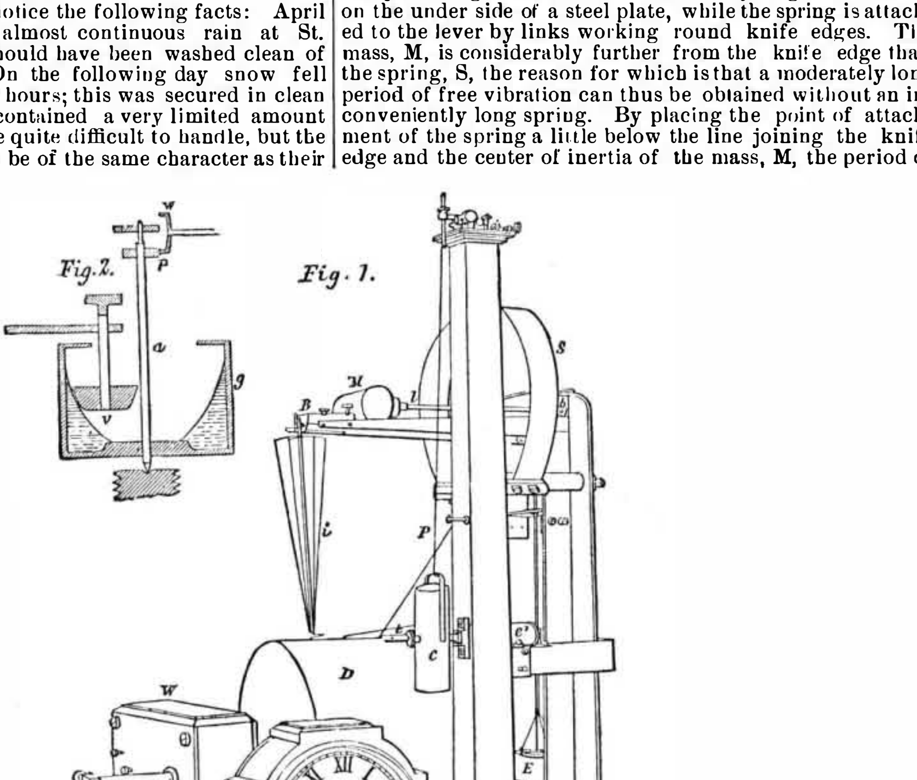
The gradual expansion of this phenomenon over the earth after the catastrophe at Java, and the finding of this peculiar deposit in snow from the Atlantic coast, in Missouri, and in Utah, at a time when the glowing sunsets were bright, force us to the conclusion that after its long flight from Krakatoa we have imprisoned the cause of this great light under our cover glass beneath our objective.

In confirmation of this, notice the following facts: April 19 and 20 were days of almost continuous rain at St. Joseph, by which the air should have been washed clean of all local or surface dust. On the following day snow fell quite abundantly for a few hours; this was secured in clean vessels and melted. This contained a very limited amount of particles so small as to be quite difficult to handle, but the microscope showed them to be of the same character as their predecessors of the winter. At this time the brilliant sunset had faded to a faint blush that lingered after the ordinary tints of the setting sun had disappeared. Thus the sunsets and the attendant dust were disappearing *pari passu*, and thereby strengthened our faith in what at first seems a preposterous proposition, viz.: the snow sediment is volcanic dust from Krakatoa and the cause of the glowing sunsets.

Since writing the above, some dust from Krakatoa that fell on the deck of the ship Wm. De Grasse on the day following the eruption has been received from Mr. Wharton, of Philadelphia. Although considerably coarser, its appearance is so strikingly similar to that gathered at St. Joseph, we are forced to believe them both to have the same origin.

H. W. WESTOVER, M.D.

ST. JOSEPH, MO.



THE EARTHQUAKE RECORDER.

THE EARTHQUAKE RECORDER.

DURING the past session of the Philosophical Society of Glasgow, a paper was read giving a description of an apparatus which had been designed for the purpose of recording the time of occurrence, the duration, and the nature and magnitude of the motions in an earthquake. In the light of recent events this paper has a special interest. The author was Mr. Thomas Gray, B.Sc., F.R.S E., recently a member of the professional staff of the University of Tokio, Japan, and now assistant to Sir William Thomson in the physical laboratory of the University of Glasgow. He stated that the apparatus had been made by Mr. James White, the well known scientific instrument maker of that city, and that it is to be used by a former colleague, Professor Milne, of Tokio, in the investigations which are being carried out by him as one of the committee appointed by the British Association for the investigation of the earthquake phenomena of Japan.

An earthquake, he remarked, generally consists of a considerable number of separate to-and-fro movements of a part of the earth's surface. These movements are irregular in period during any one earthquake, and vary very much as to period, duration, and magnitude in different earthquakes. From past experience in Japan, it is inferred that the instrument described in the paper may have to record motions varying from one-tenth of a millimeter to ten millimeters in amplitude, and from one-fifth of a second to something near one second in period; while the duration of the earthquake may vary from half a minute to about four minutes.

In order to determine the amount of movement, it is found convenient to record three rectangular compounds of it—two horizontal and one vertical. The horizontal compounds are recorded by means of the two pendulums indicated at P, Fig. 1. Each of these pendulums consists of a hollow brass cylinder, *c*, filled with lead, and suspended by a silk thread. The cylinder is held deflected from the position in which it would hang with its center of gravity vertically under the point of suspension by means of a thin tube, *t*, which terminates at one end in a sharp, vertical knife edge. One of these tubes is continued by a long and very light index of aluminum foil; while a similar index is attached to the tube on the other pendulum, close to the knife edge, and with its length at right angles to that of the tube. The knife edge rests in a flat V, cut in a hard steel plate, and the point of suspension is regulated by means of screw adjustments, capable of giving motion in three directions at right angles to each other, until it is very nearly vertically above the knife edge, and at such a height that the knife edge bears along all its length. The points of suspension are so adjusted that the planes through the axes of the tubes, *t*, and the suspending threads are at right angles to each other. In this way the indices are parallel to each other, and they are arranged to be in a horizontal plane.

The vertical component of the motion is recorded by means of the mass, M, supported on the end by the lever, *l*, by means of the spring, S, and actuating the vertical index, *i*. To the crossbar, B, which is sharpened to a knife edge on its upper side, there is firmly attached the lever, *l*. The sharpened edge of B rests in a flat V-shaped groove formed on the under side of a steel plate, while the spring is attached to the lever by links working round knife edges. The mass, M, is considerably further from the knife edge than the spring, S, the reason for which is that a moderately long period of free vibration can thus be obtained without an inconveniently long spring. By placing the point of attachment of the spring a little below the line joining the knife edge and the center of inertia of the mass, M, the period of vibration is lengthened to some extent, and it is still more increased by a box, which is mounted on a long horizontal axis and supported at one end of the lever, *l*. In order to give rigidity to the index, *i*, without making it massive, it is made of a very thin tube of aluminum, which is prevented from bending sideways by fine silk threads attached to its point, and to light crossbars of aluminum at its upper end. The threads are kept stretched by means of a light but stiff spiral spring, which presses against the top of the tube. To the point of the index a very flexible piece of aluminum foil is attached, which projects in a horizontal direction, and can be raised or lowered by a thread which passes up the center of the tube and round a pin fixed in the end of the box, B.

These three components of the motion are written on a band of smoked paper, wound around a drum, D, which is kept continuously rotating by a train of clockwork, W. The ends of the indices are arranged to lie in a line parallel to the axis of the drum, so that the corresponding vertical and horizontal components can be easily detected. The pressure of the point of the indices, which write the horizontal components on the paper, can be adjusted by means of threads attached near the ends of the indices, and passed over studs fixed in the pillar which supports the pendulums.

The clockwork, W, is driven by means of two weights acting on separate driving wheels, one on each side of the first pinion, thus, at the same time, giving a pure couple to the pinion, preventing excessive weight on the bearings of the weight barrels, and avoiding the necessity for maintaining power to keep the clockwork in motion during winding. The clockwork is governed by means of a governor in the form shown in section in Fig. 2, where *g* is a light cylindrical box, partly filled with glycerine or some such liquid, and mounted on a vertical axis, *a*, which in this instrument works in jewels at top and bottom. By means of the pinion, *p*, and the crown wheel, *w*, the box, *g*, is geared to the clockwork. The governing action is obtained by causing the liquid to come in contact with a fixed vane, *v*, which can be turned to different distances from the side of the box so as to vary the speed.

The action of the apparatus is a follows: Suppose that the earth moves in a direction at right angles to the plane of one of the deflected pendulums, then, since that pendulum is very free to move round a vertical axis, the inertia of the bob of the pendulum causes it to turn relatively to the remainder of the apparatus, and, consequently, the point of the index attached to it will move across the drum through a distance depending on the length of the pointer, and the distance of the instantaneous axis of the bob from the knife edge. There will not, however, be any motion of the other pendulum. The same is true of motions at right angles to the other pendulum, or to the lever, *l*; and hence if the motion be inclined to all of these, each one will indicate its own component, thus determining the nature, magnitude, and direction of the movement.

The duration of the earthquake is obtained from the known rate of motion of the drum, D, and the length of the record on the smoked paper

The time of occurrence is obtained by means of the time piece, T, and a system of magnets and circuit-closing apparatus. The circuit-closer is shown at E, and consists of a small pendulum, the bob of which is made to turn a light metallic tube, *r*. This tube is carried on a point resting in a conical hole in a rod rigidly attached to the framework, and it is pivoted to the pendulum by a point resting in a conical hole pierced in a small block on the end of a fine spring, so attached to the bob of the pendulum that the conical hole is under its center of inertia. The lower end of this tube hangs in the center of a dimple formed by capillary attraction in the surface of a cup of mercury, over a thin iron pin fixed in the bottom of the cup.

When the framework of the apparatus is slightly shaken, the point of the tube cups into the mercury, and thus closes the circuit of the electromagnets, e_1 e_2. The electro-magnet, e_1, attracts an armature, to the end of which is attached an index, the point of which is in the same line with the ends of the indices for writing the motions on the drum, D, and thus makes a mark on the smoked paper, which shows at what part of the shock the circuit was closed. The magnet, e_2, at the same time relieves a catch, and allows the weight, *m*, to fall, turning a shaft which passes through behind the dial of the clock. This shaft is provided with two small projecting wheels, which push the dial suddenly forward on the hands. The hands are provided with ink pads, and thus leave a mark on the dial indicating the time at which the circuit was closed. Immediately after the circuit is closed through the mercury, it is again broken by means of a simple circuit-breaker, thus preventing useless waste in the battery.

THE EXTRACTION OF GOLD.

"And is not gold the god of earth?"—P. J. BAILEY.

IT is in these days justly and generally considered as a humiliating failure if in any industrial operation we do not secure practically the whole of the valuable products. The farmer seeks to reap and garner in the entire crops which have grown and ripened on his acres. If prevented by bad weather he bewails his bad luck, if foolish; and if prudent and energetic, he secures a Gillwell harvest-drying machine. The manufacturer, of every kind and grade, is always on the alert to utilize the whole of the raw materials which enter his factory, and if any waste products are formed he moves heaven and earth to turn them to account, or to extract from them some portion at least which may have a market value.

Instances of the success of such endeavors are familiar not merely to practical men in any department, but to the whole reading public. The prevention of waste and the utilization of refuse, from coal-tar down to the waste soap-suds of the woolen mills, have served "to point a moral and adorn a tale" almost to weariness.

Such being the undoubted tendency of the age, it may strike us as strange—as scarcely, in fact, credible—that in an important metullurgical process fully one-half of the substance sought for is, in these days when science and practice are supposed to walk hand in hand, still allowed to go to waste. It will not lessen the surprise of our readers on learning that the material thus wasted is—gold!

So unexpected is this statement that we think it necessary to present briefly the testimony of mining engineers, assayers, and others of long and special experience. Thus Prof. Jack, geologist to the government of the Colony of Queensland, says: "I believe that from 50 to 90 per cent. of the gold contained in some of our complex ores is being lost."

From California, and from the gold-mining districts of America generally, comes substantially the same complaint. Of this we may be convinced on reading over the last report issued by the directors of the United States Mint, at Washington. In this report we find the testimony of Mr. B. Paul, one of the oldest and best mining authorities of California. He says: "As far as California is concerned, I am satisfied that not more than 40 per cent. of her gold is extracted (*i. e.*, 40 per cent. of all contained in the stone that has been treated). . . . Our present general system of mining is based upon the idea that gold is mainly coarse, while examination will show that the high percentage is in atoms finer than flour itself. In my experiments gold has been taken up so fine that it would not subside in distilled water in less than from five to ten minutes." He asks further, "Can you save gold of this kind by running water down stream? Can you obtain gold of this kind without minute reduction? Therein lies the secret of high assays before working and small returns after."

Prof. Eggleston, one of the most eminent metallurgical chemists of America, calculates the loss at "between 50 and 60 per cent." of the total gold present in the ore operated upon.

Mr. C. S. Dicken, F.R.G.S., in a paper read in March last before the Royal Colonial Institute, quoted the amount of gold actually contained in the "Disraeli pyrites" from the Charters Towers District, Queensland, as being on an average 4 ozs. 14 dwts. 13 grains per ton. But the quantity of gold actually obtained from this ore on the present system is only 1½ ozs., or a loss of 70 per cent. Another Queensland sample, Mr. Joske's "Ravenswood pyrites," gives on assaying 2 ozs. 18 dwts. 19 grs. of gold to the ton. But on the ordinary system of working it cannot be treated at all at a profit, and is hence lying idle.

In short, summing up all the facts and all the other evidence bearing upon the question, we can only reaffirm the statement made in a former volume of the *Journal of Science*, that "when treating the most tractable of the sulphurets, battery amalgamation (*i. e.*, the process at present in use in California and Australia) does not secure more than 45 per cent. of the gold."

We may here glance at the change which has latterly come over gold mining and gold finding in general. When the auriferous fields of California and Australia were first opened up, the precious metal was obtained in nuggets of differ-