Correspondence.

The Diamond Toothed Circular Stone Saw.

To the Editor of the Scientific American:

In the SCIENTIFIC AMERICAN SUPPLEMENT of 1st inst. is an illustration of a stone sawing machine described by Mr. James T. Pearson, of Burnley, Lancashire. In 1875 at the Cincinnati Exposition I had and operated a diamond stone sawing machine, operated on substantially the same principle, and sawed more than 40 tons of freestone into slabs of 1, 1¼, 1½, and 2 inches in thickness and never made a miscut nor lost a single diamond. I set the diamonds as shown in our hand book for dressing emery wheels. The same machine was successfully used at the Philadelphia World's Fair in 1876, and that machine is still in existence.

But carbons became expensive, and no matter how much water was forced into the cut, they soon became dull, and the enterprise was abandoned. It is now claimed by a party that they have discovered a method of producing carbons, but of small sizes yet, but hope soon to produce them of larger sizes, and very cheaply. I am hoping for success in this line, when I may become interested again in the business.

J. E. EMERSON.

Beaver Falls, Pa., April 3, 1893.

How to Convert Incandescent Lamps into Geissler Tubes.

To the Editor of the Scientific American:

The idea of utilizing burned-out incandescent lamps for performing Geissler tube experiments may be new to many of the readers of your valuable paper, and if so, would be pleased to submit it.

The experiment may be performed as follows:

Procure a burned-out lamp, if possible one in which a piece of the filament has been broken off, leaving the ends separated about an inch. Solder a piece of wire to each terminal of the lamp, and connect to the secondary terminals of an induction coil yielding about a one-eighth inch spark. Start the coil in action, and holding the globe in one hand, begin to file off the glass point where the lamp has been sealed. This operation must be performed very cautiously, using a fine file with a gentle pressure.

The filing should be continued until the discharge diffuses the bulb, and then the point is quickly sealed in the flame. It is, of course, apparent that the object in filing the point is to allow a certain amount of air to enter the globe, producing a low vacuum, through which the discharge will readily pass.

The writer has obtained quite a number of beautiful and varied luminous effects in this manner by using the lamps of different manufacture and with very little trouble.

E. M. LA BOITEAUX.

Strange Effects of an Earth Current.

To the Editor of the Scientific American:

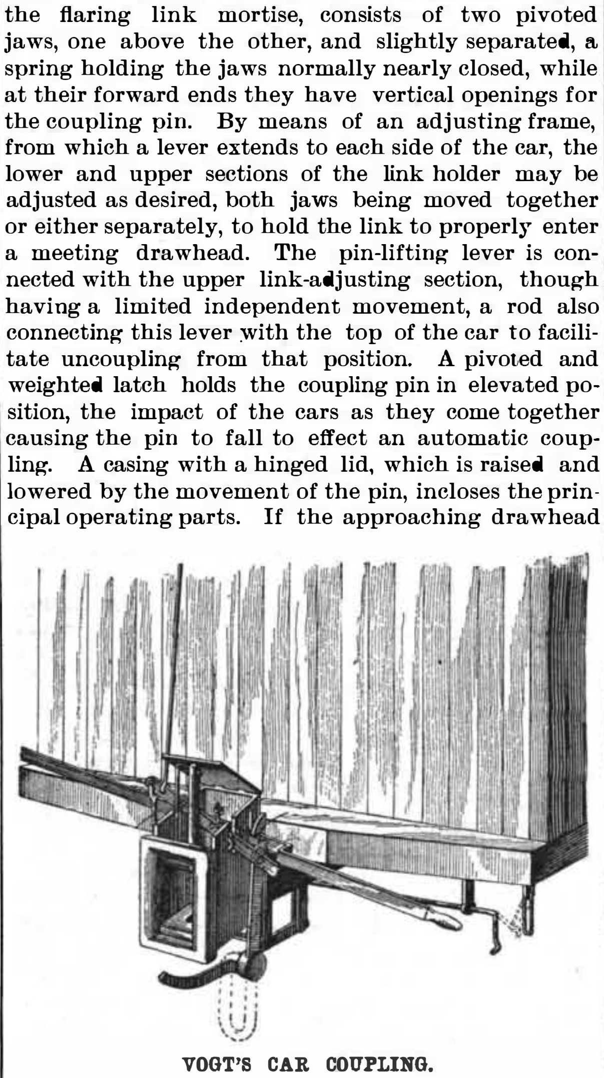
I give you below an account of the strange effect an earth current (I say earth current, because I cannot attribute its manifestations to any other cause) had on a telegraph line on March 15, 1893. The Atlantic and Pacific Railroad and the Southern Pacific run almost parallel for several hundred miles in Arizona east and west, converging at Barstow, California. A military telegraph line running in a general north and south direction connects Holbrook, Arizona, on the Atlantic and Pacific with Willcox, Arizona, on the Southern Pacific. The distance between these two points is about 250 miles. It was on this telegraph line that the earth current manifested itself. I at first supposed that either the operator at Holbrook or Willcox had made temporary connection with one of the lines of the railroads, but the operator of the military telegraph office at Holbrook (the northern terminus of the military telegraph line) states that his office is at least 100 yards from the railroad station, and that connection with the railroad telegraph line at that point was impossible. The military line was broken between Fort Grant and Willcox, so a connection with a railroad wire at Willcox was also impossible. The operator at Fort Grant grounded the line south at his office, that those between there and Holbrook might transact their business. In the forenoon of the date mentioned a powerful current on the military line was felt. It was so strong that it attracted the armature of all the relays on the line with such force as to cause the armature levers and trunnions to bend. The operator at Fort Grant, having had a galvanometer in circuit, states that the earth current was of an opposite polarity to that furnished by the battery, and that it threw the needle 90 degrees from the zero point in an opposite direction to that produced by the battery. Every operator on the military telegraph line distinctly heard "Hn," calling "N," "W," and "U" at intervals, these being not the call letters of any of the offices on the military, but those of offices on the Southern Pacific telegraph line. Curiosity prompted me to attempt to break in and ascertain if I could locate "Hn," but my attempt proved unsuccessful. As I said above that the wire on the military telegraph line was broken between Fort Grant and Willcox, it is apparent that the signals were reproduced through the agency of the earth current, which was felt for nearly half an hour. If you deem this article worthy of a small space in your valuable journal, it may prove interesting to many readers.

J. FETZER, Sgt. Sig. Corps, U.S.A., Operator.

Fort Apache, Arizona, March 28, 1893.

AN IMPROVED CAR COUPLING.

An automatic coupler, which permits of the cars being uncoupled from either side or the top of the car, so that the brakemen do not have to go between the cars at any time, is shown in the accompanying illustration. It has been patented by Mr. A. G. Vogt, of Boerne, Texas. The drawbar is hollow and open at its rear end, so that the buffer spring of the ordinary drawbar may be used. The link holder, operating in the flaring link mortise, consists of two pivoted jaws, one above the other, and slightly separated, a spring holding the jaws normally nearly closed, while at their forward ends they have vertical openings for the coupling pin. By means of an adjusting frame, from which a lever extends to each side of the car, the lower and upper sections of the link holder may be adjusted as desired, both jaws being moved together or either separately, to hold the link to properly enter a meeting drawhead. The pin-lifting lever is connected with the upper link-adjusting section, though having a limited independent movement, a rod also connecting this lever with the top of the car to facilitate uncoupling from that position. A pivoted and weighted latch holds the coupling pin in elevated position, the impact of the cars as they come together causing the pin to fall to effect an automatic coupling. A casing with a hinged lid, which is raised and lowered by the movement of the pin, incloses the principal operating parts. If the approaching drawhead



VOGT'S CAR COUPLING.

also has a link in it, the link-operating lever is set to eject one link, which is caught by a receiving hook supported to swing below the drawhead, as shown in dotted lines. With this form of coupler all of the old styles of links, pins, keys, and bumper springs can be utilized, and automatic coupling is readily effected with cars fitted for the old style of link and pin coupling.

"Piperazine."

BY W. MAJERT AND A. SCHMIDT.

Erroneous statements have appeared in several modern text books regarding the physical and chemical characters of piperazine, $C_4H_{10}N_2$, which have been confused with those ascribed by A. W. Von Hofmann and by Ladenburg to the impure substances of like composition discovered by them, and termed respectively diethylenediamine and ethyleneimine or diethylenediimine. Our attention has been directed to the fact that this misunderstanding has partly arisen from a misconstruction of our views (*Ber.*, 1890, 3719) as to the identity of these substances; we, therefore, desire to correct this impression.

Piperazine, which was not known in its pure crystalline condition until prepared by us in August, 1890, by treatment of dinitrosodiphenylpiperazine with alkali, is a crystalline substance melting at 104—107° in capillary tubes, although when the melting point is determined on large quantities it is found to be 112°, the differences being due to the hygroscopic nature of the base. It boils at 140—145°. It is very readily soluble in water and alcohol, the aqueous solution having a distinctly alkaline action. It is very hygroscopic and readily absorbs carbon dioxide, being thereby converted into the carbonate melting at 162—165°.

Piperazine is especially characterized by the formation of an insoluble pomegranate red double salt with bismuth iodide and by a dibenzoyl compound melting at 191°.

The basic substance diethylenediamine prepared by Hofmann by the interaction of ammonia and ethylene bromide consisted of a liquid mixture of bases boiling approximately at 170°. That this mixture contained a small quantity of a base identical with piperazine is undoubted, but it was only after piperazine had been prepared from dinitrosodiphenylpiperazine that Hofmann succeeded in identifying it and isolating the pure crystalline product from the mixture, which, besides higher ethylene bases, contained also a number of vinyl compounds.

Owing to the difficulty of purifying small quantities of the base, Ladenburg's experiments with diethylenediimine, obtained by the decomposition by heat of ethylenediamine hydrochloride, were unsuccessful. The product described by Ladenburg as the base was undoubtedly impure piperazine carbonate, as proved by its melting point, 159—163°.

In conclusion, it may be interesting to mention that we have succeeded in preparing the following series of hydrates of piperazine, that most readily formed being a hexhydrate which crystallizes from dilute aqueous solutions:

$C_4H_{10}N_2 \cdot H_2O$, m. p. 75°,
" $2H_2O$, " 56°,
" $3H_2O$, " 39—40°,
" $4H_2O$, " 42—43°,
" $5H_2O$, " 45°,
" $6H_2O$, " 48°.

—*Chemical News.*

The Metals and their Physical Properties.

Name.	Atomic weight.	Specific gravity.	Specific heat.	Temperature of fusion F.	Linear expansion, 32°–212° F. 1 part in	Electric conductivity.	Heat conductivity.
Osmium	199·2	22·477	0·0311	3992	152	....	....
Iridium	198	22·4	0·0326	3992	1429	....	....
Platinum	197·4	21·46	0·0324	3592	1167	10·5	0·84
Gold	197	19·265	0·0324	2990	645	77·9	0·532
Uranium	118·8	18·33	0·0619	3632	....	....	....
Tungsten	184	16·54	0·0334	4352	....	....	....
Mercury	200	13·595	0·0333	—40	....	1·63	....
Ruthenium	104·4	12·26	0·0611	3935	1038	....	....
Rhodium	104·4	12·1	0·0588	3935	1176	....	....
Thallium	204	11·86	0·0335	529	331	9·30	....
Palladium	106·6	11·4	0·0593	3632	1000	....	....
Lead	207	11·256	0·0314	617	351	8·32	0·85
Silver	108	10·4	0·0570	1832	524	100	1
Bismuth	210	9·82	0·0308	507	719	1·19	....
Copper	63·4	8·94	0·0952	1990	581	94·4	0·736
Molybdenum	96	8·6	0·0722	3632	....	....	....
Cadmium	112	8·546	0·0566	442	428	22·10	....
Cobalt	58·8	8·5	0·1069	3272	809	17·22	....
Nickel	58·8	8·297	0·109	2912	781	13·11	....
Iron	56	7·844	0·1138	2012	819	16·81	0·119
Thorium	115·7	7·5	....	....	....	....	....
Indium	75·6	7·42	0·2934	176	237	....	....
Tin	118	7·29	0·0562	442	462	11·5	0·154
Manganese	55	7·14	0·0722	3452	371	....	....
Zinc	65·2	6·915	0·0956	707	321	29	0·190
Chromium	52	6·81	0·100	3992	....	....	....
Cerium	92	6·728	0·0447	....	....	....	....
Antimony	120·3	6·715	0·0508	842	923	33·76	....
Didymium	95	6·544	0·0456	....	....	....	....
Niobium	94	6·3	....	....	....	....	....
Tellurium	128	6·25	0·0475	752	596	....	....
Lanthanum	93·6	6·166	0·0448	....	....	....	....
Gallium	69·9	5·9	0·079	86	....	....	....
Arsenic	75	5·7	....	....	788	....	....
Vanadium	51·37	5·5	....	3992	....	....	....
Zirconium	89·6	4·15	....	887	....	....	....
Barium	137	4	....	1562	....	....	....
Aluminum	27·5	2·583	0·2143	....	450	19·6	....
Strontium	87·5	2·5	....	....	....	6·71	....
Columbium	94	2·1	....	....	....	....	....
Glucinum (Beryllium)	9·4	2	0·64	....	....	....	....
Caesium	133	1·88	....	....	....	....	....
Magnesium	24	1·743	0·250	1382	....	25·47	....
Calcium	40	1·578	....	1562	....	22·14	....
Rubidium	85·4	1·52	....	135	....	....	....
Water	....	1	....	....	....	....	....
Sodium	23	0·9735	0·293	194	....	37·42	....
Potassium	39·1	0·875	0·166	136	....	20·83	....
Lithium	7	0·594	0·9408	374	....	19	....
Erbium	112·6	....	....	....	....	....	....
Selenium	79·4	....	0·0701	....	271	....	....
Titanium	50	....	....	....	....	....	....
Tantalum	182	....	....	....	....	....	....
Yttrium	61·7	....	....	....	....	....	....
Terbium	?	....	....	....	....	....	....

NEWLY DISCOVERED METALS OF UNCERTAIN PROPERTIES.

Idunium.	Norwegium.	Columbium.
Davyum.	Vesbium.	Rogerium.
Mosandrum.	Neptunium.	Comesium.
Halmium.	Lavoisium.	Actinium.
Thalen.	Uralium.	*Ya*—Yb.
Samarium.	Barcenium.	

MECHANICAL PROPERTIES OF SOME OF THE LEADING METALS.

Order of hardness.		Order of tenacity.	
Platinum.	Tin.	Lead	0·1
Iron.	Selenium.	Tin	1·3
Antimony.	Bismuth.	Gold	5·6
Copper.	Lead.	Zinc	8
Silver.		Silver	8·9
Gold.		Platinum	13
Zinc.		Copper	17
Aluminum.		Iron	26

Malleability—Hammered.	Malleability—Rolled.	Ductility.
Lead.	Gold.	Platinum.
Tin.	Silver.	Silver.
Gold.	Copper.	Iron.
Zinc.	Tin.	Copper.
Silver.	Lead.	Gold.
Copper.	Zinc.	Zinc.
Platinum.	Platinum.	Tin.
Iron.	Iron.	Lead.

Steel Pontoons.

The draught of water through the Canadian canals, while nominally nine feet, is subject to season fluctuations, and anything over this draught requires pontooning. Mr. Lesslie, manager of the Collins Bay Company, has made two cylindrical steel pontoons, and with these placed alongside the vessel it is only necessary to ballast them with water to a sufficient depth, secure them to and under the vessel, and then pump out the water until the required draught of the vessel has been reached. The utmost success has so far attended the use of these steel pontoons, and it is expected that they will be largely used during the World's Fair season.

Country Roads and Electricity.

The Wheelmen's League is agitating a scheme for improved country roads which is modestly estimated to cost not more than $10,000,000 for this State. They have introduced a bill in the Legislature for the promotion of this object, and to mollify the farmers, who are expected to object to the trifling expenditure, it is announced that only a small part of the cost will be levied on the agricultural districts. It is not announced, however, where the weight of the levy is to fall, and in the absence of more definite information it is presumed that the main part of the cost will be assumed by the bicyclers themselves, the young fellows who compose the league. The cities are careless about bicycling, and it is not thought that they could be drawn into the scheme without even a greater effort than it takes to paddle a bicycle over a muddy road.

There is an alternative plan, however, which has been considerably agitated among electrical engineers and manufacturers, and it is one that cannot fail to be of great interest to farmers when it has generally been brought to their attention. It is a plan to lay electric railways on all the country roads, and, through the general distribution of electrical power, to enable the farmers to not only travel wherever they please to go, at about any rate of speed that they are willing to risk, in vehicles under their own private control, but to do a large part of their farm labor by electrically propelled agricultural implements. The arguments in favor of this plan may be summarized as follows:

First, it will make the cheapest and the only comprehensive system of road improvement that can be considered practicable for a country so large as the United States. In most sections of this country a district 10 miles square contains about 100 miles of roadway. In the Western States the mileage is greater; but in the East and South it is sometimes even less. But in a district 10 miles square there are 600 one hundred acre farms, or their equivalent total of 64,000 acres. Then, as the electric motor has a wonderful facility for running up hill and there will be little or no grading required, it is not difficult to estimate the cost.

Taking a district 10 miles square, the surface that can be served from a single central power station, and estimating on the cost of the track, poles, wires, and central power stations of the electric railways already in operation as a basis, it is maintained that a total capitalization of $10 per acre would be sufficient to provide an electric railway system in the country, not considering any further agricultural use of the electric power. This would mean an annual interest charge of 60 cents per acre, or $60 for each 100 acres of land in the district. It seems like a very trifling expenditure when we consider the magnitude of the service proposed. But, of course, to this estimate must be added the operating expenses, and the interest on the cost of the electric wagons owned or rented by the farmers. In the calculations of the electrical experts, however, the total is not made to equal the expenditures entailed by our existing road system when we count the saving of time as an incident of value. As to the profits of the operating companies, they would accrue to the farmers themselves if they become, as it is maintained they should be, the chief stockholders.

Next after the claim for greater economy comes the claim for greater efficiency in service.

The advocates of an electric system of country roads maintain that it costs a farmer who lives at any considerable distance from town more money to get his produce to market than it afterward costs to get it to New York, or even to Liverpool; and, whether this claim be well founded or not, it is certain that, if a farmer places any value upon his time, the marketing of his produce is a very expensive undertaking. But with an electric railway in operation he need go to no considerable expense for this work. The companies owning the electric plant could send cars or trains to the different farmyards, collect the produce, and deliver it at the nearest market town for a small part of the cost entailed by slow horses and wagons, even estimating time as of no value. But this would be only the beginning of the farmer's advantanges. The ability to travel at any hour of the day or night and through any kind of weather, in a perfectly protected vehicle, at the rate of eighteen or twenty miles an hour, would be a source of inestimable convenience and comfort.

The third advantage claimed for the system is still broader than even the claim of greater economy, greater convenience, and more generally efficient service. It is commonly known that during recent years the increase of population in this country has been flowing in a disproportioned ratio toward the cities and large towns along the line of railway communication, while the little country villages remain merely cross roads hamlets, without growth or progress of any kind. This is due to the fact that the manufacturing interests of the Union are rapidly growing, and that only the towns along the line of railway communication offer the advantages of cheap production and the cheap distribution of merchandise. It costs too much to distribute coal through the country districts to permit its use for anything but domestic purposes. But with a system of electric railways in operation this disparity would disappear. On account of the greater cheapness of lands and rents, the smaller villages would become the most available points for cheap production, even while the steam engine and coal remained the only source of manufacturing power. But with the general distribution of the current would come also the general distribution of electric power; and this would add to the inducements of the country as a field for the manufacturing industry. Then the rural villages would begin to receive their fair proportion of the increase of population, and this would react upon the farmers greatly to their advantage. Truck farming would soon become universal, instead of the exclusive industry of suburban farmers, and farming operations could be universally conducted with greater profit.

But the projectors of an electric system for the country do not limit their claims to merely material considerations. It is very well known that, owing to sparse population and the difficulty of intercommunication, the educational institutions of the rural districts are very defective. The curriculum of the country school is at best about limited to the three R's, and the farmer who wants to give his children an education above the most elementary studies is forced to board them at considerable expense in some neighboring town or village, where there may happen to be a high school or academy. So serious has this drawback to country life become that in Massachusetts, a State where something more than the three R's is universally thought desirable, the people are beginning to consolidate their schools, and to send out wagons at the expense of the town to bring the children together where they can be effectively taught by competent teachers. But it is suggested that with electric railways in operation only one school in a township would be needed, and that this school, while it could be made equal to the best city schools in every educational advantage, would be superior to the city schools, with their mixed attendance, in moral advantages. Children could be transported between their homes and a centrally located village school without serious loss of time, and the demoralizing associations incidental to attendance on city schools could be avoided. Then the country would become an ideal place for the training of children, and this would bring a further influence to bear in favor of a more rapid increase of rural population. It is certainly true that the superior educational advantages of the cities are among the chief causes for their rapid growth at the expense of the country.

Finally, the argument takes a range as wide as our political and social science. The effect of practically concentrating a territory 25 or 30 miles square into a space no larger than a 5 mile radius under the ordinary resources of transit is broadly considered, and it is concluded that the social results must be beyond calculation. First after the consolidation of schools and the coming of better teachers would follow the consolidation of churches and the advent of better preachers. The people of large districts would thus be brought into more intimate relations with each other, and a more cosmopolitan spirit would be engendered. Entertainments of an intellectual and innocent kind would be found also everywhere within reach, and country life, made larger socially and more varied, would lose the monotony and dullness which now drives so large a proportion of the sons of farmers to the cities. The country, indeed, would become an ideal place of residence. Even the postman and the newsboy could go their daily rounds and the morning newspaper would become as familiar a visitor at the farmhouse as it has long been at the urban or suburban dwelling. In truth, the number of post offices in the United States could be reduced three-fourths, it is believed, and a better service rendered from the remaining one-fourth than we can ever expect to see under prevailing disadvantages.

But even yet the arguments in favor of extending the electric system into the country are not repeated in full; and it may be thought by some persons that the reason still to come should have been placed first and made the inspiration of the entire plan. The farmers, it should be pretty well known by this time, are not altogether satisfied with their profits. They think that with their large capital invested, about the largest, according to statistical estimates, in the country, they should be able to get larger returns. But it is doubtful if they can ever get larger returns from exclusively agricultural operations, or not, at least, until all the arable land is taken up and the fatal facility with which new men may become farmers is checked by the cost of investment. What the farmers seem to need is an independent field for investment—a field that will enable them to put their savings into income-producing property beyond the reach of the fierce competition of the plow and the cultivator. This, it is claimed, is precisely the field that will be opened by the electric motor. The companies building and operating the electric power plant will find a wide source of profit. They will find it not merely among the farmers themselves, but in the rural villages, soon to become considerable manufacturing towns, demanding light and power. The day is not now distant, either, when the telephone patents will expire, and then the telephone may be brought into universal use and made to contribute largely to the profits of the companies. All this can be made to accrue to the profits of the farmer, if he will display sufficient enterprise to take advantage of his opportunities.

These are some of the arguments advanced in favor of pushing out the electric service into the country. But for the discomfiture of the Wheelmen's League there is still another argument which interposes with peculiar force against their expensive scheme for old-fashioned road improvement. It is urged that the general adoption of the railway system in this country of magnificent distances and difficult means of intercommunication is inevitable, and that any kind of improvement that contemplates the perpetuity of horse traction on the highways would be a mere waste of money. It is consistently claimed that there will be absolutely no occasion for any farmer or other citizen of the rural districts to go upon the roads except in electrically propelled vehicles after the electric system has been brought into general use, and that the time when it will be in general use is not distant in any event. The stimulus to activity will not be lacking, because it is believed to be the best field of investment in the United States, and too promising to be neglected, even should not the farmers themselves become the promoters. The capital invested in electrical manufacturing in this country now amounts to many hundreds of millions, and, in addition to this large total, the iron industry and other branches of industry engaged in manufacture of railway rolling stock will be equally concerned with the electrical manufacturers in the extension of the railway system. All these large interests will work together for a common end.

At present the electrical manufacturers are overburdened in filling orders for street railways, and they are compelled to continually enlarge their plant to meet the demand. But in the course of a few years, four or five years at the utmost, the urban and suburban demand will be pretty generally met, and the orders will begin to fail. Then we can look to see the next step taken. It would not be consistent with the character of the American manufacturer to abandon a portion of his plant when the whole continent remains to conquer. He will push out into new fields, and invade the country. The country stage coach has gone. The country road must follow, and it is not believed that it would be sensible to bond the State of New York for $10,000,000 for such roads, when in less than twenty-five years at the furthest they will have become a tradition, and the bonds alone would remain as a memento. A $5,000 a mile macadamized road would be no better foundation for an electric railway than a dirt road. It would not be so good.

It is possible that against these claims the advocates of improved roads may suggest the storage battery system, and urge that we may have both improved roads and electricity. But it has been observed that wherever the obstruction of cost—the present obstruction for the storage battery—throws itself in the way of electricity it proves to be a very obstinate obstruction. It does not look now as if the storage battery could ever be more than a subsidiary source of power. Then, again, electric vehicles could never be driven at the high rate of speed that would be demanded in the country, except over iron rails.

Magnesium Zinc-Eisen.

By H. N. Warren, Research Analyst.—This compound intended solely for pyrotechny is produced either by the electrolysis of magnesium sodium chloride in contact with zinc, or by the action of sodium metal upon that compound. As in the first instance, about ten or twelve pounds of zinc are introduced into a convenient size plumbago crucible, through the bottom of which is inserted a carbon rod; an excess of sodium magnesium chloride is next added, and a current of about 50 volts passed through the whole. The zinc speedily absorbs the magnesium thus set free, while chlorine escapes abundantly from the further electrode in contact with the magnesium chloride.

When an alloy containing about 70 per cent of magnesium has been obtained the current is broken, and a small quantity of ferrous chloride introduced; a further action is thus established, metallic iron being set free, which further alloys with both the zinc and magnesium to the extent of about 12 per cent. By this means a compound is obtained possessing so brittle a texture as to be readily reduced to the finest powder.

In the second instance a saturated alloy of sodium and zinc is caused to act upon a mixture of magnesium sodium chloride; the sodium speedily changes place with the magnesium, forming the above mentioned alloy, to which an equivalent portion of iron is introduced by the action of ferrous chloride. These alloys are invaluable in photography for flash light and in pyrotechny as signals, being equal to the pure magnesium as a light-producing agent, at the same time being produced at a much lower cost.—*Chemical News.*