from Paris to Tours and back, 480 kilometers (298 miles); in the fifth, Paris to Havre and back, 290 miles; in the sixth, the same; in the seventh, Paris, Rouen, and back, 180 miles. In some of the circuits there were sections of underground lines, varying from 19 to 22 kilometers, and the resistance of the entire circuits varied from 1,650 to 3,100 ohms. These trials were made under the conditions usual on French lines. The battery did not exceed 100 Calland or Daniell cells, and the wire was of iron with a maximam diameter of 5 mm. With stronger batteries and bronze and copper wires, greater speed can be obtained.

Since commencing the trials, M. Cassagnes has added further improvements to his apparatus. These consist in the addition of a mechanical perforator and an electrical transmitter, thus bringing the steno-telegraph into the category of automatic telegraphs. By the use of a perforator, the keyboard no longer produces the electric contacts directly, but produces mechanically a band on which the signs are represented by holes. This perforated band is placed in the transmitter and drawn through by the same mechanism which effects the rotation of the rubber. A system of feelers emits through the holes in the band the currents which actuate the dies at the distant station. In a series of trials, between Paris and Orleans and back, Paris and Tours and back, Paris and Macon and back, and Paris, Angouleme, and back, distances varying from 200 to 920 kilometers, there was obtained with this apparatus the following speeds of working: Up to 350 kilometers (217 miles), 400 words per minute; up to 650 kilometers (403 miles), 17,000 words per hour; up to 900 kilometers (560 miles), 12,000 words an hour. Each section can act equally well for reception as for transmission, and the results mentioned above represent the total number of words transmitted in either direction, according to the requirement of the stations.—*Engineering.*

The Introduction of Cholera into Chili.

Dr. John Trumbull sends an interesting account of the mode in which the cholera found its way into Chili, despite the greatest precautions taken to prevent its entrance. "No country," he writes, "could be better situated than Chili to withstand the attempted invasion of such a disease as cholera. No better boundaries could be desired than the extensive desert on the north, separating the country from Peru and Bolivia, the Pacific on the west, and the unbroken mountain range on the east. The Andes, furthermore, form a natural watershed, thus preventing contamination of the water supply by the inhabitants of neighboring countries. The sole danger therefore lay in importation of the disease by infected clothing or in the person of fugitives from the eastern side of the mountains. Every port of Chili was absolutely closed to vessels coming from the eastern coast of South America, and guards were stationed at the mountain passes. A dozen of the most frequented passes were thus closed, but, the winter being a dry one, the fall of snow was light, so that more than a hundred of the less well-known passes are said to have been open. The introduction of the disease was traced directly to a party of fugitives coming from the Argentine Republic, where cholera prevailed. A cattle dealer, with four servants, crossed the mountains and remained concealed for a time in the village of Santa Maria. One of the number was sick, and five days later, on Christmas, 1886, the first authentic case of cholera occurred in the person of a laborer in that village. As soon as the nature of the disease was recognized, a military cordon was placed around the infected district, and the branch railroad leading therefrom was closed. But an exodus from the place had already commenced, and on December 30, one of the fugitives died immediately after his arrival at a small station of the main railway line, forty-five miles from the seaport. Four days later the man who had attended this case sickened and died, and thus a second center of infection was established. This case was an exception to the general manner of the spread of the disease, the water having been the carrier of the infection. In Chili, artificial irrigation is relied upon in agriculture, and the river water is carried through small canals (*acequias*), traversing the valleys in every direction, and furnishing the supply needed for drinking, cooking, and bathing. The canals then act as sewers, the water-closets being built over them, are next used for purposes of irrigation, and finally empty again into the river. No cordon could be of avail under such circumstances, and it was along the banks of the acequias carrying the waste matter from the village of Santa Maria that the disease next disclosed itself. After that a section of country miles away, but on the bank of the same river, and drawing its water supply from this source, was invaded. As yet the disease has not spread from the district supplied by the Aconcagua River, but several suspicious cases have appeared elsewhere, and much anxiety is felt concerning the future." Dr. Trumbull's letter, of which we have been compelled from pressure of other matter to give but an abstract, possesses a peculiar interest, since it seems possible that the disease may be brought to this country from the west coast of South America. Cases of suspected cholera are said to have been noted at the Isthmus, and if the disease becomes prevalent there, there will be great danger of an invasion of our own country.—*Med. Record.*

Extracting Tin from Tinned Sheet Metal Cuttings.

BY S. MONTAGUE, NANTES.

This invention consists in conveying hydrochloric acid gas into a closed vessel containing the tinned sheet metal, the separation of the tin of which is desired. After the closed vessel has become completely saturated with hydrochloric acid gas, whereby the latter combines with the tin, a shower of water is allowed to fall over the sheet metal, and the gas is converted into liquid protochloride of tin; the tin, entirely removed from the sheet metal, is dissolved in the protochloride of tin. The protochloride is drawn off, and the tin is precipitated either by means of zinc or by lime wash, the tin obtained being almost pure.

THE following is said to be a good recipe for map engraving wax: Four ounces of linseed oil, half ounce of gum benzoin, and half an ounce of white wax; boil two-thirds.

THE PORCUPINE IN THE BERLIN ZOOLOGICAL GARDEN.

The class of rodents includes mostly harmless animals, such as the dormouse, the beaver, the mouse, and the hare, and none of them, except the family of the porcupine, are armed with weapons of attack or defense. All the members of this sub-class are armed with longer or shorter pointed quills, and to these lance-bearing rodents the Canada porcupine (*Erethizon dorsatum*) belongs. This animal is about 2½ feet long, and its body is covered with thick, dark brown hair, from which project quills which are 3 or 4 inches long. Its head is short and thick. Its long and strong claws, of which it has four on its fore feet and five on the hind ones, are of the utmost importance to the animal in gaining its food. Its tail is a weapon to be dreaded. It is about 7 inches long, is flattened, and is provided with bristles underneath and spines on top. Woe to him who comes near this weapon! Quick as lightning, the animal strikes laterally with it, and is sure to hit his real or imaginary foe.

The quills will penetrate the thickest covering, and remain in the skin of the person attacked. If this porcupine cannot use its tail to advantage, it rolls itself into a ball like the hedgehog and presents a wall of spears to his attacker, and in this position it seems really unconquerable. A dog which has risked an attack turns back after the first bite, terrified and howling, for the spines stick fast in his mouth. A naturalist found a lynx which had suffered severely from such a combat. It was nearly dead, its head being very much inflamed and its mouth full of quills.

The same observer states that dogs, wolves, and even the cougar die from similar wounds. If a hunting dog comes in contact with a porcupine it is sure to be badly hurt, and therefore porcupines are heartily disliked by hunters.

The *Erethizon dorsatum* lives in the woods of North America, spending most of its time on trees, which it climbs with wonderful ease. Its food is the bark of trees, and it will entirely strip young branches, especially of elms and poplars, so that the woods inhabited by this animal look, as a certain naturalist says, "as if a fire had raged in them." Indians eat its flesh, and use the quills for decorating belts, hunting bags, etc. In captivity, the Canada porcupine soon becomes tame, and accustomed to its keeper; but as soon as occasion offers will escape to the trees.—*Illus. Zeitung.*

THE PORCUPINE IN THE BERLIN ZOOLOGICAL GARDEN.

BRILLIANT RED COLORING MATTER.—Professor Rennie, of Adelaide, has examined the coloring matter which is present in the tubers of *Drosera whittakeri*, a plant which grows plentifully on the hills in the neighborhood of Adelaide. Mr. Francis, of Adelaide, had previously extracted the coloring matter by means of carbon bisulphide, and found that it could be used for dyeing silks with various mordants. The substance is of a brilliant red color, is volatile, and can be obtained in a crystalline condition. The yield from the tubers is very small, as four quarts were required to furnish 5 grm. of the pure dye. By suitable solvents, it can be extracted from the root, and obtained in a state sufficiently pure for analysis. The numbers obtained by Prof. Rennie agree with the formula $C_{11}H_8O_5$, and from subsequent investigation, it appears that the compound is trihydroxymethyl naphthaquinone.

After crystallization of the dye, the mother liquor was further examined, and found to contain another derivative of methyl-naphthaquinone; but additional experiments are needed before the exact nature of this second compound is satisfactorily determined. It remains to be seen whether, with such a small yield, the plant can be grown in sufficient quantities to produce a dye which is capable of competing with the artificial coloring matters of similar constitution.

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The Margin of Profit.

Edward Atkinson lectured on Sunday, May 1, in New Era Hall, Boston, before the Central Labor Union. He said in part:

Even to those who make the Sunday more of a holiday than a holy day, I may give a text to this sermon on labor: Do justly. Love mercy. Walk humbly. These are the laws of humanity, however they originated. There are none who need to think of them more than some of you who try to prevent other men from getting their living in their own way, who would deprive them of their liberty of action, and who put a bad name upon them if they don't do what you undertake to tell them to do.

A great many of you work too hard and too long. No one can deny that. You don't get as good a living as you might have. There is no doubt about that. You don't want to work more than eight hours a day if you can help it. Neither do I. I don't work more than eight hours a day in order to get a living, and you do. Why should you not control your own time as well as I? You can if you choose to.

There is one kind of work that I know all about, and that is making cotton goods in a mill. I have been working about cotton mills in one way and another ever since I was a boy. When I first went into a store in 1842, the men and women who worked in the cotton mills worked thirteen or fourteen hours a day, and they could not begin to make as much cloth in a day as they do now, while they only earned half as much wages. The owners took a bigger slice out of every yard for their profit than they do now; but the product was so small that even the big slice out of each yard did not make them very rich.

It was just the same in every other kind of work then as it was in the cotton mill, longer hours, harder work, poorer pay; too long, too hard; but it took all that time and all that labor to raise food enough, or to make cloth enough, or to get fuel enough to go around. Where it took thirteen or fourteen hours then, it now takes but ten. You older men remember. Am I not giving you facts? By and by it will take less. I think it very likely that your children will be able to get just as good a living, and perhaps a better one than you do, by working eight hours a day; but they won't get it by acts of the legislature.

Nothing has become so cheap as cotton cloth. When you buy 40 yards of cotton cloth at $2.50, you pay the owner of the mill 15 cents profit, but you also pay about 15 cents more to other people for profit, that is 30 cents profit in all; and you pay $2.50 directly for labor.

Five men and women—two carding, two spinning, and one weaving—can in one day make eight yards of cloth, a great deal coarser than this; this is equal to one person's work for five days; 40 yards would take five times as much, or 25 days; and when you had the cloth you wouldn't wear it any more than you would wear a crash towel if you could get anything else, because it would be so coarse and so rough; therefore you pay a capitalist 15 cents profit on 40 yards of cloth, in order to save yourselves 23 days' work (mighty hard work at that) in getting good, smooth, soft factory cloth instead of coarse, wiry, rough homespun. Who gets the best of that bargain? If your work is now worth $1.50 a day, and you save 23 days, I make it out that the capitalist who owns the mill saves you $34.50 and charges you 15 cents for doing it. I have taken cotton cloth as an example, and it is the worst example that I could take to prove the service of capital.

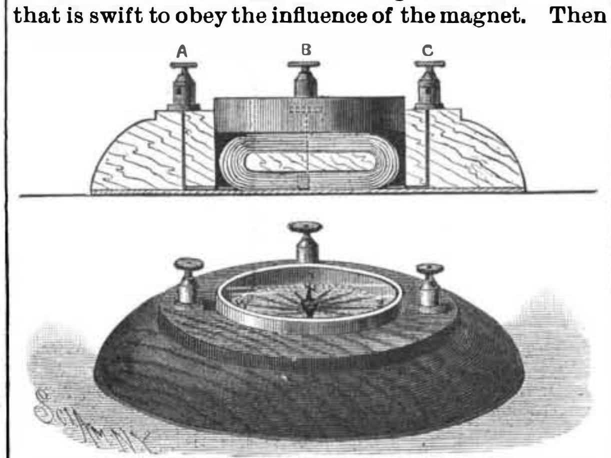
I wholly approve of the organization of labor. What is needed now is a club of "scabs," that is a liberty club, a mind-your-own-business club. If you have Knights of Labor, why not have Squires of Work? It is a great blunder to say that while the rich are growing richer, the poor are growing poorer; it is only the poor who can't work well or who won't work well who grow poor while the rich are growing rich in this country. The best times for the manufacturer are the times when he makes the most money, and they are always when the wages are highest and not when they are the lowest, because wage earners are their principal and most important customers. Therefore, I tell you, organize, organize; but organize the squires of work; call in all the "scabs" to join, and don't refuse any man who works for his living, either with his hands or his head, with his own capital, or his own tools, or his own brains, if he is an honest and a true man.

There are two things very much needed in these days: First, for rich men to find out how poor men live; second, for poor men to know how rich men work. I despise this talk about the rights of labor. The poor man has no more rights than the rich man. What you want to think about are the rights of man, whether he be rich or poor. I tell you here and now that by the acts of the legislature which you have tried for, and some of which have been passed, and by way of by-laws of your Knights of Labor, your clubs, and your associations, which you have tried to force people to adopt, you are driving capital out of the State of Massachusetts. The "scabs" of this country have managed their own affairs fairly well, without much regard to your meddlesome acts. The result of that has been that the men of special skill, who are at the head of their trades, are 100 per cent better off to-day than they were twenty years ago and more.

A SIMPLE GALVANOMETER.

A useful galvanometer, and inexpensive, may be constructed as follows:

A hardwood base, a few inches in diameter and about an inch in thickness, carries a small pocket compass, set firmly into the base over a silk-insulated wire, the ends of which are attached to binding posts on the upper side. The writer has made a neat instrument at a cost of 80 cents—better than he could buy under $5. The compass may be bought at hardware stores for 30 cents. It is well for the purchaser to test the compass, before buying, with a magnet. Select the one that is swift to obey the influence of the magnet. Then



A SIMPLE GALVANOMETER.

mark out upon the upper side of the base the outline of the compass. With a knife sink the circle thus outlined an eighth of an inch, as a pocket for the compass.

Cut the wood so as to form a bobbin, upon which is wound wire, as shown in the upper sectional view. This should be laid carefully, one end being left for attachment to binding post A, and the wire being wound about the core by passing the other end through the openings, and then attaching it to the binding post, C. About 20 feet of good quality, silk-covered wire, of size between 26 and 32, is amply sufficient. After the wire has been wound upon the core there may be attached to it, with a little care, at its middle, a short piece that will connect with a third binding post, B. This will make a short circuit of one-half the length of the wire, when terminal A or C is connected with terminal B. A fine gimlet hole will serve to carry each end to its binding post, where it is best attached to the foot of the post, leaving the holes in the posts for other connections. A circular piece of tin may then be fastened to the base, so as to cover the wire, and the whole base may then be varnished or oiled to suit the fancy. The compass may be firmly united to its receptacle with a bit of Chatterton compound or glue, care being taken to set it perfectly level.

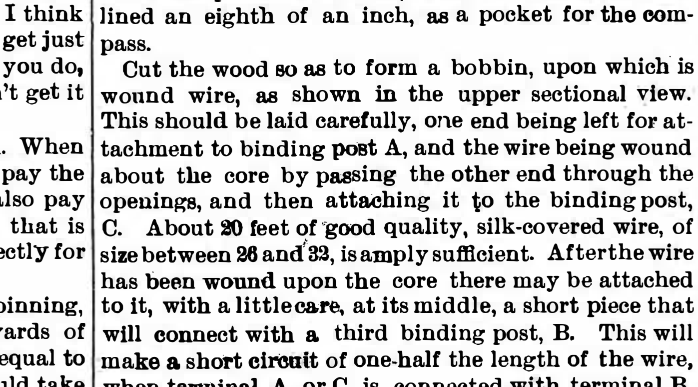
An instrument thus constructed will be sensitive to delicate currents, and forms a useful galvanoscope for amateur and professional electricians.

GEO. C. SONN.

Newark, N. J.

EXPERIMENT IN MAGNETISM.

Material, a horseshoe magnet and a common sewing needle. Insert a light thread in the needle, tie, and cut off one end, leaving a single thread 6 or 8 inches long. Lay the magnet on a table, with poles in front;



EXPERIMENT IN MAGNETISM.

magnetize the needle by rubbing it several times, always in one direction, by one pole of the magnet, after each stroke returning the magnet in an arc through the air. Take the end of the thread between thumb and finger, and suspend the needle over its attractive pole, allowing the point to come within one-fourth of an inch of the magnet, then, with a circular sweep of the hand, to keep the point in position, draw the eye of the needle down toward the other pole. This, if carefully done, will bring the needle to a horizontal position, where it will remain, floating or in suspension, as long as the thread is held steadily. The magnetic forces operating to produce this effect appear to be, first, the attraction of the left pole for the point of the needle; second, the repulsion of the right pole for the same point; and third, the attraction of the right pole for the eye of the needle, which is resisted by the thread supporting the needle; the latter also is held from approaching the left pole by the same means.

WM. SALISBURY.

[We illustrate this very interesting experiment. It can be performed with quite a small magnet. A 2 inch magnet answers perfectly. In using a small magnet, the point of the needle should be broken off to reduce it in length. The thread may be held close to the needle; an inch length of free thread is enough. The experiment may be made more effective by covering the magnet with a sheet of paper, thus concealing it.—ED.]

Protecting Animals from Flies.

At this season of the year the annoyance caused to animals by flies and mosquitoes often amounts to positive agony, and at all times, in what is called good corn weather, it is sufficient to prevent the stock eating enough to keep them in good condition. The animals will stand in the water or pass the greater part of the day in the shade, rather than expose themselves to the sunshine, going out to eat only when driven by hunger. They quickly lose flesh, the flow of milk shrinks, and a loss is incurred that cannot be easily made good again. At all times a good feed of grain is beneficial to stock, but it is especially so when flies are very annoying, since it will do much to prevent shrinkage of flesh and milk. Horses and milch cows may be protected, in a great measure at least, by wiping them all over with a sponge dipped in soap suds in which a little carbolic acid has been mixed. Bulls confined in stables often suffer enough from the attacks of flies to drive them half mad, and there is no doubt that the continued fretting caused in this way develops a savage disposition. The most satisfactory results have followed from sponging with soap suds and carbolic acid mixed a Jersey bull confined in a stall.—*Chicago Tribune.*

THE MECHANICAL WORKING OF BALLAST QUARRIES.

It is more than fifteen years ago that the engineers of the Paris-Lyons-Mediterranean Railway Company recognized the necessity of keeping the ballasting of the roadbed thoroughly permeable, and of restoring such permeability to ballast that has lost this quality through long use. They adopted as a principle that ballast should be kept in just as good a state as are the rails and ties. This principle once admitted, it became necessary to replace the old ballast, and to open up vast quarries in the gravel deposits that are found in the vicinity of several lines of the above named railway system. But, since this gravel is usually mixed with a somewhat earthy sand, and furnishes a ballast that quickly becomes as impermeable as that which is to be replaced, it has to be given greater hardness by freeing it of its sand through a rapid screening. This operation is now performed mechanically.

When ballast quarries first began to be worked mechanically, the machine used consisted of an excavator, which emptied the contents of its buckets upon inclined screens, through whose bars the sifting was effected. But, in the presence of the enormous cubage of the ballast to be furnished, not only for the construction of new roads, but for the repair of old ones, contractors soon had to modify their mode of operating, and to often substitute new and more powerful machines for their old ones.

In 1885, Messrs. Martin & James, having taken the contract for ballasting the line from Arron to Nogent, adopted the following interesting arrangement. A pump actuated by the excavator engine threw a continuous stream of water into a horizontal hopper, and as this water carried along the sand mechanically, nothing remained but the broken stones, which fell perfectly clean into the cars. These stones were afterward sorted out by means of screens, and the ashlar separated from stones at least two inches in diameter, or else the whole was allowed to fall pell-mell into the cars. The water charged with sand returned to the excavation from whence the ballast had been taken by the excavator buckets.

It took twelve minutes to fill a car with siliceous ashlar of all dimensions, and two minutes to load a car with 35 cubic feet of the material.

Messrs. Delamare & Pautz, who recently contracted with the Paris-Lyons-Mediterranean Railway Company to furnish 2,800,000 cubic feet of ballast for the line from Lyons and St. Etienne, placed in the Pierre Benite quarry an excavator (Figs. 1 and 2) provided with a mechanical device designed for effecting the screening. In this machine, the usual chute was replaced by a rotary cylindrical sieve, designed to free the gravel from the sand and earthy matter that it contained. The bucket chain of this excavator was

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