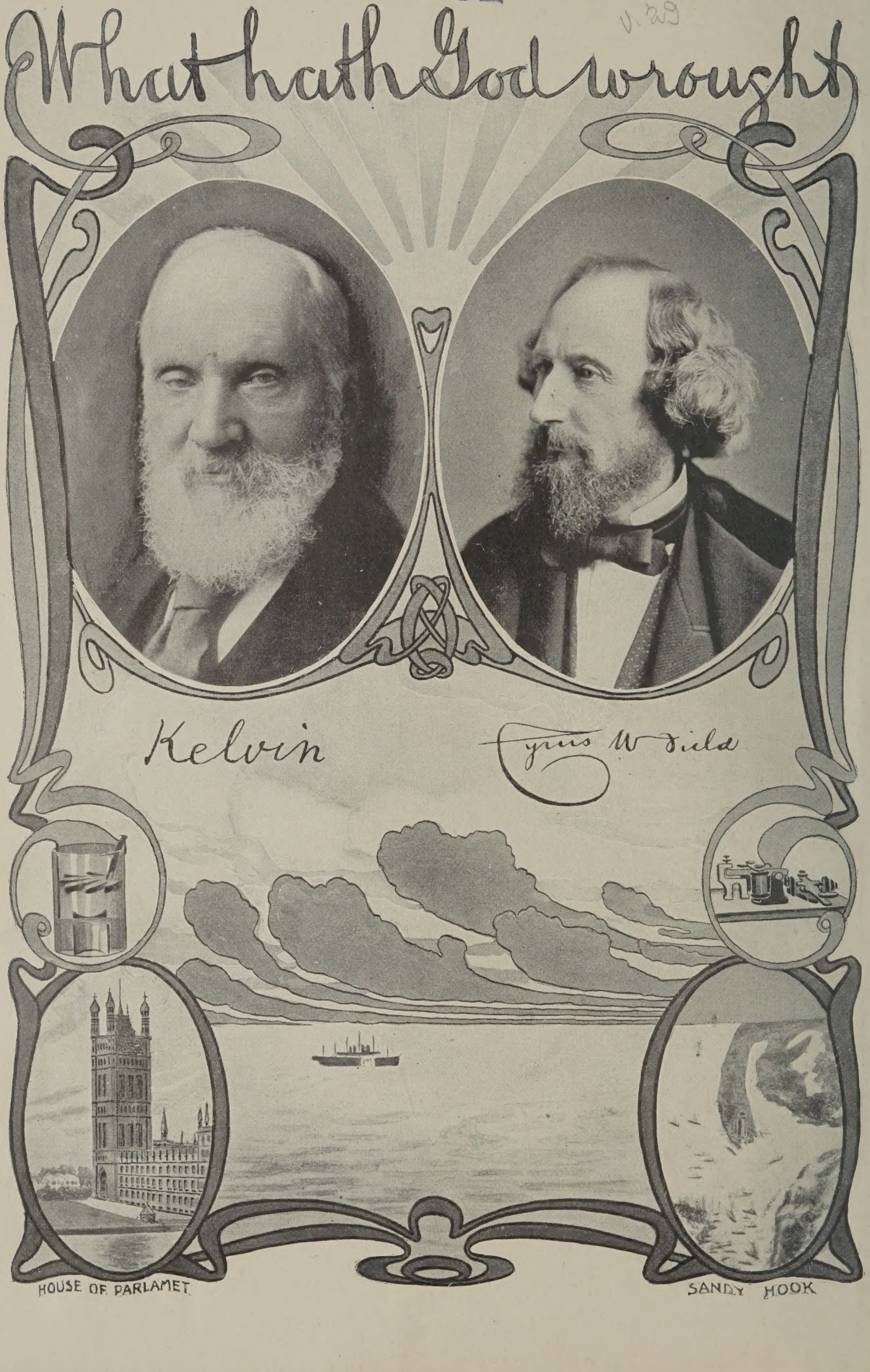

What hath God wrought
Kelvin
Cyrus W Field
HOUSE OF PARLAMET
SANDY HOOK

Jno. S. Wise

Sir William Thompson, Lord Kelvin

By the Hon. Jno. S. Wise

The reappearance in this country of Sir William Thompson, hale and hearty, and vigorous in intellect, is not only a source of gratification to the scientific world, but has started a flood of reminiscences in the minds of people old enough to remember the great electrical events which occurred between 1855 and 1870. Sir William Thompson's vigorous condition is all the more surprising because when this writer was in England nine years ago, engaged in an important electrical controversy, the venerable physicist was reported to be infirm in health and failing in intellect. It would seem, from his recent appearance and utterances, that he has taken a new lease on life. Every one familiar with his eminent contributions to science has rejoiced at the feeling that he is still with us and of us.

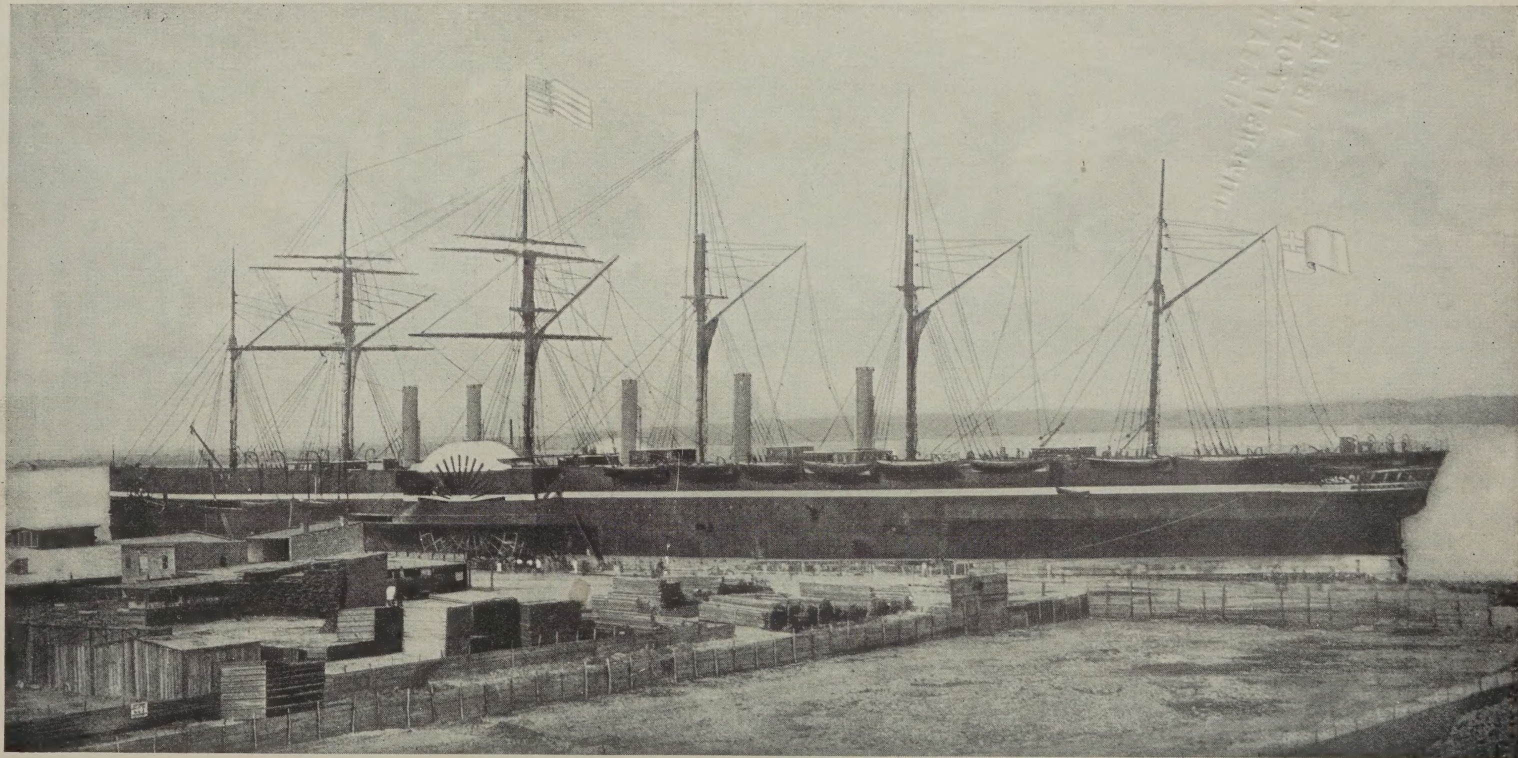
It is indeed hard to realize that this venerable man is the same who figured so largely in the days of Steinheil and Morse, Cyrus W. Field, Matthew F. Maury, and the great coterie of scientific men and financiers, now dead and gone, who stood so prominently in the public eye fifty years ago.

It is forty-five years since the illustrated papers of New York were filled with pictures of the Niagara landing the first trans-Atlantic cable in Valencia Bay, and portraits of the actors and promoters in the great enterprise. A year later, after the first failure, the Atlantic cable became once more the subject of international interest, when the Agamemnon and Niagara met in mid-ocean, each bearing half the cable, and after splicing the two ends together started, the one for Newfoundland, the other for Ireland.

England and America watched every step with intense interest and curiosity. The successive breakings of the cable were reported and excited, on the one hand, deep regret, while on the other hand, the doubting Thomases wagged their heads and repeated the inevitable "I told you so."

After many failures the Niagara landed her end of the cable in Trinity Bay, Newfoundland, August 4, 1858, and the Agamemnon landed the Irish end of the cable August 5, upon Valencia Island. Both nations celebrated the event with great rejoicing; Queen Victoria wired her congratulations to President Buchanan August 16th, and he replied. The daily press and illustrated papers chronicled every detail of the great event; the pulpits resounded with the lessons taught by this girdling of the globe, and many poems, mostly very bad, burst forth. In September public services were held in Trinity church, and a great ovation was given to Mr. Cyrus W. Field, the hero of the hour, at the Crystal Palace.

Sir William Thompson supervised the laying of the cable, furnished the delicate mechanism which made it possible to read the messages, and shared the honors with Mr. Field. In the midst of



Half-tone plate reproduced from an old photo-lithograph from nature by A. A Turner.

GREAT EASTERN,
AT HER PIER, NEW YORK.
J. V. HALL, Commander

Length, 680 ft.	Breadth, 83 ft.	Depth, 58 ft.	Tonnage, 19,000.	J. S. Russell, Builder.	I. K. Brunel, Engineer.	R. Stevenson, Consulting Engineer

these rejoicings something snapped, and the great Atlantic cable ceased to work.

We all know that nothing succeeds like success. We equally well know that no failure is counted a success. Mr. Field, for the time being, was regarded by the great public as a bursted bubble; Sir William Thompson as a dreamer; the Atlantic cable as a demonstrated failure. Cynics even went so far as to hint that the whole thing was a hoax perpetrated by its promoters for purposes of speculation.

The writer was then a boy of twelve. Somebody gave my father a section of that Atlantic cable, and it was treasured as a curiosity. Then came our great American war, when the effort to bind our nation together with hooks of steel supplanted any thought of uniting it with England by cables. Not one man in a million was thinking of Atlantic cables, but Cyrus W. Field toiled on. It was idle to expect American assistance at that time, so he turned his attention to England, and in 1864 succeeded in interesting with him Sir Thomas, afterwards Lord Brassey, and others, in conjunction with whom he raised the necessary capital, formed a company and undertook to manufacture and lay a new cable.

Profiting by experiments in the Mediterranean and Red Seas, the new company manufactured a much heavier cable, and the ship for its purposes was at hand. It was the leviathan *Great Eastern*. What American boy, who lived in the fifties, can fail to remember the *Great Eastern?* Forty-two years ago she anchored in Hampton Roads, the marvel of the seas. Beside her the coastwise steamers and even the trans-Atlantic vessels looked like playthings; the topmasts of the pungies and sloops and schooners that swarmed about her rose little above her bulwarks. Her coming and her going were the great maritime events of the day; yet, while she did mark a distinct era in naval architecture, she herself proved a most unprofitable investment for her builders. We need not enter into the details of that. Suffice it to say that in 1865 she was purchased and fitted out for the next attempt to lay the Atlantic cable. In her immense hull 2,300 miles of cable were stored, and her decks were fitted with the paying-out gear. Distinguished sailors, all of whom were afterwards knighted for their service, commanded and navigated her, and Professor William Thompson was one of the electricians representing the Atlantic Telegraph Company. The press was represented by the great newspaper correspondent Russell, the ship's crew numbered 500, and her cargo, in its number and variety, resembled that of Noah's Ark. She started on her voyage July 23, 1865. On July 31 the cable snapped, when she had paid out nearly 1,100 miles, and the *Great Eastern* steamed back to England to record another failure.

Cyrus W. Field issued another prospectus, formed another company with a capital of £600,000, and the *Great Eastern* on July 7, 1866, once more started from Valencia to lay the cable. Professor Thompson was on board. The vessel started on Friday, and on Friday, July 27, entered Trinity Bay, Newfoundland, and at 9 o'clock the following day received a message from England, announcing that the treaty of peace had been signed between Prussia and Austria. The next day the shore-end was landed, and the old congratulations were renewed, and from that time until this we have had an Atlantic cable. August 9 the *Great Eastern* put to sea again to grapple the lost cable of 1865, and with her change of luck succeeded in finding it in 2,000 fathoms of water, hooked and raised it to the surface; spliced it to the fresh cable in her hold and completed it to Heart's Content, Newfoundland, by September 7.

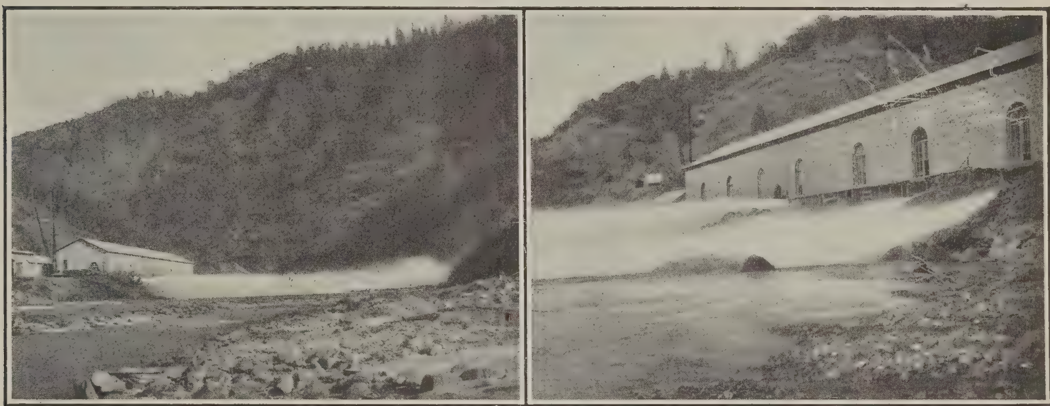
For his services in connection with this cable, Sir William Thompson was knighted. He it was who invented the mirror instrument and siphon-recorder used in connection with these cables. They are marvels of ingenuity as well as efficiency, and were devised as substitutes for old mechanisms, which were found utterly inefficient for use upon a cable of that length subjected to the peculiar inductive influences of the sea. It is no part of this article to describe them, even if the writer felt competent to do so. They are but two of many such inventions which have made this man illustrious. It is not saying too much of him to declare that he has done more for the mariner; more for the submarine telegraph; more, in fact, in the whole field of electrical science than any other man who ever lived. To-day he stands alone, not only alone in eminence, but alone as the sole survivor of all the great and active men who were associated with him in this greatest of enterprises. The hearts that beat, the brains that throbbed about him in the days of his activity are at rest. Even the ship that bore his greatest enterprise has been broken up and distributed. The queen that knighted him has passed away after the longest reign of any English sovereign. Other men, other manners, other methods have sprung up about him. He still is spared to us, and not the least of the marvels connected with his name is that he adapts himself to changed conditions, still labors, abandons old mistakes, sees the merits of advanced science, utilizes the discoveries of the present, and lives in the to-day without wasting or sacrificing it to the memories of yesterday.

California's Power Transmission Lines

By Arthur Stanley Riggs

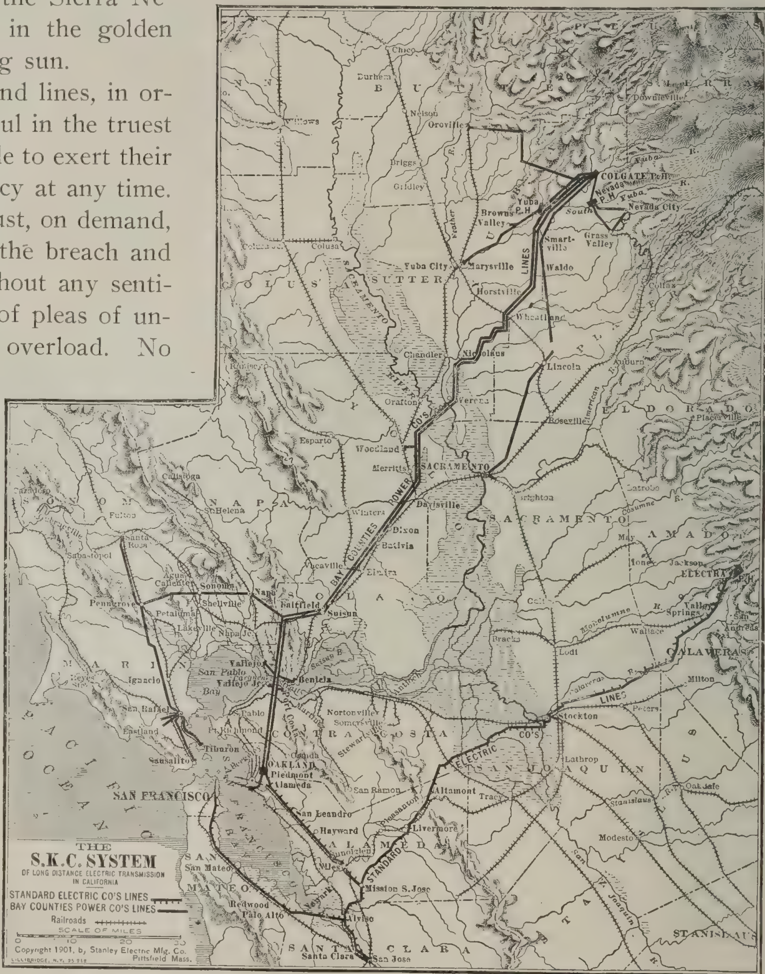
Out in the dim and storied hills of the cold, grey Sierras, the mountains that no man can know thoroughly, and where the screech of the eagle rings through the misty passes and chasms, lies one of the greatest results achieved by modern engineering skill. When California was created, presumably last and most beautiful of our states, she was granted a mildly beneficent climate and dashing mountain streams to make up for her other deficiencies. When the middle states, with their subterranean riches of coal, came into being and took shape, the utilitarian balance was well preserved. But though the middle states are passing rich underground, they are not ideal homes, and long after the anthracite and bituminous riches of such communities have been mined to the last pennyworth, California will still be in the heyday of her perpetual youth.

The history of the state has been, and is still remarkable, and from an historical standpoint, the frontier of a nation is its most vulnerable point, the one which calls out to the full all the daring, skill and true courage of the pioneer. To him came by circumstance and stern necessity deeds and accomplishments impossible, and frequently well-nigh incredible, to the city colonial. It is primarily to the surveys of Captains Lewis and Clark, in the Oregon-California region, in 1805-1806, that we owe the state of to-day, with its marvelous power-transmission lines, the longest in existence. After the Lewis and Clark expedition, came the no less famous Fremont, and after him was Hayden. And these three incursions into the hither unknown wilderness, opened up the entire mountain system and slope of the Pacific coast.



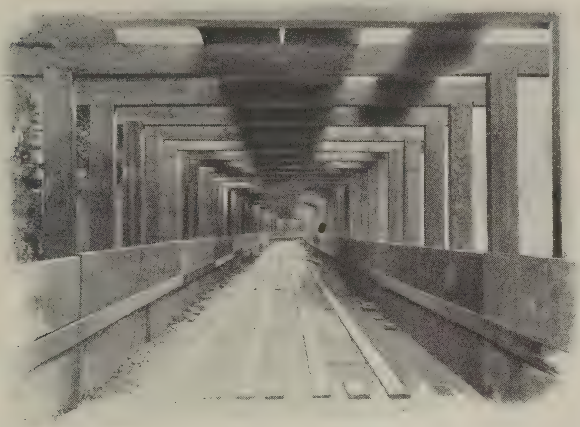
Outflow at Light Load. The Stream Sometimes Shoots Across the Cañon; It Does Not Strike the Buckets and Is Uncontrolled.

So rapidly are we using up our stock of coal and similar fuels, that an authority on the fuel supply, with particular reference to the supply for vast industrial undertakings, recently prophesied its failure within the next hundred and fifty years, perhaps sooner. A century and a half perhaps seem a long time, too long a time, and too far ahead to cause us any great amount of worry, for by that time surely we will be gone. But the nation will continue, and when there is no more underground fuel waiting the drill and the shovel of the digger—what then? Other power will be needed, and it seems as if the successful solution of the problem has been reached in the construction and operation of the great generating stations and transmission lines out on the western slope of the Sierra Nevada mountains, in the golden land of the setting sun.



Map of the Standard Electric and Bay Counties Power Companies' Lines

Power plants and lines, in order to be successful in the truest sense, must be able to exert their maximum efficiency at any time. Such a system must, on demand, throw itself into the breach and do the work, without any sentimental nonsense of pleas of unpreparedness or overload. No answers of "line is busy now" are accepted. The peak of the load comes—and the current does the rest, no matter how hard the load pushes. A marked tang of romance and "derringdo" has ever characterized the Golden State, and the twentieth century achievement of installing what were otherwise merely prosaic and uninteresting sets of generating apparatus, turbines, flumes, pole-lines, and wires, thus becomes a mystic matter of the keenest interest, because of its associations and the memories it recalls. It was also of more than the ordinary interest because of the fact that California saw the first intelligent effort made to illuminate a large city on a comprehensive plan by a public lighting company. This was in San Francisco. Later on, in the same city, a ten thousand volt constant current motor circuit was installed, and also a transmission system, which was put into service in the nearby mines. The system was, of course, unsuccessful, but its failure was due to faulty design and manufacture. That the problem the electrical pioneers attempted to solve prohibited failure by the very largeness and importance of its nature, is best shown by the fact that to-day, with perfected apparatus and fuller facilities, two transmission lines are now working over distances hitherto considered insuperable. Later attempts than the one just mentioned met with better success; a long distance, single-phase line was installed in Bodie, and an alternate current lighting plant at Pomona. Redlands had the first successful working plant of the multiphase type, and it is perhaps largely to the irrigation experiment that the present progressive stage of the business is to be credited.



The Colgate Flume. Grade 9 feet per Mile. Interior Dimensions: 8 ft. 6 in. by 6 ft.

Until within a very short time the limitations to the possibilities of California power-transmission lines were practically prohibitive, for there seemed to be small use for the current, except in the mines within the radius prophesied by Dr. Louis Duncan, in 1896, before the American Institute of Electrical Engineers, when in delivering his presidential address on inauguration, he said: "If we consider the records of the present transmission plants, we can safely say that it would not be going out of the safe limit of development to transmit at least fifty miles at a potential of twenty thousand volts." But what a difference to-day! The limitations of six years ago have vanished into thin air. Cost and loss which then were considered too great to make it possible, to say nothing of practical, to send current to great distances, have been worked out in so satisfactory a manner that the present radius of regular every day commercial transmission has increased to two hundred and twenty miles.

When the plant at Niagara was opened, a circle with a fifty-mile radius did not mean much to Buffalo, but now the radius has been more than quadrupled in California, and the pressure tripled, the present potential being 60,000 volts. Though Niagara could undoubtedly transmit as far as the western lines, the local conditions are strikingly different, and the larger portion of her energy is utilized at her own doors, while there seems to be a steadily growing tendency

Lake Francis Dam. Dirt Filling Is Washed into the Dam by a Pipe on Falsework Above.

toward the upbuilding of a great and powerful manufacturing city at the wonderful falls. It is an interesting and indeterminate question whether Buffalo will absorb Niagara or Niagara Buffalo.

Leaning Tower of the Carquinez Span.

Several rather notable installations of this general character have been put in operation at scattered points along the Pacific slope within the last few years, notable among them being the one at the beautiful Snoqualmie Falls, high in the picturesque and rocky fastnesses of the Cascade mountains. The little town subjacent to the power station, with its bright lights and varied life, the whole set in the shimmering, glittering framework of the noisy river, makes a brave show, but something seems lacking. On the very bottom of the rock over which the Snoqualmie river tumbles, two hundred feet below the surface, rest the six 1,500-kilowatt generators in a roomy, whitewashed cave blasted out of the solid mountain side. This machine-room is reached by an elevator. The reasons for this seemingly freakish location are very simple, when understood. The spray from the falls made a station at their foot impossible, and to go further down the stream would have required a location where a costly canal would have been a necessity. So the cavern was hollowed out of the solid rock as being the least expensive and most satisfactory, and there, where the sunlight has never penetrated, work the machines which have helped make the state notable in the annals of electrical engineering.

It will be remembered by those who followed the matter in the beginning, that the Snoqualmie system claims to have been the first to employ aluminum wires for transmission purposes. This claim is disputed by the Standard Electric Company, for though the lines were built at the same time, the latter organization's were first in actual use. In his description of the Snoqualmie plant Dr. F. A. C. Perrine said in his recent lecture before the New York Electrical Society: "Power is transmitted at sixty cycles to the cities

Redwood City Substation and River Crossing.

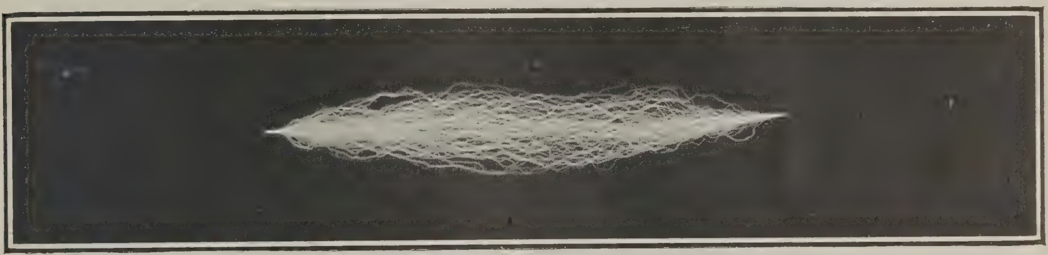
of Tacoma and Seattle, where lights and railways are operated. In Seattle rotary transformers are used for the conversion, but in Tacoma motor-generator sets are employed, and regulation obtained by a combination of synchronous and induction motors. Much of the complaint and criticism of this plant seems to have been due to the apparent fact that there is little harmony between the seller and the largest users of power, and both the large companies at Seattle and at Tacoma are at present installing some steam in spite of the fact that at no other point on the coast is power sold at a lower rate, and that the difficulties with regulation and general service from the plant are largely chargeable to the attitude of the users of the power themselves.

"As regards the plant itself, one feels compelled to admire the boldness and audacity of the scheme.

"Of course, as one descends on the elevator into the cavern below the falls, the fear of something new and untried overcomes him, and the strangeness of the plan warps his judgment, but let me assure you that there is much more to admire and much less to criticise about this remarkable plant than is commonly assumed by those who have not seen it.

"The original transformer equipment consists of banks of small units, and in spite of the complexity of the system as a whole, the original equipment is still in service. Indeed, it is remarkable and interesting to hear the engineer whose days have been made full and whose nights have been made sleepless by this complex plant, declare that from his experience the best plant is one of independent generators and motors, and to hear him speak of machines with high inductance and almost no regulation to mention, as being in all respects the best adapted to continuous service, while to one familiar with more modern plants there is nothing so remarkable about the installation as the energy of this man who keeps it all running and giving satisfactory service.

"As we move southward into California, the power plants begin to multiply, and connected with every one is something, generally, much of interest. Many have historical importance, though most have long ceased to attract particular attention. The traveler in the mountains finds, far away from any appearance of civilization, a well-kept canal, or ditch, as these pioneer engineers would call it, and following it for a few miles, a low, constant, not unmusical note reaches his ear, and he knows that beneath his feet along the river bank lies one of those power plants, ceaselessly generating current to be used in the neighboring mines or the distant cities. Throughout the centre of the state a constant type of plant prevails, and it will be of more interest to confine our attention to two most



A 120,000-Volt Arc Between Needle-Points of the Spark-Gap in Testing-Room at Electra.

A Bird's-eye View of Colgate All Supplies Come Over the Winding Road at Left.

remarkable recent plants than to attempt to mention the many. The type of plant to which we refer is that of one supplied with water in a ditch varying from five to fifty miles in length, producing, by its combination with the rapids along the river, a head of from 300 to 1,500 feet, which is utilized with impulse wheels running at a high speed and direct connected to generators. These feed step-up transformers and the high-voltage current is transmitted for use over distances of from five to 200 miles and more."

The two companies in California, the Bay Counties Power and the Standard Electric, are allied and they have several sources of energy to draw on, but of all the plants now in operation the one at Colgate is the one with which we are most intimately concerned, in that its development has been the most notable on account of the great difficulties encountered in its construction and the long range of its current-supplying network of transmission lines.

The Colgate installation is situated on the northern bank of the North Yuba river, at the spot where the historic old Missouri trail crosses it. Something over seven miles up stream the water is impounded and let from dam to power-house in a wooden flume which is watched day and night by a corps of lynx-eyed inspectors, much in the same way that railroad companies look after the conditions of their respective road-beds and bridges. Eight million feet of the soundest possible red spruce, pine, and cedar were required to build this flume, the timber being hauled up a tramway nearly a mile in length—1,275 feet, to be exact. This tramway was built especially for the purpose, and ascends the long hill in a startling manner. The flume has the enormous delivering capacity of rather more than 23,000 cubic feet per minute, pouring the water into the large reservoir on the top of the hill, at the foot of which the power-house is located, more than 700 feet below. It will be seen, therefore, that the water has a tremendous head on it when it finally crashes into the turbines, almost four times as far below the water level as the

An Angle in One of the High Tension Lines.

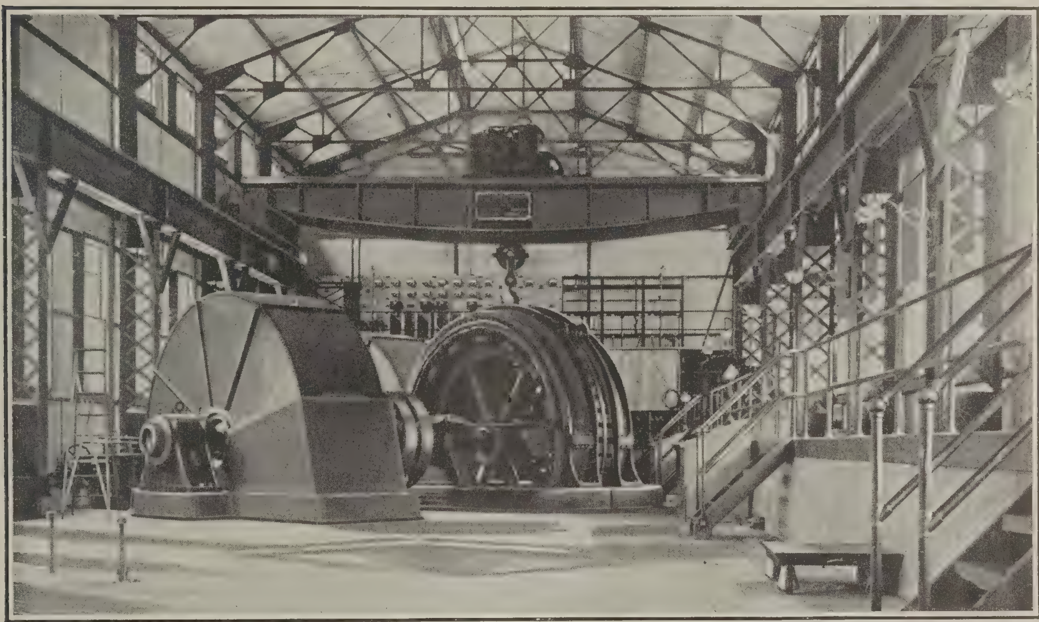
Niagara turbines. The whole secret of the success of this and of similar plants like the one at San Joaquin (which has a 1,400-foot head), lies in the thoroughly Californian practice of using a comparatively small stream of water with great head, and thereby getting fully as much power out of it as from a larger stream with a small head.

The power-house, built to permit of enlargements as required, contains seven units in all, with an aggregate of 15,000 horsepower in 3,000 h. p. generators and four of 1,500 h. p. each. Perhaps the most noticeable of the machines, because of their being of the latest design, are the great Stanley generators, which are of the three-phase type. Long experiment has proven the greater utility of the alternating over the direct current, and, therefore, all the long distance transmission lines are equipped with polyphase alternating current machines, the high potential enabling the current to be sent to great distances with comparatively trifling loss. The direct current, at low pressure, is used mainly for city service and local distribution, as it is safer and easier to handle than the high pressure alternating.

After leaving the generators in the Colgate power-house at 2,400 volts the current goes through the step-up transformers and comes out with a two per cent. loss at a potential of from forty to sixty thousand volts, and occasionally, during very bad weather, at even 80,000. It is stepped down again, on reaching its destination, to the potential required for the local service, which varies all the way from 110 to 5 volts.

The 120,000-Volt Arc Just Before Rupturing.

Losses are an important feature of any transmission system, and one on which the efficiency of the line very largely depends. Working a line with such tremendous pressures as are here employed the losses are comparatively insignificant. In other words, 1,000 actual horsepower sent from the power-house at Colgate two hundred and twenty miles, to San Francisco, should and really does lose only about one hundred and fifty horse-power in transmission, netting seven hundred and fifty horsepower at the receiving station. Mr. T. Commerford Martin estimates the losses in current as follows: In the generators, six per cent.; step-up transformers, two; regulation and line losses, fifteen; and two per cent. again in the step-down transformers, thus making a total of about twenty-five per cent. Further interesting statistics appear in the report of the company, as is shown by the following financial table:



Interior of Electra Station. Machines Placed Diagonally to Lessen Angle in Pipes Bringing Water at 1,500 foot Head.

1901	Gross Receipts	Expenses	Net Profits.
April..........	$13,913.21	$4.466.35	$ 9,446.00
May..........	16.195.76	4,590.86	11,604.90
June..........	18,219.78	4,217.11	14,002.67
July	20.903.46	6,674.15	14,229.31
August	24,185.70	6,033.51	18,152.19
September.....	25,463.52	6,864,59	18,598.93

Other figures show that the cost of the completed property of the Bay Counties Power Company was considerably greater than was expected at first, but as the demand for power, and the consequently increased earnings of the concern were also in excess of the estimates, the company was satisfied with the showing made. In October, 1901, the assets of the company were $56,339,442.04. First and second mortgage bonds have been issued, and on these the interest amounts to $9,375 per month for the first, and $3,750 per month for the second. While considering the purely financial aspect of the company, it is of interest to note that the company has contracts for supplying additional customers with the power, the value of these contracts being about $15,000 per month. With a net cost for operating expense and maintenance of approximately $9,000 a month it is evident that the company's gross earning capacity of $50,000 a month, which should very shortly be fully taken up, will make the proposition a handsome dividend-payer.

In a development of this character it is almost impossible to get at exactly the cost per horsepower of plant installed, and it may be said that so far as the hydraulic and electric installation is concerned, no accurate estimate of the cost can be given for the total

A Mountain Mule Provision Train out on the Plains

At Left a Transformer being Loaded into Mountain-Wagon ; Cut at Right Shows Outfit Starting.

horsepower, including land, water-rights, buildings, machines and accessories complete for operation. The pole-lines, because of some of the very expensive engineering features connected therewith, can be roughly estimated at approximately $20,000 per mile. Such data as can be given regarding the Colgate line shows that the wire used varies from three-quarter-inch diameter down to number one B. & S. The line loss between extreme points of production averages about 12 per cent, i. e., C^2R loss.

No accurate statement regarding the division of power between the consumers is available on account of the number of kinds carried by the company, and the various undertakings in which the consumers are engaged.

Returning again to the mechanical features, it may be said that the construction of the Colgate plant and the founding of the Bay Counties Power Company was an achievement rather than a growth. About thirty years ago the Blue Lakes Water Company was founded to furnish water power to the mines in Amador county, and a ditch system over eighty miles long was constructed. By degrees the value of the property fell away and only a small profit was received from it as hydraulic mining declined in that vicinity. Then came Prince Andre Poniatowski, the real father of this great baby, and took up both the profitable and unprofitable mining concerns and built an electric plant on the Mokelumne river, distributing power to his new mines and thereby cheapening the cost of operation. As the values of his enterprises in California extended themselves, he in turn extended the electrical lines, and the present advanced state of transmission is largely due to his efforts.

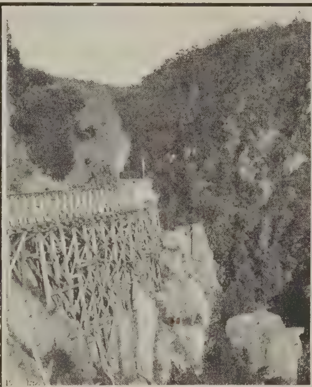
The flume which conveys the water to the power-house has a watershed five hundred and thirty-two miles in area to draw from, and is seven feet wide and six feet deep for a large part of its length. From the flume itself the water drops from the power-house through five separate steel and iron pipes thirty inches in diameter, and after passing through the gate-valves impinges upon the turbine wheels, which are driven at high speed and direct-connected to the generators. Perhaps the most spectacular part of the plant, to say nothing of the one involving the most difficult engineering feat, is the famous Carquinez span where the cables cross the Carquinez Strait two hundred feet above the water. This span is four thousand four hundred and eighty feet in length, or about three times the length of the Brooklyn Bridge, and the steel towers which carry the shore-ends of the cable are not only wonderful when viewed from the engineering standpoint but are also beautiful pieces of lattice work. The cables themselves are four in number and are made of stranded plow steel.

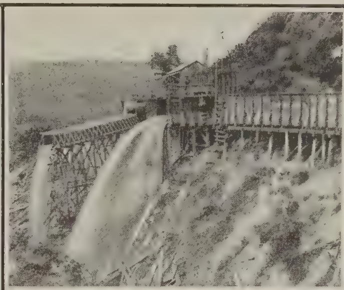
Insulators of the Locke type are used on the poles. The company experimented for some time to try just what effect rain would have upon them. The result of the experiments was that the insulators permitted the water to run off

Overhead Cableway Across Yuba River.

the top in a steady stream at no voltage, while at a pressure of 40,000 volts the water was so electrified as to be sprayed off at an angle of about ten degrees. One of the transmission lines is built of alumi-

Flume Tender's Cabin on the Colgate Flume





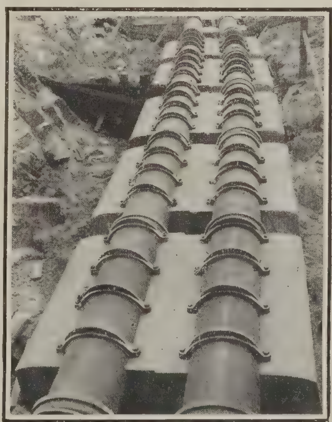
Spillway or Overflow Drain from the Colgate Flume

Central Picture Shows Point on Colgate Flume Known as Cape Horn.

num and measures barely one-quarter of an inch in diameter, having a total length of sixty-one miles, running from the power-house at 40,000 volts, and another line similar to it goes in a northwesterly direction for thirty miles to Oroville, where power is delivered to two sub-stations, which in turn supply energy for the gold dredges of the Feather river district.

Passing from the plant at Colgate the ones at Electra and other points may be described in very similar terms, but of them all the Colgate plant is the most important, both on account of the difficulty of its construction and the great amount of power it supplies. As has been seen, Colgate is the largest distributing center, and from it the wires branch out like the tentacles of an octopus in all directions all the way from the power-house to Stockton, 218 miles distant, San Jose and Red Wood City, respectively, 198 and 200 miles distant.

Considering what has been done by the labor of the engineers and financiers who backed them, to put the plant into successful execution, it is but meagre credit to mention their names in connection with the great work they carried to such a successful conclusion. Beside Prince Andre Poniatowski, Messrs. John Martin, W. R. Eckhart, R. H. Sterling, C. O. Poole, and J. F. Kelley are deserving of all the credit that can possibly accrue to men of nerve, brain and consummate skill.



Concrete Anchorage Piers for the Water Pipes.

Processes of Combustion

BY PAUL J. SCHLICHT

Processes of combustion may be divided roughly into three general classes, viz:

Those in which atmospheric air is supplied to the fuel, cold;

Those in which there is an auxiliary supply of hot air:

Those in which all the air for combustion is furnished hot.

Cold air processes may be divided into those in which the air is supplied

(a) Upward through the grate-bars and the fuel;

(b) Downward through the fuel resting on hollow grate-bars, which contain water connected with the boiler;

(c) Mixed with pulverized coal and injected into a furnace which is without grate-bars;

(d) Mixed with oil-vapor and steam, or finely divided particles of oil and steam;

(e) Mixed with a gas.

Auxiliary hot air processes may be divided into those in which the air is supplied to the fuel;

(a) Heated by contact with hot surfaces of brick or metal, heated within the sphere of useful work;

(b) By contact with metal or brick surfaces outside the sphere of useful work;

(c) By contact with the products of combustion themselves, in which the air moves in an opposite direction to the movement of such products in the same channel.

Cold air supplied upward through the grate-bars and fuel, has the disadvantage, with ordinary hand-stoking, of permitting a large excess of cold air to pass through the bed of fuel, lowering the temperature of the furnace, cooling the heating surfaces of the boiler, and reducing the chimney temperatures. The writer has known instances where such low temperatures as 375° to 400° Fahr. have been pointed out by engineers of high standing as evidences of great efficiency, the engineers entirely overlooking the fact that one hundred to two hundred per cent excess of air had anything to do with the matter. In fact, the writer had this cited by an eminent engineer superintendent of a plant having fifty-two boilers with an enormous chimney, as an indication of economy, although the refuse with George's Creek coal was more than twelve per cent.

As George's Creek coal does not average more than about four per cent of ash, the item of ash refuse tells the story of excessive air supply producing this result. Tests afterwards made showed that he was losing at least fifteen per cent by such excess.

The supply of excess quantities of air upward through the bed of fuel, permits the escape of free hydrogen, which exists in all fuels. When a mechanical-stoker is used and a thin bed of fuel is carried on the grate, similar but not quite such pronounced results are obtained, besides which there is a reduction of the capacity of the boiler.

When cold air is fed downward through the bed of fuel resting on a water-grate, and passing over a thin bed of fuel, on a second grate below it, although the capacity of the boiler is increased and smoke prevented, the excessive heat from the open feed-door into the boiler-room, and the impracticability of cleaning the tubes of the water-grate makes this system in practice fall short of what is claimed for it. In Rochester, where this system has been very extensively adopted in many large plants, the owners and engineers stated that they were compelled to abandon it and go back to the old system because the firemen refused to work as many hours where it was in use as in plants having the old system. Many accidents have also occurred from explosions of water-grates.

When cold air and pulverized fuel are blown into a boiler-furnace without grate-bars, results have been produced experimentally that give promise of excellent practical results. Much of the waste, no doubt, is occasioned by the fact that the air is cold. By introducing air into the chimney and injecting the pulverized fuel alone into the combustion chamber, some excellent results have been obtained. The pulverization of the fuel and its economical burning in the combustion chamber, would seem an excellent substitute for the complicated and rather expensive mechanical-stokers. The principal difficulty with pulverized fuel processes, according to the writer's understanding, has been the escape of a large proportion of the pulverized coal, which is carried out of the chimney by the force of the draught. The retarding effect upon the outflow of combustion-products produced by the introduction of a supply of air for combustion into the chimney, in contact with uprising products as well as the heating thereby of such air by waste products, would seem to be a step in the right direction.

While the mechanical-stoker has been successfully applied, and has considerable economic significance in large boiler-plants with an ample boiler capacity, because of the saving of labor thereby effected, a diminution in the demand for it is certain to result from the recent developments in the Texas oil-fields, which bid fair to make this oil a powerful rival of coal in large plants. But it has not yet been proven in the East that oil can be successfully used in competition with coal in plants where one stoker is able to look after several boilers. Even though three and a half barrels of oil are equal to one ton of buckwheat coal, there is not as yet any reason to believe that the adoption of oil as a fuel is likely to be general except in the territory adjacent to the oil fields. That it is bound to revolutionize methods of producing power, and that inventors should take up the problem of converting this valuable fuel more economically, is now very plain. Authorities are agreed that the vaporization and mixing of oil with steam is not so effective a system as that which first converts the oil into a gas. The fact that William M. Barr, one of the best American authorities on combustion, is convinced of this, has led the writer to the belief that, notwithstanding some other evidence which is far from convincing, furnished by a recent evaporative test made in New York by Professor Denton, with Beaumont oil, it will only be a short time before the industrial importance of oil as a fuel is realized in large plants.

The production and burning of producer gas in steam-boiler furnaces, has not recently received much attention in this country, but it should be an entirely feasible plan of utilizing fuels of poor quality. Having such abundance of coal in the United States, the necessity the engineer in Europe has found to provide means for the utilization of such fuels, does not exist here, but the time is coming when this subject also will be one to interest the fertile brains of our engineers and inventors.

The first of the auxiliary air-processes of any importance, was invented by the eminent Charles Wye Williams. Mr. Williams, in his well-known work on the "Combustion of Coal and the Prevention of Smoke," strenuously objects to the use of hot air, stating that advantages are secured by the use of cold air supplied through small apertures. The fact is, that the feeding of cold air at the bridge-wall, continuously, is a disadvantage rather than an advantage. Subsequent inventors produced boiler-settings in which the air was heated in pipes or channels in the brickwork of the furnace, and furnished over the fire at the bridge-wall. This system made it possible to burn the smaller sizes of anthracite coal in this country, and greatly reduced the volume of black smoke from soft coals. But this class of apparatus deteriorated very rapidly, and is no longer in favor.

Admission of air through the feed-door to the top of the bed of fuel does not produce uniformly beneficial results, as whatever gains are made are offset by the losses due to the admission of cold air into the combustion-chamber when not required. The foregoing references are wholly to the supplying of air within the sphere of useful work, the heat being abstracted from the walls, sides or front of the combustion-chamber itself, and not from the combustion gases after they have done useful work.

Referring now to the processes of combustion, in which air is preheated, outside the sphere of useful work, there are three that deserve attention because of their demonstrated efficiency. Perhaps the most extensive experiments that have been made in the preheating of air by the waste products of combustion (outside the sphere of useful work) in boiler-furnaces, were those carried on by Hoadley for a manufacturing association, which provided sufficient funds to make experiments as thorough as any ever made, except, perhaps, the experiments made by the writer and his associates.

In the experiments of Hoadley, the apparatus used was a series of pipes about two inches in diameter, with extensive heating surfaces, between and around which the products of combustion were made to flow, the air being forced first through the pipes by a blower and then under the grate and through the bed of fuel. While the tests all demonstrated that a higher evaporation could be secured with this system, the necessity for frequently cleaning and scraping the surface of the tubes, the original cost of the apparatus, deterioration, etc., offset the economy, and as a consequence the system was never adopted. A similar method, known as the Howden hot-blast system, is much used for marine-boilers, and the special advantage claimed for it is that it permits of the burning of low grade fuel.

In the writer's combustion-process, the discovery that if a current of air is properly started in a chimney or flue, the air will flow down to the place of combustion in actual contact with but in an opposite direction to the products of combustion escaping therefrom, is utilized. In September, 1898, the writer read a paper before the Franklin Institute describing the large number of experiments he had made. This paper was published in the Journal of the Institute for March of 1899, and was reprinted by many of the technical publications interested in the subject. In the opinion of many it constituted an important addition to our knowledge of the physics of combustion, while some seriously questioned the correctness of the observations made of the phenomena described. Recently, however, these claims have been verified by the late Henry Morton, until his death president of the Stevens Institute of Technology; Frederick R. Hutton, professor of mechanical engineering, Columbia University, and secretary of the American Society of Mechanical Engineers; Arthur L. Rice, Professor Hutton's assistant, and George H. Benjamin, for many years engineer to the late Sir William Siemens, who is regarded as a very high authority on heating. The writer is informed that in Europe Sir Frederick Siemens and Professors Reulleau and Moissan have also confirmed his claims that important economical results should be obtained by a proper application of the system.

The current theory of draught seems incomplete in view of the phenomena observable when this combustion-process is carried out. The writer's purpose in referring to this new process of combustion, is that the application of the principle to new plants should bring about modifications in chimney and flue-construction, and that the chimney can be made to perform the double function of carrying off products of combustion, and also of preheating the feed-air introduced into the chimney or flue. Short stacks equipped with means of heating air therein through contact with the products of combustion, should produce such a high degree of efficiency that the tall, expensive stack would soon fall into disfavor. Already such short stacks are being used in connection with a Green fuel-economizer, which utilizes a part of the waste heat driven up the stack by a blower. The expense of the blower and economizer could, it seems, be saved and a higher evaporation secured by the use of the writer's system, which is exceedingly simple. A proper air-starting device either at the top of the stack or at a point in the flue far enough from the combustion-chamber to insure a substantial preheating of the air, is the principal requirement. Hundreds of experiments have conclusively demonstrated that this new regenerative process not only gives a higher evaporation, and that low grades of coal may be used successfully, but also that the horse power of boilers may be increased with economy by preserving a greater uniformity in steam pressure. The writer made quite a large number of experiments on locomotives with the new process, obtaining excellent results, and these experiments very forcibly impressed upon him the great economic value of induced draught in rendering efficient the heating surfaces of boilers. These tests led to inquiries as to tests made with stationary boilers, and it was found that at the Crescent Steel Works in Pittsburg, a horse power was produced with only 2.4 square feet of heating surface. It is believed by the writer that with his system he can secure with the stationary boiler the same economy and efficiency that were demonstrated in the locomotive tests.

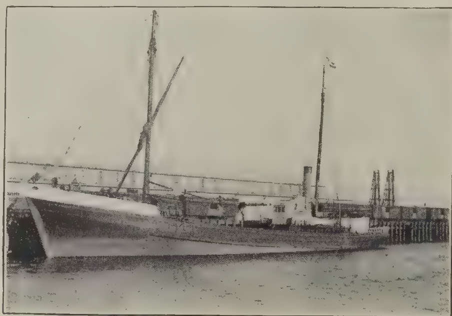
Artificial draught produced with blowers, and induced draught with fans have also been demonstrated to have great utility under certain conditions where small sizes of anthracite coal must be used. The fierce competition of to-day makes it necessary that owners of power-plants take cognizance of all modern improvements confirmed by actual practice. In the space of a magazine article it is not possible to do more than touch upon so large a subject as processes of combustion, and the writer therefore begs indulgence for his seeming discursiveness. At most, such an article can be at the best merely suggestive, and if the writer has succeeded in starting inquiry he will have accomplished as much as could be expected.

Laying the New Alaska Cable

BY GEORGE F. PORTER

Perhaps the best way to start a story of this character is to begin at the beginning, and follow the cable from the factory to the furthermost end of its circuit.

With this in mind, the first detail of interest may be mentioned as the manner in which the cable was shipped. When the writer laid the now famous Nome-St. Michael's cable the wires were wound on the familiar reels and shipped on flat cars. In many respects this proved unsatisfactory; in the first place, this method necessitated making a great many joints, or splices, all of which took time and ran into money heavily. In the present instance, therefore, both to avoid making a great number of joints and to save expense of return freight on the reels, the cable was coiled into box-cars, fifteen miles of cable to a car. A greater length than this was impossible to ship, because the railroads west of Chicago, fearing for their tracks and bridges, refused to haul anything heavier than 80,000-pound cars. Had we been able to obtain transportation for cars weighing 120,000 pounds, the matter would have been simplified considerably, because there would have been fewer joints to make when the cable arrived at Seattle. As the cable weighed about 4,700 pounds to the mile for the main line, and about 12,000 pounds to the mile for the two shore-ends, it will be seen that the 80,000-pound cars carried almost exactly their full capacity.

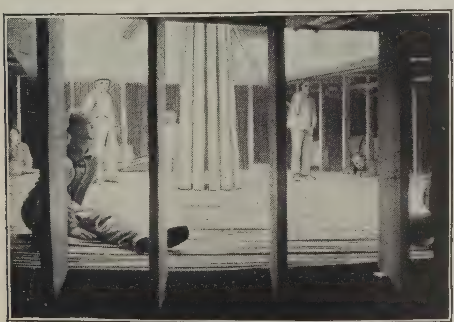


The *Lakme* at the wharf in Seattle.

As there may be some of the readers of the ELECTRICAL AGE who are not familiar with the construction of the Kerite cable, it may be permissible to present a brief idea of it. The main cable itself consisted of seven number twenty-one B. & S. gage, tinned copper wires, insulated with pure Para rubber one-sixty-fourth of an inch thick. On top of the rubber comes the Kerite, thus increasing the diameter to nine thirty-seconds; this in turn is taped with a double lap and sufficient jute bedding to receive sixteen number eleven B. & S. gage steel armor-wires. On top of this protection there were two reverse layers of jute. This, of course, is for the main cable. The shore-ends of the cable are constructed exactly the same, except for an extra outside layer over the jute of eighteen number six B. & S. steel armor-wires. This additional armoring is put on to protect the cable against chafing, due to under-tow, shore-currents, and the scraggly bottoms usually prevalent. In deeper water there is much less friction, and consequently very little actual wear from that source on the armor.

When the cable arrived at Seattle the whole length of it, one hundred and twenty-two miles, was coiled down into the hold of the ship, in the very short space of sixty hours. This was made possible by the way in which the cable was loaded in the cars. In order that there should be no delay, the tail-end of the cable in each car was made fast to the roof, and the main body proper coiled down on the floor of the car. This made it possible, when the cars were opened, to get at both ends at once; accordingly, while one gang was hauling the cable from the cars and coiling it down in the tanks of the steamer *Lakme,* another was busy making a splice between the tail end from that car and the forward end of the cable from the car following. As will be seen, this effected a large money saving. The total time which it took for the cable to come from the factory at Seymour, Conn., to Seattle, was fifteen days. From Seattle to Skagway took five days more by the steamer.

When the contract was first obtained for the cable from the government, no specifications of a detailed character were given. It remained, therefore, for the writer to obtain the best map available from the United States Geodetic Survey; this map gave the soundings along the route from Skagway to Juneau, a distance shown to be about one hundred and ten miles. From the map some idea was gained in the rough of the contour of the ocean-floor—but, oh, such a calculation! The depths given on the map in fathoms ranged from two hundred and fifty, in the vicinity of Skagway, to something less than twenty farther down toward Douglas Island. In figuring the length of cable required, ten per cent was estimated in excess of the calculation.



Interior View of Cable-Tank, S.S. *Lakme.*

We got the *Lakme* away from Seattle in good time, and arrived off Skagway at about three o'clock in the afternoon, five days later. So speedy were the operations that the shore-end of the cable was landed, the connections all made with the local telegraph office, communication opened through the entire cable, and everything was ready by seven o'clock in the evening.

The *Lakme* off Juneau.

We weighed anchor at daybreak. Over the choppy waters of Lynn Canal lay the cold arctic fog, thick and clammy. No other fog in the world so impresses one with its raw density and utter cheerlessness. We persevered, however, and felt our way along, paying out the cable steadily as we went. So uniform was the speed with which the line was paid out, that the observations taken every five miles (the cable was tagged every five miles) showed that the speed did not vary more than sixty seconds between each observation. When the ship had proceeded twelve miles, the writer found to his horror that a full eighteen miles of the cable was gone; that was a trying day. It will be remembered that a ten per cent excess had been figured, and here was a loss of over fifty per cent. We were wondering how long the cable would last; there surely were two hundred and fifty fathoms of water! Perhaps those soundings were made with a two hundred and fifty fathom line, which may and may not have reached the bottom, but which probably did not. Whether the *Lakme* sailed over the crater of an extinct volcano must always remain a mystery, but one thing is certain, the configuration of the ocean floor for those first few miles was as rough and mountainous as could possibly be expected, even in such a volcanic region.

Our troubles were of comparatively short duration, however, for at the twenty-fifth mile we were taking up slack and gaining on the loss. Shelter Island was reached at eight o'clock in the evening, the water having shoaled rapidly until, when we reached our anchorage, there were found only seventeen fathoms.

Next morning the fog lifted some and we crept off cautiously down the west coast of Douglas Island, and turning to the southeast, made our way into Juneau, anchoring three miles off the town at about half past two in the afternoon. Here the shore-end of the cable was spliced on, after which we got up the anchor and steamed in until we lay just off the junction-box, which was about a half mile outside the town. Next morning the shore-end was landed, the tests made and everything found to be in excellent working order. All this was done between five and ten in the morning. When it was all over we found that there were 1,843 feet of cable to spare, 121.6 miles having been laid. The actual time spent in laying this cable was twenty-two hours.

Hauling Cable out of the Cars and Coiling Down into the *Lakme's* Tank.

Splicing the Cables in Car-Lengths of 15 Miles Each on the Seattle Wharf

Although in many respects the laying of this cable was not so difficult as that of the former one, it had features about it that were unique. Experience is a very good teacher, and what we learned in handling the St. Michael's cable, saved money, brain-fag, and time in the present instance. An idea of the attention given to details may be gathered from the statement that the sheave on the end of the boom from which the cable was paid out made 440,000 turns.

As this Skagway-Juneau cable is the longest in the Alaskan waters, and in view of the fact that the wide difference in depth between what we actually found and what was indicated on the government chart, the feat of laying it successfully and in so short a time may, we believe, be considered without parallel in the records of cable-laying, particularly when it is remembered that the work was done in Arctic waters, in a ship which we had practically to rebuild entire internally, by taking out her stanchions, building in a tank, a bridge on deck for the reel, and other laying apparatus.

Passenger Traffic and the Automobile

By Charles R. Flint

Little, if any, apprehension is felt in street railway circles in regard to the cost and possibility of handling heavy street traffic by automobile conveyances, no matter what the power employed may be. Many of our most successful men of affairs think that the day is not far distant when a thoroughly practical vehicle can take care of traffic of this nature on the city streets, but in view of the great difficulties in the way, this theory seems at present hardly tenable. In order to make an automobile service of this nature really a practical commercial success, it must be made to compete, in the matter of cost, with the horse-drawn vehicle. Stated in brief form, the chief obstacles to such competition seem to be: Heavy weight per passenger; vehicles not easily dirigible; increased requirements of operator; impossibility of using soft tires economically; pavement-limitations; extremely high cost of operation; loss from running empty vehicles.

From the foregoing brief outline, some idea may be gathered of the situation as it presents itself to the practical man in a city like New York. In a number of foreign cities automobile tram-cars are quite extensively employed, but this service is hardly to be compared with that in American cities, because of the low rate of fare for the distance carried as well as the great difference in local conditions. A public conveyance of the American style, with a capacity of thirty-four passengers, including the roof-seats, weighs nearly 22,000 pounds, eleven tons. This same vehicle, if properly tired and operated on the ordinary street pave, would require an increase in its weight of just about twenty-five per cent, making a net load of about three and a half tons, or 7,000 pounds, for each wheel. The same automobile equipped with only two four-wheel trucks, which would have a decided tendency to make the vehicle unwieldy, awkward and even dangerous, would bring a pressure of only about 3,500 pounds load on each wheel. Rubber tires of the conventional solid type for machines of this character, would be possible, but not commercial, on account of excessive wear and tear and general depreciation.

Taking a horse-drawn cab as a means of comparison with the present electric vehicle, statistics like the following are readily obtained and as easily proved.

ELECTRIC CAB.

	Pounds.
Weight	4,400-4,600
Driver and two passengers	525
Total (average)	5,025
Weight per wheel	1,256

HORSE-CAB.

	Pounds.
Cab	1,050
Horse	1,200
Driver and two passengers	525
Harness	25
Total	2,800
Weight per wheel	700

This shows at a glance that the load per wheel is almost double (for the passengers carried) for the electric machine. With extra weight naturally follows increased cost of keeping and operating, though not necessarily in direct ratio. Another source of increased cost is the rolling friction, so that the total cost for the automobile would practically be about three times as great as for the electric street-car, considering always that the volume of business be equal for both kinds of conveyance, provided perfectly smooth pavements to withstand the heavy service could be secured, and the other difficulties be overcome. In addition to these phases, there is the great difficulty of steering and controlling so heavy an apparatus. Automobiles have shown a mild disregard for the wishes of their drivers, particularly on wet pavements, in that they insist on endeavoring, when in good spirits, to climb up front stoops, swish up onto the sidewalks and perform other pleasant little antics, buzzing all the while like a healthy but savage mosquito, to the consternation of the gentle citizen.

With the use of the automobile, comes the demand for employees of a higher grade of intelligence. A simple coachman will not do. To operate an automobile the chauffeur must be trained in several branches, beside being a thorough mechanic, with enough knowledge of machinery to know what to do and how to do it in case anything goes wrong with his machine. The operator must also have a certain amount of "horse-sense" —if such a phrase is permissible when discussing the horseless vehicle. He must be cool and careful, know when and why to ring that grim gong at whose shrill and hasty command we all jump, and understand the general operation of the motor, brakes, gears, and levers in every respect.

In operating vehicles of this excessively heavy sort, it is obvious that the great wheel-load makes an economical use of the relatively soft rubber tire an impossibility. Every piece of broken glass, sharp stone, shell, bent nails, and other similar objects always found in the roadway are certain to mangle the tire. The only possible remedy for this evil in itself, is to have a tire composed of thread of jute fibre and rubber, the strands being vertical to the pavement when the tire is in use. Such a tire was said by its maker to be about two years old, and had traveled in that time considerably over 7,500 miles. In the face of the tire, which was worn less than half an inch, were imbedded firmly a nail, part of a broken spike on which the wheel had run, and several pieces of glass. While a tire of this class requires no attention and costs practically nothing after it is bought, it has but little resiliency and, therefore can be used only on vehicles that are mounted on proper and easily resilient springs. Even with the soft rubber tire the great weight of the apparatus cuts into the pavements in a marvelously short time. In New York city, where the Fifth avenue stages turn into South Fifth avenue, there is a deep rut eaten out of the pavement, and in Chicago, on Adams and Rush streets, where a line of herdics is operated at relatively small load and infrequent passage, a deep rut may be seen at a fixed distance from the car-track, which it parallels. This is caused by the outer rear wheel of the herdic, the inner one running along on the track. The forward wheels have a norrower tread, not tracking with the rear wheels, which do the propelling and carry much the greater portion of the load. This single example may be taken as a fair instance of what heavy-wheel pressure does to ordinary Belgian block.

In considering the various pavements, particular attention should be given to their density, brittleness, and resistance to abrasion. When all these have been carefully weighed, both separately and collectively, the point is at once reached where it is conclusively evident that with anything like the wheel-pressure that now obtains on street-railroads, our present street pavements will not answer. In order to use the present pavement commercially, the wheel-load must be kept below 2,400 pounds, and rubber tires can only be employed at something under this weight at a cost of about four cents per tire mile.

When all the points cited have been considered, the increased weights, power, rolling friction, class of labor, and the fact that the power is divided into small units, it would seem that the power-factor, including cost of maintenance and interest, would be from three and a half to five times the cost of the same factor in the case of the electric street-railways. And very probably the operating expense, aside from power and power-machinery, would be about one and seven-tenths times the present cost for the same item in pure electric-tram traction, to say nothing about the probable increased accident account.

We have been told that grass in the streets of this busy city will soon be considered the harbinger of progress rather than the accompaniment of decay, and pleasant pictures of the horseless, sparrowless city of the year A. D. 2000 have been drawn to tickle our mental palates. Perhaps we may live to see Broadway and Fifth avenue long lines of neat greenswards, with shining steel by-paths for the rapid automobile on either side of the street, but certainly without the steel pavement, or at least, under existing conditions, the dirigible automobile conveyance can not replace the track-running street-car as a practical public carrier, either of freight or of passengers.

Public Heating from Central Stations

By I. H. Babcock

Heating from a central station has become so common that no one need question the feasibility of this form of heat distribution. In natural gas districts, the people are educated to receiving their heat supply from a common source, and are pleased with the plan, because it relieves them from keeping fires on the premises, and from storing coal and disposing of ashes. But the trouble with the gas fuel is that in many localities the supply is failing, and the people must either go back to the individual apparatus or find some other form of central station heating. Fortunately, the system of an underground steam supply has been amply demonstrated, and towns in the gas districts are adopting from central stations this method, which has proven more satisfactory and cheaper than heating by natural gas. The pioneer in steam heating from the central stations was the American District Steam Company of Lockport, N. Y. Some of its plants have been in operation now more than twenty years, and have proven satisfactory to the companies, and to their patrons. During the past few years the work has been quite rapidly extended, and the original plants have been greatly enlarged. So popular has it become to heat from central stations that other companies are proposing to distribute hot water to accomplish the same purpose. This requires force to distribute, as water is a sluggish medium, and though the object aimed at may be attained, it can hardly be believed that it can be made a paying investment for those who supply the capital. Steam is inexpensive to distribute as a slight pressure is all that is required to deliver it to customers anywhere within the radius of a mile or more from the generating plant.

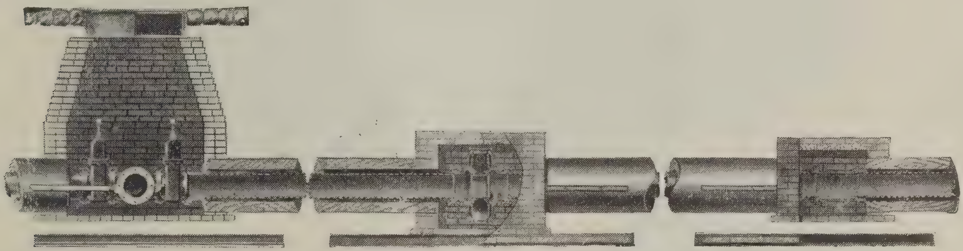


Fig. 1.

The first plants constructed were for the supply of steam direct to the various customers. This plan is still being followed, but of late the electric power-stations have enthusiastically taken up the matter and are utilizing the large amount of exhaust steam, which they heretofore have been throwing away in the air. Within the past five years steam heating devices have been perfected, so that insulation of the underground pipes prevents any but a small fraction of loss in transmission. The contraction and expansion of the pipes are amply provided for, and an absolutely correct meter enables the company and the customer to know just how much steam is being used. This last device is one of the indispensable features, as on it may depend the company's success, or failure, financially. The customer is equally interested, as he should have the means of knowing how much heat he is using, and be able to economize, and to benefit thereby.

The insulation used is a sectional casing, made from thoroughly kiln-dried lumber banded with galvanized wire and coated with asphaltum, instead of solid logs bored, as formerly, which are liable to serious checking, and loss of efficiency. The writer is able on this subject of insulation, to give some results from careful tests made and not before published. The city where the tests were made is in the northwest, and a cold climate. The tests were on one mile of seven-inch pipe underground, being insulated with the improved wood casing.

Results showed a loss of output of steam from the station due to condensation in the street mains, as follows: In October, 6 per cent.; November, 4 per cent.; December 7-10 of one per cent.; In January, 3-10 of one per cent.; February, about the same as December, and from that time on, a gradual increase to the percentage shown in October. In the mild months, the increased percentage was, of course, due to the steam delivered being far less than the capacity of the pipe, while the condensation continued the same. And even in December and January the output did not exceed 68 per cent of the capacity of the pipe. Delivery at full capacity would have shown even less rate of loss. As it was, the test shows a loss in the mains from condensation not exceeding one and one-half per cent of the total output.

On the question of earnings of a heating system installed in conjunction with an electric light plant, it is possible to give some figures from a plant which was constructed five or more years ago, and which has been under intelligent management. I do not give the name of the concerns, because it would not be proper to publish the private business affairs of a corporation, so as to identify it with the figures submitted. The writer can, however, vouch for the correctness of the report. The income from steam heat is given in connection with the total fuel bills for the station, which bills cover fuel for all purposes, electrical and steam heating, at times in the coldest weather when the exhaust steam was insufficient to supply total requirements.

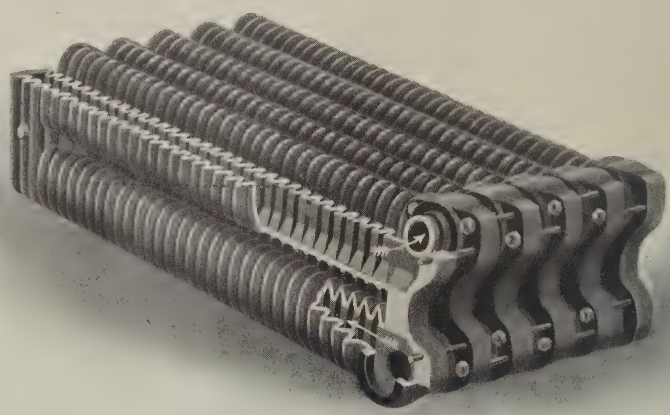


Fig. 2.

	Steam Heat Income.	Total fuel bills for Electric Light and Steam Heating.
October, 1901	1,638.85	2,135.37
November, "	3,530.29	2,950.82
December, "	5,528.09	3,792.65
January, 1902	5,223.48	3,845.57
February, "	5,716.55	3,522.25
March, "	3,630.65	2,768.09
Total	25,267.91	19,014.75

Estimating that April and May would add about $1,000 to the credit margin, the showing is that after paying fuel bills for all purposes at the station for those months, there is a credit balance of $7,753.16. There are many other plants in operation, showing equally as good or better results.

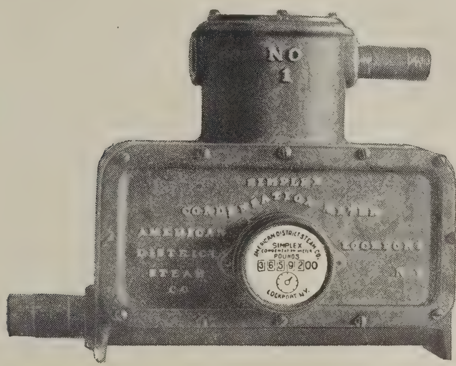


Fig. 3

The method of charging may be per thousand cubic feet of space, or per square foot of radiation, or by meter. No gas company would supply light other than by meter, and no such company could live and supply light by any other method. The same necessity for meter charges exists in the conduct of a steam heating enterprise. In constuction, the most thorough work is the cheapest, as cheap material and slipshod methods will assuredly swell the repair account in future years.

Regarding the earnings derived from this heating plant operated in conjunction with the electric-light station, the following details may be of interest, being taken from actual everyday operation. Nor is the plant from which these figures are taken a new one. Electrolysis in the early days caused considerable trouble, but this has been wholly overcome, so that the maintenance charge is practically nil.

Cost of heating plant........	$60,000
Operating:	
Extra labor—boilerhouse	$800
Extra fuel (approximate), due to steam plant............	6,000
Maintenance	84
Interest on investment.......	3,600
Total expenses	$10,484

Receipts from sale of heat.$29,107.91

Net profit from heating, $18,683.91, equals, say, 31.14 per cent profit on an investment of $60,000, after paying interest of 6 per cent.

The station in question is fitted with simple-cylinder engines and one tandem compound; total rated capacity of the station is 1,350 horse power, with a maximum load of 1,150 horse power on a 500-volt circuit, on which are 240 arc-lamps and 15,800 incandescent lamps. The fact is that the steam plant is carrying the entire fuel bills of the station and producing an excess of more than $7,000. This fact with the low operation and maintenance charges should commend the adoption of this method of

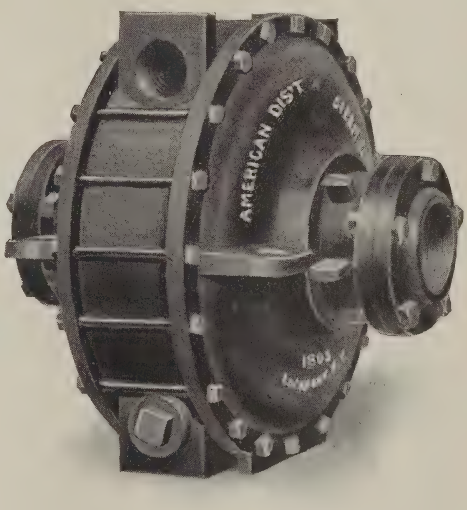


Fig. 4.

increasing the dividends of many electric light properties.

Electric lighting and power production should be regarded the same as any other manufacturing plant. When the proper machinery is installed, it is then a question of economical management, and this includes the utilizing of all waste products that can be turned out at a profit. The gas companies and oil refineries and many other industries do not neglect to turn all such products to their financial benefit, and it is from such that their profits are largely derived.

When the lines of steam mains are constructed, the service mains should be as carefully laid, and protected in the same manner. Frequently two or more customers may receive their supply through a single service main by lateral branches from one building to another. The steam fitting should be of the best, and, no boiler being required, a considerable saving is effected over the installing of an individual apparatus. A mixed system of direct and indirect heating is recommended. The condensation from the direct radiation is conducted to an economizing coil in the basement, which is enclosed, and through a register in the floor above, the heat goes to rooms where desired, and the water is discharged cold. Among the entire list of public utilities, it may be confidently claimed that central station heating excels all others in the comforts and conveniences which it brings its patrons, and at the same time, is a safe and profitable investment for the capitalist.

The Civilization of Northern China

Penrhyn S. Mylles

Of the active forces in use to-day for the furtherance of civilization throughout the universe, the telephone and the short-line railroad are most potent. Under existing conditions the railroad, with its wonderful facilities for promoting the interests of the public at large, is no more used than the telephone, though it accommodates somewhat greater numbers. Recent inventions improving the service and lessening the cost of the telephone will be the means of bringing commercial correspondence and business travel into comparative disuse, of greatly increasing the convenience of suburban life, of materially lessening expense now unavoidable, and of making possible a more nearly ideal social and economic mode of life in the city and country. Who will travel to Chicago to arrange business details when they can be determined upon over the wire in a few minutes at a nominal cost? Many of the conditions which now enforce irksome duties will be done away with and in their stead will arise new associations and circumstances preferable greatly to the old.

Unaided, neither telephone nor telegraph nor railway can accomplish this, but, each supplementing the other, the desired result is obtained by coöperation. The logic of history shows beyond controversy that transportation and communication—either by animal or mechanical means—is the opening wedge in the civilizing process. First comes the pioneer in the forest, blazing his way among the trees or on the rocks in the open country. After him came a hardy few in single file, making the trail. The dirt road follows the trail, and after the road is the railway line. Thus is communication effected, and though sometimes the telegraph precedes the rail line, as in the case of the Cape Town-Cairo line in Africa, the latter is generally first in the field.

The key to the solution of the situation in the northern part of China is undoubtedly the electric railway. There is but small doubt that the steam line will never prove so valuable in that country as the smaller and less costly electric system. For light traffic at high speeds and at moderate distances the former cannot be displaced. The steam locomotive of to-day is the most highly specialized and perfected example of engineering skill the world has ever seen. It is infinitely the superior of the stationary engine. Presume a large pumping engine, for example, to be mounted upon a bed-plate, one corner of which is not true or plumb. After a very short time, possibly within a week, that engine will rack itself to pieces. The locomotive, on the other hand, has no bed-plates at all and its wheels—the drivers—jump alternately clear of the track with each revolution at a good speed, yet the machine may be used with safety for years. For very long runs at high speeds the steam train may never be surpassed by electric traction. It is cheaper and better than on light, short range service, and for heavy speed work at long range.

Directly opposed to the locomotive is the electric motor car, its capacity for hauling heavy loads and maintaining very fair speed for moderate distances, making it the superior of the steam machine in every instance. The essential features of the motor are its smoothness of action, cheapness of operation, capacity for work and many others easily to be seen.

To anyone familiar with Chinese habits and the country itself it will be clear that foreign capital must be the developing power. Left to her own devices China will certainly and surely retrograde; but already there are enterprising "foreign devils" at work, and making very handsome profits on their investments. A road, in China, may mean a trail on which are laid slabs of stone three by one-and-a-half feet, or a dirt highway so badly rutted and so blocked with heavy rocks and boulders as to be utterly impassable to a European vehicle. In many cases the "wheelbarrow roads" are so bad that even the native coolies cannot traverse them comfortably. The Chinese wheelbarrow is a curious box-shaped affair with a large wheel in the center. To facilitate travel stones about three feet long and from eighteen to twenty-four inches wide by five or six in thickness are placed end for end along the trail. A rain comes and washes away some of the supporting earth; or a root pushes one end of the slab out of position. Slowly the stones are tilted and upset until the rocky corduroy is a veritable mountain chain on a small scale. Yet the patient coolies push their barrows along as best they may with an occasional prayer in the most picturesque language in the world to the demon who has execrated the road to remove his malign influence.

The dirt highways are equally as bad. Only by the painful experience of riding over them can the foreigner appreciate the force of the statement: "They are the worst roads in the whole earth." Frequently in the mountainous portion of the empire huge boulders roll down from some hill to find a secure resting place in the center of the road, where they are nearly always certain to be left undisturbed. With such roads it is easy to understand why the merchants of Shanghai import all their coal, though there are fields of inexhaustible and rich veins only a few miles away in the interior.

In her natural resources China is fortunate. We really know very little of the country beyond the mere names of the towns and cities and rivers. We do know, however, that she possesses vast supplies of coal, gold, silver, iron and other valuable mineral deposits. The mines are easy to work, but what could poor Crusoe do with his bag of dollars on the desert island? When the coal or the ores are mined they cannot be taken away from the pitmouth; there is no way to remove them to the coast. The little China ponies are good horses and willing, but a horse could not carry enough coal on his back in one day of twelve hours to pay for his food and other expenses. Coal worth perhaps two dollars per ton lies untouched because no one can carry it away. With the ores the same proposition holds good. They are heavy and bulky and hard to carry, so that the experiment does not pay.

A railroad system that would enable the capitalist to work the mines and transport his coal and raw ores to the coast or to nearby cities where the coal could be burned and the ores converted would be a swift and powerful money-maker. Lines may be run from a center like Peking, Tientsin or some other large city to the series of towns grouped around it within a radius of fifty miles on any side. From the town it will be easy to reach the mine, and later on, as the country develops, small towns will grow up like mushrooms at the pitmouths. Experience with the mines in the United States and in Great Britain proves that the miners live as near the workings as possible. It will be so in China. There seems no reason to disbelieve the statement recently made by one of New York's prominent exporters, wherein he said:

"Development will be rapid in the land

of the fan. The electric railway, having valuable advantages over the locomotive, will be the developer, supported entirely by foreign or outside capital for a long time to come. In considering the situation there are two things which must be given attention before the other details are determined. The first is the initial expense, which will be enormous for a practical working line of any length and quality. Under this head come all the matters incident to installation, maintenance, traffic, franchises, options and so on down the entire list. No one can guess even at the money cost of such a project until the preliminaries have been arranged. The second, and much more vital consideration is foreign competition.

"For many years China has been an important and increasingly powerful factor in the foreign trade and relations of Europe and the United States. At the present time there is no activity in electrical lines except at Shanghai, Kow Loon and a few other cities whose population is cosmopolitan for the very good reason that they are seaports. In spite of this I feel there will be heavy exports of electrical materials from this country in the near future for building railroads and installing power plants for their operation. But if we do not bestir ourselves and hasten the work, some shrewd German or Englishman will be ahead of us. Of course we cannot expect to control all the electric railway systems in China, but there is a deal of sense in striking the first blow. So far as I know the Englishmen are asleep; they either have failed to appreciate the situation or, with the customary deliberateness of their race, are waiting to see someone else make the experiment. This is not so with the Germans, who, being a nation of keen traders, are ever on the alert for further opportunities to introduce German manufactures wherever possible. We must watch the Teuton rather than the Briton."

The tremendous influence and power of the electric railroad as a civilizer has been shown so remarkably in the last seventeen years in the United States that we may readily apprehend the northern China of fifty years hence as being similarly affected. The conditions that exist there to-day are the same that were encountered here by Vandepoele, Sprague, Morris and other pioneers, being merely more aggravated. Though the Chinese peasant is far lower in the scale of intelligence and humanity than the low class American, he is very far from being a fool, and some day the world at large will wake up to that fact, startled and perplexed. Not only will the projected roads handle an infinite quantity of freight, but millions of passengers. The Chinese nation numbers nearly, if not actually, one-fourth of the entire human race, and probably seventy-five per centum of that vast people is able and anxious to patronize any good means of transportation.

As matters stand now in China it is very reasonable to suppose that the liberal views of the young Emperor, Kwang Su, who is slowly but surely pushing out the Dowager Empress's party, will favor any legitimate American or European enterprise for the development of his country. Franchises and rights of way will be granted willingly by the Imperial Government to the men who prove that their intention is legitimate and who can show that the fulfillment of their plans means much to the empire. But if the American people are to be leaders in the most important enterprise of the day they must be up and doing without any further delay. Already plans are afoot in Germany and the great electrical corporations are becoming interested in the project. German enterprise and capital together fail to recognize defeat; they combine the fire and energy of the Gaul with the pertinacity of the Norseman, and their resources of skill and money meet every demand.

The difficulties to be encountered in the raising up of any nation are tremendous, and with the mental lassitude of the Chinaman, his stubborn refusals to widen the narrow streets of his cities, the nature of the country itself and the unsettled condition of the realm, the outlook is not less forbidding than the chances of the hardy few who landed at Plymouth in 1620. In spite of all this and other unforeseen obstacles which will arise as the work goes on, the supersession of present conditions is a certainty within the next half century.

There is good to be done to a people in dire need of assistance and who, when they appreciate that help, will rise to meet it; who will do it? There are millions to make; who will make them? There are lives and fortunes to be lost in the undertaking; who will risk them? Shall we, who have risen to the top and pinnacle of skill, capital and commerce, permit ourselves to be outstripped in this race by nations whom we have already distanced in other similar encounters? Let the people rise and go to the work, which, once begun, can end only in fresh triumphs and the glory of conquest.

Electro-Magnets

By Richard Varley

Electrical engineering and manufacturing is, in all its branches, largely a business devoted to specializing, but specializing in design and construction, in such a way that the special products are best adapted to the uses of the general commercial public. The successful man is almost always the specialist, and it is of one particular and very interesting line of electrical manufacturing that the writer is competent to speak.

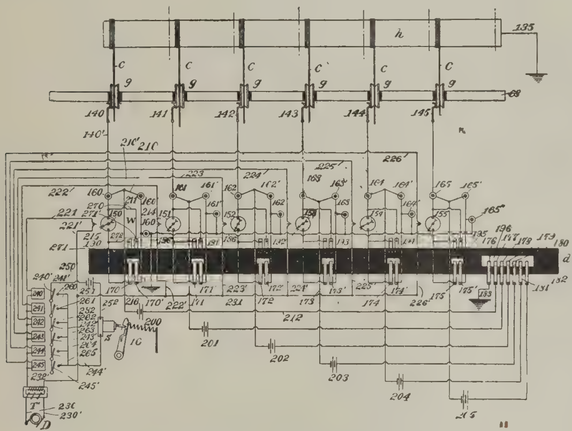


Diagram of the Winding Machine No. 1.

Less than ten years ago, a company was formed for the express purpose of supplying wire to the electrical trade in the form of spools or solenoids. An enormous number of difficulties presented themselves, but by continuous employment of engineers specially skilled in the electrical business, each problem was mastered about as fast as presented. It must not be gathered from this, however, that the company's sole business is that of making bare wire magnets, for it supplies magnets of all the sorts employed by the electrician. It takes a vast amount of missionary work to tell our story, and even when all is said and done, it frequently appears to be labor lost. There are places where insulated wire must be used. Furthermore, a large amount of apparatus has been thoroughly standardized in the past few years, and it is almost impossible to get the specifications changed to our style of winding. Bids are frequently required on coils which are described as follows: The wire to be used is No. 33, single, silk-covered; resistance, 150 ohms, at seventy-five degrees Fahrenheit. When a specification is worded like the foregoing, the manufacturer assumes that the engineer who drew up the paper knew his business and also had no time for reference the bare wire winding. The result is,

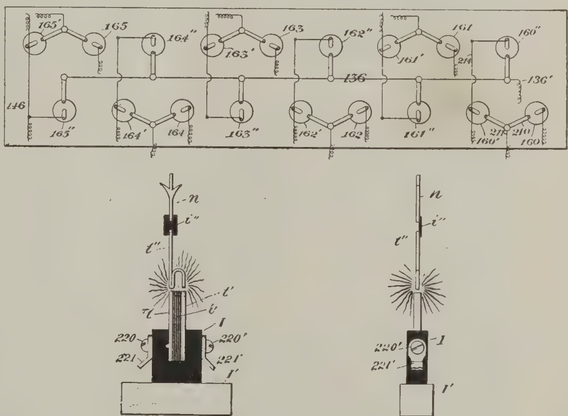
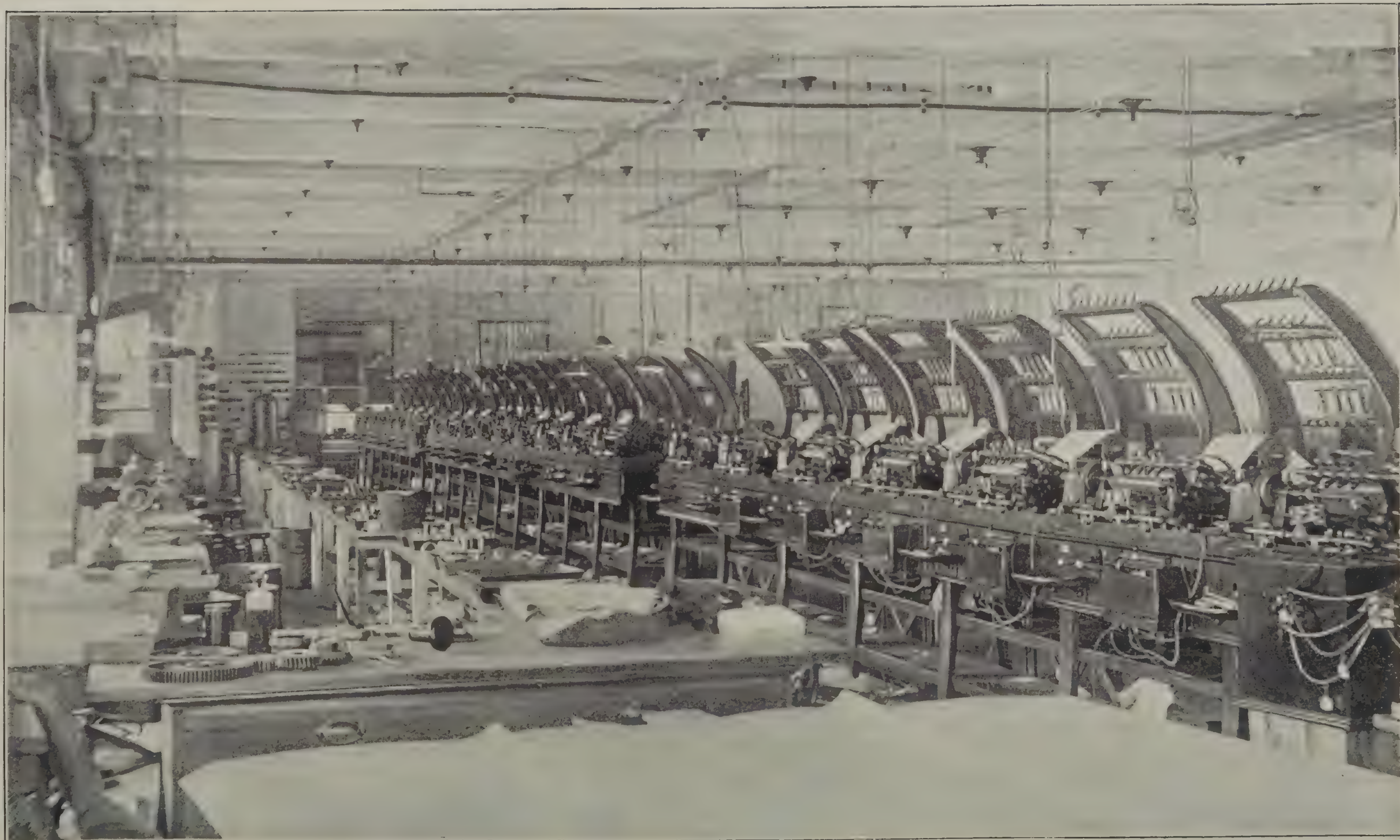


Diagram No. 2.

that to-day the Varley Company make winding machines that are most properly styled "Universal Multiple Automatic" winding machines. Each machine will wind almost any magnet or coil upon any diameter, to any diameter, to any



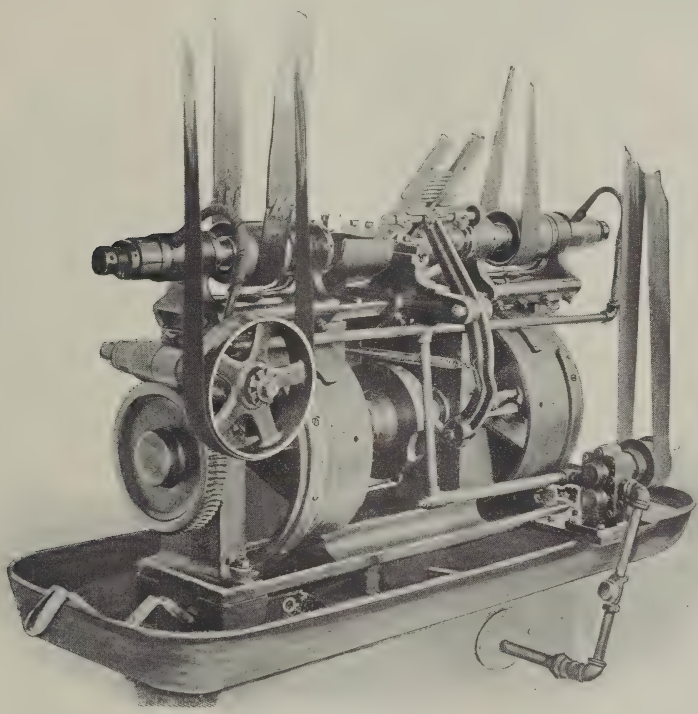
Looking Down the Winding-Room in the Factory at Phillipsdale.

length, with any feed, to a definite number of turns, to a definite resistance, and with any size of wire. All of the adjustments are made in less than ten minutes. Once the machine is set, the coils are turned out with remarkable rapidity.

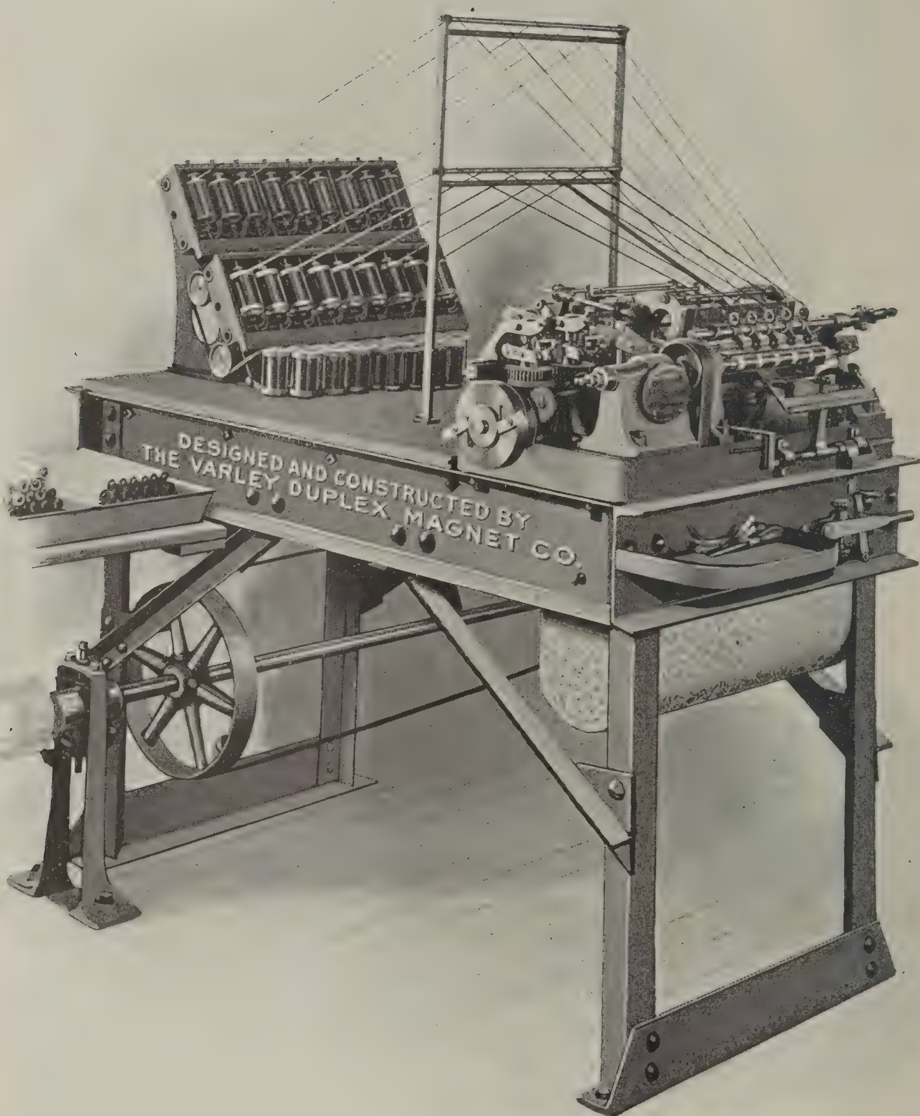
Instead of winding the insulated wire directly onto the bobbin, the wire is coiled about a tube over a mandrel, and suitable paper is inserted into the winding at the end of each layer, thus forming a "bridge" upon which to wind the next layer. The windings are wound in multiple, and form a "stick," which is sawed into sections, after its removal from the machine. The result is a perfectly uniform winding, with many more turns than can be obtained in the old way, where paper has to be occasionally inserted in the winding.

The machines are absolutely automatic, requiring only one operator to attend several machines, keeping them supplied with wire, silk and paper. Perfect windings are made on these machines from bare wire, with hard twisted silk between the adjacent turns, and paper between adjacent layers, thus insulating the wire as it is wound into the magnet.

While the bare wire winding is remarkable in many respects, its chief commercial value lies in the fact that, by means of the special machines employed in its construction, it can be supplied complete, core, wire, silk and paper, to the instrument maker, or electrical worker, for less money than he would spend in buying the insulated wire alone, in the open market. There is no longer any necessity for the manufacturer to wind his own magnets. The art of magnet-winding, for it was more of an art than a profession, by hand, has been left in



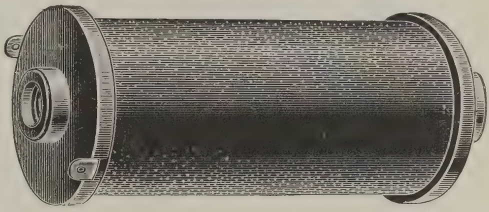
One of the Core-Machines at Work.



Winding up a "Stick" of Magnets in the Phillipsdale Factory.

the past, along with the other methods now archaic. To the manufacturer of small instruments of various sorts, lamps, and similar apparatus, the ready-to-order magnet is not only a tremendous convenience, but a very welcome and effectual money-saver. In other words, to be able to buy a finished product, ready for delivery, at less, by a good deal, than the raw material would cost, to say nothing of the labor of core-making, winding, and the constant risk of having a non-uniform product, saves brain, time, and money, the three most important factors in modern business life.

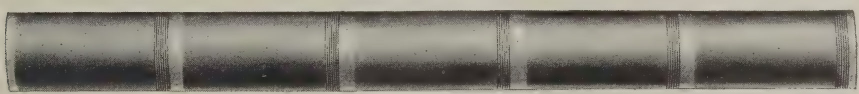
Another great advantage of the bare wire winding, is its high coefficient of space utilization, due to the thinness and strength of the insulation; hence, for a given winding volume, the magnet contains more turns for the same resistance than the insulated wire windings. Another matter very interesting, is the automatic testing as the bare wire is coiled into the winding. Each individual coil is wound to the exact required resistance, and then cut out automatically, thus saving excess wire and labor, which is usually lost in calibrating. The machines are operated at a high rate of speed, and as each machine winds several magnets simultaneously, the actual time consumed for winding each one is almost incredibly small. In one of the cuts is shown a row of the automatic winding machines. Each machine winds millions of perfect magnets annually, and the floor area occupied is less than one per cent of the space taken up by necessary machinery to manufacture magnets in the old way. After the "sticks" are sawed, the sections are slipped onto cores with a washer on one end, in which are fastened thin strips of brass or copper, to which are soldered the wire terminals. The front washer is then forced onto the core, making a complete electro-magnet.



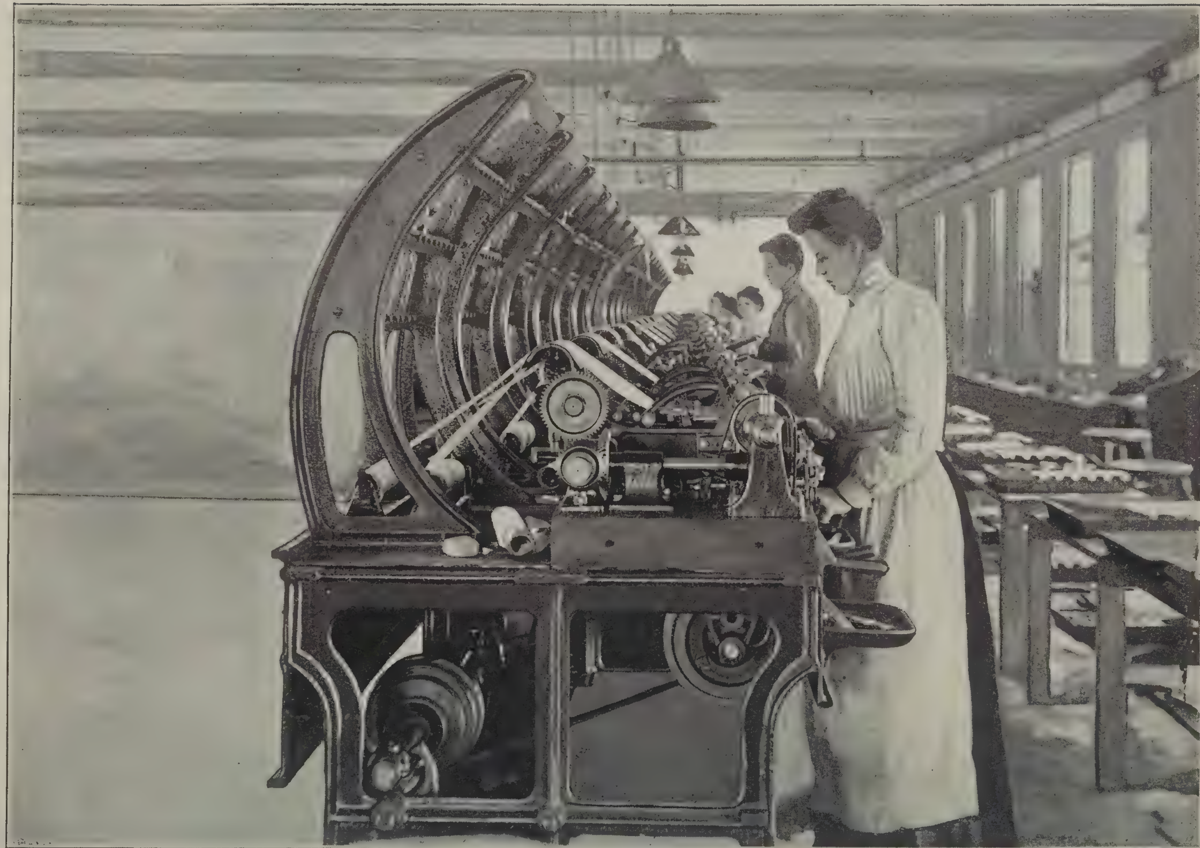
A Complete Magnet.

A very interesting feature is the perfect system of calculation, and the absolute results which are obtained. On the machine a pointer is set on the dial, giving the turns per inch, and a stop can be set for the required length of the winding; the specified wire, silk, thread, and paper are then placed in the machine, and several perfect windings are quickly produced; for example, five windings, each containing approximately 12,000 turns, may be wound in less than four minutes, which is less than fifty seconds for each coil of 12,000 turns.

All machines and devices, the inventions of the company's engineers, are built at the company's factory, the factory being isolated from the winding departments. After the machines are completed and adjusted, they are taken from the machine-shop assembling-room and placed in the winding-factory. It then requires but one or two weeks of instruction to a new operator to teach her properly and quickly to supply the machines with wire, paper, and silk; the operator is also taught how to gauge the



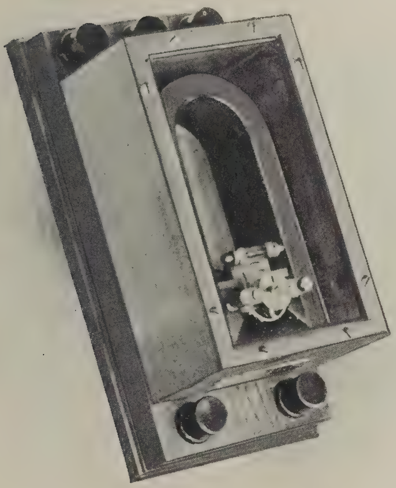
The Completed "Stick" Before Sawing.



Winding the Magnets in the Phillipsdale Factory.

material, to see that the wire, silk, and paper agree accurately with the winding specifications.

The chief operator looks after the setting of the machines for each style of magnet. With no breaks in the copper and silk, the operator has nothing to do but look on and take the magnets out of



Ringer-Magnet Complete in Box.

the machine when automatically stopped. Great difficulty was at first experienced in getting fine copper wire reasonably true to gauge, and of sufficient length to feed the machine for one or two hours. Fine wire is now supplied to the machines in one continuous length, averaging from two to ten miles, without a break.

All of the silk used by the Varley Company is made exclusively for their business, as is also the paper, which is delivered to the factory at Phillipsdale direct from Germany.

On account of the time required in making Swedish iron cores for electro-magnets, by the ordinary screw machines, the company's engineers recently designed the new core-making machine shown in one of the illustrations. This machine finishes over 3,000 cores per day, as against an average of 700 made by the ordinary machines.

This company commenced operations in Jersey City several years ago, but the business grew so rapidly that it was soon found that serious delays were being experienced in getting sufficient fine copper wire from the large mills in the East; this delay so limited the company's progress that in the latter part of 1900 it was decided to move the plant east, and a working arrangement was made with the American Electrical Works, who were also made the general sales agents for the Varley magnets. The Varley Company did not associate itself with the wire works for the sole purpose of making the bare wire magnets, but to carry on as well, a very much wider range of business of the same general character.

Much more could be said regarding the practical utility of these magnets, and the conditions which gradually led up to the working out of the commercial features of the proposition, but in this brief sketch it has been the writer's idea more to outline the reasons for his specialty than to present a more technically detailed description of the product itself. All the older electrical men, and many of the younger ones as well, remember with mixed emotions the trouble that the old, hand-wound covered wire magnets gave. Magnet-winding was a special and most provokingly unreliable feature of the shop-work, and the men and boys who did the winding, besides being humanly fallible, were often so crowded that they could not do full justice to their work, a condition impossible in the present state of the purely machine-made magnet, for the machine is infallible.

Ten Years' Progress in Electric Lighting

By Louis Bell, Ph.D.

Most technical arts have progressed with startling rapidity during the last decade, but electric lighting has had a growth in theory and application that is exceptional, even among the hurrying records of the last century.

Casting back ten years one finds the electric light in principle fully developed, but in practice lacking much of the full usefulness which has since come to characterize it.

In 1892 the incandescent lamp had been pushed further toward its present state than any other single element of the art. Indeed, incandescent lighting came into a working condition of usefulness with extraordinary rapidity, and while the lamp of 1892 was not in all respects equal to the lamps of to-day, still there are many incandescent lamps on the market now which are worse than the current product of ten years ago. The law of the survival of the fittest is, perhaps, inexorable, but it requires geological time for its fulfilment.

From a manufacturing standpoint the most important addition to incandescent lamp practice is the chemical process of exhaustion, which has largely replaced the slower and less regular method of exhausting by mercury pumps. The average of the quality of filaments has been improved. Considerable economy has ben introduced in the details of construction, but in spite of all such changes the incandescent lamp is to-day clearly recognizable as the lamp introduced by Edison a score of years since. Of minor details in improvement of manufacture there are many. Ten years ago the replacement of filaments in incandescent bulbs was not a commercial art, so that there was considerable unnecessary waste in manufacture which is now for the most part obviated by the ease with which filaments can be juggled into bulbs once considered only fit for the scrap heap.

In the application of incandescent lamps great progress has been made toward a high voltage product, and correlated to this is the production of small lamps for ordinary voltages. We cannot say even to-day that the 220-volt incandescent lamp is equal in all respects to the old 110-volt lamp, but it is far nearer to it than would have seemed possible in 1892. Experience gives facility in most manufacturing processes, and it has enabled the lamp manufacturers to produce a reasonably durable filament for 220-volt lamps in 16 c. p. units; a very creditable filament for lamps of the same voltage in higher candle-powers and in addition an extremely useful lamp in as low as 4 c. p. for 110-volt circuits.

All these changes have tended to popularize the incandescent lamp, to make it more facile of application to various problems of lighting, and in general to broaden its sphere of usefulness. It stands to-day, in spite of all attempts to supersede it, as the back bone of electrical illumination.

Apparatus for running incandescent lamps has changed most notably. In spite of the Jumbo dynamos of earlier years, a big direct coupled unit was practically unknown in 1892, and the giant dynamos with which modern electric lighting stations are equipped were hardly looked upon then as plausible possibilities. Their production is due not so much to any radical change in theories of dynamo design, as to the commercial necessities which drove engineers to solve the variety of practical problems, on which increase of size depends more than it does upon the fundamental theory.

Of auxiliary apparatus, the most important practical addition made to the list within the last decade is the storage battery. The storage battery has just this year attained its majority, but for the first dozen years of its life it was in a precarious condition of health. It was only by careful nursing at the hands largely of our laborious and unwearying German confreres that it has reached its present state of comparatively robust health. It has now taken an important place, both in central station lighting and in isolated work, to both of which it has proved itself peculiarly applicable. Ten years ago one had to treat the storage battery as an outcast, lodged in the dangerous ward of the electrical hospital. During the succeeding years it has gradually convalesced and now has become a useful member of the honorable fraternity.

The changes in arc lighting have been vastly more radical than those in incandescent lighting. In 1892 few dynamos of more than fifty lights capacity were in commercial use. It was the turning point in the design of stations for arc lighting. In 1892 and prior thereto the arc lighting station of any considerable city was an enormously complicated affair with a liberal number of small dynamos hitched up to an unconscionably complicated mass of shafting. The change to larger and more efficient units came with considerable rapidity, and even before the introduction of multi-circuit dynamos, arc machines of 100 lights capacity or more came into considerable use and they simplified both the generating station and the distributing circuit.

The next far-reaching change in arc lighting was the introduction of the enclosed arc lamp, which has now practically driven the open arc for constant potential circuits into innocuous desuetude and is rapidly relegating open arcs for all purposes to the same amiable limbo. With American prices for labor the care of arc circuits has come to be very oppressive, and the enormous reduction of these items of expenditure and also of carbon consumption was a most welcome change to the station manager. The additional voltage required for operating enclosed arcs made the operation of series circuits of 100 lamps or more a pretty serious matter, and the natural result was the popularizing of the multi-circuit machines which are now so widely used. The enclosed arc is a great convenience and is economical. Moreover it improves the steadiness of the light in a very conspicuous degree, so that arc lighting after its introduction became feasible in situations where the flickering of the ordinary open arc would have proved a serious obstacle to its introduction.

For street lighting the improvement in distribution which has followed the abolition of the crater is so considerable as to make the enclosed arc an immediate favorite, not only of the station manager, but of the public, and to-day it is safe to say that the only stations running open arcs are those that are unable or unwilling to incur the outlay necessary to change the system in spite of the economy of operation which would thereby be gained.

It is indubitably the fact that the enclosed arc has not made a strong impression on European practice. Abroad both labor and high grade carbons are much cheaper than here, and the economy of operation to be gained by the use of enclosed arc is far less than in American practice, while the lessened cost of care makes it possible to use abroad successfully open arcs that would give unsatisfactory service under ordinary American conditions.

A still more radical change in methods of arc lighting has been the widespread introduction of alternating current arcs of the enclosed type, operated both in series and in parallel. The alternating arcs for series distribution working from constant current transformers or regulators have come into very extended use within the past five years. The gain in the efficiency of energy supply attained by the use of such devices has been conspicuously great, while the arcs themselves are extremely satisfactory for street lighting purposes. Alternating current arcs for constant potential circuits are also widely used, but have attained far less popularity than those for series connection. A certain amount of noise seems inseparable from the operation of alternating current arcs. While this is not in the least objectionable for street lighting it is frequently a source of complaint where the system is used for interior lighting. For interior lighting constant potential lamps are used. However, the best modern constant potential arcs have to a very considerable degree lessened this objection, and to-day they are more widely used than ever before, but have not reached and probably never will reach the popularity which has been accorded to the constant potential direct current arc, which can to-day be considered the standard powerful radiant for interior lighting.

The design of arc lamps has been so far improved in the last ten years as to render them much more applicable for general illumination than ever before. Ten years ago the arc lamp was a thing of unwieldy, unsightly bulk. The introduction of the carbon feed instead of the carbon rod so shortened the lamp as to render it practicable for use in many places where otherwise it would not have been admitted, and has been directly responsible for no inconsiderable part of the growth of modern arc lighting. Not only have the lamps themselves been made less bulky, but it has proved feasible, particularly in the case of standard potential direct current lamps, to design satisfactory lamps of smaller illuminating power than the old standards, thus producing a more effective distribution of light than was possible ten years ago. It is therefore practicable to use arc lights under circumstances which at a prior epoch would have demanded incandescents with a lessened gain in efficiency.

As to methods of distribution, the last decade has seen the introduction of large and well designed alternating systems, which have widened the scope of electrical illumination in a most conspicuous manner. It has also seen a wonderful commercial development in the transmission of power by polyphase currents, which has rendered it possible to economically supply great regions, which otherwise would have found electric lighting an unattainable luxury instead of an economical necessity. The sight of cities electrically lighted from plants twenty, fifty, one hundred or even one hundred and fifty miles distant, is one that would have been very startling in 1892, though to-day it is commonplace in engineering.

The same methods have been applied with tremendous effect in solving the enormously difficult problem of the efficient generation and distribution of current in large cities. Distribution by direct current becomes frightfully unwieldy when the area to be covered is large, but the introduction of large polyphase generators in connection with efficient motor generators or rotary converters—both of them scarcely known ten years ago—has entirely changed the economy of the lighting situation and the great stations operated in this manner, which have come into existence in the last three or four years are striking monuments of the immense importance of power transmission methods in general electric service.

The development from the Pearl street station to the Waterside station in New York City, is the best possible comment on ten years' growth in electrical engineering, and yet much remains to be done in electric lighting. To look at an incandescent lamp and to realize that its luminous efficiency is at the most only three or four per cent of that theoretically possible, ought to take the conceit out of any engineer who feels complacently satisfied with what even the last decade has done. Such inefficiency is a standing reproach and challenge, and some of the best efforts of modern science are being put forth toward the improvement of this exasperating situation. The result is that we have now in 1902 reached a tentative and questioning stage with regard to the future progress of the art. It seems hardly possible that the problem of efficient light production should continue indefinitely to defy solution.

Efforts of improvement have been directed along two promising but radically different lines. The first involves forcing the temperature of the light giving body to the highest possible limit. It is best exemplified in the Nernst lamp, only recently placed upon the market in this country and is not sufficiently past the experimental stage to enable the observant engineer to value its possibilities. The Nernst filament is unquestionably more refractory than a carbon filament, and hence will endure higher temperatures and will give greater luminous efficiency. How great the advantage thus gained and at what cost remains to be determined. It is a case where the proof of the pudding is in the eating, and the eating, let alone the digestion, belongs to the future rather than the past.

The other line of attack on the ever present problem of high luminous efficiency is by the Geissler tube. Lamps of this type are now in a confessedly experimental stage, although near enough to commercial development to render it probable that within a comparatively short time they may be put to practical tests in every day working. In theory a vacuum tube lamp furnishes a better line of attack than improvements merely designed to attain higher working temperatures of incandescence, but whether a more practical commercial article can be secured in this way, however, remains to be seen. At present the data are insufficient to enable one to form even a tentative judgment

Methods of lighting, apart from the particular form of radiant used, deserve much more careful attention than they have yet heretofore received. The ultimate object of electric lighting is not to provide a certain number of lamps of a certain stated power each, but to attain certain results in practical illumination. Economically it is more useful to make one 16 c. p. lamp do the work of two than it is to provide two incandescent lamps by better utilization of the energy previously spent upon one. Electric lighting as a science and an art implies much more than the mere production of electric lights. It implies a knowledge of principles, involves their application and the reduction of this knowledge to practice. The economical advantage to be obtained by study of this side of the problem is very great, particularly in enabling the electrical engineer to meet unavoidable competition of other illuminants than his own. The next decade should show, not only much more efficient lights than the past, but much more effective utilization of these lights.

*American Telegraphers and Linemen in the Philippine Islands

By an Ex-Private, Signal Corps, U. S. Army

After having spent three years in active work in the new American possessions in the South Pacific, the writer can state, from his personal experience, that there is an unfailing demand for telegraph operators, linemen and experienced hands for general signal corps work. Your correspondent came to the Philippines in 1899 as a member of a volunteer regiment, and was occupied with the signal corps for a year, during which time we opened up the southern part of the group and established lines of communication between a number of quite widely separated points.

Sometimes the insurgents would destroy the line in less than a week, and it had to be replaced. On one occasion the natives cut the poles into small chips, and again, they chopped the wires into pieces an inch in length for nearly a mile in the jungle. But those days of war and darkness are gone, and to-day the electricians are wanted to work in peaceful territory where lines of communication have been permanently established. This fact has led up to the increased call for telegraph operators and linemen of all stations and experience. One sees numerous natives in service because of the lack of Americans. These natives are trained by the Americans, and in some cases prove to be very serviceable men.

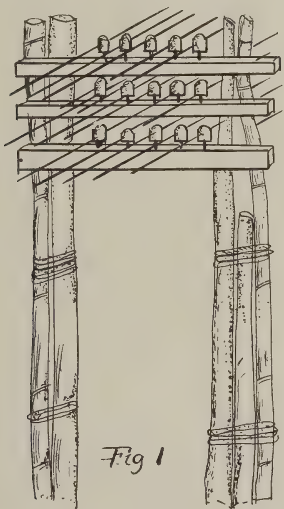
The most pressing need of telegraph men is in the service of the government, which handles messages for commercial and private enterprises, as well as for the transaction of its own business. But there is a vast amount of government telegraphing needed. All stations in the islands are now joined, and there are several hundreds of them. All the important islands are connected by cable. Your correspondent visited many of these telegraph stations, and was informed of the shortage of men, owing to the enlistments expiring, and the increased call for operators resulting from the extension of lines to new points, requiring the opening of new offices. The government is doing wonders in this direction of putting in new lines, and it is sending over hundreds of good and competent operators, linemen and servicemen. Islands like Luzon, Panay, and some others, are literally covered with stations. Mindanao and the more southern points are just being opened up, and many new men are wanted.

Plenty of good men apply for positions with the government, although the pay as private is but $20 per month. But this includes everything, and so the man comes out ahead at the end of the month. In a short time the private is a first-class private, with increased pay, and by and by a corporal. When he gets to be a sergeant, the pay, so to speak, is practically as good as that of a second lieutenant in the line. The chief operator is the next highest position, and this is not beyond the enlisted man. The commission is also available to the enlisted man, and many of my old friends, with whom I "hiked" along the line two years ago, are now commissioned officers.

It is of interest to see some of the complications with which the linemen meet.

* Editor's Note: This article, but slightly changed from the form in which it reached us, presents briefly a view of the telegraphic situation in the Philippine Islands as seen by a private soldier. The illustrations are from sketches made on the spot by the correspondent.

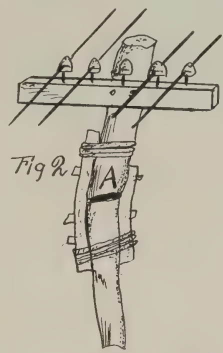
In going into a new territory, of course, one begins new and sends out his natives to get the tall cocoanut trees, while he has another gang digging holes. The wires are strung, and, as a rule, the job is serviceable. But sometimes there is old ground to cover, and the work of the Spaniards crops up in the defective poles and cross arms, a sample of which is shown in Fig. 1. Manila has this outfit. The new American poles are first-class, but the old poles are merely pieces of bamboo set up as shown and bound together. Numerous wires are loaded on. On Panay Island we saw Spanish poles rigged like that shown in Fig. 2. The pole had snapped short off at one time, and the ingenious workmen had spliced it as at *a*, by placing slabs of wood along the sides and winding them



Spliced Bamboo Poles in Luzon.

with cordage and split palm-stock. These split portions of palm are everywhere in use.

The white or wood-eating ants are a source of much trouble to the American linemen. The linemen put in poles of good, substantial wood, only to find that in less than a year the numerous ants common to the local soil have sawed into the edges pretty much as shown at *b*, Fig. 3, so that the next gale sends the pole to the ground. All sorts of remedies are employed to overcome this trouble, one of the most common of

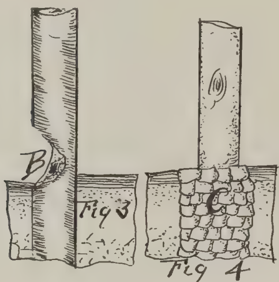


The Spanish Method of Pole-Mending is Still Much Seen.

which is shown in Fig. 4, in which the base of the pole is protected with stone work packed with a peculiar clay-like matter. If a cement is obtainable the cement is preferred. The packing of the pole at *c*, in this way keeps the ants off and the wood is not harmed.

The linemen of the Philippine service are hampered much more than might at first be supposed by the class of laborers which it is necessary to employ. It is the custom to send out a certain number of native laborers with each two or four Americans, and these laborers have to be trusted to do some of the work. The results of their work may be seen now and then in the defectiveness of certain systems. These native laborers are improving all the time, but still, their work is not right yet. In one case, just as a chain was being adjusted to sustain a buoy in position to mark the location of a cable, to ward ships off from anchoring there, the American overseeing the job was taken ill, and the natives completed the work alone. The result was that they failed to allow chain enough for a rise in the tide, so that when the tide was high, the buoy always disappeared below the surface of the water, as at *g*, Fig. 5, being pulled down by the chain fixed to the stone weight *h*. Therefore, one day a transport came along and, not seeing the submerged warning buoy, dropped anchor. The cable happened to be resting upon a stone, *e*, at that point, and the anchor point glided below the cable *d*, as at *f*, so that when the anchor was raised and the transport moved slowly off, the cable was torn up.

The native linemen, if left alone, will perform quite shiftless work. Every signal corps man has seen them tie up insulators with strings and wires in all sorts of ways to all sorts of things.

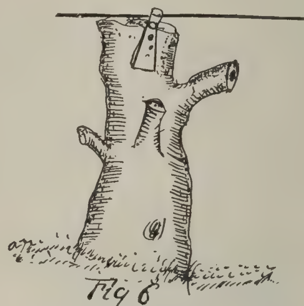


Post Eaten by Ants, in Fig. 3. In Fig. 4 the Cement-Packed, Stone Setting is Shown.

Sometimes a frail bamboo pole must do, while again one sees the wires on the trunks of powerful trees as represented in Fig. 6. The native, if left to his own plans, would put in a line of wire through a town in short order, by nailing up the connections on houses. His ideas of effective service are very remote. For this reason one always sees American signal corps men or operators superintending even the simplest of work. The Filipino cannot be made to understand American methods, because he is so thoroughly impregnated with Spanish shiftlessness.

Perhaps it will be of interest to refer to the outfit of the lineman in the tropics. First his chest of equipments, mess kit, clothes, papers, come as the most important, and a view of one of these native-made, camphor wood chests is shown in Fig. 7. The ants dislike this camphor wood, and will not eat the clothes if placed within it. The natives make good camphor wood chests, but the soldier has to provide the hinges, locks, etc. The native will carve the chest for you in good order, and with considerable rude skill.

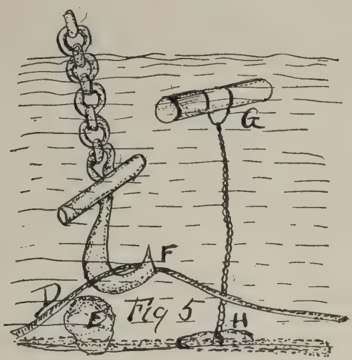
The quarters are usually in the signal office or the telegraph office, and there the signal corps man is king. Your bunk is there, and you can mess there alone or with the non-commissioned staff. You are allowed rations, and you turn these rations into the non-commis-



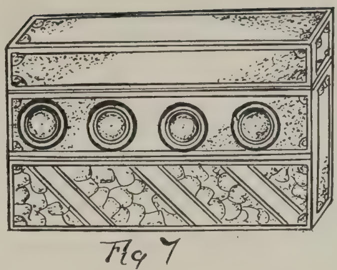
Some of the Lines are Strung on Heavy Trees

sioned officers' mess. You draw your clothes, and you can save money even on the private's pay. You must inspect your section of line about once a week, taking natives along to do the work. Two years ago you would take a guard of four soldiers, but nowadays the country is quiet and you need no guard, but you have your revolver in your belt. As to climate, that never bothered me. I have been on duty every day for three years, "hiking," fording rivers, and twice in 1900 dodged bullets while up a pole. If a man is sober, eats properly and does not go to excess in anything, he is as safe in the Philippines as he is in the United States.

That there is most pressing need for good men is at once apparent to every one who knows the situation and is acquainted with local conditions. The



"The Transport Moved Slowly Off; the Cable Was Torn Up."



Camphorwood Box Built and Carved; by Filipino Workmen.

main trouble is to get the men. They all seem to think the islands are a howling wilderness, with only savages. The truth is, that Manila is a European city of 250,000 inhabitants, the merchants being mainly French, Spanish and German. There are two large musical instrument factories in Manila, besides other important industries. The city has car lines, some electric lights and various other earmarks of civilization. Other cities in the islands, though not so large as Manila, are very similar, and when once a large enough force of American telegraph men get well located there, the country will have as good facilities for urban intercommunication as the rural districts in the United States.

The Supply of Cable-Insulating Material

By Hawthorne Hill

Intent upon his work of compelling the electric force to accomplish new tasks for man, the specialist in this branch of science is apt to give little thought to the fact that, without an insulating agent, electricity in the past—whatever may be developed hereafter—would have been uncontrollable. The layman gives even less regard to the subject, however he may be impressed by the electrical transmission of power, light or heat. The newer developments in this field have been accompanied by little change in the practice of insulating electric conductors, and not much with regard to the materials used.

India-rubber first came into notice as an insulating material in electrical work, gutta-percha not then having been discovered. When the British government became confronted with the need of closer communication with its then new Indian empire, a parliamentary committee brought into existence a voluminous report on submarine cable construction, which covered all the existing knowledge on the subject. The ablest experts of the day—it was in 1860—gave testimony which led the committee to declare that "of the materials which have been submitted to us, the best insulation by far is india-rubber."

It might be of interest to trace the actual beginning of cable construction on a large scale, practically in the hands of the same men whose views led to this expression, to develop the reasons why, after all, gutta-percha was preferred in practice, and has continued to be used, so that to-day, with over 200,000 miles of under-sea cables at work, only a small percentage has been insulated with any other material. It is true that the area of the earth's surface on which gutta-percha has been proved to exist is limited, and every few pounds of the material that comes to market represents the destruction of a tree that has required many decades for its maturity. A second supply from a given district is not possible within the same generation. But, fortunately, the world's cables seldom need to be replaced; about often enough, indeed, to keep pace with the recuperative capacity of the gutta-percha forests. And before the last of the existing trees has been felled, there is reason to believe that the English, Dutch and German interests now in control of the gutta-producing districts will have found means to conserve the native trees, by requiring them to be tapped and not cut down.

Besides, the cultivation of gutta-percha trees is as practicable as that of the tea-plant, except that the long wait for their product deters the investment of private capital in this industry. Governments can wait longer, however, and the hope of a future supply of gutta-percha rests upon the prospects of government plantations, the protection of young wild trees in reserves created wherever they are found abundant, and the enforcement of regulations for the extraction of gutta from mature trees without cutting them down. Formerly this latter would have been impossible, but new methods of government are being introduced in the Far East, and new results are to be hoped for. Incidentally, it may be mentioned that, while little exact knowledge has come to light respecting the existence of gutta-percha in the Philippines, there have been shipments lately of this material from the southernmost islands. Coastwise lines in Europe and Asia, insulated with india-rubber, have shown good results, after a long test of time. And there are American manufacturers to-day, with considerable capital invested, who are willing to risk their reputation as well as their money in laying rubber-insulated cables if they can only get the orders. It appears that at the beginning there were mechanical difficulties in the way of sheathing wires with india-rubber, which did not exist in the case of gutta-percha, and the contention of the American manufacturers is that new processes have overcome the faults which, forty years ago, led the English cable-works to discard rubber for gutta-percha.

But the question with which this article will deal relates to the sufficiency of the supply of these insulating materials for further needs. Gutta-percha has been described as a scarce article from the year in which it first appeared in the markets. Three years after its discovery on the small island of Singapore the supply there had become exhausted. But with every new demand new supplies have come to light on neighboring islands and in the Malay peninsula, so that it is doubtful if any seriously projected cable was ever postponed for a day through difficulty in securing gutta-percha. And, doubtless, every cable-building company to-day would welcome new orders, without fear of any shortage of supplies or a prohibitive rise in prices.

At the same time, it must be considered on a scale which would indicate that the gutta-percha resources there are worthy of consideration. And mention of the Philippines suggests that all the cables laid there by the United States signal service are insulated with india-rubber.

One more point bearing upon the possible exhaustion of insulating materials is that, while many projects for governmental and privately owned cables are always being considered, it generally takes a good while to get one started. Witness, for example, the laying only this year of the first section of the British Pacific cable, which the Ottawa Conference of 1894 was called to consider.

But even if capital may be cautious to-day about laying india-rubber insulated cables across oceans, on the score that such an undertaking might prove a too costly experiment, enough actually has been done in rubber cable-making to demonstrate its practicability on short lines. As the aggregate of existing cable lines of less than one thousand miles each forms an important percentage of the world's total, it is quite possible that we shall yet see a gradual building of new short lines with rubber insulation, with the result that the pressure upon gutta-percha supplies will be reduced, leaving the material for the longer lines to be constructed hereafter. Meanwhile, the prospect for insulated conductors, as a whole, being superseded by wireless telegraphy does not seem to be so imminent as to discourage further experiments as to the practicability of india-rubber—a cheaper, more plentiful, and now a more easily manipulated material—for submarine telegraphy under the most exacting conditions.

The Efficiency of the Test for Efficiency

By An Expert at the Trick

The American Society of Mechanical Engineers has formulated rules for the testing of various devices, mechanical and other, which are admirably and carefully drawn, but no rules of the kind, however elaborate, can possibly take account of the personal equation of the person or persons conducting the tests. This is particularly true in cases wherein the possessor of the "personal equation" is producing erroneous results. The following are a few examples in illustration of the manner in which this "personal equation" may be used to advantage in boiler trials.

Two methods, known as the standard and automatic, of starting and stopping tests, are recommended by the American Society of Mechanical Engineers. In the former the boiler is fired for several hours before the test begins in order that no heat may be lost during the trial by absorption in the brick-work. All of the fire is then rapidly removed from the grates, the fire recharged with a known weight of fuel, the water level noted, and then the trial begins. At the end of a pre-agreed number of hours the fire is removed from the grates, the water level again noted, and the trial is ended.

This all seems very simple and apparently should gain accurate results. But let us consider how the "personal equation" of the "expert firemen" (he deserves the title) can be used to advantage. He knows a great many things about boilers; that is his business. One of these things is that the brick setting of a boiler will hold quite a lot of heat, and that this heat may be used for steam-making.

He therefore fires as hard as he possibly can for several hours before starting the test in order to raise the walls of his setting to the highest possible temperature. At the moment of beginning to clean his grates preparatory to starting, he has his fires at the hottest point, and a large amount of incandescent unburned coal on the grates, which is raked out with the ashes. While cleaning and re-charging, he closes the damper to prevent an in-rush of cold air from absorbing any of the heat which he has so carefully put in storage, and with a properly organized gang of assistants he can pull out the old fire and start a new one in about two minutes, when the grates are, say, eight feet wide by seven feet deep.

With the damper closed, as stated, but little heat is lost from the brick-work during this interval, and as the boiler is operated at a moderate rate during this trial, the walls gradually give up this stored heat to the boiler, which consequently appears to evaporate a considerable amount of water in excess of what should be justly credited to the fuel weighed during the run. During the last hour of the run, the expert fireman allows the fires gradually to burn out and the furnace walls to cool to a temperature considerably lower than that obtained during the run, thus giving up another moment of heat to the boiler. Meanwhile, by careful nursing, the steam pressure is not allowed to drop below the average, and such is his skill that at the moment when he rakes out the fire, just before stopping, there will be practically nothing but ashes on the grates.

The conditions at the beginning and end of the test, when thus manipulated, are in marked contrast. When fires are cleaned just before starting, the furnace is at its hottest, and a whole furnace full of good coal is raked out. When cleaned at the end of the test, the furnace is cold and almost every pound of coal weighed and charged against the boiler has been consumed to advantage, while the heat stored in the brick-work has been utilized to the greatest possible extent in making steam. Result: a gain in efficiency of several per cent.

Only those who have reduced firing to a fine art can successfully carry out this schedule, so great is the difficulty in burning the fire out during the last hour without allowing the steam pressure to run down, while the rate at which the fuel burns must be timed with the greatest nicety, lest the fire die completely out even a few minutes before the time arrives for the final cleaning.

But this is not the only source of gain in efficiency which the expert fireman knows how to draw upon and does draw upon to his advantage while practicing the trick just described. He knows that when his fires are hot, and the boiler is steaming rapidly, the water stands at a higher level in the drain than when little or no steam is being formed. He also knows that by forcing cold water into the boiler the water level will lower.

The intensely hot fire at the beginning of the test causes the water to rise in the drum, and its level is noted and marked at this time. But during the fifteen minutes preceding the closing of the test, our expert has practically no fire at all on his grates and is consequently making but little steam. He therefore gradually pumps the water several inches above the starting point during the first three-quarters of the last hour of the run, and when his fires are almost burned out, the water level, owing to the small amount of steam being generated, will lower, and he augments this effect by running his pump at high speed. In this way he makes a further gain in efficiency which is due to the fact that he starts with a boiler filled to a certain mark partly with water and partly with steam bubbles, while he ends his test with the boiler filled to the same mark with solid water. By so doing, he cheats to the extent of pumping into the boiler a volume of water equal to that occupied by bubbles at the time of starting; and this may amount to some hundreds of pounds in weight.

Both of these tricks are rendered much easier of accomplishment by having the boiler under test connected to a steam main into which other boilers are feeding, which will keep up the steam pressure while he manipulates matters during the last hour.

Still another source of gain lies in the possible opportunity to store a goodly quantity of coal on the bridge-wall before the test begins, which may be pulled down onto the grates and burned to advantage during the run. A couple of hundred pounds of good coal have frequently been utilized in this way to pull a test out of a tight hole. But it is when starting and stopping a test by the "alternate" method that the expert fireman is in his glory. This provides that the fire be burned rather low, then cleaned and the amount of coal left on the grates carefully estimated; the steam pressure and water level are then recorded and the test started, and this performance is repeated at the end of the test.

Now, the expert fireman can tell, almost to a pound, how much coal is left on the grates after cleaning, while, as a rule, the "expert engineer" cannot.

It is a very simple matter, then, for the firemen to start this test with a fire quite thin at the front, and quite thick, but not too thick, at the bridge-wall, and to end his test with a thin fire in front and no fire at all at the bridge-wall.

If he happens to have a coal which smokes nicely, he gently sprinkles a small quantity of it over the front part of his fire so that its smoke will obscure the evidence of his handiwork at the rear, which same smoke, by the way, also obstructs any view of the coal secreted on the bridge-wall. He can thus "steal" quite a large item of coal from under the very noses of those who are watching him. Besides this opportunity of increasing efficiency, the alternate affords all of those described in connection with the standard method of conducting tests when using flat grates. As to results obtained with certain types of mechanical stokers, which are so constructed that only a portion of the grate can be seen, it would be difficult to estimate the quantity of coal which is frequently secreted in invisible nooks and corners at the moment the test begins.

It is on account of such practices as are here described that the scientific or gilt-edged test has fallen into disrepute among owners and operators of boilers. Not that they have been able to catch the expert at any of his tricks, for he is shrewd, and quickly runs to cover when he finds them on his trail (moreover, he is a good fellow, and sets up beer and cigars to the boys about the boiler and engine rooms, so they don't care to roast him), but after he has gone, leaving behind the tanks for weighing water and other paraphernalia, the chief engineer and manager, if they happen to be of a mechanical turn of mind, frequently conclude to have a try at testing boilers themselves, and the results obtained frequently conduce to more or less pungent remarks by the manager on the lack of skill and intelligence possessed by the engineer and his crew. He would not have complained at a difference of three or four per cent. perhaps, but fifteen to twenty per cent is too much. The engineer is dazed. He cannot understand it, and finally concludes that he has been tricked somehow, while the manager, who keeps a sharper eye on the steam-plant, learns more about that end of the business than he ever knew before, and seeing that the men are really doing good work, he cannot understand it, finally concluding that there was a "nigger in the fuel pile" somewhere.

Well, now you know where to find the "nigger," and that the art of firing can be cultivated to a high science.

American Engineers

Prof. Henry S. Carhart, LL.D

Professor Henry S. Carhart was born in Coeymans, Albany County, N. Y., on March 27, 1844. He was graduated from Wesleyan University, Mich., with the class of '69, and was elected the class valedictorian. After teaching for two years and studying for one year at Yale University, he was appointed to the instructorship in the Northwestern University at Evanston, Ill. In 1873 he was elected professor of physics in this institution where he stayed until 1886, with the exception of the years 1881-2 which he spent abroad in study. He was then appointed to the same chair in the University of Michigan, which he temporarily vacated for the year 1899-1900, when he again went abroad to spend the year in study.

Henry S. Carhart, LL.D.

The course in electrical engineering was introduced by Professor Carhart in 1889.

Dr. Carhart has planned and built two physical laboratories, one at the Northwestern University and the other at the University of Michigan.

He is a fellow of the American Association for the Advancement of Science, of which he was elected vice-president in 1889. He is a member of the American Institute of Electrical Engineers; foreign member of the London Institution of Electrical Engineers, and member of the American Physical Society. He has taken a very prominent part in the leading expositions during the last quarter of a century.

At present he is actively engaged as consulting electrical engineer for the Detroit Public Lighting Commission.

He is the author of "Primary Batteries," 1891; "Elements of Physics, 1892; "Physics for University Students," Part I., 1894; "Electrical Measusements," 1895; "Physics for University Students," Part II., 1896, and "High School Physics," 1902. The elementary books were prepared in connection with Mr. H. N. Chute, and "Electrical Measurements" in connection with Professor George W. Patterson, Jr.

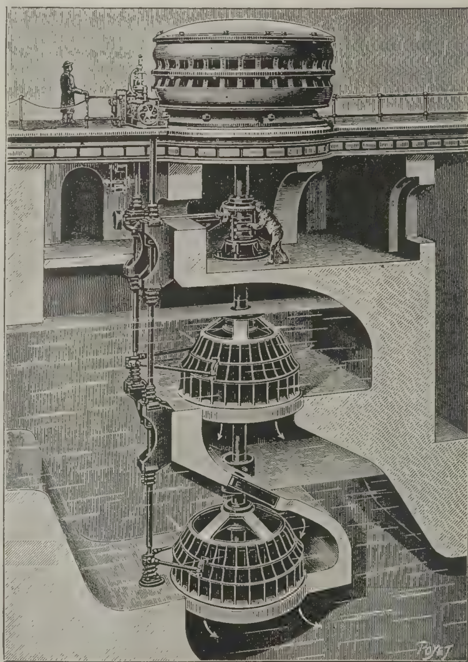
Professor Carhart has published about forty papers on electrical subjects in the American electrical journals, the *American Journal of Science,* the *Journal of the Franklin Institute,* the *Physical Review,* and other English papers.

A Two-Story Turbine Plant

When the city of Geneva established its electrical-generating plant at Chevres-on-the-Rhone its engineers found themselves confronted with a new and difficult problem, because of the great difference in height of water at various seasons. The head of water at Chevres varies from 8.50 meters at high water to 4.30 meters at low water

It was necessary to provide some arrangement which would give constant speed and power for the driving of the generators.

This problem was cleverly solved by building a two-story water station and placing two turbines, one above the other, on each dynamo shaft. The plant has eighteen sets of turbines. Three of these are used for the exiters. These give but 150 horse-power each. The others which operate the generators give a mean output of about 1,000 horse-power each.



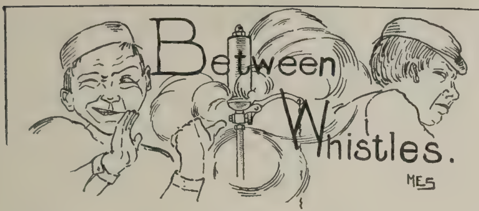
Sectional View of Chevres Turbines in Position.

Of the output of the plant about 5,000 horse-power is used by electro-chemical factories, 4,500 horse-power for large motors and for the maintaining of about 55,000 electric lamps, and about 1,850 horse-power for the running of small motors.

Friends of the Crocker-Wheeler Company of Ampere, N. J., will be pleased to learn that the company is obtaining a very gratifying share of the increase in demand for electrical machinery.

During the greater part of last year it was found necessary to keep a night force at work, and this continuing throughout the winter, a most natural means of relieving the congested condition of the shops was found in an increase of floor space. With this in view a new building is now in course of construction. It will be of brick, 200 feet long and seventy-five feet wide, slow-burning, mill construction, and containing three floors and a basement. The latter will be given up to experimental and standardizing laboratories. The three main floors will be used for the winding department, with the mica cutting, coil-taping and insulating, spool-winding, etc., that goes with that department. A part of the factory office force will occupy a portion of the building, and the rest of the space will contain light machine-tools taken from the main machine-shop. This will permit of further additions being made to the number of large machine-tools the company uses, and enable it to give even better attention to orders constantly coming in for many small units, or for larger units than have heretofore been manufactured.

Mr. William P. Field, C. E., is the architect and engineer in charge.



Workmen who know the kinks of their trades, the tricks played by machines and tools, and ready methods for meeting shop emergencies, are invited to contribute to this department.

Apprentice: Say, boss, that pencil-pusher out there told me to turn the face of this pulley-crowning; why does he want the curve on it?

Mr. Lathe: My son, that man out there in the draughting-room, with the long hair, is a theoretical engineer, and follows closely what is in the books on the theory of crowning pulleys; of course, if the subject were better understood *practically,* there would be very little to write, but you will have to crown the pulley, because the blue-print calls for it.

Apprentice: But why does the blue-print call for it?

Mr. Lathe: Because, my son, from the time belts were first employed the theory was accepted that a belt would run to the highest part of a pulley. It is true that a belt will remain on a crowned pulley, even though it be not exactly in line with its mate; or is widened by a quarter-turn belt; but I would advise you not to inquire too closely into the drawing-room theories, if you want to keep your job.

Apprentice: I should think if you hollowed out the face of the pulley instead of crowning it, the belt couldn't *snake off*. Say, don't you think the pencil-pusher made a break in the picture.

Mr. Lathe: My son, no sane mechanic would contend that a belt will run uphill any more than water would. If this theory were correct, the belt on a cone drive would tear itself apart in trying to climb up to the largest diameter of both cones. However, to have an unguided belt operate properly, *in practice* it is necessary to crown the pulley; but the accepted theory of the draughting-room don't go in the shop; we never dispute these points with the draughtsmen, because they always pull the book on us.

Apprentice: Say, Boss—

Mr. Lathe: My son, the next time you drill holes in copper with a twist drill, try ordinary milk instead of oil, and you will do about four times as much and better work, and avoid breaking drills and tearing up things generally.

Apprentice: But you don't answer my question; do you think a hollow-faced pulley could be patented; do you think it would work; did you ever try it; will I——?

Mr. Lathe: Hold on, young man, you have asked me a half-dozen questions all at once. I will try to answer you if you will keep quiet. First, I have never tried a hollow-faced pulley as you suggest, but I fear that the trouble would be with the edges of the belt. It would seem to me that the edges would turn over or double up, as is often seen in a wide belt if you try to force it off the pulley with a stick while running, and further, because the edges of the belt always stretch more than the center. This of itself tends to increase this edge-stretching until the belt, of its own accord, would double on itself. You perhaps will better understand what I mean by looking at this twenty-four-inch belt. You see the pulley is very bright in the center, at the highest part of the crown, and gradually decreases in brightness until here, six inches from the center on each side, you notice the belt rarely touches the pulley, so that practically six inches of the belt have to do all the work.

Apprentice: There goes the whistle.

Railway Experiments in Germany

Although five months have elapsed since the high speed tests on electric traction over the specially prepared railway line between Berlin and Zossen, no final report of the result has been given out. Individual engineers have contributed to various magazines in both Germany, England and America, interesting accounts of the equipments and methods employed, but nowhere in any of the articles so prepared has any one ventured to predict exactly what would be the actual effect upon railway progress in the German Empire. With this idea in view, United States Consul-General Frank H. Mason, of Berlin, has prepared the following account given below, and though he does not state positively what his opinion is regarding the actual development of the German railways, it will be noticed that he points out concisely what seems to him to be the most advantageous form of transit for given sections of the country.

Consul Mason says:

It will be remembered that in former reports of this series, the experiment were described as being made by a society specially organized for that purpose, which included as members the General Electric Company, of Berlin, and Messrs. Siemens & Halske, each of which firms furnished a motor car of its own construction, and several associated banks, which contributed the necessary capital; that the trials were made after long and careful preliminary study and experiment, and with the expectation of accomplishing a speed of 125 to 150 miles an hour. The trials finally took place during the latter half of October last year, beginning at forty miles and gradually increasing in speed until on the 3d and 4th of November, a speed of 150 kilometers (93.2 miles) an hour was attained. Then the experiments abruptly ceased, for the reason, as it was understood, that at the latter place, the strain on the track and roadbed was so great that they had to be repaired at night, and it was found that the limit of practical utility and safety had been reached with the facilities which were then at command.

The nearest approach to an official verdict on these trials which has yet been made was a paper read recently before the "Verein für Eisenbahn Kunde" (an association of railway experts) by Geh. Baurath Moritz Lochner, an eminent engineer belonging to the Prussian State Railway Administration, and who in the experiments represented the government, which had furnished the stretch of military railway line over which the tests were made. The address is withheld from publication, but, in substance, it confirms the conclusions of the other experts and may be summarized as follows:

The line, 28 kilometers (17.4 miles) in length, was laid with rails of the old Prussian standard, weighing 33.4 kilograms (70.14 pounds) per meter (39.37 inches), resting on metal ties. The track had been in use for a number of years, but prior to the experiment it had been put into perfect repair. At ordinary speeds, everything worked perfectly, and no trouble was experienced with rails or motor cars. The side swaying of the cars was scarcely noticable, not sufficient to cause the slightest inconvenience to passengers. But as a speed of 130 kilometers (81 miles) was approached and exceeded, new and serious conditions were encountered. The rails and ties both proved too light for such a strain, the track began to give way, and the side swaying of the cars increased seriously. The highest speed attained was 160 kilometers (99.4 miles) per hour on two occasions, and, as a result of the conditions then developed, the experiments were discontinued, the net result being that up to a speed of 81 miles an hour, they had been successful and satisfactory.

But as the pronounced purpose of the trials had been to make tests of speed up to 125 and 150 miles an hour, the actual result spread a chill of disappointment among electricians in this country. The trials had, indeed, shown that a polyphase alternating current, carried on triple overhead wires and taken off by trolley, could be introduced at high potential into the rapidly moving car, and there reduced by portable converters to a safe and effective working pressure. The trolleys and the motors—one of which was hung on springs, the other set solid on the axle—worked to perfection. There was left no longer a doubt—if, indeed, any existed before—that, given a sufficient voltage, the current could be "got into the car for any speed that might be desired. From the standpoint of the electricians, therefore, the experiments were technically successful.

The disappointment lay in the demonstrated fact that a large portion of the German railways could not, even if it were desired, be adapted to high-speed electrical traction without being practically rebuilt. While some of the leading lines have been relaid with rails of the new Prussian standard, 44 kilograms (97.4 pounds) to the meter, many of the principal and all the secondary railways are built with rails of the old and lighter standard, which failed so conspicuously at Zossen when the motor car surpassed the speeds which have been approximated in other countries by steam. They are laid to a large extent on metallic ties, which have not proved satisfactory under the severe test of high speed or heavy trains, and the rail joints likewise leave something to be desired from the standpoint of modern improved construction. The Prussian state railways are conservatively and economically managed; they yield a large and steady revenue, which the royal treasury needs from year to year, and it is clearly seen that any scheme of rapid, long-distance transit which would require the state lines to be torn up, their curves straightened, and their track relaid with heavier rails will have long to wait. In fixing a definite limit of safety and utility to the present track system, the Zossen experiments have helped to relegate the hourly high-speed electric express cars from Berlin to Hamburg, Leipzig, and Breslau—which had been so confidently predicted by amateurs here and in America—to a remote and somewhat indefinite future.

It is, perhaps, as a more or less direct corollary to all this, that the German Society of Mechanical Engineers has again taken up the problem, and at a recent meeting voted a series of prizes, viz, 5,000, 3,000, and 2,000 marks ($1,190, $714, and $476), for the first, second, and third best designs for a steam locomotive and train which will be designed to form a unit in a scheme of rapid long-distance passenger service. The prizes are of merely nominal value but the honor and prospective profit of winning one of them will be worth any and everything that the competitive effort may cost. The proposed locomotive and train are to be adapted to the Prussian railways as they now exist. The engine must be capable of hauling a train weighing 180 tons over a straight, level track at a speed of 120 kilometers (74.5 miles per hour, and must be able upon trial to maintain this pace for three hours without stopping. Troughs for automatically replenishing the tank of the locomotive while in motion are to be provided at intervals of 75 miles. The cars are to include in their plan and construction all modern improvements, and to be so designed as to form trains of three or four carriages, each capable of carrying one hundred passengers and their baggage, with full provision for their food, drink, and every necessary comfort during a journey of from five to ten hours. The cars must be so built that they can be run safely over a good track at a speed of 150 kilometers (93.7 miles) per hour. The cars must be planned and built of such material as to minimize the danger to passengers in case of derailment, collision, or other accident. Especial importance is attached to safe, effective, and easily controllable lighting and heating facilities. The drawings and specifications—which are to show clearly every detail of construction, weight, cost and material used—are to be delivered to Mr. F. E. Glaser, secretary of the Association of German Mechanical Engineers, before noon of December 1, 1902, the plans of each competitor being marked with a cipher for identification after the awards have been made. The competition is restricted to German subjects and to locomotive and car builders of other nationalties who are permanently domiciled in this country.

Although it can not be ascertained that the State railway authorities are officially or directly connected with this enterprise, many of them are members of the Society of Mechanical Engineers, and it is well understood that the competition has been decided upon as a reach in a new direction toward improvement in railway service. Four large and important cities—Hamburg, Leipzig, Dresden, and Breslau—besides several smaller towns like Hanover, Brunswick, Halle, Magdeburg, Chemnitz, Görlitz, and Stettin, are within a run of four hours by ordinary express trains, of which there are three or four daily in both directions. If, instead of, say, four daily trains of ten or twelve cars each, running from 30 to 40 miles an hour, the service were divided by day into hourly trains of three cars, carrying 100 passengers, and running 50 to 60 miles an hour, it is clear that the public would be far better and more conveniently served. This much, at least, could be done with comparatively small expense and with but little change in the existing lines, which are generally well surfaced and in good condition. Northern Germany is, for the most part, a vast level plain only a few feet above the level of the North Sea. Over this area, railway grades are generally slight and tracks for the most part straight, level, and well adapted for much higher rates of speed than have yet been undertaken. It is generally assumed and understood that, by one method or another, the facilities for travel between Berlin and the other large cities are to be improved in respect to both speed and convenience. It now remains to be seen which direction — whether through the use of electricity or steam—these improvements will take.

Fluid Clutches and Their Applications

By Paul G. Tismer

One of the most serious problems of early electric railroading was the controlling of the speed of the car. The series parallel system was not then in use, and it was found to be difficult to start a loaded car with rheostat control. An ordinary starting box did very well on a direct current motor (the only motor then used), when starting with a light load, but it was an altogether different matter to get a starting torque of thirty horse power out of a motor rated thirty nominal, by means of rheostat-control. Mechanical means were sought where electrical had been found wanting. Some experimenters kept their motors running at full speed all the time. This drove a pump, which in turn forced water through a water motor, thus driving the car axles. A by-pass was provided between the pipes connecting pump and water motor, and a valve in this by-pass was the means of control. When this valve was opened wide, the pump would be short-circuited on itself. The oil (the liquid usually employed) went out through the pressure side of the pump, through the open valve, and returned on the suction side.

A partial closing of the valve forced part of the liquid through the motor, thus turning the axles. When the valve was entirely closed the car ran at full speed, all liquid passing through the motor. This worked beautifully in theory, and it even worked in practice, but was not economical. The losses by friction, in pump, pipes and motor, were very great, and it made little difference how great the load, or at what speed the car was running, the loss being about the same.

The George Westinghouse device was a great improvement on this by-pass method. Mr. Westinghouse employed two rotary pumps, one as driver, the other as the driven. By arranging one of these as a pump, with a variable delivery —this he accomplished by changing the eccentricity of the pump—he was able to change the leverage and, therefore, the speed. But he still had both pumps running when at full speed. Since electric railroading means the coal-pile in the station on one side, and the number of passengers carried on the other, and since the efficiency is never one hundred per cent, when using the pumping device, as it is in the series parallel system, when running either series or parallel, and all resistance out (the motor itself is not here considered in either case), the pumping device had to be abandoned.

Atwood came forward with a much more promising scheme by mounting the piston of a rotary pump on his car axle and driving the pump-housing with the motor. Only one pump was used, the pressure side being connected with the suction-side by a pipe and valve so arranged that it was manipulated by the car-driver. It operated as follows: The valve was thrown wide open and the motor started by means of a starting-box, the motor running until the car returned to the barn. The valve being wide open, the liquid flowed out of the pressure-side, through the valve into the suction-side, through the pump and out again. The pump being closed on itself, could have the pistons as a driver, and the housing as a driven or the reverse.

To bring the car up to speed, the driver closed the valve gradually, offering a resistance by the reduction of its opening, until, when fully closed, the housing and the piston revolved at equal speed. This arrangement was much better than either of the first named devices, since it had only one pump, and had an efficiency of one hundred per cent when at full speed, the pistons and housing not then moving in relation to each other.

In the mean time, the well-known series, parallel controller, was perfected. It found favor, and the Atwood device was allowed to fall into disuse.

The wide use of automobiles for the past few years has presented many new problems to designers along these lines, chief of these being the control of a vehicle driven by internal combustion engines (gas engines). Unfortunately, at this time, no self-starting gas-engine is made, nor one having a speed range and control like a steam-engine. It is, therefore, customary to start the gas engine empty, by means of a crank, and throw it in with the gears and chains by means of a friction clutch. A slight variation in speed is accomplished by the quantity or mixture of the gasoline or alcohol used as a gas producer.

However, changing of gears is the method most resorted to for changing the speed of the vehicle. This is a cumbersome, noisy apparatus, but is the best available at present. Why not use a fluid clutch? This would require, beside the engine, only one set of grade-climbing gears, a gearing for the reverse movement, and the fluid clutch. Since the experiments of Atwood, others have worked on these lines, and clutches have been built that allow a perfect speed control by simply moving a lever. At full speed, as said before, there is no lost motion between the engine and the axles, and at all other speeds a slippage takes place. The slower the axle, the greater the slippage, until, when the controlling lever is thrown to the extreme of no-speed, the engine drives the pistons, churning the oil idly. It was here that Atwood's machine was lacking. By the use of this by-pass and valve, he obliged the liquid to make too many turns and bend, which is very objectionable in hydraulics. This clutch required too careful an adjustment also. It had no compensation for natural wear. But these difficulties have now been overcome. Fluid clutches have been built which have neither by-passes nor valves, and which are self-compensating in wear.

It must be understood that no increase of leverage can be had with a fluid clutch. It is a matter of slippage only, slippage under control, therefore the efficiency falls off with the speed, having, however, one hundred per cent. at full speed, as shown before.

The fluid clutch heats, and this might be considered a drawback. However, the gas engine also gets so hot that it is necessary to resort to water-jackets for cooling, except for the smallest types. No one has condemned the engine for that reason, since it does the work.

Digest

Engineering Literature of the Month

Electricity publishes an abstract of a paper read before the Southwestern Gas and Street Railway Association at San Antonio, Texas, on fuel oil in power plants, by W. W. Reed. The paper cites an instance of an oil-burning plant at the station of the Houston Power and Lighting Company, and states that one boiler using oil now does the work formerly requiring two coal-burning boilers.

Magnetic Alloys.

Some very interesting anomalies are presented in the magnetic behavior of certain alloys. Thus two and one-half per cent. of nickel in iron hardly affects the magnetic quality, and five per cent. of manganese in steel leaves a strongly magnetic material. But two and one-half per cent of nickel, plus five per cent of manganese in steel, makes non-magnetic steel. Two iron alloys are described as being magnetically superior to soft Swedish iron. One contains two and one-half per cent of aluminum, and the other two and one-half per cent of silicon. The former alloy is said to possess a permeability of 6,000 or to develop a flux density of 12,000 maxwells at a magnetizing force of two. This property ought to be useful in particular classes of magnetic apparatus. Curiously enough, it has been known for years that aluminum added to cast iron in the furnace increased the permeability of the casting; but it frequently happened that analysis failed to reveal an appreciable quantity of aluminum in the resulting alloy. It was, therefore, sometimes believed that the aluminum was valuable more in the breach than in the observance, and was useful in combining with the impurities of the cast iron, by eliminating such impurities in the form of a slag, leaving the cast iron purer and more permeable.—*Electrical World and Engineer*.

British Columbia's Smelting Progress

A long article is found in the issue of May 3 by William M. Brewer, who goes into considerable detail regarding the progress made in British Columbia in mining and smelting of ore in the Boundary district. Prominent features of the article are the accessibility of the district, its geology, character of ore bodies, ore in sight, developments, and values.

On account of the self-fluxing and non-sulphurous character of the ore, smelting costs rather less than two dollars per ton, while the vast deposits of ore enable mining at a cost of not more than seventy-five cents per ton on the surface by the quarry system, and underground by the pillar and stope method.

Four years ago, when the only smelters in the interior were those at Trail and Nelson, coke cost twelve dollars a ton delivered, while to-day the cost is only seven dollars, including freight. Until the completion of the Crow's Nest branch of the Canadian Pacific Railway, Vancouver Island supplied all the coke used in the province, but since the fall of 1899 the supply has been drawn from the Fernie coal mines in the Crow's Nest Pass. The Vancouver Island coke is strong, but high in ash, averaging about fifteen per cent, while the Crow's Nest coke has about the same, if not greater, strength and carries only about ten per cent. ash. The railway haul from the ovens to the Greenwood smelter which is the most westerly plant in operation at present on the main land of British Columbia, is about three hundred miles, while the haul by steamer from Comox, on Vancouver Island, to Vancouver is about sixty miles, and from there to Greenwood by rail about six hundred miles.

In this portion of British Columbia there are several parallel zones of variable extent which are mineral bearing. Deadwood Camp is situated in one of these zones, which may possibly be connected with the zone occupied by Phoenix camp, about six miles in an air line to the eastward. The rock formation is quite difficult to classify, because the alterations from the original rocks has been so marked. Metamorphism, shearing, crushing and faulting, as well as erosion from glacial action, and uplifting from eruptive disturbances, have all left their marks. Apparently the original rock was diabase, but to-day much of the country rock is quartzose and calcareous, while intrusions of porphyry occur in the ore bodies evidently of a more recent period than that during which the ore was deposited. These intrusions appear to have had no effect on the ore, even close to the lines of contact.

Undoubtedly because of the disturbances which caused the shearing movement, an excellent opportunity has been afforded for the deposition of the enormous bodies of mineral which have been discovered, and occur with lenticular structure, usually without well-defined walls and often reaching several hundred feet in length, and upwards of 100 feet in width. Apparently the basic rock yielded the magnetite, which is almost always the gangue in which the chalco-pyrite is found. Through this magnetite, solutions charged with copper must have percolated, depositing as a resultant chalco-pyrite, sometimes in masses of considerable extent, at others in crystals and small particles as impregnations. The deposition of ore is not confined to the magnetite, for the chalco-pyrite is often found in paying quantities in the diabase, associated with garnets and hornblend, the latter sometimes altered to asbestos. Calcite crystals and veins also occur through the ore bodies as well as in the country rock, but in the latter are usually only found, where shearing has made the country rock schistose.

Referring to the Sunset mine, the writer says that there are about 250,000 tons of ore above the one-hundred-foot level and he believes that the cost for mining should not exceed eighty cents per ton. From this and other conclusions and a consideration of the general low cost he believes there is a great future for low grade ore in British Columbia.—*Engineering and Mining Journal.*

Germany's Ore Imports.

The following report is given of the importation of iron into Germany for the year 1902:

From:	Tons.	Per cent.
Spain	1,367,016	42.4
Portugal	2,580	0.1
France	88,157	2.7
Algeria	304,587	9.4
Norway	38,912	1.2
Sweden	1,041,317	32.3
Italy	58,524	1.8
Greece	134,625	4.2
Newfoundland	189,460	5.9
Total	3,225,178	100.0

Importation of manganese-ore for the year was as follows: Russian sent 128,-537 tons; Turkey, 3,840; British India, 9,980, and Brazil, 2,954, making a total of 145,311 tons. Spain sent iron and copper pyrites amounting to 272,754 tons. Nickle-ore came from New Caledonia and amounted to 13,213 tons.—*Stahl und Eisen.*

Therapeutic Action of Blue Light.

A clinical report from Vienna announces the remarkable results obtained by Dr. G. Kaiser in treating human tuberculosis with blue light. In his experiments he has observed that the rays emanating from an electric arc lamp, concentrated on an object immersed in a bath of methylene of a blue color destroyed the tuberculous bacilli in about thirty minutes. The application of this treatment is practicable and the results obtained in the treatment of two consumptives whose malady had reached an advanced stage merely proved the observations previously noted in the laboratory. Dr. Kaiser also observed that it was possible to utilize the same blue rays as anasthetics.—*La Nature.*

Testing Electric Meters in Russia.

Beginning with the first of next year only such electric meters as have been tested and officially approved by the Department of Measures and Weights of the Ministry of Finance will be recognized in Russia. This royal decree will not invalidate types of meters known and used before January 1, 1903, but afterwards rejected by the inspecting board. Such meters will be permitted until January 1, 1908. The tests made by the inspectors will be practical.—*Ex.*

Composite Filament.

A large number of experimenters have been investigating the best means of combining other materials with carbon for the improvement of filaments for incandescent lamps. The success or otherwise of these inventions can only be determined by years of trial, but in a good number of instances results have been obtained which point to considerable improvement being possible from admixtures. We understand that Mr. F. de Mare, of Brussels, proceeds on somewhat the following lines in the manufacture of the new filaments which he is turning out. He first prepares a core of magnesia, tar, and carbon. Through this filament a current is passed while it is exposed to the air. The consequence is that all the carbon is burnt off, leaving a hard surface of magnesia. The next process is to flash the filament in a hydrocarbon vapor, which results in the deposition of a layer of carbon on the outside of the magnesia. This is said to furnish an exceedingly strong filament, and one which gives a good efficiency. We have not, however, yet heard what average watts per candle are obtainable with lamps equipped with this new composite filament.—*London Electrical Engineer.*

Karlsruhe Electricity Works.

A new generating station has been recently established by the municipality of Karlsruhe, Baden, Germany, and three-phase high-pressure current is being distributed. The generating plant itself consists of three steam-alternators, space being allowed for a fourth. Each machine is of 560 kilowatt capacity and operates at fifty cycles and 4,000 volts per phase. Six boilers are provided, each having 2,600 square feet heating surface, of which 600 square feet are superheater surface. The boiler pressure is 140 lbs per square inch, and the steam is superheated to 480 deg. F. Two electric pumps lift the feed water from a sunk well to the filters, from which it flows to two tanks, each of 10,000 gallons capacity. Steam feed pumps supply the feed water to the boilers through feed-water heaters.

The engines are of the horizontal tandem compound type, supplied by Messrs. G. Kuhn, of Stuttgart, and each is rated for an output of 600 horse-power normal, and 760 maximum at ninety-one revolutions per minute.

The three-phase generators are of the

flywheel type, direct coupled to the engine, and separately excited from overhung dynamos. The magnet-wheel weighs thirty-four tons, and carries sixty-six poles, wound with rectangular copper tape. The variation in angular velocity is not greater than 0.3 per cent and the generators consequently run well in parallel. The exciter is wound for about seventy volts, and its armature can easily be drawn off the main shaft. The construction of the generators is especially designed to give free access to all parts of the winding and the lower half of the armature winding can be easily inspected from the alternator pit. If necessary, the whole frame, after being fixed to the magnet-wheel, can be rotated so that the lower half is open to inspection from the engineroom floor.

The cables from the alternators are led into a chamber reserved exclusively for all the high-pressure apparatus, where plenty of space is allowed for the fixing of "live" parts at a safe distance from each other and from the framework. Special attention is given to the high-pressure fuses, and each is separately enclosed on three sides in a glass and porcelain case to prevent the damaging effects of an arc. The cases are open only to the front, to allow for replacement.

The generating plant is controlled from the main switchboard in the engineroom, on which no apparatus has a higher voltage than 120, this being also the pressure of supply. The transformers for the ammeters and voltmeters are placed in the high-pressure chamber. No measuring instruments are provided for the exciters; their regulators are fixed on the generator panels. To facilitate the paralleling of the alternators, the governors of the engines can be separately regulated by means of small electric motors, operated from the generator panels; also, by means of a mechanical coupling, all the governors can be regulated together from the centre panel. Under running conditions, therefore, the attendant has only to watch the centre panel—the voltmeter which shows the pressure at the distributing points being fixed on this panel —and need only give attention to the generator panels when starting or stopping one of the machines.

The feeders are taken from the bus bars in the high-pressure room, each feeder having a separate panel equipped with the necessary instruments. The feeder network consists of two complete ring systems, one for lighting and one for power, each ring feeding two distributing points. Two of these points are in the town, and two on the harbor (Rhine), and from these points branch off the high pressure distributing cables to the transformer stations; forty miles of cables in all have been laid down.

Coming now to the transformer plant, five of the transformers are underground; forty-four are in towers above ground, thirty-six throughout the town, and eight on the harbor, and ten are in private houses. In all, seventy transformers are in use, varying in output from fifteen to fifty kilowatts.

In the interior of the transformer tower three switchboards are arranged in the form of a triangle, and the tower itself can be revolved, so as to give access to all the gear, one door only being necessary. This door opens opposite the low-pressure board, and the tower can then be turned into the second position for the high-pressure gear, and to the third, which allows for easy inspection or replacement of the transformer. The great advantages obtained by this simple arrangement are at once apparent, as regards both safety and convenience. The disposition of the plant in the other transformer stations is on the same lines.

A system of connecting boxes is in use where the low-pressure distributing cables cross each other, so that if a breakdown occurs in one of the cables, its effect is greatly reduced by disconnecting this cable, and connecting to the other.—*London Electrical Review.*

School and Club Rooms For Elevated Railroad Employees in Chicago.

An instruction and reading-room for the benefit of its employees has recently been established by the Northwestern Elevated Railroad Company, of Chicago, on the top floor of its office building, which is situated above the car-barn and repair-shop at the northern terminal of the road.

The room is fifty feet wide and sixty-five feet long and has windows on the east, south and west sides, affording an abundance of light and also splendid views of Lake Michigan, Sheridan Park, and the surrounding fine residence district. In this room have been provided writing and reading tables, the latter being well stocked with current files of the principal electrical, mechanical and railway papers, as well as many of the popular magazines. Copies of all the bulletins and orders for the employees are also kept here for reference.

The principal feature of the room and the one that will unquestionably prove to be most valuable to the employees, as well as to the company itself, is the equipment provided for giving air-brake and electric instruction to the men. The apparatus is situated in the northwest corner of the room and the general arrangement is shown in an excellent illustration. A dummy car, seen at the center of the picture, is mounted upon a platform so that the brake apparatus may be easily viewed. Only the car equipment up to the car floor is provided, as the body portion is not essential for instruction purposes. A complete air-brake equipment, corresponding to what is regularly provided on the Northwestern company's motor cars, is mounted on the dummy car. The two wheels on each side of each truck are represented by a single wooden wheel, and the brake shoes engage with the opposite sides of this dummy wheel as if each side represented a wheel. As a further help to simplify the apparatus, an old-style brake gear connecting the cylinder with the brake beams has been used. This is much simpler in action than the more complicated gear used on the motor cars, and as its principle is the same, serves the purpose better.

The remainder of the dummy-car equipment comprises a main train-line air reservoir and a car air-tank. An air-gauge is mounted above the car floor so as to show at a glance the condition of the air pressure in the two tanks. This gauge is not provided in the motor cars and is used simply as a means of instruction. Supported on a stand at the right of the dummy car is an air-tank and cylinder, such as are used on one of the trail cars of a train. The piston of the cylinder, instead of being connected to a brake gear, is stopped in its outward movement by a wooden block.

About twice every week R. B. Stearns, superintendent of the Northwestern Company, takes five or six of the motormen and gives them an hour and a half of instruction on this apparatus. The action of the air-brake, the motorman's valve, the triple valve and other features of the braking system are clearly and thoroughly explained to the men and then they are allowed to ask questions. About a week afterward they are examined by Mr. Stearns and if found conversant with all the features of the system and competent to handle a train they are given a certificate which is good for a year. At the end of that time they are examined again. All the old motormen of the company are now being examined in this way, and whenever a new man is employed he is required to pass a satisfactory examination before he is allowed to take charge of a train.

After the air-brake instruction is over the men are given an explanation of the electric controller and shown how the different connections on the motors are obtained by means of the banks of lamps. They are also shown the interior construction of the controller, how to operate it in order to prevent damaging arcs and how to repair a broken contact or other trouble that may arise. In general, the learner is made thoroughly familiar with the whole motor-car and train equipment, so if an accident happens he knows where to look first for the trouble and how to repair it after it is found.—*Western Electrician.*

References:

Electric Elevators, Electric Hoists and Telpherage.

A serial article made up of papers and the discussion of them at the one hundred and sixty-fourth meeting of the American Institute of American Engineers.—*Electrical Review, N. Y.*

The Quebec Bridge.

A well done description of the new cantilever bridge over the St. Lawrence River near Quebec. Seven illustrations. —*E. A. Hoare, C. E., in Canadian Engineer.*

Water Power Development.

What has been done in improving and modernizing the plant at the Shawinigan Fall.—*Ibid.*

Current Engineering and Scientific Notes

ABSTRACTS FROM THE FOREIGN PAPERS

Cosmogonic Electrical Phenomena.

Revue Scientifique.

Mr. Michael I. Skvortzow, in a recent contribution to this paper, considers at some length that electrical energy originally played an important part in the history of the earth, and that heat energy has become more and more important in proportion as the earth has assumed a more material form, so that the more its energy has passed from the dynamic to the static form, the greater has been the absorption of dynamical energy in overcoming resistances. The author attributes the heat of the earth to electric currents circulating mostly near the surface; the interior of the earth, on the other hand, he thinks may be as cold as the greatest depths of the ocean, says the *Electrical Engineer*. Changes in the aspect of the earth, as well as meteorological phenomena, he attributes to electric currents induced by solar influence. With regard to temperatures of different planets, the author holds that these depend less on their distance from the sun than on their reserve of energy, and on the currents which the sun induces on them by virtue of their axial and orbital motions.

Reduction of Tantalic Acid in Electric Furnaces.

London Electrical Engineer.

Tantalic acid has always been regarded as infusible and non-reducible by carbon, and it has remained for Professor Henry Moissan, the French experimenter, to discover that not only is it reducible in the electric furnace, but that the metal tantalum, or, as it is more commonly called now, columbium, is thereby obtainable in a nearly pure state. To this end the tantalic acid is agglomerated into cylinders with sugar-charcoal, and after calcining is placed in a graphite crucible, which is heated in the electric furnace. The temperature must be very high in order to melt the metal after it has been reduced. A current of 800 volts and sixty amperes is used, and after the mixture has been heated for about ten minutes the metal is separated in a fused state, and upon cooling has the appearance of a brilliant metallic mass with a crystalline fracture. It is said to be nearly pure, and in some cases contains only five-tenths per cent of carbon. The cast metal is quite hard, and will easily scratch glass and quartz. It is not fusible in the oxyhydrogen blowpipe, but in this case is transformed into tantalic acid. To melt it in the electric furnace requires the use of a very powerful arc. The density of tantalum has been found to be 12.79, while powdered specimens have shown a density of between 10.08 and 10.78.

Negative Boosters to Diminish Earth-Currents.

Elektrotechnische Zeitschrift.

Herr Ziehl recently related a series of interesting experiments by himself on Kapp's system of inserting negative boosters along an electric road at various places to diminish the earth-currents. Without detailing too much, it may be said that the booster used with alternating current is a simple transformer with bifilar windings. In other words, the ampere windings act against one another. In the experiments, which were conducted in the laboratory, non-inductive resistances were used to represent rails and earth. An English contemporary, in commenting on the article, says that by varying the number of turns in one winding of the transformers, and hence also the ratio of the numbers of turns of both windings, the author obtained the following interesting result. According to the value of the ampere windings acting against each other, the E. M. F. induced in the transformer winding may be positive or negative—*i. e.*, producing or consuming volts; volts are always produced in that winding the ampere windings of which are overcome by those opposed. It follows that by properly choosing the ratio of the turns of both windings, it is possible to make the earth current either positive or negative or zero. The author concludes that such transformer boosters, as they need no attendance, would be very suitable for alterating-current railways.

Incandescent Lights.

London Electrical Review.

In an article on this subject in a recent number of *Der Gastechniker,* Mr. G. Rothgiesser mentions that electrical vibrations exercise a favorable influence upon the mixing of gas and air in the incandescent burner. The same is the case with sound vibrations, which bring about a considerable increase in the illumination of a burner in which the gas supply is in excess. It is conceivable, therefore, that it might be advantageous to construct burners with some arrangement for producing artificial vibrations. In the same manner that electrical vibrations affect the thoroughness with which the gas and air mix, the light waves, the author thinks, also may act. This action, perhaps, may afford an explanation of that capriciousness in illuminating power of the incandescent gaslight which has hitherto not been accounted for. Great differences in the illumination given off by an incandescent gaslight are likely to be obtained according to whether there are or are not sound vibrations permeating the room, and it follows that the reflected light and the temperature of the apartment in which photometric tests are made must be taken into consideration in future.

The present studies were made from the records of nine different voices, securing enough variety, it is believed, to eliminate from the results conclusions based on peculiarities of utterance that are merely individual. The waves were measured under a microscope, with appropriate attachments. As a result of his observations, the author defines the American "a^{ϵ}" as consisting of the following acoustic elements: First, a chord-tone more or less strong, according to the amount of reinforcement which the mouth cavity gives it, varying within great range. In general it is quite strong below 200 vibrations to the second, and weak between 250 and 600, above which last point it becomes very strong, coinciding with the lowest observed mouth-resonance of the vowel. In the second place, he finds that a characteristic "a" resonance in the region of 1,550 vibrations to the second is always present, but not absolutely stationary, because the vowel may tend more or less toward "a" or toward "e," with endless nuances. This characteristic resonance is not a particular point, but covers a considerable region. His third conclusion is that there is a strong resonance at one or two lower regions centering in 650 and 1,050 to the second respectively. Both may be present, but one at least must be Great individual variation is shown in the relation of these resonances to each other and to the fundamental. The characteristic "a^{ϵ}" resonance at ("c^{a}") 1,550 largely determines the vowel character, but it must receive "body," so to speak, by one or more reinforced lower tones. This gives to the ear a certain fulness or openness which it requires, setting it in sharp contrast to the thinness of "i" (as in pique). From the information given by the author it is apparent why all "a$^{\epsilon}$'s" whether pronounced by man, woman, or child, are heard by the ear as a unit sound. There is a large element which is substantially a constant. The very able chord-tone does not disguise the identity, for the ear has learned by long practice to dissociate this form from the function of vowel-differentiation. On the other hand it is equally clear that no one "a$^{\epsilon}$" is ever quite like any other, and that, without isolating the essential characteristics of the vowel, there is room for infinite variety of individual utterance. Not the least important deduction which this careful investigation would appear to warrant is that it will be practically impossible to decipher a record of speech from the photograph of the sound vibrations.

Electrolytic Estimation of Iodine.

London Electrical Engineer.

Mr. Erich Müller, in a recent paper on the electrolytic estimation of iodine in the presence of bromine and chlorine, shows that when an alkaline or neutral solution containing various haloid salts is electrolyzed, the iodide is quantitatively converted into iodate, which can be estimated by treatment with potassium iodide and titration with thiosulphate. To prevent the reconversion of iodate into iodide, the electrolysis is carried out in the presence of a little potassium chromate, which must be allowed for when titrating. The cathode used was a gauze of platinum wire 10 cm. long and 0.5 cm. thick, the anode a piece of platinum foil 14 cm. square and platinized on each side; a current of 1 ampere for one and one-half minutes is employed, and the E.M.F. must not exceed 1.7 volts or some bromide will be converted into hypobromite.

Formation of Ozone by the Electric Discharge.

London Electrical Engineer.

This subject was recently studied by Mr. A. de Hemptinne, who has now published his conclusions in the form of a paper. He finds, as a result of his research, that the amount of ozone produced by means of the electric discharge varies greatly with the distance of the tinfoil plates from one to another, and with their size. It is not proportional to the amount of air passed in a given time, and the pressure has apparently little influence. The intensity of the electrical current has also a very considerable influence on the amount of ozone formed, a current of low potential and high density being more advantageous than one of high potential. For a given value of electrical energy, there will be a given value of those different factors for which the formation of ozone is a maximum. The increase in the amount of ozone by employing oxygen instead of air is not sufficient to justify its use from an economic standpoint.

By-Products the Dividend Earners

By Charles A. Lieb

Central electric power-stations being so very modern, and those in control of them being so much more than occupied in endeavoring to keep the business offered, that the conditions are not comparable with and are quite different from those of any other large financial undertaking. Central stations are constantly being torn down and then built up. This has occurred time after time, and the great stations now going up in New York for the electric light and railway companies will probably scarcely be in operation and running on a successful money-making basis before being abandoned for economical reasons. Why should not new stations be built directly at the mines, or power be transmitted direct from hydraulic-plants like those at Massena or Ramapo, both of which are within commercial distance of the city? The central station has been scrapped, or thrown into the junk-heap, on an average of once every six years, although the period of successful electric lighting business has been hardly more than twelve years. This condition is one financially impossible in any other business enterprise, but so constant have been the improvements in apparatus, all looking toward more economical production of current, that only in small towns, where the plant originally installed was equal to an increased demand, have any efforts been made to utilize the investment to its maximum capacity by the manufacture of by-products during the hours when the station-load was low.

In large coal-burning stations, especially, the maximum load is carried approximately only four hours out of the twenty-four, but in spite of this it is necessary to maintain a full crew at all hours, regardless of the amount of current output. This, it will readily be seen, involves a steady loss and is a drain on the resources of the company operating the plant. Any means of earning money outside the sale of current should be utilized, thereby effecting an economy of general operation, which is ineffectual if the fixed charge kills it. No matter how large the territory is in which the station is located, all charges should be kept at the minimum. If the consumer receives the benefit of, say, one-half the saving and current is sold at a reduced rate, competition is discouraged and dividends increased, which is safer from an investment point of view than an exclusive franchise.

Beginning at the construction of the plant, the outlay for land in a large city is always heavy, and in New York this is especially the case, as the modern stations call for river-frontage property. Many mistakes have been made in selecting the locations for power houses and in the treatment of the properties so as not to suffer serious losses when they had to be abandoned for operative reasons. The cable building of the Metropolitan Street Railway Company in New York is a striking example of all around good judgment. It is now abandoned for use as a central power-station, but the building itself is a thoroughly modern office structure and no doubt a dividend-earner on its own basis. It is but natural for the members of a corporation to take into consideration the increasing value of real estate, when planning to erect a new station. This fact is frequently considered of such great importance that an old building will be destroyed and the land alone sold for more than the original cost of both building and land, but how much wiser it would have been in the first place to have erected a building which could be used as a factory or office, with the ground floor or basement devoted to the station. The station building might have a height of, say, fifty feet between floor and roof, with an independent fire-proof roof. Above this a towering office-structure can be built, and the complete steel and stone building used for manufacturing or other revenue-earning purposes. To the hypercritical engineer it might seem perhaps that this fireproof roof, being independent, and having such a slant as to drain well, would be a decided disadvantage, and the structure above impracticable. This, however, is a matter easily taken care of, for a level floor could be built above the roof and apertures left in the side of the building to allow the drainage to pass off; little space would be lost and in case of a fire and the consequent pouring of vast quantities of water into the superstructure, the central station could continue to operate steadily without any danger of flooding or loss. The fireproof roof should be so designed that a collapse of the entire superstructure would in no way endanger the station proper.

A building of this nature would not only be a radical departure from methods now employed, but would also be a very important asset to the company owning and operating the central station. In fact, taking into consideration the very high office rentals now demanded in our large cities, it is possible that the floor-space of such a building would account for a large proportion of the total expenses of operating the station. The adjacent property would also increase in value, and this would steadily aid in raising the value of the station property itself in many ways.

Perhaps objections would be made to this class of building from a purely aesthetic or sentimental point of view, and also as regards ventilation, coal-handling, etc. These latter points are easily met and disposed of by capable engineers, and when the matter is thoroughly sifted, the sentimental objections will be found to fall very flat. As an example of this take the great building of the Metropolitan Street Railway, at Broadway and Houston street in New York city, which formerly operated the great Broadway system from the Battery to Fiftieth street. How many people who have passed through or by that building were aware of the fact that a plant of the first grade and size was continually in operation in the basement? Are there any smells in that building—smells of coal dust, oil, or the sickly odor of greasy steam; is there any noise or dirt? Surely, that building is as clean, as noiseless and as odorless as any building on Broadway. In fact, from the standpoint of the practical man it is an adornment to the street, being good to look at, and is also a very decided and satisfactory money-maker on account of the stores and offices which entirely fill it from the ground floor to the top story.

Central stations which are located in busy portions of a city should be advantageous as depots for the delivery of artificial ice, which can readily be manufactured in connection with an electric lighting station and for considerably less than one dollar per ton, laid down in the store house or delivered on board wagons. Fixed contracts can be made with responsible ice companies to take the entire output at about two dollars per ton. In connection with an ice-plant a cold storage warehouse could be operated in the superstructure, and at a good profit. A feature of this which is striking and extremely practical is that the refrigerating and ice-making plants would permit of a cutting out of the power required from the electric light circuit for as long as four hours at a time without inflicting any serious losses in the ice-making plant. The central station superintendent can easily see the additional insurance which extra plants of this nature in the power-station building would give him, and he will be the more ready to take to the idea on considering that he can switch off his power from the motors that operate his refrigerating pumps and compressors without giving the public notice that he is in trouble, and, in fact, without doing any serious damage or causing any loss of an appreciable amount, either to his ice-plant or lighting circuit. As a rule, the station troubles last only a few minutes, especially if the lighting-load can be promptly and materially reduced. It requires about four horse power for twenty-four hours to produce one ton of artificial ice, so that if a five-hundred-ton daily capacity ice-plant were installed, the switchboard operator would have in this case practically a storage reserve for immediate use on his main lighting circuit of about two thousand horse power.

It was not intended in this article to go into the details of making artificial ice or any of the many other of what are called, perhaps for want of a better name, by-products. The purpose was to suggest the wisdom of providing for the profitable use of a central station building from the first and later to deal with these matters in detail. It is confidently believed that important power customers can be secured in a great city who will use power only at such hours as are named by the lighting company and that these can be served at a price so low that the Niagara water power could not compete. For instance, if a large consumer for current could be secured who would agree to use power only between the hours of midnight and eight o'clock in the morning and on Sundays, the rate at which power could be sold at a profit is surprising. Indeed, this might be called another by-product. The subject is almost inexhaustible; the central station manager has barely scratched the surface. Many questions remain to be solved, such as the heating and lighting of large buildings, hotels, etc. Electro-chemistry and many other applications should be taken up from time to time, and though the problems incident to such subjects may not now be solved, there is every probability that their open consideration and discussion will result in much advantage to station operators.

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PUBLISHERS' NOTICE

THE ELECTRICAL AGE for June greets its readers in a new form and a new dress. These changes are, however, of minor importance as compared with the wider scope of the magazine now inaugurated under the present management.

Since THE ELECTRICAL AGE was founded in 1883, remarkable changes have taken place in commercial and financial fields. The tendency of the time is toward consolidations. Electrical interests no longer stand by themselves. The trend of events is toward the consolidation of electric lighting plants with gas properties, and the street railways and the absorption by financial interests having a community of interests of each and every one of the corporations which cater to the general needs. This is particularly true in the larger cities.

The present owners of THE ELECTRICAL AGE believe that its field should be broadened to cover all of these closely related interests. With this in mind and with the paper conducted by men of practical experience in the building, operating and financiering of corporations and the conducting of industrial enterprises, as well as versed in science and mechanics, it is believed that THE ELECTRICAL AGE will come nearer to filling the ideal of a trade periodical than any now in existence.

It is the purpose of the publishers of THE ELECTRICAL AGE to make a magazine which shall give to the financier, the street railway manager and the officials and managers of the electrical lighting and gas companies, all the most valuable and interesting news of their businesses; to combine with this, papers from leading men in each department upon various technical problems; to retain, in fact, all the most valuable features of the trade journal.

But, it is also the design of the publishers to break away from trade traditions; to have every article written in terms which the layman can understand and to make every article interesting to the general reader.

It is intended to make THE ELECTRICAL AGE valuable to the men in the shops, to the linemen and the men on the cars, to those who manage the dynamos and engines at the central stations and every other workman in the electrical field who desires knowledge, as well as interesting to the men who manage and direct our public utilities.

The Telephone and the Sky-Scraper.

In considering the various phases of city life in this twentieth century, several things stand out with striking prominence from the curiously jumbled background of which they form an integral part. We are essentially a busy people. No other nation can grasp fully the swing and the stride of our giant enterprise, because they lack the first principle of such understanding, a true concept of what a "day's work" means to an American business man. Even Germany, our most aggressive competitor, seems unable to put into ten hours much more than a half or three-quarters as much as we can put in them. And so we prosper and forge ahead.

Of all the influences at work to-day for promoting ease and luxury, electricity, with particular reference to its applications in railway, telephone and telegraph matters, stands easily foremost. And of the three, the telephone is the most powerful. To its distance-annihilating magic may be credited the existence of many great and powerful businesses. It has come to be an important if not almost a vital factor in the cities' home life. Its active place in the daily routine could not be replaced by any other instrument of like size and practical utility. In New York city alone there are eighty thousand stations under the control of one company, and perhaps a fourth of these are situated in other than places of business.

Manhattan Island is divided by the local telephone company into precincts or districts with a central station in each. Turning to the familiar Cortlandt exchange or central station, let us consider what would happen if, for the brief space of one day, it were cut out and could give absolutely no service. Practically all the "snap-shot" financial business of the city would be at a dead stop within ten minutes. Then the ticket offices and express companies would feel the paralysis stealing rapidly over them with numbing force and restless impulse. Frantic brokers, unable to get advices, would weep and laugh hysterically, curse, tear up to the telegraph instruments—and find the hastily scrawled notice posted above them: "Owing to pressure of business, no rush messages will be accepted." Then the newspapers would feel the icy grip of silence, and next morning four pages would appear where there formerly were fourteen.

And if the exchange named, or, for the sake of argument, all the instruments below the City Hall, should be cut out or in some other way put out of business, the matter would become one of the gravest moment. Suppose such a case: how is the volume of business now transacted by telephone to be done? Must the tenant in a twenty-seventh-story office in the great Syndicate building come out and walk down to Bowling Green to talk to a customer on the twentieth floor of that sky-scraper? He will send a messenger, is the reply. Very well; would he? Taking three of the large office buildings below City Hall as averaging ten thousand calls apiece daily, divided equally between incoming and outgoing messages, and figuring an average of approximately one hundred and fifty thousand calls a day for the district named, and we have a basis on which to consider the justly famous A. D. T. boy, the leaden-footed Mercury without wings. Each of the three large buildings has ten elevators. The average number of trips per hour is about fifteen, a round trip being made in four minutes, and the passengers carried, five. This gives a total of about twenty-four thousand passengers carried a day under normal conditions. Each building also has about ten thousand telephone calls per day. Accordingly, should that efficient instrument, the telephone, be cut off, the elevator service would have to be considerably more than doubled. Fifteen thousand incoming boys and fifteen thousand outgoing boys in three buildings! They could not get into the buildings, or, if in them, they could not get out. Side streets would choke up, traffic in the usual highways and byways of commerce would cease, giving place to the blue-coated army. Tremendous inconvenience and even great financial loss would result—but how the Italian push-cart men would profit!

Going a trifle farther into the matter we may consider, leaving the question of elevator capacity out of the issue, the one hundred and fifty thousand calls a day for the entire district. There are not one hundred and fifty thousand boys in New York to-day available for messenger work, but supposing that there were, they would make a carpet for all of Broadway from the new site for the Custom House to about Astor Place. Strung out so that one lad's outstretched fingers touched the heels of the one before him, and allowing each one a total length, thus placed, of five feet six inches, the vast army, bigger than the combined forces of the Confederacy and the Union at the famous battle of Gettysburg by several thousand, would reach from the Grand Central station in New York city to a point three miles north of Albany. Marching in columns of fours, as in usual parades, it would take the boys—provided they marched at regular speed, made no stops, and had no distracting novels to worry them—about fifteen hours to pass a given point. But if they were allowed to run loose in Broadway without let or hindrance during the working hours of a business day, traffic of all kinds would be instantly ended. Street cars, cabs, vehicles of all sorts, general pedestrians and everything else would be stopped by the seething jumble of the boys in blue, who themselves would be unable to do more than move a foot an hour, if so much. Not only in Broadway would this be true, but in the side streets also.

Should such a telephoneless condition ever eventuate—and we may well hope it never will—the whole nature of public and private life would be totally changed in a miraculously short space of time. It is true that though the telephone eases business pressure and makes life better worth the living for all of us, it also creates pressure and causes conditions of life peculiarly its own, for where there is no telephone there is no rush. Northern China, for instance, is not in a hurry, is never very weary and always ready to put off duty. Much of Mexico jokes with to-morrow and blarneys to-day, smoking the inconsequent cigarette of blissful idleness and calm indifference to mere trite conventionality in the shape of work, and these peoples, in their ignorance, smile in contemptuous good humor at the innocent little instrument that enables us to cram forty-eight hours' work into ten, and go home at night too tired to eat or sleep with comfort. A telephoneless Arcady may be delightful, but it is not *au fait* in America or its metropolis.

General panicky conditions in the stock markets, spasmodic jumps in the prices of food, heavy profits for shoemakers, the probable loss of millions of dollars to the newspapers, a vast army of former employees out of work and desperate, a quadrupling of the present heavy city and local mails, still more congestion of traffic on the Brooklyn Bridge and the various ferries than now exists, and the rapid fall of rents in the lofty office buildings would be the consequences of partial telephone paralysis in New York city. And "yellow journalism" would be impossible.

It will be seen from this somewhat fantastic sketch that the sky-scraper exists only by aid of the telephone. Rapid-fire business has become so large a part of our commercial life, during the past ten years, that to men engaged in it the telephone is an imperative necessity. Having also to be within easy striking distance of certain definite points, like the banks and exchanges, better accommodations were demanded. These are the conditions that led to the erection of such buildings as the Park Row or Syndicate, Broad-Exchange and many others which, without the telephone, would be as impossible as it is to enjoy a trip in the trolley across "the bridge" during rush hours.

As a prominent engineer said to the writer recently: "Oh, yes, I know. Telephone's a great thing. But how much devilment can be charged to it?"

The Atlantic Cable

BY WILLIAM J. LAMPTON

Oh, link of language
Long drawn out,
Oh, thread of discourse
Spun between two lands;
What wondrous thing you are,
Down, down upon the nether edge
Of ocean's deeps,
As silent as the silentest,
And faster than the flight of time,
Yet carrying to one half the world
The story of the other half,
And linking every race
Into a chain
Of common circumstance
That unifies mankind.
Time was,
Before you had annihilated it,
When every corner of the earth
Kept to his own,
And made of man
A thing apart,
Dissociate from his kind
In all those human happenings
Which make the world akin.
Then came the Cable:
You and Cyrus Field
And that great ship;
And straightaway,
Every corner of the earth
Drew near the others,
And, as the sun rose
On its circling course,
A girdle of "Good Mornings"
Was greeted round the world
For man, through you,
Was neighbor to his fellow man,
However distant, or remote.
Hung on a tenuous filament,
Beneath the waves,
Two continents
Touched hands and hearts and lips,
In words of sorrow
Or of joy,
While yet the tear was warm,
The smile was new,
And all of humankind
Became as one community.
You bear the spark
That lights the march of news
Around the globe,
To fill the gap of knowledge,
But when you came,
The first fast link
That made an endless chain
Of common news and interests,
The world went forward at a bound,
But not ahead of you,—
As yet,
So near the infinite are you
In wonderful accomplishment.

The National Electric Light Association

Twenty-Fifth Annual Meeting

On Tuesday morning, May 20, the twenty-fifth annual convention of the International Electric Light Association was opened at the Grand Hotel, Cincinnati, Ohio, with the annual address of the president, Mr. Henry L. Doherty, and an address of welcome by General Andrew Hickenlooper, of Cincinnati. Mr. Frederick Nicholls responded to General Hickenlooper, after which the business of the session was begun.

Mr. W. E. Moore, of Augusta, Georgia, presented a paper on the "Treatment of Poles with Creosote Oil and Other Compounds." In the discussion that followed, Mr. Moore's opinion on the advisability of this method was freely discussed and the general conclusion arrived at was that for cedar, spruce and pine poles, such treatment was advisible. Mr. Moore's attention was called later on to the method of treatment used in the Philippine Islands where it is necessary to set the poles in several coatings of clay-like matter or cement to protect them from the white ants. His response to this suggestion was that he believed that the method employed in the southern states for making the pole last longest was to set it in cement, allowing it to slope above ground in pyramid form to a height of about two feet. After Mr. Moore, Mr. Fred W. C. Bailey, of Columbus, Ohio, was heard, his paper being entitled, "Performance of the Present 220-Volt Lamp." After this paper and its consequent discussion, the report of the committee on Standard Rules for Electrical Construction and operation was filed and the meeting adjourned.

On Tuesday night over three hundred delegates from various parts of the country had resigtered and the hotel presented a brilliant scene. Through the efforts of Mr. Russell Spaulding, General Manager of the International Electric Improvement Company of New York, the foyer and façade of the hotel presented an appearance not unlike that of the electrical building at the World's Fair. The famous Elblight cables were strung from the centre of the rotunda in festoons to the wall; outside, on the façade of the hotel, similar cables ran from a brilliant crown on the roof in graceful curves to the corners of the building. The major portion of the evening was taken up by a smoker and reception. Many of the members had their wives with them and the hospitality of the Cincinnatians was thoroughly enjoyed by all, special committees having been appointed to provide suitable entertainments for the ladies.

On Wednesday morning at ten o'clock the convention reassembled and the business of the meeting was continued. Mr. B. A. Behrend, chief engineer of the alternating current department of the Bullock Electric Manufacturing Company, of Cincinnati, and Mr. Charles F. Scott, chief electrical engineer of the Westinghouse Electric and Manufacturing Company, of Pittsburg, presented a joint paper on "Three Phase vs. Two Phase for City Distribution." The discussion that followed was highly interesting and many points of importance were developed. After dinner Dr. F. A. C. Perrine, president of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., and Messrs. L. Denis, Quebec; P. N. Nunn, Provo, Utah; P. M. Lincoln, Niagara Falls, and H. C. Gille, of

St. Paul, presented a joint paper on the "Protection of Long Distance Transmission Lines" which proved of great interest and developed a number of important items. In the discussion the best methods of protecting high tension transmission systems from lightning, and how storage batteries may be protected when operated in connection with induction or synchronous apparatus, were developed.

President Doherty, as chairman of the committee on the Photometric Values of Arc Lamps, then presented his report, which was freely discussed. This session was comparatively short, an adjournment being taken at four o'clock to accept the invitation of the Bullock company to visit its works at Norwood. Accordingly, the delegates, some five hundred strong, took the special train provided and inspected the company's works, where refreshments were served. The visit was greatly enjoyed by all.

The evening session, which began about half-past eight, had only two papers presented before it, one by Mr. Russell Spaulding on "Display Lighting, Signs and Decorations," and "Possibilities of Sign and Decorative Lighting," by E. J. McAlister, of Newark, N. J. Considerable canvassing was done on Tuesday and Wednesday for the selection of a new president for the association. Prominent among the gentleman named were Louis Ferguson, president of the Edison Illuminating Association, of Chicago, and vice-president of the Electric Light Association, and Mr. Murray, of the New York City Edison Illuminating Company.

On Thursday morning Mr. Doherty opened the meeting with a joint paper on "Rates," prepared by himself and Messrs. Ferguson, Phillips, Wallis, Patterson and Scovil. After the discussion, Mr. Charles H. Williams, Madison, Wisconsin, presented an important paper on the "Advantages of the Gas Engine," after the discussion of which another paper was read on "Boiler Firing with Oil." This paper was the work of Messrs. James W. Warren, of Los Angeles, and H. T. Edgar, of El Paso. The report of the committee on the "Analysis of Flue Gases" followed. The afternoon session was taken up by two papers on "What Improvement is Desired in Meters" and "Hot Water vs. Steam Heating," each being followed by a discussion of some length.

At the executive session held on Wednesday evening, the following officers were elected for the ensuing year:

President—L. A. Ferguson, of Chicago.

First Vice-president—C. L. Edgar, of Boston.

Second Vice-president—E. H. Davis, Williamsport, Penn.

Executive Committee (for three years) —S. T. Durham, of Hartford, Conn.; P. G. Gaselee, Montreal, Quebec; H. D. Hartman, Philadelphia.

For Two Years—J. H. Perkins, Youngstown, Ohio; C. F. Hewett, Elkhart, Ind.

For One Year—Arthur Williams, New York.

Secretary and Treasurer—James B. Cahoon, New York.

Assistant Secretary and Treasurer—Miss Harriet E. Billings, New York.

The following committees were also appointed:

Nominations—Fred Nichols, Toronto; James D. Ayer, Boston; H. H. Fairbanks, Worcester, Mass.

Memorial—E. H. Davis, Williamsport, N. Y.; W. E. Moore, Augusta, Ga., and F. E. Smith, Somerville, Mass.

The paper presented at a previous session by Messrs. Behrend and Scott was freely discussed and a very considerable difference of opinion was registered by a number of the delegates, each side claiming that its position was the right one.

In his address of welcome made to the convention on Tuesday morning, General Hickenlooper, on behalf of the Cincinnati Gas and Electric Company, and of the city itself, assured the delegates that every effort would be made to make their stay in the city pleasant and also to give them some definite idea of the commercial progress of Cincinnati itself. In brief, General Hickenlooper's address was as follows and was warmly received:

"Gentlemen of the National Electric Light Association: It affords me pleasure to acknowledge the compliment of being assigned to the agreeable duty of extending, on behalf of our citizens and your resident fellow-craftsmen, a cordial and heartfelt welcome to

"'The Queen of the West, in her garlands dressed,
On the banks of the beautiful river.'

"A city which, within her territorial and tributary limits, embraces a population of nearly half a million people, 200,000 of whom are directly engaged in manufacturing enterprises, turning out every year products valued at $300,000,000, which find their way, over twenty centering lines of railways, to every section of the habitable globe.

"A city that contains the largest soap works, the biggest tannery, the most extensive lithographic establishment, the greatest shoe industries and a larger number of carriage factories than any city in the world.

"And last, but by no means least, one of the best-equipped and most efficiently managed electric manufacturing plants in this country, which, based upon its past history and phenomenal growth, gives promise in the near future of taking its place in the front rank of the great electrical industries of our country.

"From the mere nucleus of a plant employing but twenty men in 1896, it has in this brief period of half a dozen years grown to the dimensions you will be afforded an opportunity of inspecting; briefly stated, having ultimately a producing capacity of 10,000 kw. machines and employment of 800 men.

"To you, gentlemen, who have honored us with your presence, it is unnecessary to say more than to briefly refer to the pleasure we feel in extending this welcome to men who have by their energy, genius and scientific attainments rivaled the accomplishments of Aladdin, with whose phenomenal success in the lamp business it is presumed you are all still more or less familiar.

"But in order that you may not claim an 'exclusive patent' on his business methods or arrogate to yourselves all the credit for success in changing 'new lamps for old ones,' I desire to call your special attention to the fact that, even in his case, it became necessary to enlist the services of two promoting agencies—the 'genius of the lamp,' which you may properly represent, and the 'genius of the ring,' a term not infrequently locally applied to gentlemen like myself, who have rendered material assistance in promoting the introduction and utilization of the appliances which your genius has created.

"It has been said of the immortal Lincoln that for a time 'he forged the thoughts that governed the world.' You, gentlemen, have not only forged the thoughts, but have molded into practical shape the crude ideas of others, which have made possible their application to industrial pursuits and business enterprises that have enriched the world and added materially to the comforts and happiness of mankind.

"It is not my purpose to weary you with words of fulsome praise, but only to, as briefly as possible, voice the sentiments of all thinking people who recognize the fact that you have established for yourselves reputations for ability, energy, integrity, and that type of manhood which marks each and every member of your association as distinctive characters of an age which, in scientific accomplishments, stands unparalleled in the world's history.

"We sincerely hope that this, your twenty-fifth annual meeting, may prove no less enjoyable and professionally profitable than those which have preceded it; and when you have finally exchanged all your new lamps and ideas for our old ones, and leave for your distant fields of labor, we trust that each and every one may carry with them naught but pleasant memories of your only too brief visit to our city."

Convention Notes

Mr. James Blake Cahoon, of New York, was elected secretary and treasurer, vice George F. Porter, resigned. Mr. Porter's resignation was due to his being compelled to go to Alaska once more on cable business, which will detain him there indefinitely.

C. M. Gest, the contractor who is laying 1,000,000 feet of underground conduits for the Cincinnati Gas & Electric Company, converted the great manhole at the corner of Charles street and Central avenue into a Turkish room, where the delegates were received. The manhole is said by Mr. Gest to be one of the largest, if not the largest in existence, having a capacity of one hundred and fifty incoming cables and one hundred and thirty-seven outgoing. It was draped artistically with Turkish hangings and illuminated with colored lights in a highly fantastic and pleasing manner. Refreshments were served, and the members of the association made both pleasant and profitable calls to the novel parlor. The great storm of Wednesday morning drowned the place out temporarily, but with his customary energy, Mr. Gest got rid of the water, and by afternoon was once more ready for his guests.

Mr. F. G. Bolles, of the Bullock Electric Manufacturing Company, as fast as the names of the delegates were registered, had them drawn off the book and set up in printed list, which was later distributed with the compliments of the Bullock Company in booklet form. The book could not be completed at the last, but it had 550 names in it.

Letters of regret were received during the opening session of the convention from Messrs. Nikola Tesla, Prof. Forbes and R. E. Compton, of England; E. L. Nicholls, of Cornell University, and many other prominent electricians.

Mr. Calvin W. Rice, formerly of New York, has resigned his connection with his old company there, and has accepted the second vice-presidency of the Nernst Lamp Company. Mr. Rice is now located at Pittsburg.

Prof. Elwell Goldsborough, of Purdue University, Lafayette, Indiana, and chief of the electrical department of the World's Fair, St. Louis, was a prominent figure among the delegates, and took an active interest in the discussion of many of the papers. Prof. Goldsborough has been a contributor to The Electrical Age in the past, and expresses himself most favorably regarding the change effected in the policy and scope of the paper.

Mr. Ray D. Lillibridge and W. V. Bergenthal, who represented the Stanley Electric Manufacturing Company, of Pittsfield, had an attractive exhibit, a feature of which was a large autograph portrait of Lord Kelvin, who was photographed while reading Dr. Perrine's lecture on "Power Plants of the Pacific Coast." The core and coils of a thirty-light S.K.C. oil-transformer were also shown. This transformer has been the cause of some litigation and attracted very general interest.

The technical press was represented as follows: *Western Electrician,* Chicago, Messrs. Norman Collins, Frank L. Perry, Godkin and Downer; *Power,* New York, L. W. Hume, Chicago; *Engineering News,* New York, E. E. R. Tratman, Chicago; *Electrical Review,* New York, Charles W. Price and Stephen H. Goddard; *Electrical World and Engineer,* New York, T. Commerford Martin, G. W. Elliott, of New York; and J. R. Cravath, Chicago; *American Electrician,* New York, E. E. Nord and A. E. Clifford; Electrical Age, New York, Arthur S. Riggs.

Messrs. Probasco and Fleming, representing the Westinghouse interests, had an attractive exhibit, which included a number of Nernst lamps.

Thomas J. Ryan, district manager in Cincinnati for the Fort Wayne Electric Works, found so many people interested in his exhibit, which included the ingenious revolving fan, that he was compelled to telegraph for a salesman to help him receive and talk to his guests.

Russell Spaulding, general manager of the National Electric Improvement Company, was a very busy man; so busy, in fact, that the Cincinnati papers presented a caricature of him clad in a "shirtwaist." The beautiful decorations on the façade and in the foyer of the hotel, were largely due to Mr. Spaulding's efforts, and proved one of the most brilliant and attractive exhibits ever seen at a convention of this kind. Mr. Spaulding, besides his large decorations, had his exhibit-room fixed up with a number of attractive emblems, and in the corridor swung a large American flag, through which the lamps had been thrust into Elblight cables, producing a very pleasing effect.

H. W. Benedict represented the Standard Paint Company, and presented souvenirs to the various guests and delegates which were appreciated in many ways, being, perhaps, the most eagerly sought for of any. Mr. Benedict's friends were presented with fat perfectos, the blank part of their labels bearing the well-known "P. & B." stamp. Mr. Benedict covered the hotel with his signs and made many friends.

Neat gold-washed medals were distributed by the Bullock Electric Manufacturing Company. On one side the medals bore a bas-relief of the well-known Bullock dynamo, and on the other the name of the association and the place of meeting.

Prominent figures among the visitors were: E. H. Mullin, General Electric Company; R. B. Corey; H. B. Kirkland, American Circular Loom Company; C. E. Corrigan, Osburn Flexible Conduit Company; Paul T. Brady, Westinghouse Electric and Manufacturing Company; Dr. F. A. C. Perrine, Stanley Electric Manufacturing Company; Mr. Hinds, Syracuse, Crouse-Hinds Company. Mr. Corey was the biggest man and Mr. Hinds the smallest.

The Shedd Electric & Manufacturing Co., of New York, attracted a good deal of attention, with its "Comfort Oscillating" fan. Four of these fans were installed in the center of the foyer of the hotel; others were scattered about in various parts of the building and distributed a very welcome breeze.

The "Nights of Other Days" was the title of a booklet which was scattered broadcast by the New York & Ohio Co., manufacturer of the Packard incandescent lamp. Certainly if warm colors and unusual arrangement count for anything, the book should do its work. It was unique in many respects. Another little folder gotten out by the same company was somewhat on the same order, but plainer. Both were much sought after.

General News

Electric Railways in Switzerland

Consul Henry H. Morgan, of Aarau, Switzerland, has written home, saying:

The old-fashioned diligence which up to the present has been the means of transportation between the smaller towns and villages of Switzerland, which are off the lines of railway, is being rapidly superseded by electric railways, and the day is not far distant when most of the towns of the country will be so connected. A short time ago, an electric line was opened connecting Aarau with Schöftland, a distance of about ten miles. Until the opening of this line, the time consumed in making the journey (by diligence) was one hour and ten minutes. Now, including the several stops at villages along the line, the time occupied is forty minutes.

A company is seeking a concession for a line from Aarau to Menziken, on the border of the Canton of Lucerne, and this will be joined by a line running from the city of Sursee northward, thus making an electric tramway connection for a distance of about thirty miles. Still another line is projected to run from Aarau to Frick—a most important plan, as it will place Aarau in direct communication with Laufenburg, Säckingen, and other towns in the Rhine Valley. The length of this line will be also about thirty miles.

The power to be used by these different roads will be derived from the waterfalls of the country.

In view of the important works in contemplation, it might be of advantage to our manufacturers of electric railway supplies to investigate the subject.

Some days ago, in a former report, the writer noted the efforts made in Sweden to replace the steam railways with electric lines, and reported that the Maschinenfabrik Oerlikon, a firm of Switzerland, which has petitioned the Swiss Government for a concession to construct a line of twenty kilometers (12.4 miles) of standard gauge electrical railway for experimental purposes, has agreed to furnish a Swedish company free of all charge, the necessary electrical engines and motors for the trials in Sweden, provided said company would furnish the electrical force.

Electricity in British Mines

Before the South Staffordshire and East Worcestershire Institute of Mining Engineers, at Birmingham, recently, a paper was read on "Sparkless Electrical Plant for use in Mines and Ironworks," contributed by Mr. J. H. Whittaker, A. M. I. E. E. The London *Electrical Review* says that the author, in introducing the subject, remarked that electric power plants for colliery work had been very little adopted in England. The power had been applied to surface work and surface lighting, and for lighting the pit-bottom and underground engine-rooms, but beyond that little had been done in the way of taking the current into the workings, probably on account of the difficulties of running and maintaining the cables, because of the falls of roofs, etc., and also the danger from sparking of the motors. Electric transmission of power was a matter mining engineers could not afford to neglect, in view of the growing foreign competition. While many advantages were claimed for the continuous-current system, and series, shunt, and compound-wound motors, the ideal system was the three-phase system. The three-phase alternator was the best generator, which could, if necessary, at times stand 100 per cent overload, and the three-phase motor was the best machine for all-round work. The switchboards were of simple construction, but by some it may be considered a disadvantage to have to lay triple wiring and cables. This, however, was more than made up for by the saving in copper effected (about 50 per cent), as the wire needed to carry this current was of a smaller gauge. The advantages claimed for the three-phase motor were mentioned. Three-phase was the system of the future for power plants, but was not so suitable for lighting. He had seen three-phase motors put to every class of work with the most satisfactory results. The system was much in use on the Continent and in America. Mr. T. H. Bailey, M. Inst. C. E., thought the paper an interesting one, and the subject of much importance to mining engineers; but he would like to ask if Mr. Whittaker was aware of the litigation between the Metropolitan and District Railway Companies, in which Mr. A. Littleton was appointed arbitrator. Mr. Littleton had decided that the proper system of current to adopt was the continuous current one and not the three-phase. He thought that in the face of such advice as that mining engineers should proceed with caution. Mr. Isaac Meachem, Jr., remarked that he had listened to the paper with much interest, and was looking forward to the further discussion, as he had recently put down a plant for pumping, hauling, and lighting, and wanted to put it down for drilling. The electrical engineers had recommended the continuous current system, but now he wished to extend his system they had gone back on what they had previously said and advised the adoption of the three-phase.

Summer Work of the C. P. R.'S Wire Department

Press dispatches from Montreal say that during the summer work the Canadian Pacific's telegraph department will be kept busy with new construction, preliminary to which a contract has been let for 200 tons of No. 9 copper wire—or about 1,900 miles. Not a pound of this will be used in bringing in new territory. It is all to go toward increasing the existing facilities of the company. New lines are to be strung from Sydney to Halifax, from Montreal to St. John, and from Montreal to Sault Ste. Marie. In addition, about 130 miles of iron wire will be strung between St. Thomas and Walkerville, Ont.

Osmium Lamps

Mr. Gabriel, the chief engineer of the company which has to do with the Welsbach patents, recently issued some statements as to the results obtained by lamps with osmium filaments, says the London *Electrical Engineer*. It commenced with an efficiency of 1.5 watts, and then fell to about 1.42 watts per candle-power, and kept practically at this value for the rest of its life. The candle-power curve for this lamp showed that it commenced to give about 14½ c. p. and rose in the course of 300 hours to about 16.8 c. p.; the curve then falls in practically a straight line to 15 c. p. at 1,100 hours.

Record of Lightning Strokes

The London *Times* states that the Lightning Research Committee, which was organized in January, 1901, by the Royal Institute of British Architects and the Surveyors' Institution for the purpose of obtaining accurate records of the action of lightning strokes on buildings, with a view to improving if possible the means of protection, has enlisted the services of over 200 competent observers in the United Kingdom, besides a considerable number in the colonies and India and in foreign countries. The War Office, the Home Office, the Post Office, the Trinity House Corporation, and the United States Department of Agriculture, have signified their willingness to furnish the committee with the required particulars of damage to buildings under their control resulting from lightning stroke. The heavy thunderstorms of last year afforded numerous opportunities of investigating and recording, upon lines laid down by the committee, the damage caused by lightning to buildings within their area of observation. The net result so far is a series of some seventy or more trustworthy records, which furnish promising material for the committee to work upon when sufficient *data* have been collected to enable them to formulate their conclusions. The committee makes a point of getting photographs immediately after the occurrence of a disaster in cases of importance, says *Nature*. As regards the system recommended by the Lightning Rod Conference of 1882, *data* to hand are not at present complete enough to afford a practical test of its efficacy. The recently issued report, however, of His Majesty's inspectors of explosives goes to show that the system has been found wanting, and that there is ample justification for the present inquiry. Besides the grants made by the Institute and the Surveyors' Institution, the committee has been aided financially by the government grant committee of the Royal Society, and by the Royal Meteorological Society. Valuable help has also been given by the Royal Institute of British Architects, the Surveyors' Institution, the Institute of Electrical Engineers, and the Royal Meteorological Society, by circularizing their members with a view to getting observers. The committee is constituted as follows: Mr. John Slater, chairman; Major-General E. R. Festing, C. B., F. R. S.; Mr. J. Gavey, M. I. C. E., General Post Office; Mr. W. P. Goulding, F. R. G. S., F. S. I., Dr. Oliver Lodge, Birmingham University; Mr. W. N. Shaw, F. R. S., Mr. H. Heathcote Statham, Mr. A. R. Stenning, F. S. I., Mr. Arthur Vernon, F. S. I., Mr. Killingworth Hedges, M. I. C. E., honorary secretary.

The Edison Battery for Automobiles

Mr. Thomas A. Edison announced on May 28 that he had perfected his new storage battery for automobiles, and believes the construction of the apparatus is such it will outwear four automobiles.

In endurance tests already made with the battery, it has shown its ability to run with ease over heavy roads and grades, varying from two to twelve per cent, without material loss. One run of sixty-five miles was made, and another of eighty-five. Mr. Edison purposes to hold a five-thousand-mile endurance test in the near future, and is confident that he has solved the problem of automobile batteries.

Electricity in British Honduras

Work has just been begun on the first telegraph line in this British colony. The line will extend from Belize to the Rio Hondo, a distance of 100 miles, and communication with the outside world will be established by a connection with the overland line through Mexico at the Hondo river. It is further proposed that a telephone service should be set up at each of the offices along the line of route, and that the one circuit should be used for both purposes, the telegraphing being discontinued for two hours each day to accomplish this object, says the London *Electrical Engineer.* We understand that the consent of the home government has been obtained to the above proposals, and an appropriation of £2,000 voted. Electrical progress in British Honduras is not, however, to stop at this point. A bill is now before the Colonial Councils by which the district authorities are seeking powers to contract for the establishment of an electric light plant in the town of Belize. In the event of such powers being granted, of which there is little doubt, the gloomy oil lamps which at present supply the town with illumination, will make way for the electric lamps. The next thing we may expect to hear from this quarter is that the town is going in for electric trams.

American Locomotives in Tunis

Vice-Consul St. L. A. Touhay, in a new report, writes:

A serious collision recently took place on the railway line, a short distance from Tunis, between an incoming passenger train from Algiers and an outgoing freight train. The investigation of the causes of the collision developed a good deal of conflicting testimony as to who was in fault, but one engineer asserted that the origin of the whole trouble was the unmanageableness of the Baldwin locomotive attached to the outgoing train. He declared that, on observing the signals of the incoming train, he promptly reversed and put down brakes, but ineffectually, owing to the impetus gained by his engine.

In order to clear up all doubts as to who was responsible for the collision, it was decided to reconstitute the train in precisely the same conditions as when the accident occurred. One of the most reliable engineers on the road was put in charge of the engine, and repeated experiments proved that the train could be easily stopped at a distance of 150 feet from the spot where the collision occurred. The ease and certitude with which the huge locomotive answered the handling was considered nothing short of miraculous by the authorities of the road.

As it is probable that important railway extension will be effected in Tunis in the near future, this circumstance will very likely be a factor in opening negotiations for supplies of material from the United States.

Street railway companies, electric lighting companies and gas companies which desire their reports to appear in the Financial Bureau of the ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Monthly reports are requested showing gross receipts and when possible operating expenses. Companies are also requested to furnish the highest and lowest prices for which their stock has sold in the market for the previous month.

STREET RAILWAY STATEMENTS

Metropolitan Street Railway Company's report for quarter ending March 31 not yet prepared. (May 29).

Brooklyn Rapid Transit System (All Systems)

Comparative Statement of Operations for Month of March, 1902 and 1901.

	1902.	1901.		Changes.
Miles operated, single track	489.3	488.9		.40
Gross receipts	$1,030,917.42	$955,502.50	Inc.	$75,413.52
Expenses, including taxes.	768,347.86	714,004.35	Inc.	54,303,51
Net receipts	$262,569.56	$241,459.15	Inc.	$21,110.41

(For Nine Months ending March 31.)

	1902.	1901.		Changes.
Miles operated, single track	489.3	488.9		.40
Gross receipts	$9,426,365.87	$8,854,604.37	Inc.	$571,761.50
Expenses, including taxes.	6,784,899.03	5,864,450.73	Inc.	920,448.30
Net receipts	$2,641,466.84	$2,990,153.64	Dec.	$348,696.80

Includes leased railroad of N. Y. & Brooklyn Bridge, 2.6 miles and Trackage Rights over Coney Island & Brooklyn R. R., 2.4 miles.

International Railway Company, Buffalo, N. Y. (All Systems)

For Nine Months ending March 31.

	1902.	1901.	Inc.
Gross Receipts....................	$3,654,291.56	$2,169,376.80	$1,484,914.76
Operating expenses................	1,817,169.39	1,101,481.80	715,687.59
Net earnings from operation.........	1,837,122.17	1,067,895.00	769,227.17
Miscellaneous earnings..............	125,930.32	80,032.54	45,897.78
Total earnings....................	1,963,052.49	1,147,927.54	815,124.95
Fixed charges.....................	885,404.16	757,570.77	127,833.39
Surplus	1,077,648.33	390,356.77	687,291.56

Manhattan Railway Company

General balance sheet, March 31.

Assets—	1902.	1901.	Changes.
Cost, road and equip	$73,279,635	$66,804,505	Inc. $6,475,130
Cost of leases	6,149,665	10,362,231	Dec. 4,212,566
Loaned on collateral	14,014,000	14,014,000	
Other per. investments, real estate	3,245,315	3,257,408	Dec. 12,093
Supplies on hand	462,110	313,201	Inc. 148,909
Accrued int. prepaid insurance	16,767	19,073	Dec. 2,306
Due by agents	453	145	Inc. 308
Due by others	8,352	8,023	Inc. 329
Open accounts	77,434	212,662	Dec. 135,228
Cash on hand	258,200	269,292	Dec. 11,092
Kuhn, Loeb & Co., rel'mpt, '22 of Met. 2d Mtg. bds	....	29,000	Dec. 28,000
Est. of Jay Gould, suretyship	300,000	300,000	
Central Trust Co of N. Y. Trustee, etc.	4,593	4,524	Inc. 69
Sundries	329,744	212,111	Inc. 117,633
Total	$98,146,268	$95,816,175	Inc. $2,330,093

Liabilities—	1902.	1901.	Changes.
Consolidated capital stock	$47,999,700	$47,999,700	
Subs. to increased capital stock	300	300	
Funded debt incl. $4,000 N. Y. El. 1st 7s and $29,000 Met. 2d called for redemption	39,545,000	39,574,000	Dec. 29,000
Sundries	37,893	38,267	Dec. 374
Int. due and accd	200,285	165,585	Inc. 34,700
Div. unpaid	22,358	7,358	Inc. 15,000
Due for wages	105,031	79,398	Inc. 25,633
Open accounts	59,026	68,799	Dec. 9,762
Due for supplies and taxes	781,631	340,764	Inc. 440,867
Coupons due, not presented	60	60	
Manhattan 4 per cent. bds special	300,000	300,000	
Profit and loss sur	5,828,146	4,688,509	Inc. 1,139,637
Concert. b'd certfs	42,035	42,035	Inc. 713,390
Taxes in litigation	3,224,801	2,511,411	Inc. 713,390
Total	$98,146,268	$95,816,175	Inc. $2,330,093

Manhattan Railway Company

For the Quarter ending March 31.		Previous Quarter.		Changes.
Gross earnings	$2,878,236	$2,502,043	Inc.	$376,193
Operating expenses and taxes	1,400,378	1,348,136	Inc.	52,242
Net earnings	$1,477,858	$1,153,907	Inc.	$323,951
Other income	....	....		......

July 1 to March 1:		Previous Half Year.		Changes.
Gross earnings	$7,808,661	$6,917,680	Inc.	$890,981
Operating expenses and taxes	4,117,478	3,925,544	Inc.	191,934
Other income	514,511		Dec.	80,710
Fixed charges	2,043,871		Inc.	13,733
Dividends	1,440,000			
Surplus	721,823		Inc.	604,614

Rochester Railway Company

For the quarter ending March 31:

	1902.	1901.		Changes.
Gross earnings	$264,659	$244,433	Inc.	$20,226
Oper. expenses	146,932	161,882	Dec.	14,950
Net earnings	$117,727	$82,551	Inc.	$35,176
Other income	....	1,771	Dec.	1,771
Total income	$117,727	$84,322	Inc.	$33,405
Fixed charges	74,374	71,598	Inc.	2,785
Net income	$43,353	$12,733	Inc.	$30,620

United Traction Company, Albany, N. Y.

April report:	1902	1901		
Gross receipts	$116,458	$109,512	Inc.	$6,946

St. Louis Transit Company

April report:	1902	1901		
Gross earnings	$509,609	$464,454	Inc.	$45,155

Gas and Electric Companies

Cincinnati Gas and Electric Co.

Annual report:

Gross receipts	$2,104,308
Operating expenses	1,167,959
Net profits	936,349

Massachusetts Electric Co.

March report:	1902	1901		
Gross receipts	$410,000	$382,000	Inc.	$28,000

Cleveland Electric Co.

April report:	1902	1901		
Gross receipts	$192,852	$174,849	Inc.	$18,003

Franchise Bureau

The ELECTRICAL AGE intends to collect for reference purposes copies of every franchise issued by the various states to electric lighting, street railway and gas companies, and particularly those granted by special acts of legislation. All persons who can do so are requested to send copies of such franchises to the "Franchise Bureau, ELECTRICAL AGE." Copies not returnable.

Texas

GAS AND OIL. — Parties controlling franchises for supply of gas and oil at Beaumont, Texas, the great manufacturing city of the south, would like to interest parties financially. For further information apply to Franchise Bureau, ELECTRICAL AGE.

Virginia

Parties controlling Potomac Western Railroad charter, granted by the legislature of Virginia, giving broad railroad rights, both electrical and steam, seeks financial assistance. Copy of charter can be seen at the office of the ELECTRICAL AGE, Franchise Bureau.

Financial Notes

Copper has been advancing in price since the latter part of April. Similar advances have occurred in the European markets. John Stanton, of New York, quoted 12⅝ to 12¾ for lake and 12½ for electrolytic. On May 26, he said: "There is now an unprecedented demand for copper. All the copper and brass mills are at work to their full capacity. I believe that more copper is being consumed throughout the world than is being produced. The only cloud on the horizon is the coal miners' strike, which, if extended to the bituminous mines and continued long enough would tie up all industries, copper mills included."

An interesting development in the iron trade is the apparent awakening of the steel rail trade. Chicago reports a sale of about 30,000 tons, and Eastern mills have closed probably more than double that quantity. It is understood that these sales are for delivery toward the close of the current year, but it is doubtful whether any of them can be rolled prior to 1903.

The tentative form of contract for the building and lease of the tunnel extension to Brooklyn of the New York Rapid Transit system was made public by the Rapid Transit Railroad Commission on May 24, and a public hearing upon it is set for June 5. The work will cost about $8,000,000. A construction bond for $1,000,000 and an operating bond for $1,000,000 are required. Subcontractors' bonds must be approved by the Commission.

A circular containing terms offered by the General Electric Company on the purchase of the Sprague Electric Company stock has been made public. Seventy-five per cent of the stock must be offered to make the sale complete. It is understood that more than this has been secured. The Sprague Company is capitalized at $3,500,000, and has $1,200,000 five per cent bonds. The terms offered are as follows: For each share of Sprague preferred stock deposited under the plan of exchange, an equivalent amount par value in 3½ per cent forty-year gold debenture bonds of the General Electric Company; for each share of Sprague common 41.9 per cent of a share of Otis Elevator Company common stock and 20.42 per cent in General Electric 3½ per cent debentures. Sprague bondholders will get 55 per cent of the par value of their bonds in Otis Elevator preferred stock and 45 per cent in cash.

The plans for the consolidation of several Staten Island properties which have been in progress for more than a year have been completed. The new corporation will have authority to issue $2,500,000 four per cent 50-year first and collateral trust mortgage bonds, and $3,000,000 capital stock represented by a five-year voting trust. The exchange of securities will be as follows: Staten Island Electric Railroad Co. first mortgage bonds par in new bonds and consols par in new stock; New York & Staten Island Electric Co. first mortgage bonds, 120 in new bonds, interest to be adjusted in cash, and stock 30 in new stock; New Jersey & Staten Island Ferry first mortgage bonds, par in new bonds and stock, 10 in new stock, and Richmond County Power Co. receipts, 125 in stock. The trustees of the voting trust are H. H. Rogers, Walter G. Oakman and William L. Bull. The new securities have been underwritten.

The United States Steel Corporation's stockholders on May 19 voted to ratify the $250,000,000 bond issue. The affirmative vote was 3,745,731 shares of preferred and 3,958,557 shares of common. The preferred stockholders now have the privilege of turning in forty per cent of their holdings in exchange for the new bonds and an amount in cash equivalent to ten per cent of their holdings for an equivalent amount of bonds.

Subscriptions for the new stock of the Twin City Rapid Transit Co. will be received from June 5 to July 1 at the rate of ten per cent of the subscriber's present holdings. Warrants for the right to subscribe may be obtained and transferred at the office of J. Kennedy Tod & Co., agents in New York for the company.

The first dividend of fifteen cents a share in the 1,000,000 shares of $25 each of the Philadelphia Electric Co. was declared on May 23. It is payable June 16 to stockholders of record on May 31. Six dollars and twenty-five cents have been paid in on each share thus far and a further $1.25 is called for payment on September 2.

The Kingston (N. Y.) Gas & Electric Co., has been incorporated at Albany with $700,000 capital.

Stock Market Reports

Street Railway Stocks

	High.	Low.
Allegheny Trac. (Pitts.)	51¼	50
Am. Rys. Co. (Phila.)	46½	45½
Birmingham (Ala.) R. L. & P.	53	53
Bleecker St. & F. F. (N. Y.)	34	33
Boston El.	169	168½
Broadway & Seventh Avenue	249	247
Brooklyn City	248	246
Brooklyn Rapid Tr. (vot. tr.)	68½	64¼
Cal. St. Cable (San F.)	167½	167
Cent. Crosstown (N. Y.)	265	260
Central Pk. No. & E. River (N. Y.)	208	208
Chicago City RR.	215	214
Chi. Union Trac. com.	21	18½
Chi. Union Trac. pref.	57	57
Christ. & 10th Sts. (N. Y.)	185	185
Cincinnati, N. & C. Lt. & Trac. com. prf.	88	86½
Cincinnati St. Ry.	145	142½
Citizens' Pass. (Phila.)	352	352
Citizens' Trac. (Pitts.)	71½	70
Cleveland City Ry.	105½	103
Cleveland Elect. Ry.	82	79½
Cleveland & East.	31¼	29½
Columbus (O.) St. Ry. com.	52¾	51¼
Columbus (O.) St. Ry. pref.	107½	105
Coney Island & Brooklyn	350	325
Consol. Trac. (Newark, N. J.)	70½	69
Cont. Pass. (Phila.)	154	154
Dayton (O.) City Ry. com.	166½	165
Dayton (O.) City Ry. pref.	182	180
Denver City Tram.	94	94
Detroit United	73½	71¾
Dry Dock, E. B. & Bat. (N. Y.)	120	113
East Reading (Pa.) Elec.	75	75
Eighth Av. (N. Y.)	400	400
Fairhaven & West. (N. Haven)	47½	47
Frankford & Southw. (Phila.)	452	452
42nd & Gd. St. Ferry (N. Y.)	405	400
42nd, M. & St. N. Av. (N. Y.)	70	60
Germantown Pass. (Phila.)	147	145

	High.	Low.
Grand Rapids (Mich.) Ry. com	55	45
Grand Rapids (Mich.) Ry. pref	96½	95
Green & Coates St. (Phila.)	150	150
Hartford St. Ry	160	160
Indianapolis St. Ry	63	50
International Trac. (Buf.) subs	118	118
International Trac. (Buf.) pref	59½	59
Jersey City, Hob. & Pat	17½	16½
Lake St. El. (Chi.)	13⅞	13⅛
Louisville (Ky.) Ry. com	117½	117
Manhattan El	132⅝	130½
Market St. (San F.)	100	100
Mass. Elec. Co. (Bost.) com	45	45
Mass. Elec Co. (Bost.) pref	98	98
Metropolitan Security sub. recpts	116¾	108
Metro. St. Ry. (N. Y.)	150	146¾
Metro. West Side El. (Chi.) com	40⅛	39
Metro. West Side El (Chi.) pref	90	90
Nassau Elec. (Bklyn.)	83	83
New Orleans & Carroll	76½	75
N. Orl. City & Lake com	33	32½
N. Orl. City & Lake pref	112	111½
N. Orl. City & Lake tr. rects	108½	108
Newark (N. J.) R. Trans	255	255
Newark (N. J.) Pass. Ry	118½	117
Ninth Av. (N. Y.)	200	200
Norfolk (Va.) Ry. & Lt	11	10¼
Northampton (Mass.) St. Ry	187	182
North Chicago St. Ry	194	190
North Jersey St. Ry	28¼	27
North. Ohio Trac. (Akron) com	35	35
North. Ohio Trac. (Akron) pref	83½	82½
Northwestern El. (Chi.) vot. tr	38½	38
Northwestern El. (Chi.) pref	85¼	85
Phila. Trac	97½	97
Pittsburg & Birm. Trac	44½	43½
Reading (Pa.) City Pass	150	150
Richmond (Va.) Trac	50	50
Ridge Av. Pass. (Phila.)	305	305
Rochester Ry. com	68	63½
Rochester Ry. pref	98½	98
St. Louis Trans	30½	30
St. Louis & Subur	75½	75
Savannah Elec. com	19½	18¼
Savannah Elec. pref	90	90
Second Av. (N. Y.)	217	217
Second & Third Sts. (Phila.)	305	300
Sixth Av. (N. Y.)	180	170
South Side El. (Chi.)	114	114
So. Ohio Trac. (Cin.)	62¾	61⅞
Springfield (Mass.) St. Ry	215	215
Syracuse (N. Y.) Rap. Trans	25	25
Syracuse (N. Y.) Rap. Trans. pref	65	65
Third Av. (N. Y.)	131	129
Thirteenth & 15th Sts. (Phila.)	305	300
Toledo (O.) Rys. & Lt	26⅞	26
Twenty-third St. (N. Y.)	408	400
Twin City R. T. com	122¾	120
Twin City R. T. pref	157½	155¾
Union Pass. (Phila.)	245	240
Union Trac. (Phila.)	43⅞	40¾
Union Trac. rights (Phila.)	3½	3¼
United Power & Trac. (Phila.)	252	250
United Rys. (St. Louis) com	31⅜	30½
United Rys. (St. Louis) pref	84½	84
United Rys. (San. F.) com (w. i.)	24¾	24¼
United Rys. (San F.) pref. (w. i.)	61	59
United Rys. & Elec. (Balto.)	16½	15⅞
United Trac. (Albany)	105	100
United Trac. (Pitts.) com	14¾	14¼
United Trac. (Pitts.) pref	51	50
United Trac. & El. (Prov.)	113½	113
Washington Cap. Trac	114	112
West Chi. St. Ry	100½	94
West End (Pitts.)	34⅞	33⅛
West End (Bost.) com	96	94
West End (Bost.) pref	115½	115
Western Ohio (Lima)	16¼	14½

ELECTRIC COMPANY STOCKS.

	High.	Low.
Buffalo Gen. Electric	100	100
Buf. & Niagara Falls	100	100
Central Lt. & Power (S. F.)	2½	2¼
Chicago Edison Co	175	171½
Columbus Edison Co. com	35	33
Columbus Edison Co. pref	102	102
Edison Elec. Ill. (Bost.)	270	265
General Electric	326	300
Hartford Electric Lt	198	198
Kings Co. Elec. Lt. & Power	198	194
Lowell Elec. Lt	106	106
Minneapolis Gen. Elec. com	75	75
Minneapolis Gen. Elec. pref	107	105
Narragansett (Prov.)	100	98¼
N. Y. & Q. Elec. com	40	39
N. Y. & Q. Elec. pref	75	74
Niagara Falls Power	85	85
R. I. Elec. Protec	125	125
Salem Elec	138	133
Syracuse Lighting	15	15
United Elec. L. & P. (Balt.)	41	40¼
United Elec. of N. J	15	13¾

GAS COMPANY STOCKS.

	High.	Low.
Am. Light & Trac. com	36½	33¾
Am. Light & Trac. pref	91	90
Balt. Consol	71	71
Binghamton (N. Y.) Gas	24	23½
Bay State (Bost.)	2¼	2
Brooklyn Union Gas	236	236
Buffalo City Gas	11¾	11
Charlestown Gas & Elec. (Bost.)	87½	87
Cincinnati Gas & Elec	103¼	103
Columbus Gas Lt. & Heat. com	91	90
Columbus Gas Lt. & Heat. pref	110¾	109⅞
Consolidated Gas (N. Y.)	224½	219¼
Consol. Gas (N. J.)	16	15
Consol. Gas (Newark, N. J.)	60	56
Denver Gas & Elect	22	21
Detroit City Gas	50	50
Elizabeth Gas-Light	175	170
Essex & Hudson Gas	30	27
Grand Rapids Gas	100	100
Gas & Elec. Bergen Co	25	25
Hartford Gas-Light	50	49
Hudson Co. Gas	30½	23
Indianapolis Gas	75	73
Jackson (Mich.) Gas	73	69
Kansas City Gas	22	18
Laclede Gas com	88	80
Laclede Gas pref	108	105
Louisville Gas-Light	117	116
Madison Gas & El	67	66
Mutual Gas (N. Y.)	350	330
Municipal Gas (Albany)	270	270
New Bedford Gas & Edison	130	130
New Eng. Gas & Coke	4	3½
New Haven Gas-Light	76	76
New Orleans Gas-Light	115	114¾
New Orleans Gas-Light tr. certs	115	114½
Oakland Gas & Light	60	59
O. & Ind. Cons. Nat. & Ill	18	18
Pawtucket Gas	98	98
Paterson & Passaic	25	24
People's Gas (Chi.)	108¾	104¼

	High.	Low.
Pittsburg Consol. Gas	44	44
Providence Gas	100	97
Rochester Gas & Elec. com	110	110
Rochester Gas & Elec. pref	112	112
Salem (Mass.) Gas-Light	140	140
San Francisco Gas & Elec	45	44
Savannah Gas-Light	23	22
Syracuse Gas	16	15
Troy Gas	160	160
United Gas & Elec. (N. J.)	37¼	35½
United Gas & Elec. (N. J.) pref	87¼	86
Washington (D. C.) Gas	81	80

Denver and Northwestern Company Mortgage

A $6,000,000 bond issue, payable in gold coin in New York, May 1, 1932, has been made recently by the Denver & Northwestern Company, of Colorado, the mortgage being made out in favor of the Mercantile Trust Company, of New York. The issue is a first mortgage collateral, and is made with the purpose of constructing the entire road, and also of purchasing the entire capital stock of the Denver City Tramway Company, which is valued at something like $5,000,000. The main line of the railroad proper will be built from Denver to Alvada, to Coal Creek Cañon, thence through Gilpin county, across the Continental divide about two miles north of James Peak, and thence westerly through the valleys of the Frazer and Grand rivers, to Hot Sulphur Springs.

With Our Foreign Consuls

Automobiles

Opening for Automobiles in Japan.—Consul C. B. Harris, of Nagasaki, writes:

It is likely that a cheap automobile, holding one person, to take the place of the jinrikisha (made of the same width), would find a ready sale in Japan. There were, on the first of April, 1901, 206,848 jinrikishas in use in the Empire, 193,249 being made for seating one person, and 17,339 for two.

Inquiries for Automobiles from Syria.—Consul G. Bie Ravndal, of Beirut, said in a recent communication to the State Department at Washington, that while it may sound strange, it is nevertheless true, that inquiries about automobiles are being made in Syria. Only one specimen, an inferior second-hand French machine, has been seen here; but it is thought that in Syria and Palestine, with their lack of railroads and street cars and with their rapidly developing carriage-road systems, automobiles would do well. A new road is now being built between Sidon and Beirut, and will soon replace the ancient bridle-path. While this road will be level, others throughout this region are steep and make numerous sharp turns. Vehicles in use, therefore, must be strong and durable. Between Haïfa and Nazareth, the most satisfactory carriages employed in the tourist traffic are powerful, two-seated surreys made in Buffalo, N. Y. In these parts, horses suffer greatly from the heat; this difficulty would not apply to a machine. In Beirut alone, 500 carriages are running, and hundreds more are in use in the Lebanon region and in Palestine. The country is poor, and, except possibly for the accommodation of tourists, there would not at present be much demand for automobiles outside of Beirut.

The tourist traffic has more than doubled in Syria during the last ten years. At present, about 750 foreign tourists pass through Beirut annually, most of them proceeding to Baalbek and Damascus. Twice this number go through Palestine. Galilee is also growing in favor among tourists. The figures given do not include pilgrims, thousands of whom seek the holy places, nor the special excursions which lately have come into vogue. Among local physicians, there is a growing sentiment in favor of the automobile. American manufacturers may address, on this subject, Dr. Harris Graham, Beirut, Syria.

Motor-Boat Exposition at Berlin.—Consul Frank H. Mason, of Berlin, Germany, sends a supplementary report to Washington regarding this subject and says:

In a recent report from this consulate some account was given of a special international exposition of motor boats and all that pertains to their construction, use, and maintenance, which is to be held at Wannsee-on-the-Havel, a few miles west of Berlin, from June until September of this year. For reasons which were therein stated, it was urgently suggested that American builders of motor boats, engines, and other appliances pertaining thereto would find here an excellent opportunity to introduce and exhibit their work before a chosen and highly appreciative audience, and that the commercial advantages of such a display would probably be important and valuable.

The response to this appeal, as well as to the prospectuses and correspondence sent out by the association itself to leading American boat builders, has been disappointing, the general tenor of such replies being that they are all busy with their orders at home, that their whole output for this season is sold, and that they have nothing to spare for exhibition purposes. This may be true, but it is a fair question whether neglect to utilize an opportunity like this will not be a repetition of the mistake which the makers of fire-extinguishing apparatus committed, when they failed to exhibit at the special exposition of firemen's appliances held here last year. The one American firm which did exhibit an electric fire-alarm system is now putting it in for the city of Hanover, and has under negotiation contracts for similar installations in other German cities.

There is abundant evidence that a good representative American display at the motor-boat exposition this year would be an unusually promising investment for the exhibitors. It is fully understood here that our country is first and foremost in all that relates to the construction and use of motor boats as naval auxiliaries and for pleasure and business purposes. It is also recognized that Germany—the original home of the gas engine—is so far behind in that class of water craft that the field is practically unoccupied. So many inquiries have been received by the committee about probable American exhibits—their tonnage, cost, and other details—that there is evidence of a real demand, and the committee states that from all such indications, American exhibitors of standard types of motor boats, engines, etc., would be practically certain not only to sell their entire lists of exhibits, but to take numerous orders for future delivery. Responsible firms here and at the large German seaports are eager to accept agencies to represent American builders, and German machinists will be on the watch to purchase valuable patents in that class. Obviously, all novelties should be patented or registered, and the patents applied for before being exhibited anywhere in Europe. It will be many years before another special international exhibition and classified competition of motor boats will be held in this country, and the present opportunity once lost will not soon recur. The committee authorizes the statement that every reasonable concession and assistance to facilitate a representative American display will be gladly and promptly accorded. Berlin is the centre and mart of a vast system of canals, lakes, and canalized rivers which could be freely navigated by motor boats, where few or none now exist. If American builders will not reach out to grasp an opportunity like this, the builders of other countries —notably Great Britain, France, and Belgium—certainly will.

Machinery

Sugar Crushing Machinery for Java—Consul Eugene Seeger, of Rio de Janeiro, Brazil, declares that a number of wealthy gentlemen are interested in sugar in Java, and states that they want, among other things, electrical sugar machines of every kind, including cane crushers—not cutters—and dynamos and motors, variously described as of 220 kilowatts, 330 effective horsepower, 220 and 440 volts — in short everything requisite for the installation of large sugar refineries. They are desirous of securing the sole agency for American rails for narrow-gauge roads of from 75 to 100 centimeters (29.5 to 39.37 inches) in width, and for locomotives and other rolling stock to be used in the transportation of sugar over such roads.

American houses desiring to enter into negotiations for supplying the machinery required should address Stork Frères, Hengelo, Holland.

Telephone and Telegraph

Wireless Telegraphy in Sweden.— Consul R. S. S. Bergh reports from Gothenburg, Sweden:

A lieutenant-colonel in the Swedish army, Mr. G. Baunerhjelm, has for some time experimented with wireless telegraphy (Marconi's system). It is claimed that he has recently made improvements in this line which, if practical, will be useful for military purposes and at sea. The newspapers state that he has invented an electric radiator or reflector which, combined with the Marconi system, can send the electric waves, and with them the message, in the desired direction. I have not read any description of the apparatus, which is now being tested by Swedish experts, but its construction is said to be based on the theory that electric waves are reflected by metallic surfaces. The drawback of the system seems to be that a telegram can not be sent in a certain direction a longer distance than twenty-five or thirty miles, but for many purposes this may be sufficient. The experiments will be continued, and further improvements may be made.

General Information

Electrical Progress in Canada.— Consul John L. Bittinger, of Montreal, Quebec, in a long report recently made to the Department of State at Washington, says:

The use of electricity in Canada continues to increase, and electrical supplies come largely from the United States. They are admitted to be of a better quality than can be had from any other country, and they can also be ordered and received within a few days.

Electric Light.—Mr. George Johnson, the Dominion statistician, in his annual summary of the use of electricity in Canada, says the number of lighting companies has increased from 259 in 1898 to 306 in 1901. The arc lights in use increased from 10,389 to 12,800, and the incandescent lamps from 463,615 to 815,676. The use of electricity for lighting purposes has risen sixty per cent.

Of the total 306 companies, the province of Ontario has 196, or sixty-four per cent.; Quebec has fifty, Nova Scotia twenty-one, British Columbia fourteen, New Brunswick, eleven, Manitoba, six, Northwest Territories five, and Prince Edward Island three.

Ontario cities, towns, and villages have availed themselves of electricity for lighting purposes to a very great extent. There are seventy-eight of them which have either municipal plants or are supplied by companies; some have more than one plant. In Quebec, forty-two cities have electric-light plants; in Nova Scotia, twenty, and in New Brunswick, ten.

Rural Electric Railways.—Should the electric railway charters which the legislature has been asked to pass this year be granted, and should all the lines projected be constructed, no less than 1,046 miles will be added to the rural electric railway mileage of the province of Ontario. Twelve companies figure in the applications, the territory in which they are interested extending from Cornwall to Windsor; and if the tracks were laid, there would be a continuous line between those two points, with the exception of a short hiatus from Glencoe to Tecumseh; while to the north, another system will reach from London to Owen Sound, skirting the shore of Lake Huron.

These railways would revolutionize transportation in the country districts and give remote sections market facilities which would greatly enhance the value of farm products. Many of the lines tap territory not conveniently served by present railways. It is stated that American capital is behind the roads projected to radiate from Hamilton to Toronto, Guelph, and Waterloo.

Many of the electric railway charters passed in recent years have contained special clauses restricting the passenger rates.

In the province of Quebec, a number of electric railway companies have recently been chartered by the provincial legislature, and it is expected that fifty miles will be constructed during the coming summer.

Demand for Coal-Handling Appliances in Lourenco Marquez.—Consul W. S. Hollis reports from Lourenço Marquez, South Africa, that, in a recent conversation with Senhor Albers, head of the harbor commission, he was informed that it is intended to make that port a great coaling station. Senhor Albers particularly requested to be put in communication with people in the United States who could supply him with the most economical and up-to-date coal-handling appliances, such as trestles, cranes, and machinery for delivering coal from freight cars (3-foot 6-inch gauge) into the holds and bunkers of vessels. Any written or printed matter addressed to the consul will be submitted to Senhor Albers.

A New Acetylene Generator in Germany.—In answer to inquiries from the United States, Consul-General O. J. D. Hughes, of Coburg, reports that Mr. Erik Cornelius, chemist at the carbide-factory at Trollhattan, has invented a new acetylene-generator. This generator, says the consul-general, is described as being much simpler in construction than any yet placed upon the market, and occupies but little space. In its operation, the falling of the carbide into the water is automatically regulated by a hollow rubber ball, which, as soon as it is filled with gas, closes the valve between the carbide and the water. When the volume of gas decreases, the rubber ball contracts and the feed valve again permits the carbide to drop. The gas is stored partly in the rubber ball and partly in the space between the funnel-shaped carbide-magazine and the water. If more than the normal amount of gas is generated, it secures more room by forcing the water through valves into the water jacket in the sides of the apparatus. A separate gas tank is therefore not needed. Should too much gas be produced, both the water and the gas escape through a safety valve. Common carbide is used; no cartridges. The gas is dried by being allowed to pass through the carbide magazine, where the carbide absorbs the moisture. As there is no gas tank, and as the quantity of gas thus stored is insignificant, it is considered that the fire-insurance companies will, without raising the premiums, approve of the apparatus, even when it is placed in dwelling houses.

Bahia's Water-Works and Drainage System.—Consul-General Eugene Seeger writes from Rio de Janeiro, Brazil, about the city of Bahia, which is situate on the coast, and has 17,000 houses, containing all told about 200,000 inhabitants:

The water supply available for this population is entirely inadequate. A local company, called "Queimado," has had the contract of furnishing the city with water ever since 1852. It conducts the water from neighboring mountains, and altogether has spent about $1,500,000 for waterworks, a pipe system, fountains, fire plugs, etc. Long negotiations between the Queimado Company and the city of Bahia for the purpose of adequately increasing the waterworks came to a conclusion a few days ago. The Queimado monopoly is renewed for forty-five years and the company is awarded some valuable franchises and privileges. On the expiration of the contract the city has the option to buy the company's plants, at the valuation of experts. The use of water is made obligatory for each dwelling and the municipality of Bahia regulates the price —three dollars a month for the average dwelling for 400 liters (422 quarts) a day and twenty reis per twenty litres (21 quarts) for water furnished at the public fountains and hydrants.

The improvements called for in the Queimado Company's new contract would cost about $600,000. Plans and specifications have been made by experts. Owing to the financial crisis at present prevailing in Brazil, the company is unable to obtain the money required to complete the Bahia water system, and for this reason desires to sell its plant and privileges. The price asked is $1,100,000. The earning power of the Bahia waterworks, when completed in accordance with the new contract, is estimated at $300,000 per year. The agent of the above-mentioned company assures me that the person or corporation furnishing the city of Bahia with water under the new contract will also be awarded the contract for establishing a drainage system in the city and for furnishing the houses with sanitary plumbing. I would advise Americans in this line of business to investigate this proposition. The above-named facts and figures I have extracted from the statutes of the company, and a report submitted to me at my request. If desired, I can easily procure all the necessary details.

Personal

Prof. Franz Soxhlet, director of the Agricultural Experimental station and the Munich technical school of Germany, was recently made a chevalier of the Order of Merit of the Bavarian Crown.

Mr. George F. Porter, manager for W. R. Brixey, is now on his way to Alaska once more on cable business. Before leaving Mr. Porter said that the laying of the Skagway-Juneau cable, an account of which will be found in this issue, was attended with tremendous difficulties. No regular cable-ship was available, and Mr. Porter was compelled, practically, to rebuild the whole interior of the *Lakme's* hold, tearing out her stanchions and building tanks, while on deck a temporary bridge was constructed to hold the reel and other laying apparatus. In the face of all these obstacles, the cable was successfully laid in a most remarkably short time, and Mr. Porter justly regards the matter as an achievement.

Mr. H. R. Sutphen, who has been appointed general manager of the Electric Launch Company, of Bayonne, N. J., is at present actively engaged in directing affairs at the yards on the Passaic.

Mr. A. C. Pain, of Beliss & Morcom, Ltd., the high-speed engine builders, of Birmingham, England, in company with Mr. T. H. Parrott, the general manager of the plants, is now in this country, to study the application of steam and other engines in electric light and railway work.

Mr. C. L. Etheridge, chief engineer of the Chicago Telephone Company, for a number of years, and lately western agent of the Evans-Almiral hot-water heating system, recently accepted the appointment of chief electrical engineer of the Pullman Company, to succeed Mr. D. Avery Kimbark, who has resigned that place to start in business on his own account.

Mr. W. B. Jackson, traveling engineer for the Stanley Electric Manufacturing Company, sailed recently on the *Kronprinz Wilhelm* to make an indefinite stay abroad.

Major G. W. Foster, under the recent reorganization of the Southwestern Telephone and Telegraph Company, has recently been appointed assistant general manager, with headquearters in Dallas, Texas.

Mr. M. C. Rypinski, for the last five years associated with Mr. L. T. Robinson in the General Electric laboratory at Schenectady, N. Y., has resigned that place in order to take charge of the factory of the Empire Electrical Instrument Company, in New York City.

Lieutenant A. Clyde Caldwell, who was recently connected with the survey department of the Royal Military College, Kingston, Ont., has lately been appointed to a place in the geological survey.

Mr. George Leroux, who has recently been appointed secretary of the R. E. T. Pringle Electrical Supply Company, Montreal, Quebec, was formerly accountant of the Cornwall Electric Street Railway.

Mr. Ward S. Arnold has resigned his place in the General Electric Company's office in Chicago and accepted the position of sales engineer in the Chicago office of the Stanley Electric Manufacturing Company.

Mr. W. Dulles, Jr., who has just been

made president of the American Stoker Company, has been elected a resident member of the New York Chamber of Commerce.

Mr. John D. Curtis, for two years general manager of the Washburn Wire Company, has left that company's employ.

Professor Howard Barnes has been in New York for the purpose of attending the sessions of the American Physical Society, before which he read a paper. Mr. Barnes is head of the physical department of McGill University, Montreal, Quebec.

Mr. James F. Cummings, who is now on a visit to the United States, is a guest at the Hotel Imperial. Mr. Cummings is manager of the British electrical engineering and contracting house of Maguire & Baucus, London.

Lord Kelvin, after visiting Niagara Falls and seeing the manufacture of graphite from amorphous carbon, by means of high-temperatures, is reported as saying that "it ought to be easy to manufacture the diamond."

Mr. M. K. Eyre assumed entire charge of the selling organization of the Buckeye Electric Company, on May 1st.

Mr. C. A. Coffin, president of the General Electric Company, at the last session of the New York Chamber of Commerce, was elected a member of that body.

Mr. M. de K. Thompson, who has been appointed instructor in electro-chemistry, has been granted leave of absence to study abroad. Mr. Thompson is assistant in the Rogers Laboratory of the Massachusetts Institute of Technology.

M. Alfred Cornu, since 1867 professor at the École Polytechnique, in Paris, France, has died at the age of sixty-one years. He was an eminent physicist.

Mr. H. D. Ellis, who was previously the engineer in charge of Toronto's city roadways, under Mr. E. H. Keating, C. E., and Mr. W. T. Jennings, C. E., and who is now commissioner of public works to the Rajah of Sarawak, has been made a member of the English Institute of Civil Engineers.

Mr. Arthur Kennelly, son of Captain D. J. Kennelly, Sydney, who spent some time with Thomas A. Edison and the Thomson-Houston Company, has been appointed to the chair of Electrical Science in Harvard University.

Mr. Cyrus O. Baker, Jr., of the platinum refining firm of Baker & Company, sailed for Europe recently to be gone a couple of months.

Mr. William K. Ryan and President Herbert H. Vreeland, of the Metropolitan Street Railway Company, left New York recently in company with Mr. Thomas F. Ryan, of the Morton Trust Company, to visit Mr. Ryan's lead properties in Missouri.

Mr. Samuel Insull, president of the Chicago Edison Company, will be president of the United Gas and Electric Company, of New Albany, Ind. The company has a capital of $1,000,000, and has acquired control of the three gas and electric companies of New Albany and Jeffersonville.

Mr. Frank S. Gorton, secretary and treasurer, and one of the Chicago Edison Company's organizers, has resigned from that company and retired from business. After an indefinite sojourn abroad, Mr. Gorton will return to Chicago and devote his attention to personal interests.

Mr. Reginald J. Wallis-Jones is now on a visit to this country from England, making a tour of inspection in regard to electrical matters.

Mr. Arthur D. Wheeler, at a meeting of the directors of the Central Union Telephone Company, in Chicago, was elected first vice-president to succeed Colonel R. C. Clowry, who recently came to New York as president of the Western Union Telegraph Company.

Incorporations and Franchises

WISCONSIN.

Madison.—State Telephone Clearing Company, Weyauwega; incorporators: Ned W. Lowe, A. L. Hutchinson, H. E. Kepler. Capital, $5,000. To act as a clearing company for toll-business of the other telephone companies.

Interstate Telephone Company, of La Crosse; amendment of charter, thereby increasing capital from $100,000 to $150,000.

McFarland Telephone Company; $2,-500; incorporators: W. G. MacLachlan, E. N. Edwards, Frank Siggelkow, and M. D. Larson.

Fox River Valley Gas and Electric Company, of Appleton; increase of capital stock from $350,000 to $400,000.

Orfordville Telephone Company, of Orfordville; incorporators: O. P. Gardner, H. C. Taylor, J. A. Lorgh, G. Clementson, H. W. Kirthley and T. E. Tollefsrud.

Montello.—Dr. Wood, of Hancock, has organized the Marquette Telephone Company. A line will be built from Montello to Portage.

Athens.—The officers of the Athens Telephone Company, which has been installed here, are: W. L. Erbach, president; Joseph Braun, vice-president; Frank Blechs, secretary and treasurer. A local exchange will be installed.

INDIANA.

Indianapolis.—The secretary of state has been notified by the Parker Telephone Company, of Parker, of an increase in its capital from $2,500 to $10,000.

ILLINOIS.

Chicago.—United Water and Light Company; incorporators: Gail Dray, George C. Madison and Waldo F. Tobey.

Springfield. — The number of directors of the Bloomington Electric Light Company has just been increased from five to seven. The capital stock of the People's Telephone Company of the same city has been increased from $4,000 to $10,000.

Brunswick.—The officers of the New Township Telephone line, just organized, with its central office here, are: Dr. E. D. Kerr, president; Edward Fritz, vice-president, and John Boys, treasurer.

Decatur. — In Ridge township the Farmers' Mutual Telephone Company has been lately organized.

MINNESOTA.

Annandale. — A franchise has been granted by the city council to the Annandale Telephone Company, which has been incorporated under the state laws with a capital of $10,000.

Stockholm.—The officers of the Stockholm Telephone Company, which has been organized to construct a line between here and Cokato, are: president, John Eklof; vice-president, M. P. Mortensen; secretary, V. N. Mellquist, and treasurer, J. A. Peterson.

OHIO.

Cincinnati.—The Cincinnati Telephone Company, with a capital of $10,000, has been granted permission to locate in Cincinnati. It is a Kentucky corporation. The company will conduct a telephone and telegraph business throughout the United States. D. J. Hauss is president, and also the agent for Ohio. The incorporators are: P. Nodler, Joseph H. Becker and Charles H. Trame.

Warrensville.—Articles of incorporation have been filed by the Warrensville Telephone Company, whose capital is $5,000.

Columbus.—The Elyria Southern Telephone and Toll Company has increased its capital from $20,000 to $40,000.

Ada.—The Ada Telephone Company has increased its capital from $30,000 to $75,000.

Columbus.—The Upper Sandusky Telephone Company has increased its capital to $30,000.

Stryker.—The Stryker Telephone Company recently made an increase to its capital, which now amounts to $10,000.

KENTUCKY.

Salt River.—Salt River Telephone Company, $110,000. Wood Ash, incorporator.

Victoria.—The incorporators of the Victoria Telephone Company, which has been incorporated with a capital stock of $150,000, are Rufus S. Hall and others.

Frankfort.—Citizens' Electric Light and Power Company, of Carlisle, have a capital of $12,000.

OKLAHOMA.

Guthrie.—The officers of the Topeka, Lawrence & Kansas City Electric Railway Company, which has a capital of $2,000,000, are: J. B. Adams, R. Levan, T. S. Salathiel, H. M. Levan, M. L. Adams, and E. R. Salathiel.

Oklahoma City.—The incorporators of the Metropolitan Construction Company are: James R. Keaton, Frank Wells and Marian L. Spitler.

TENNESSEE.

Jackson.—The Jackson Home Telephone Company, which was chartered recently, has obtained a franchise from the city and will have a line in operation within sixty days. The incorporators of this company are: R. F. Spraggins, Joseph L. Dunn, J. D. Lloyd, J. H. Hoffman and W. D. Nelson.

NEW JERSEY.

Jersey City.—The incorporators of the Municipal Electro-Chemical Company, which has a capital of $100,000, are: Osborn Congelton, George H. Cook and Henry F. West.

The Del Rio Water Power Company, which has a capital of $75,000, has for its incorporators, George R. Allison, H. G. C. Thornton, and John W. Avery.

NEW YORK.

Addison.—The Addison and Bath Co-operative Company, whose capital is $4,000, has been incorporated to connect the towns of Addison, Bath, Risingville, Bonny Hill, Campbell, Sarona, Cameron, Rathbone, Woodhill, Thurston, and Bath with a telephone line. William V. Criniling, M. A. Angst, and Andrew Shanyer, of Thurston, N. Y., are the directors.

Albany.—The directors of the Hunt & Etrick Telephone Company, of West Chenango, whose capital is $1,200, are: W. A. Johnson, Frank Brigham, and E. B. Green, of West Chenango.

Skaneateles.—The object of the Skaneateles Telephone Company, which has a capital of $5,000, is to connect Syracuse, Auburn, Cortlandt, and the village of Skaneateles with telephone communication. The directors: F. Eugene Stone, Herbert L. Smith, and E. Clarence Aiken.

COLORADO.

Denver.—The incorporators of the Central Electric Company, of Colorado Springs, which has a capital of $15,000, are: W. S. Boynton, Robert G. Mullen, and Frank E. Boynton.

VIRGINIA.

Maidens.—The officers of the Goochland Telephone Company, which has recently been organized here, are: H. D. Leake, president; C. H. Powell, secretary; W. H. Holman, treasurer; R. H. Powell, general manager.

PENNSYLVANIA.

Slatington.—The Citizens' Telephone and Telegraph Company has been chartered with a capital of $5,000.

IOWA.

Kingsley. — The incorporators of the Kingsley Telephone Company, which has been incorporated with a capital of $2,500, are: J. C. Cotrell and others.

Larchwood.—The incorporators of the Larchwood Telephone Company, which has just filed articles of incoroporation, are: W. T. Ryan, J. M. Haggardt, Frank Lawler, T. H. Bradley, and E. J. Riegel. The company's capital is $1,500.

MAINE.

Portland.—The officers of the General Telephone Company, which has been incorporated to manufacture and deal in telephone instruments, are: H. W. Axtell and Maurice Pillsbury, treasurer. The capital is $10,000.

MICHIGAN.

Hancock.—The matter of organizing a Citizens' Telephone Company for an independent line in Hancock and vicinity was discussed at a recent meeting of local business men, who wish to run lines all through the county in opposition to the Michigan Telephone Company.

MISSOURI.

Newtonia. — Dr. Harrison, of this place; Bell & Hughes, of Granby, and others, are interested in the U-need-a Telephone Company, which has been organized here. A telephone line will be constructed to Pioneer.

St. Joseph.—A mutual telephone company is being formed by the farmers of Andrew county, and will be capitalized at $5,000.

NEBRASKA.

Clay Center.—A meeting was held here a few days ago at the court house for the purpose of discussing the formation of a local telephone company to connect the towns of the county with outside towns, and to include rural service.

MASSACHUSETTS.

Orange.—Those interested in the organization of a new telephone company to compete with the New England Telephone Company held another meeting, at which Hartley Walker, E. B. Miller, Cephas Morgan, Charles Taylor and Ashley Cooley were chosen to draw up articles of incorporation and take steps to have the company incorporated. E. B. Miller, in order to find out where these private lines exist and find their method of operating, was chosen to visit several towns where these private lines exist. It is believed that over one hundred and twenty-five citizens are ready to become subscribers. Applications have already been received from firms as far west as Chicago to put in bids for building the lines. In order to hear the reports of the different committees, another meeting will soon be held.

Gas Companies and Washing

By Charles Terhune

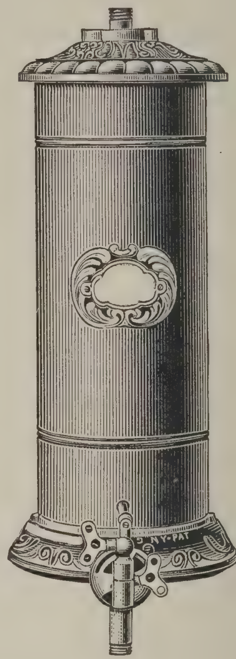
Gas companies do not seem to realize the opportunities before them for increasing their market by supplying some suitable device for heating water in the kitchen boiler or in other ways meeting the household demands for hot water in the bathroom and kitchen. It should be the object of the gas companies to educate their customers to the use of gas for every household need, rather than merely as a makeshift to tide them over the summer months.

By furnishing water heaters the gas companies could gain the business of wash days, equal alone to more than one-seventh of the total summer output of fuel gas. With the bathroom needs supplied the increased output would be much more. If a satisfactory water-heater were installed in households beside the gas ranges which the companies have spent so much efforts to introduce the coal range would become superfluous. Furthermore, if hot water were furnished at a reasonable cost, the housewife would begin to use gas weeks earlier in the spring and continue to use it weeks later in the fall than is now customary.

By supplying water-heaters, therefore, the result would be a large increase in the weekly fuel output and a season from five to twelve weeks longer than at present.

In the accompanying illustration a water-heater is shown which is built on thoroughly practical lines. For manufacturers who require hot water for any purpose in large quantities, the heaters may be used in batteries at a cost which will compare favorably with their present methods of heating water.

It is a well recognized fact that the gas companies must look for an increased output to gas for fuel rather than to that sold for illuminating purposes. Gas for fuel and electricity for lighting make an ideal combination for the household.



A Practical Water Heater.

In order to demonstrate what the gas water heater will do for the housewife a series of careful experiments have been made. It has been shown that sufficient water for washing the hands and face may be obtained in five minutes, enough for the dish-washing in ten minutes, and ample for the bath in twenty minutes. A thirty-gallon boiler full of water can be heated from 70° and 145° with the consumption of thirty cubic feet of gas. This would make the cost, with gas at one dollar per thousand feet, a trifle less than three cents. For an ordinary bath ten gallons of water at 145° is sufficient to make the balance of the water in the tub comfortably warm.

Surface Condensation

By James A. Anderson

Up to the present time this subject has received a great deal of attention, both favorable and otherwise; favorable for the reason that a vast amount of money can be saved by the use of surface-condensers when properly operated, unfavorable because of the high first cost, as compared with the ordinary jet-condenser in common use, and the aversion engineers in general had to the use of the water in the boilers, it containing a large amount of oil which resisted nearly all efforts to filter it thoroughly. But this question has been settled, and thereby one of the greatest objections removed, placing the surface-condenser on the basis of one of the greatest money saving devices connected with modern power plants.

To consider the monetary value of a surface-condensing plant, properly equipped with filters adapted to the work to be done, we will assume that we have a plant of twenty thousand horse power, which is a medium-sized plant at the present time. The water consumed by the plant will cost ninety-one dollars daily, basing the engine economy at twelve pounds of steam per h. p. hour, and the station fully loaded. This assumes vast proportions, when we consider the yearly charge, which amounts to $33,215, a great part of which is useless expenditure, as a complete system to save at least seventy-five per cent of this water-bill can be installed in a plant of this size for about $30,000.

As the separation of oil calls only for straight filtration, so-called water-purifiers are not required, the water from the condensers being distilled and, therefore, free from all the impurities common to water drawn from the city mains or wells, the only element to be contended with being the oil, and the possibility that the water may be too pure for boiler use. This can be easily accomplished by the proper filter in conjunction with intelligent treatment of the water in its progress from the condensers to the boilers.

In estimating the total cost of a plant of the size referred to, there must be taken into consideration the fixed charges, the cost of maintenance, labor, and power for operation:

Fixed Charges	6%	$1,800 00
Maintenance	4%	1,200 00
Labor, 365 days	$2 00	730 00
Power, 365 days	$1 00	365 00
Total yearly cost of filter operation		$4,095 00

As the operation of surface-condensers under the new condition will demand more careful attention, both as to the condition of the tubes and the cleanliness of the machines, it will be imperative to provide the necessary labor to keep them in as near perfect condition as possible. Assuming that material for repairs will be based on a life of six years, for each set of tubes, a statement like the following may be obtained:

Yearly cost of tubes, (about)	$3,750 00
" " " labor	730 00
" " " filter operation	4,095 00
Total	$8,575 00

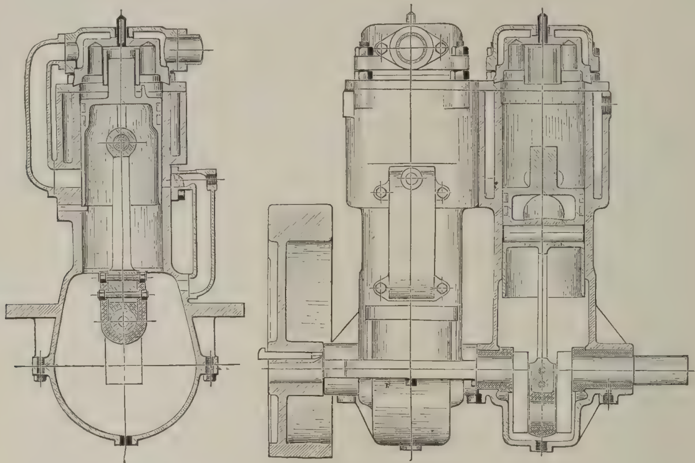
This allows ample margin for the increased cost of surface-condensers and maintenance. On saving seventy-five per cent of the water we have:

Gross gain	$24,911 00
Deducting cost of filter operation, labor, etc.	4,095 00
Net yearly gain	$16,336 00

This sum at first sight seems to be a remarkable return from the $30,000 invested, but the only reason that a plant of this capacity would cost more to install, is the location, as these figures are based on favorable conditions and prices, as they rule to-day.

A Simple Oil Engine

In the accompanying illustration is presented a view of a compact and economical kerosene engine manufactured by the International Power Vehicle Company. A demand for an oil-engine which should be not only effective, but also economical, simple and durable, has given rise to the designs shown herewith, which are believed by the manufacturer to have more power at their command than any other engines. This type of machine dispenses with the unpleasant and dangerous features connected with the ordinary explosive gasoline or naphtha engines, requiring no flame for ignition and no spark either to start or to keep the machine in motion. The engine is, as well, practically noiseless and odorless; as no boiler is used with it there are no repairs of the sort required by engines of that type.



An Economical Oil Engine.

As the fuel employed is ordinary kerosene oil, which is obtainable in the most insignificant country village, the engine will run anywhere, and since only one gallon of oil is required per horse-power for each ten hours' operation, no other expense being necessary for operation or maintenance, excepting a little lubricating oil, it will be seen that the economy effected by the use of an engine of this sort is considerable.

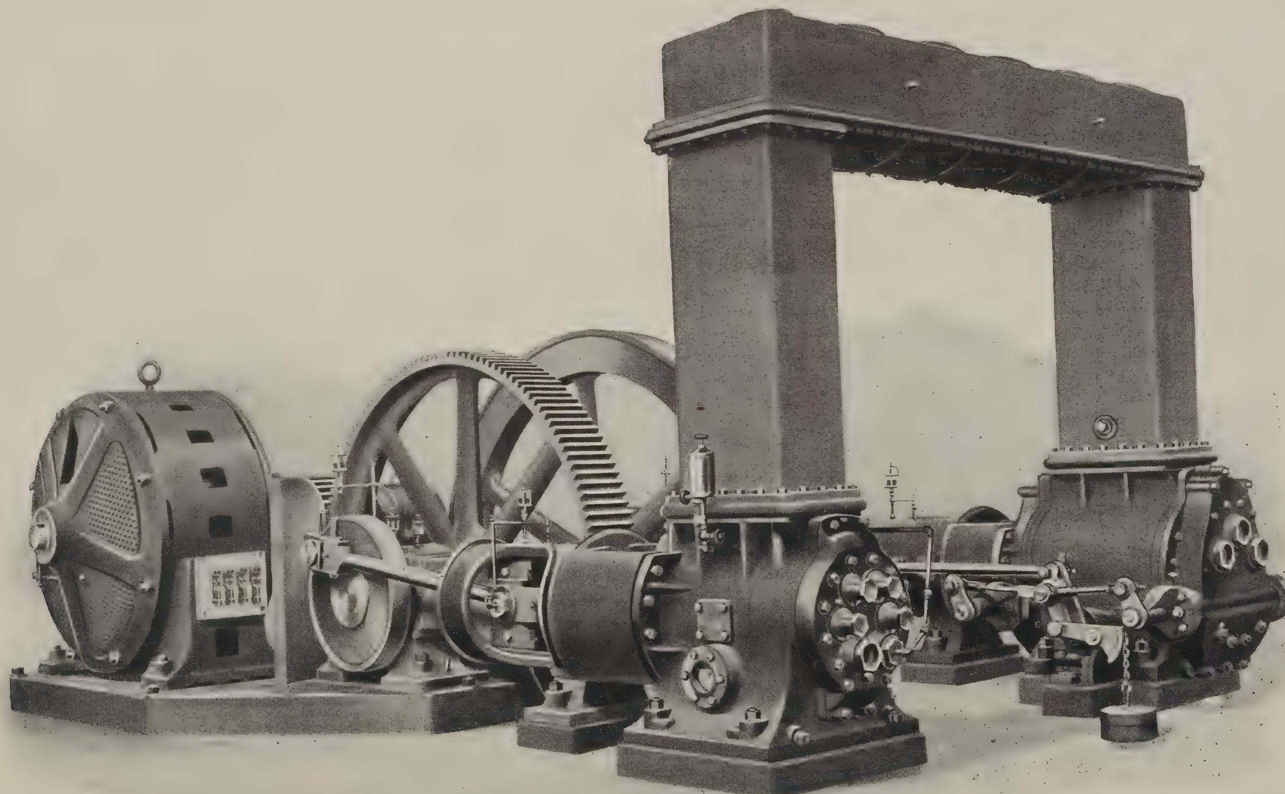
Ordinary common sense and the instructions given by the builder are the only requirements for running the engine, which will operate anything, according to the manufacturer's claims, from the smallest plant to the largest factory, while its uses are manifold. It is claimed to be particularly effective where other machinery either cannot be obtained or is for some reason undesirable.

Inquiries should be addressed to the manufacturer, Stamford, Conn.

Navy Yard Air-Compressor

One of the interesting new machines in the reconstructed shops at the Navy Yard in Brooklyn is a great air-compressor, which supplies power for scores of riveting and caulking machines, for chipping machines and hoists in the machine and boiler shops.

Like all the other new Navy Yard



RAND "D_2" AIR-COMPRESSOR DRIVEN BY ELECTRIC MOTOR
CROSS-COMPOUND AIR CYLINDERS FITTED WITH AUTOMATIC UNLOADING VALVES.

tools, this air-compressor is electrically driven. It is the largest machine of its kind so operated.

No tests have yet been made to establish its efficiency, but this is believed to be high.

The machine was built by the Rand Drill Company. It is of a type usually belt-driven. The gear connection, it is estimated, saves a loss of about seven per cent in friction over belt-loss.

The motor takes two-phase 220-volt current, and runs at a speed of 480 revolutions per minute. This is geared down to one hundred revolutions on the main driving shaft, through the medium of a stranded rawhide pinion, working into a cast-iron wheel with machine-cut teeth.

The air-compressor does its work in two stages. In the first stage, the compression is thirty-five pounds pressure to the inch. In the second, it is one hundred pounds. The arched connection shown between the cylinders is the intercoiler. In this the air passes through one-inch pipes, which are surrounded by water. The cylinders are also water-jacketed. The low-pressure cylinder has Corliss inlet valves and poppet outlet valves. The high-pressure cylinder has poppet valves for both inlet and outlet. Both cylinders have the Rand unloader. The capacity of the machine is 1,000 cubic feet of free air per minute.

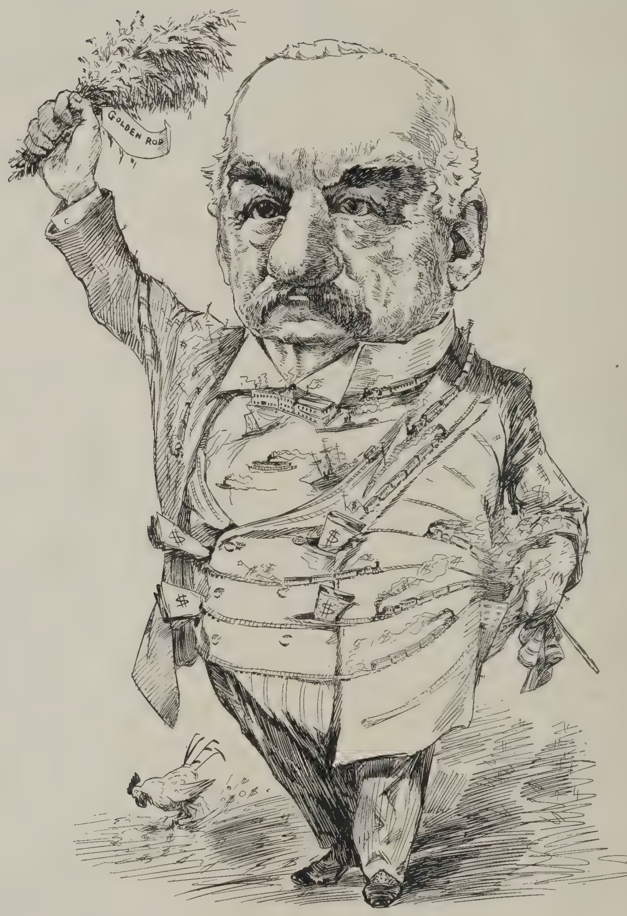
N. E. L. A. at the World's Fair, St. Louis

At the recent annual convention of the National Electric Light Association, held in Cincinnati, Ohio, so keen an interest was manifested in the importance of the association taking an active part in stimulating a prominent and important display of electrical apparatus and appliances at the International Exposition, to be held in St. Louis in 1904, that it culminated in the unanimous passage by the convention of the following resolution, which was presented by Mr. James I. Ayer of Boston.

"*Resolved,* That the annual meeting, to occur in 1904, of the National Electric Light Association, be held on the grounds of the Louisiana Purchase Exposition Company at St. Louis, Missouri, and that the Association will lend its best endeavor to contribute to the achievement of such an electrical exhibit as the consideration of the Exposition management and the industry demands."

Prominent members of the association expressed themselves as being highly desirous of seeing the industrial applications of electricity established on a large scale at the Louisiana Purchase Exposition, and they voiced their willingness to co-operate in any way to secure this end, for the reason that the Exposition will have the effect of opening up a great deal of territory now undeveloped electrically, and both the electrical central station managers and the manufacturers are alive to the fact that a proper exploitation of the wide application of electricity will have much to do with extending the use of electrically operated and controlled apparatus and appliances, as well as the augmenting of, in no small degree, the present use of electricity as applied to illumination. It is quite probable that the association will have an exhibit of its own for the demonstration of all present methods for measuring and selling electric energy, whether for light or power. This exhibit will be educational in character, and be intended to make the general public more familiar with the methods employed by electric companies in keeping their accounts and in making their charges.

Action was taken this year to hold the 1904 meeting at St. Louis for the reason that the members are convinced that much better working exhibits will be forthcoming if the electrical manufacturers understand that the central station men are thoroughly interested in having all electrical apparatus exploited on a large scale. Within the membership of this association are included as active members the men most prominent in the development of electricity, beside dealers, manufacturers and others.



"GENERAL OF INDUSTRY."

The General of Industry

Ho, Captains of Industry, take off your hats,
And cheer with a vigorous vim,
For the General of Industry has arrived,
And all of you recognize him.

You Captains of Industry represent what
Is best in this wonderful land,
In all that develops the national strength
And gives it the power to command;

But you're only captains—a greater is this,
The General of Industry, he,
Who stretches his hand for every good thing
That thrives on the land or the sea.

He marshals his legions of dollars and brains;
He moves them about as he will
To capture the prizes the earth may present,
With billions to settle the bill.

The question of price never enters his mind;
He wants what he wants, that's enough;
And straightway he grabs it, because it's his rule
To always stand good for his bluff.

He bunches the prizes he picks from the push,
Which vastly increases their worth,
And he thinks, in a way, it would better affairs
To Morganize heaven and earth.

But let him go on; perhaps he does grab
Just a little too much for one man;
Yet it isn't so bad, for whatever he gets
He makes it American.

He's Yankee all through, the Stars and the Stripes
Fly higher all over the free
Because of his deeds; so let us applaud
The General of Industry.

What odds if the cash that he backs with his nerve
Pulls all of the plums to his pie?
What odds if he own us? There are others besides,
And he'll own all the world by and by.

He's in it to win, and he's going to win,
He is King of the Golden Rod,
And some day we'll hear of the well-known firm
Of J. P. Morgan & God.

VERITAS.

A Vista

By Oscar T. Crosby

In Pompeii—provincial but prosperous—residences of even the better class are seen to have shop fronts. Generally the older quarters of European cities still show the close juxtaposition of working-place and resting-place. The factory may be found in the back yard of the owner's home. The mere weight of us as masses of matter and the short range of the hearing-sense thus combine closely to limit the area traversed by a given individual in a given time. But the thinking part of man has been very busy in the last century finding means of transporting men, and things, and thought very quickly and very cheaply.

The latest developed flowers of this new springtime in humanity's epoch are the electric railway and the electric telephone; and now the play-ground may be removed from the workshop—so far removed that he who rests or amuses himself in the one may forget his toil in the other.

Time was when this separation of work and play was accomplished chiefly by permitting class A to play all the while and condemning class B to work all the while. Now the separation is seen in the individual life of Smith, which is stratified into play-time and work-time, as society was once stratified into workmen and play-men.

The hours of toil being eight, and the time of transit over a distance of five miles being half an hour, Smith may have six waking hours of rest, out of fifteen, and these in surroundings wholly different from those that smell of work. The process has already gone far. The lower part of New York city, where the traffic is in ideas, not in material things, is the office for many thousands of widely scattered workers who are thus brought within short range of each other, permitting easy personal contact for those occasions which yet seem to require the looking into each other's eyes. Meanwhile the telephone, and the telegraph, and the tickers diminish the need, relatively, of this frequent personal contact, and thus increase the distance which may separate men desiring occasionally to see each other.

In like manner, the other typical industries in all great cities are segregated in their respective quarters; each quarter constantly growing larger, with an increasing convenience of intercourse in spite of increasing area. Let us suppose the inventions for transporting matter and thought continually diminish the cost and time of transportation, thus increasing the radius of activity from a given center. Let us, indeed, use the "method of limits," by supposing the cost and time of transportation over any distance to be negligible.

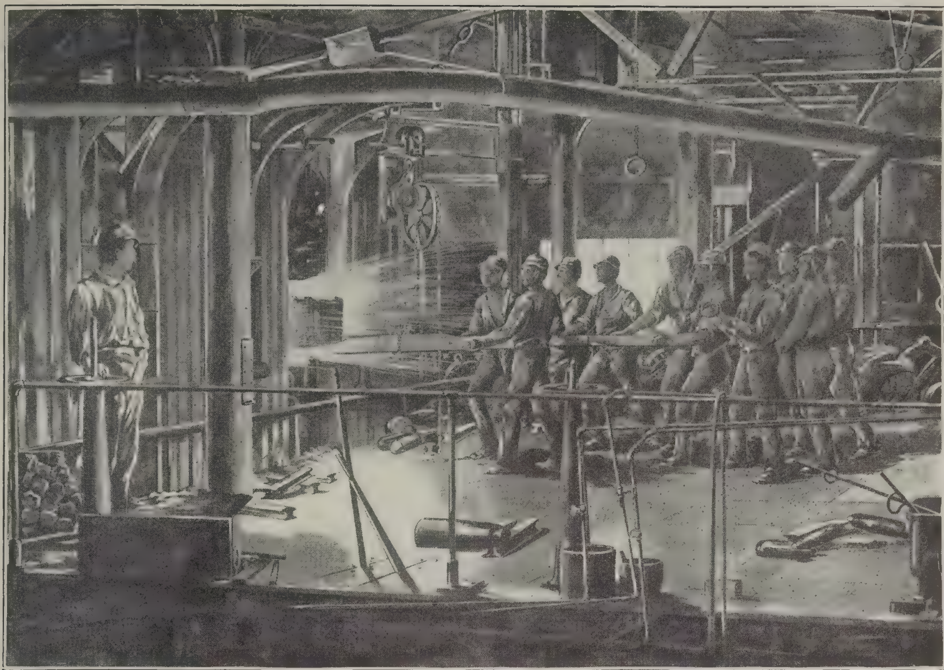
What would be the result?

The world would have one great office-city, probably one great work-city for all industries, while men would live in any corner of the earth whose climate and society might please the individual fancy. Until synthetic chemistry shall have annihilated agriculture, only the most fertile fields throughout the continents would be cultivated; while areas now smiling with green crops might be left deserted. This condition of zero cost and zero time for transportation is, indeed, chimerical, but we are ever moving toward it—the social conditions produced by the resulting concentration of industries, to a degree not now understandable, are those which the future must bring to the race. Those conditions cannot here be particularly presented.

Each reader will dream his own dreams; and this foreseeing by the many constitutes part of the adjustment which nature makes in order that its creatures may be duly fitted to stand new strains. There is no promise of the elimination of evil, but there is a suggestion that each surviving human and brute life may be better worth the living, because men shall, by invention's grace, see and know more of the world we live in.

Norwegian Duty on Transformers

Reports from Norway state that transformers, which have hitherto been admitted duty free, will in future be subject to customs duty at the rate of five per cent ad valorem. A duty on incandescent electric lamps has also been fixed.



The Old Way. Crew Charging an Open-Hearth Furnace by Hand.

The Homestead Steel Works

Something more than twenty years ago Mr. Andrew Kloman, of Pittsburg, thought that an iron and steel maker by the name of Carnegie was making money too fast, and he accordingly put forth his best efforts to make his rival work for all he got. The result of Mr. Kloman's endeavors was the inception of the present great plant at Homestead, Pennsylvania, the largest of its kind in the world.

It was in 1881 that the plant was begun, and it ran as a Kloman property, and consequently a competitor of the Carnegie interests, until about 1883 or 1884, when it was turned over to Andrew Carnegie. From almost the very day of the sale it has grown steadily, until at the present time it covers nearly two square miles of river front on the Monongahela.

In the Homestead yards the Carnegie Steel Company has a line of regular standard gauge railway track and fifteen sixty-ton standard locomotives, fully the equal of any rolling stock of the mogul type used by the first-class companies. In this gigantic yard there is handled a shipping and switching traffic that would put the yard business of many a large trunk line to shame. As an example of this it may be said in passing that the traffic handled by the Homestead plant and actually sent out of the yards of the mills during the month of April last, was in round numbers about 43,000 cars of finished steel products. In finished products the output of all the mills at Homestead maintains a monthly average of about 120,000 tons of structural and plate steel. To the uninitiated it may be said that the new store building going up in New York city at the corner of Sixth avenue and Thirty-fourth street is being constructed with girders and beams, angle iron, braces and other shapes turned out at the Homestead plant.

Just across the Monongahela river from Homestead lie the Carrie furnaces, and connecting the two yards is a railway line which runs over a specially built bridge of steel 1,100 feet long. This railway is built broad gauge, and the track is made of regular seventy-pound rails to give it the proper tenacity, for over it run the heavy ladle-cars, each carrying a burden of many tons of boiling, effervescent iron, which goes from the furnaces on the Pittsburg side of the river to the open-hearth mills on the Homestead side.

The Carrie plant is of interest most particularly in regard to the manner in which the coke and ore are brought into the yard and handled before going into the furnaces. The yards are practically square and are divided into three sections by the ore and limestone bins, which run at right angles to the river and terminate at the stockyard wall where the coke-bins are. Running parallel with the river and crossing the yard are two bridge tramways. On the arrival of a train in the yard the tipple or car-dumper is brought into play to unload the car. Each train is made up of cars which are specially selected for the material that they carry, being loaded respectively with ore and limestone flux. As soon as the train is switched onto the dumper tracks the cars are pushed toward the tipple until all are beyond the apex of the line. The locomotive then uncouples and runs back to push up the train on the other track, the brakes of the cars, which are now on the descending grade, being fully set. The two tracks unite at a point near the bottom of the grade and just before they reach the long pit which contains the "ground-hog," which is run on narrow gauge track laid inside of the standard gauge. Wire cable attached to the end of the "ground-hog," and supported by rollers set between the narrow gauge rails passes to the dumper. On starting this cable the "ground-hog" is drawn up toward the dumper. On releasing the brakes of the first car of the train it starts down the grade and is carried by its momentum to a point beyond the pit, where it is checked by the ascending grade between that point and the dumper. As it passes the pit the ground-hog rises and follows it, finally catching the car and pushing it up the grade and on to the detached level section of track which forms the dumper-floor.

This car-dumper or tipple consists of a massive cradle floored with track and large enough to hold the biggest of the ore-cars which come into the yard. At the top of this cradle on one side is a ten-inch horizontal shaft about which the cradle is made to revolve, while to the other side near the bottom are attached wire cables by means of which cradle and car may be elevated and turned about the shaft. To hold the car firmly in position, hydraulic columns are attached to the cradle and have such a wide range of motion that any size car can easily be dumped. Guided by a steel apron, which extends the entire length of the car, the contents are thrown out into the dumper bin; this is built of steel and has eight compartments, each terminating in a chute which is shut by a rotating gate, the partition being double, its sides being ten inches apart to allow for the gate-operating mechanism.

The bridge tramways which run the entire length of the yard carry the ore-buckets. The trolleys which operate on these bridge tramways can be readily moved to any point within the limits of the structure and the entire tramway itself can travel on its tracks to any part in the other direction, thus enabling the whole area of the stock-yard to be served.

The equipment of the plant consists of

DUQUESNE FURNACES AND STEEL WORKS, DUQUESNE, PA.

HOMESTEAD STEEL WORKS, MUNHALL, PA.

EDGAR THOMSON FURNACES AND STEEL WORKS, BESSEMER, PA.

CARNEGIE STEEL COMPANY, PITTSBURG, PA., U. S. A.

Principal Mills and Furnaces of the Carnegie Steel Company. The Homestead Plant is the Largest of Its Kind in the World.

eight stoves and two furnaces, which are automatically fed by means of skip-dumps. The skips are rectangular buckets whose front wheels are of the ordinary flange type; the rear wheels are practically double, having two flanges, one on the center and one on the inside, thus enabling the use of a double track. Both tracks are inclined from the ground to the furnace top in the same inclined plane near the charging frame, where the inside track or main line leaves that plane and follows a vertical curve whose center is below the track. By this means the front of the skip is led in toward the orifice in the furnace top while the rear wheels tend to carry their burden on toward the top of the furnace. By this means the furnace is charged.

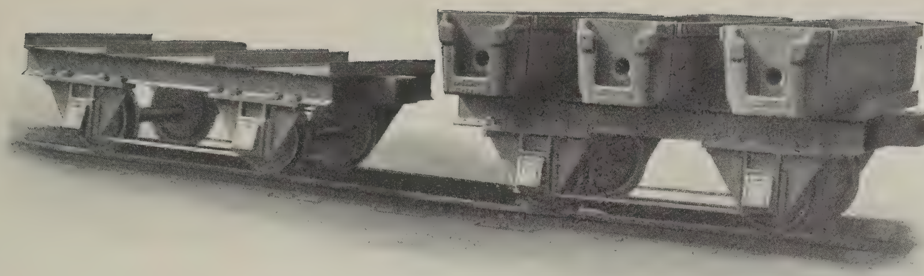
The Carrie furnaces have not been very long in the possession of the Carnegie Steel Company as compared with the rest of the Homestead plant, but in that time considerable saving has been effected by the introduction of various mechanical devices which have done away with hand labor to a great extent, so that at the present time the two furnaces are producing steadily about 1,400 tons per day of pig-iron.

The feature of the heavy rails on narrow gauge track strikes the visitor as a most peculiar thing until he sees the great weights the track is required to support. It is an occurrence of every minute to see huge steel ingots weighing from one to ten tons apiece standing quietly on the little cars in the Homestead yard, waiting to be fed into the stomachs of the glaring titans whose sizzling breath scorches and sears the face and clothing of the unwary one who ventures too close in his eagerness to get a better view.

But all the track in the yard, heavy though it be, is not in use by the standard locomotives. Sneaking little consumptive shunting engines, bobtailed and noiseless, save for a racking and disagreebly intermittent cough, steal around the enclosure as silent as shadows and as certain to frighten one as anything can be. Back and forth they shoot, whizzing to and fro, towing bubbling ladle-cars filled with molten iron, pushing with snorts of contempt at loads of scrap and pig, or careering past in full flight to join a train at some distant point in the enclosure. Somehow these engines, in spite of their usefulness, impress by their very littleness and silent celerity, and their almost human screeches of delight when they vent their shrill whistle under one's very ears. In the hubbub caused by the roar of the converters, the shears, the deafening rattle of the rolls and passing tables, the clanking and rumble of the great cranes and charging-machines, the whistles of the engines pierce to the heart with their sudden demand for right of way, and the imperious note is easily dominant. Combined with the wild and sudden noises and apparent confusion of the great mills is an atmosphere of heavy smoke and clouds of dust, cinders, calcined bits of steel, and over and through all a stifling heat that sickens and weakens and wearies the workmen even, in spite of their habitual exposure to it and consequent indifference to temperatures that appal any but a steel-worker.

To give a thoroughly detailed description of the great Homestead plant, or in fact, any of the other works of the Carnegie Steel Company, is obviously impossible on account of their great size and the vast amount of work they do. But in the brief sketch that follows some idea of the former plant is presented in very condensed form.

Beginning at the forty-eight-inch Universal plate-mill, as the best starting point the visitor enters a large building full of weird noises and heat and smoke. This is the latest and best of its kind in the entire plant and is fitted with the most modern appliances for work. This mill rolls



Narrow Gauge Cars and Charging Boxes Used at the Open-Hearth Furnaces at the Homestead Works.

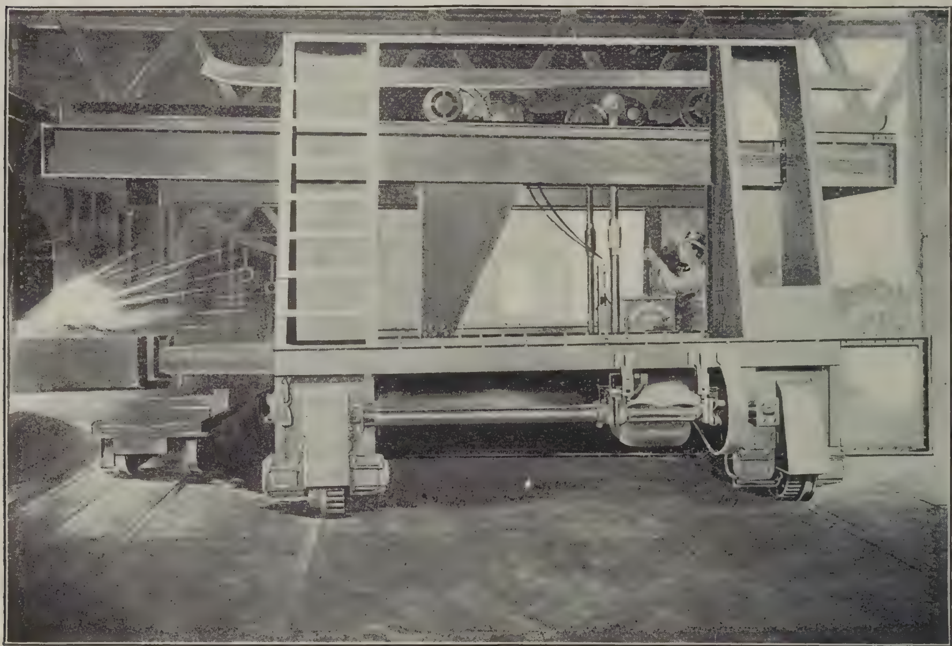
plate from forty-five to twenty-two inches in width and from one and one-quarter to five-sixteenths of an inch thick, to one hundred and fifty feet in length. Each month's production is, roughly, about 10,000 tons. The total electrical horse power employed in this mill is 886.

Slowly the eye grows accustomed to the glare of the hot ingots and the peep-holes in the furnace doors, through which the natural gas fires can be seen playing around the ingots in what is known by the millmen as the reheating process. Coal cannot be used in these reheating furnaces. Waste heat might be used, but it would require a complicated readjustment of the plant, which was not designed for it, hence natural gas is employed. As the supply of gas is limited it is used only where actually necessary. The coal used in the works is only for the boilers.

The most striking features of this mill are the big charging-machine, the "buggy" and electric crane, which is rigged across the shop, and the three sets of rolls. The first of these machines, the charging apparatus, is a huge affair, and somewhat resembles the machine employed to hoist the shells for and load the great guns on our modern naval vessels. The charger is a square truck, running on a track. In the inside of the structure is a second carriage, so constructed as to be able to run back and forth in the machine. Five controllers with their corresponding levers, are situated at the rear where the operator can grasp any one with facility. Each lever and switch controls a separate motion, some being for the charging action, others for the moving of the machine proper from point to point in the shop. The heavy gripper which is seen projecting at the front of the machine is lowered at the moment it enters the furnace door, the jaws opened wide, a firm hold taken on the glowing ingot, and the whole withdrawn. The machine then lays the ingot gently down on one of the cars designed for the purpose, which puts it in the arms of the transverse crane, which carries it down the mill to the rolls and passing tables, where it is rolled out into the shape and size required by the specifications on which the mill happens to be working at the time. The entire operation of charging and conveying has been so simplified by the use of electricity that four men, each in a different position, are sufficient to handle the matter properly. The furnaces are opened and the ingots drawn out in exactly the same manner and handled by the same four men.

This mill has three sets of rolls, one being horizontal and the other two vertical, all being worked by steam, though the gauges are operated by electricity, as are also the three 115-foot span cranes, the hot-bed and the transfer-tables. The three shipping-cranes are all 220-volt, direct current, twenty-ton machines. At the far end of the plate-mill the finished product is sheared to size and placed in piles, each plate bearing the heat-number and other identification marks. When the plates get to this department they are taken care of by the shipping department, which sees that they are all properly classified and loaded on to the right cars. This part of the mill has the standard gauge railroad and the freight cars run up directly into the clang of the shops and receive the still warm sheets.

When the ingot leaves the furnace door and is sent down by car and crane to the rolls the interesting part of the work begins. Once placed on the rolls, the hot parallelogram of steel is shot rapidly and with unerring precision into the squeezing rolls. The heavy rolls close down upon it and it comes out smaller in diameter but considerably longer, and slides away down the back rolls for a short distance. Then these rolls are reversed and the ingot comes back at a good speed and passes back and forward again and again through the rolls, until it has been crushed into the proper size. By this time it has lost all resemblance to the heavy piece of metal that went into the rolls five minutes before, for now the color is a deep, cherry-like purple, and the sheet is perhaps two feet wide by fifty long and anywhere from a quarter to five-sixteenths of an inch thick. After passing through the shears, where the sheets are cut into the desired lengths, they go to the shipping casters. These queer affairs are simply ordinary casters built of more than usual strength, and planted inverted in the earth or stone floor on iron rods two inches or more in diameter, the roller ends being uppermost. Over these casters are moved the cut sheets, and as there is no regular arrangement of the casters, a space of several inches being left be-



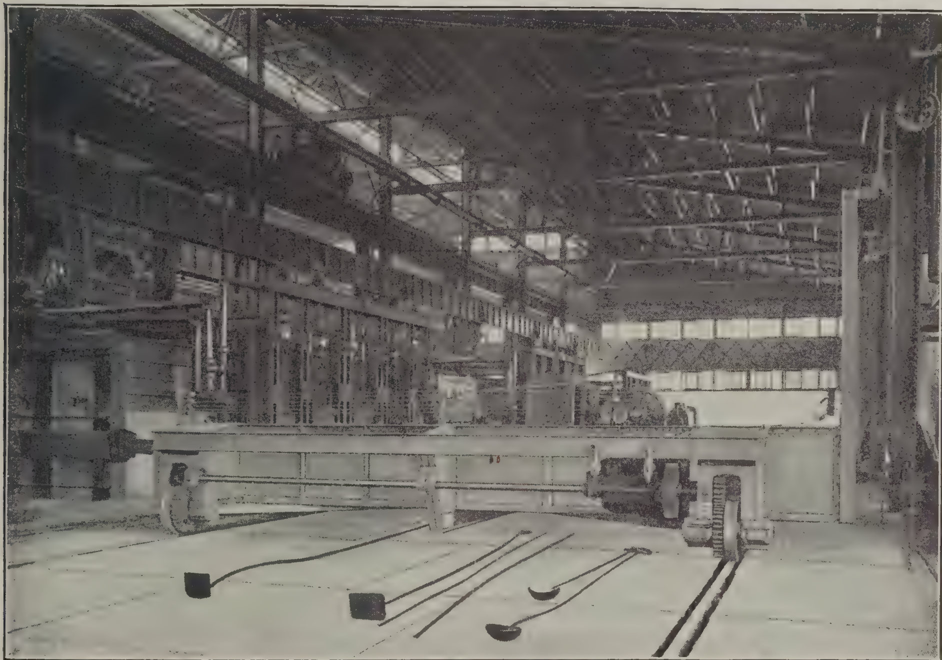
The New Way. Old-Style, Double Decker Charging-Machine Feeding an Open-Hearth Furnace at the Homestead Works, Carnegie Steel Company.

tween each one, the men can move freely in and out among them, handling the sheets and sliding them readily over the wheels from place to place until they are finally loaded into the cars.

The boiler-plant, which lies next to the plate-mill, is also an interesting sight. An electrically driven coal-handling machine feeds the chain-grate mechanical stokers from bins below, where the fuel is kept stored. Every month the forty-eight inch mill produces about 10,000 tons of finished products.

In connection with the open-hearth mill, number two, which comes next to the plate-mill, there is what is known as a hot-metal mixer.

Ladle-cars come across the river, a distance of 6,000 feet from the blast-furnace to the open-hearth furnace, filled with molten iron from the Carrie blast-furnaces, and the ladle part of the car is lifted by a fifty-ton crane and the hissing contents poured with a rush and roar into the mixer, which is really nothing but a reservoir, as the iron is not mixed with anything but itself. The process, however, is necessary. The mixer hangs on trunnions and an hydraulic cylinder is connected to it in such a way that it can be made to rotate and thereby effect the mixture of the metal. This device also enables the great caldron to be turned over on its side and the contents poured out into other ladle-cars. The mixer has a capacity of 200 tons, though on looking into it and seeing its apparent shallowness this figure seems exaggerated. The electric crane which lifts the ladles and swings them back again has a seventy-five-foot span and travels on an overhead line close beside the mixer.



New, Low Type Rotary Charging-Machine in the Open-Hearth Mills at Homestead. Several of these Machines are in Daily Use.

Scrap makes up a certain portion of all open-hearth work, and the method of charging and drawing from the furnaces is as follows:

In charging, the little cars are ranged up alongside of the furnace doors and between them and the charger. At a twist of the right lever, the giant machine pushes forward its beak, inserts a square head into a corresponding slot in the end of a car, lifts the box and its load of scrap, the furnace door swings up easily and the beak thrusts its burden into the fire within, turns the car over so as to dump out the load, withdraws the empty, sets it again upon its car, and the operation is closed with the sliding down of the furnace door, which is hydraulically operated. One department of the open-hearth mill, number two, is the famous armor-plate section, where the government contracts for protective armor are filled. Here the charging boxes are lifted into the furnaces just as in the other case. One of the transverse cranes in this part of the work is the largest in all the plant, its capacity being one hundred and fifty tons. It is rigged to travel overhead and is equipped with two seventy-five-ton trolleys, the whole crane having a sixty-foot span. There are altogether forty-eight open hearth furnaces in the Homestead works, all of them being of the well known Siemens standard regenerating type. It is interesting to note that when the lower portion of this open-hearth plant was built, several years ago, Homestead had only two, or perhaps three, electric cranes, while to-day the works can show a total of one hundred and eight cranes installed and in use night and day. Eight new ones have been ordered and will be in operation before the cold weather comes again. The casting pits in the armor-plate section of the open-hearth plant are of great interest. Here are pits some twenty feet deep, sixty or seventy long, and rather more than twenty feet wide. In them lie the great moulds which contain the castings for large steel shafts, armor-plate, and other big work of a similar nature and which requires special attention and special compounds of steel. The armor-plate, of course, is all of the very tough nickel steel, and has to be prepared especially for the purpose, as the steel used in making it would not do for other and more general purposes. The moulds for the armor-plate and also for other heavy and important castings are so large that they have to be removed from the metal one section at a time, beginning at the top, each step of the process being accompanied by a corresponding period of cooling.

The big thirty-two-inch mill is practically the same as the universal slabbing-mill with the exception that it rolls a heavier product and is used to finish up the armor-plate. Beside this, however, no finished products are turned out of the mill.

Open-hearth mill number one is the same as the other open-hearth mills save that the hoists are hydraulic. This being one of the older mills it has not the same facilities as some of the newer ones. In connection with it is the one hundred and nineteen-inch plate-mill, which is one of the oldest plants in the entire works, and the machinery in it is accordingly operated in the old way—by water and by hand. It is intended in the future to reconstruct this important mill in a thoroughly modern manner and fit it out with the proper electrically driven machinery.

On leaving the one hundred and nineteen-inch plate-mill and entering the far end of the big structure that shelters the converters, the ear is met by a low, deep roar of sullen depth and swell that rises clear and distinct above the rattle of the rolls and the other confused and varying noises of the works. Through the dim and smoky atmosphere, cloudy with steam, reeking with the odor of natural gas smoke, and filled with dust and bits of cinder, a lurid glare of blinding intensity can be seen at the opposite end of

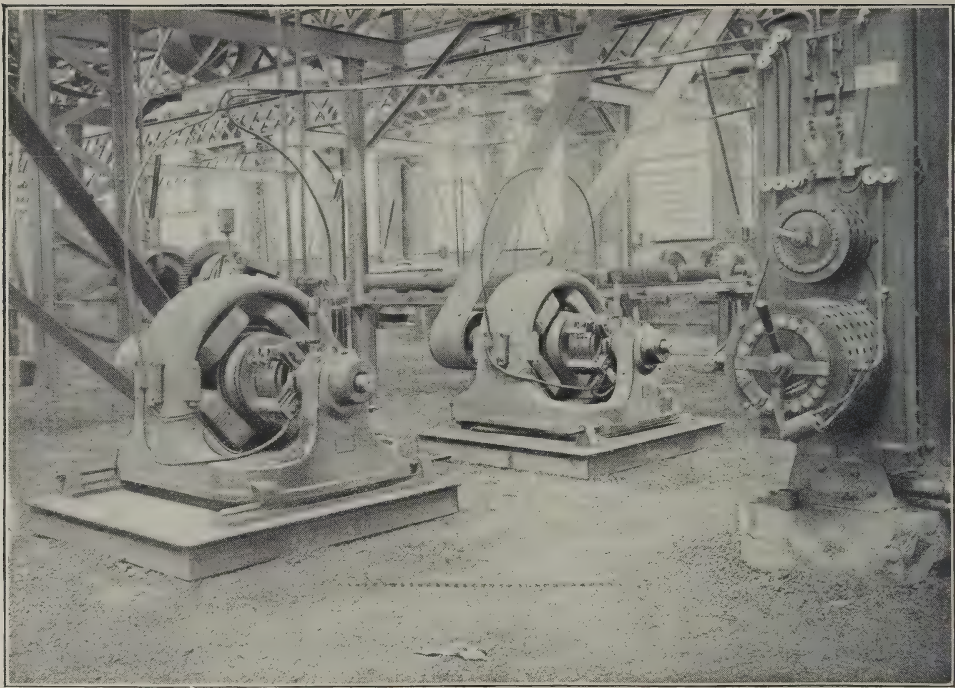
Unloading Crane, Edgar Thomson Mills, Carnegie Steel Company, Bessemer, Penna.

the mill. Passing along up the shop, dodging a white-hot ingot here, shielding face and hands against the heat of dripping, melted slag there, and keeping a sharp lookout for the swift little cranes and trolleys with which the works are filled, the visitor works his way cautiously along to the converters.

But the great sight is reserved for the converter-section of the mill. Here are two giant, swinging caldrons with bell-shaped tops, perforated with a hole in the center and mounted on trunnions, roaring and flaming, spitting solid columns of sparks as the fresh metal is poured into them, and making more noise than fifty New York fire-engines at one fire. But to describe the converter properly it is necessary to go back to the beginning and show the way the work is done.

Back of the converters and outside of the shelter are huge bins. Into these is poured and thrown carload after carload of bessemer pig-iron. A gang then loads the pig into a hoist, which carries it up to the charging-floor of the cupola-house, where it is quickly melted in the capacious cupola, the blast for which is supplied by large and powerful motor-driven fans. From the cupola, the molten, bubbling stuff is poured, with much hissing and sputtering, into a ladle-car, which is at the proper moment drawn along the track to the converter. Back in the cupola-house are the five-foot direct-connected fans that supply the blast for the converters, running at a velocity of 1,200 revolutions per minute, and the noise they and the other apparatus makes, baffles all description. Suffice it to say that when the converter is ready to be recharged or tapped, and consequently turned on its side, showering forth a vast eruption of sparks, the men in charge of the monster make no attempt at warning the bystander to get out of the way, for they know by long experience that it would be a waste of energy; so, flaming and spitting, the converter is slowly turned and tapped, while the fiery shower spouts like a heavy rain over the ground below for a distance of twenty feet on every side. So noisy are the mills of this character that the present president of the Carnegie Company, Mr. Corey, has many times had the converters blow off directly upon him, but he always got off with nothing worse than a few small burns from the sparks, which are bits of the burning steel.

An interesting feature of the converter



Direct Current, Multipolar Motors Driving Shafting for Axle Lathes in the Howard Axle Works of the Carnegie Steel Company, at Homestead, Pa.

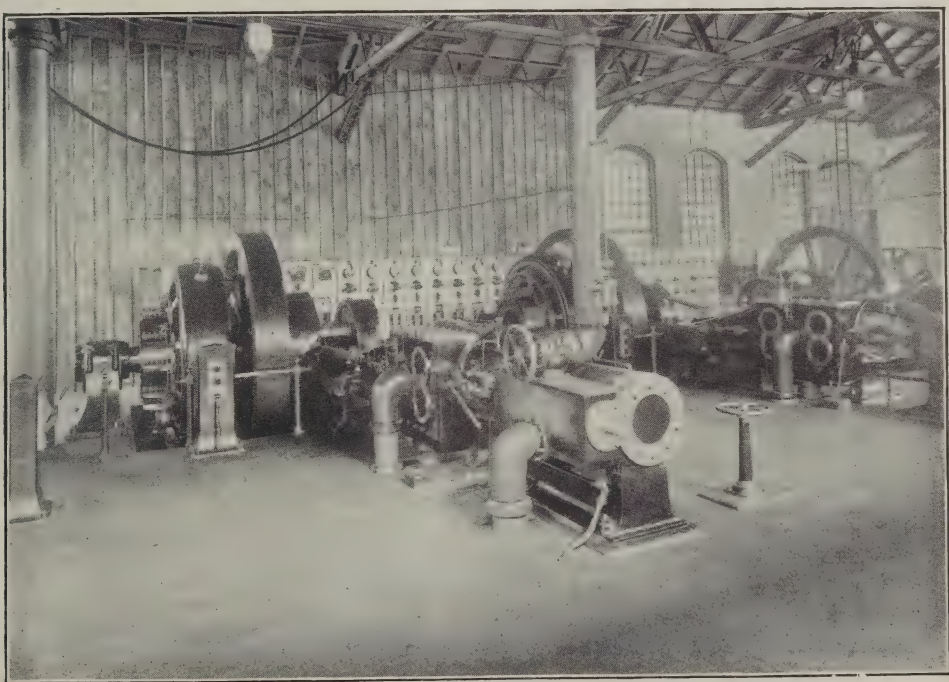
plant is the flames which pours out of the top of the converter after the charge has been put into it. When the molten steel first comes in contact with the blast, little flame, but vast showers of sparks are seen. This, however, lasts only a moment, and as the fire gets into the mass the sparks lessen in volume and the flame appears. At first it is a bright orange color; then delicate nuances steal through it and the tint slowly changes until, when the conversion is complete and the metal is ready to be poured out, the flame is nearly pure white. The roar of the blast is somewhat intensified at the moment of pouring, and the huge pot swings slowly over on its side, once more vomiting sparks, the ladle being below and the stream of glistening steel falls like so much brilliant water into the mould on the car. The different colors in the converter-flame just referred to are caused by the presence of foreign matter in the metal, such as sodium, in occasional instances, silicon and carbon. It is only when a large proportion of these foreign substances have been burned out that the steel is ready to pour, and the operators judge solely from the color of the flame when the psychological moment has arrived.

Blooms and billets are rolled in the thirty-eight-inch blooming mill, which is next reached in a trip around the yards. Bloom, according to the metallurgical definition of that article, is "a mass of malleable iron from which the slag has been forced by hammer, rolls, or squeezer." But this bare statement gives small idea of the real bloom. When the white-hot steel ingot leaves the grip of the machine which draws it from the reheating furnace, it is put on a car and swiftly sent down to the rolls. As soon as the rolls are ready for it an hydraulic pusher shoves it upon to the passing-table or rollers, and it glides along toward the heavy rolls where it is to be shaped into the right size. Then it reaches the press, bumps against the resistless rolls, hesitates a moment, and goes in. When the ingot gets fairly into the press every one, even including the men operating the mill, steps out of the way and hides behind some convenient post or piece of machinery, for as the hot metal passes the rolls of the press its hinder end explodes, detonating with a very considerable force and scattering bits of hot slag and metal a hundred feet behind it. This is the operation which removes the slag, and after the first passage through the press there is no further commotion, and the bloom, now perhaps fifty feet long and still glowing, behaves like any other big piece of material.

The thirty-eight-inch mill handles blooms from ten by ten inches to four by four, the latter size and smaller sizes being known also as billets. After the bloom is rolled out into the length required it passes down the roller table and while still red hot is cut by the shears into regular lengths. All the apparatus in this mill except the rolls and shears, is electrically operated. Only one operation is carried on by hand, that one being the stamping of the heat number on the still hot lengths by a boy with a light sledge as the pieces come from the shears.

The old twenty-eight-inch blooming mill is a hand-operated affair and looks very quaint and strange when compared with its more modern and bigger sister machine further down the shop. But the twenty-eight-inch mill does full and good work in spite of its slowness. It is soon to be replaced, though, by an electric mill of the same size.

Passing from the metal-making mills to the quieter part of the great plant, the



Part of the Power Station at the Edgar Thomson Works of the Carnegie Steel Company at Bessemer, Pa. The Machines are two 450-K.W., Engine Type, Direct Current Generators.

next shed contains the roll-shop, where the company makes all its own rolls for the presses that squeeze the ingots and blooms into shape. The feature of this shop is its stillness and the entire absence of the scorching, oppressive heat that makes the other mills so trying. Not a pound of steam is used in this shop, the entire equipment being operated by electric motors, most of them being direct-connected to their respective lathes. Even the big grindstones are so arranged as to be run by the motors, and the shop may be properly considered one of the most complete of its kind in the country.

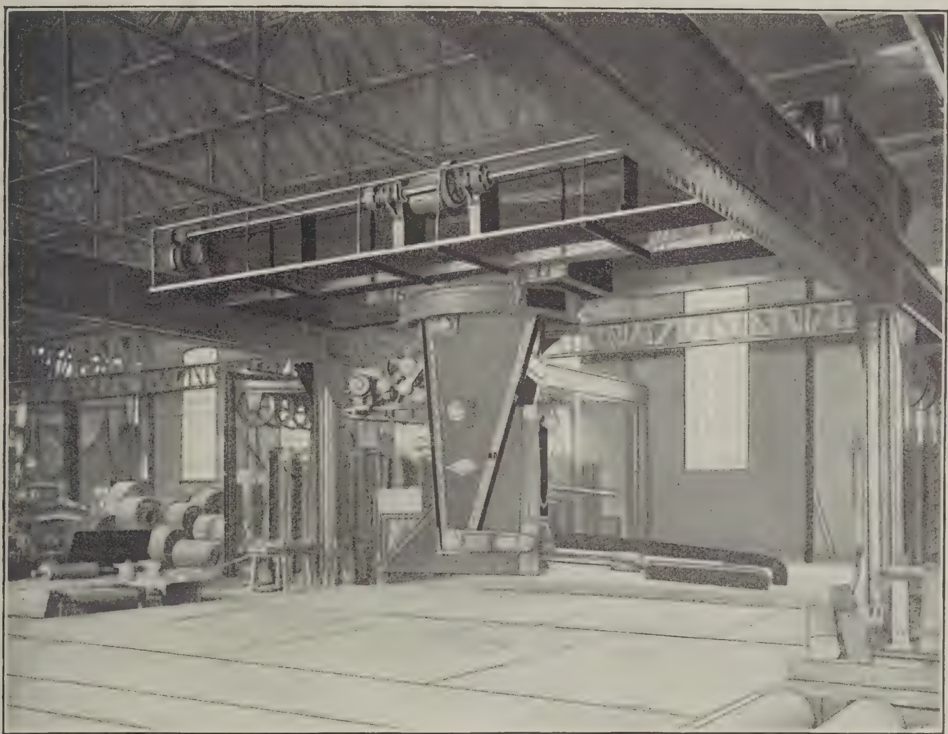
In the twenty-three-inch and in the thirty-three-inch mills, the first installations of electrical apparatus at the Homestead plant were made some years ago. These mills turn out angles and other structural steel. When electricity was introduced into these mills, it was necessary to rebuild all the machinery in order to adapt it to the requirements of the new operating force.

The ten-inch mill is another one of the old timers and is also hand-operated. Compared with the mills of more recent construction and equipment, it presents a curious appearance, and adds to the general interest of the shop in which it is located.

In the rapid description of the twenty-three, thirty-five, forty, one hundred and twenty-eight and forty-two-inch mills which follows, but little detail is given for the reason that these mills are similar in contour and design, to say nothing of the product they turn out, to those already described at length. Beginning with the twenty-three-inch mill as the first in order, it may be described as a duplicate of the others excepting that the pass-table extends about an equal distance on either side of the press, which is located in the middle of the structure. In this mill, the pass-table, charging-machines and buggies are electrically operated.

In the forty and thirty-five-inch mills structural and shaped steel only is turned out, most of the work being channels and "I" beams, measuring from twelve to twenty-four inches. The charging-cranes in both these mills are electrical, while the tables are all steam, the rolls also being steam-operated; the screw-down, however, is operated by an electric motor. The forty-inch mill rolls large blooms for the thirty-five-inch mill to finish, and the blooms are sawed before getting to the latter, while still heated. In the thirty-five-inch mill the pass-table is steam-operated just at present but has been condemned recently on account of its inefficiency, and a motor-operated table is to be installed and in operation by December. The shipping yard connected with this mill is unique in one respect—that it has roller-tables extending all the way down from the mill itself to the yard gates, a distance of about 350 feet; there are also ten ten-ton cranes in the thirty-five-inch mill.

The next mill reached in a tour of the yard is the open-hearth number three, which is a thoroughly up-to-date representative of its kind. The scrap and cold material used for charging the furnaces is hauled up in the charging-boxes over a narrow-gauge, heavy track and the furnaces charged in a similar manner to that employed at the number two open-hearth mill. Cast-iron is added in melted form without mixing, being brought from the Carrie furnaces across the river in the heavy-ladle cars which go over the bridge specially constructed for that purpose. Here again the scrap is thrust into the furnaces by a charging-machine, in this instance of the new, low type, while the hot cast-iron is brought in by means of a forty-ton crane. The steel is taken by seventy-five-ton ladle-cranes, conveyed to the pouring pulpits, and there poured into the molds. From the molds the ingots go to the ingot-stripper and thence to the shipping yard. The whole operation is very interesting to watch, partly because of the celerity with which it is accomplished, and partly because of the seeming indifference of the men who handle the huge masses of molten steel, or the ingots that stand out in the darkness like the Israelites' pillar of flame.



Vertical Traveling Electric Crane, Showing Method of Carrying the Ingot. Homestead Works, Carnegie Steel Company.

Passing through open-hearth number three, the thirty-inch slabbing-mill is next reached, where different sizes of slabs are rolled for the one hundred and twenty-eight and forty-two-inch mills, which take from fifty-two by twenty-inch ingots down to the smaller sizes. In this mill the ingots are charged and drawn by electric cranes, rolled and passed on to the hydraulic shears; then the metal is handled by the new electric tables and cranes, which pick it up in turn. Then it is loaded and shipped off to the one hundred and twenty-eight and forty-two-inch mills. About 400 electrical horse power is employed in the thirty-inch mill, whose monthly tonnage averages 23,000. At both the mills just mentioned the same general methods are employed, the metal being taken from cars by a rotary charging-machine, which also charges and withdraws the reheated steel from the furnaces; thence the hot metal passes along the electric table to the steam-rollers.

While the forty-two-inch mill is not so modern as the forty-eight, it is exactly the same after the slabs reach the rolls, the balance of the shop being electrically operated, while the one hundred and twenty-eight-inch handles down through three straightening rolls by the electric table to three large steam-shears. Here the plates are sheared to sketch and shipped. It is in the yard of the one hundred and twenty-eight-inch mill that the railroad enters directly into the building. There are in the works forty miles of standard and thirty miles of narrow-gauge track. The forty-two-inch is known as the Universal plate and the one hundred and twenty-eight-inch is called the sheared-plate mill. The power plant is next seen, with its contiguous repair shop, in which all mechanical repairs to the cranes and other large machines are carried on. There is one central electric power station, but the boiler-houses are scattered throughout the works. The mills are supplied with power by means of heavy copper cables carried on steel poles. Each mill has its own circuit and switchboard.

The company does all its own armature winding and makes its own armature and field coils. This work requires quite a force of men to be constantly at work, and in view of the fact that practically all of the motors and generators are carrying a peak twenty-four hours in the day, it is easily to be seen that necessary repairs are frequent and that no machine can have a very long life under such conditions without careful and constant attention.

The total horse power in motors employed in the mills at Homestead, amounts to 13,280. In the power plant there are 3,000 horse power in four generators; 500 horse power is always held in reserve for emergency cases. Two of the units are of 1,000 horse power capacity each and the other two of 500. These machines are all direct-connected to steam-engines. The power house also contains seven eighty-light Brush arc-machines for yard and general lighting, while two one hundred horse power generators furnish the power for lighting the company houses and mill offices with incandescent lamps. All told, there are in the Homestead works, 562 motors of various sizes, ranging from two to two hundred and fifty horse power each and driving a most bewildering aggregation of machines. Beside the cranes, which number one hundred and eight in actual operation, there are thirty charging-machines, some of them being of the new, low type, while the others are of the older and heavier double-deck order. At the present eight new cranes have been ordered and it is expected that before the snow flies they will be installed.

Open arc lamps of 2,000 nominal candle power are used for general yard lighting, while for special places in the mills and yards clusters of six twenty-four candle power incandescent lights are burned directly on the power circuit. All of the open-hearth stock-yards are so lighted, the arc lights having been found inefficient on account of the excessive wear due to the vibration of supporting structures. For the open arcs the current comes from eighty-light Brush arc machines at nine and one-half amperes, while for the power arc lamps used for inside mill lighting, two hundred and twenty volt direct current is employed at three and one-half amperes.

For the incandescent lamps in the mill offices one hundred and ten volt alternating current is transformed from the 1,100 volt primaries. For the clusters for yard lighting two hundred and twenty volt direct current is used, the lamps being 110-volt connected two in series. At points where the line fluctuation is excessive separate lighting lines are installed from the switch-board to the point of consumption for both the power arc and the incandescent lamps. Sixteen candle power lamps are used in the offices, and twenty-four candle power for the clusters.

The total number of men employed in the Homestead works is 7,800.

In conclusion it is but scant justice to the writer to say that a plant of such immensity as the Homestead Steel Works cannot properly be described from data gathered in a single short visit, but it is hoped that the effort made to give an intelligent idea of the small city which exists within the yard gates has been moderately successful, even though faulty and hesitating. The illustrations are reproduced by courtesy of the Wellman-Seaver-Morgan Engineering Company and the Westinghouse Electric and Manufacturing Company.

Practical College Professors

Dr. Louis Duncan's recent appointment to the chair of electrical engineering at the Massachusetts Institute of Technology marks the inauguration of a new policy in the administration of that admirable institution.

It is the intention of President Pritchett to have at the head of each department men like Dr. Duncan, who are actually engaged in active professional work for commercial purposes as well as being authorities in their professions in the academic sense.

It would appear to be indisputable that in the electrical department this plan must give particularly good results. In most other fields theory and practice have gone along side by side for so long that the academic professor is well versed also in the mechanical appliances which all good practitioners would use.

In electricity, however, the advances are and have been so rapid that the teacher who has been shut away from the active commercial field for any great length of time must find himself out of touch with the active art when he emerges, and his pupils would, of necessity, suffer from this cause. And this is what the Institute's new policy aims to forestall by the selection of such men as Dr. Duncan, and the experiment will doubtless prove the value of such instruction.

Machinery at the St. Louis Fair

Congress has appropriated $5,000,000 to aid in making the Louisiana Purchase Exposition, which is to be held in St. Louis, Mo., in 1903, a notable success. This sum is stated to be a mere drop in the bucket when the other resources and capital of the company are considered. A total, including the government appropriation, of more than $15,000,000 has already been raised.

Contrary to the usual custom no charge whatever is to be made for exhibit space or, within the director's discretion, for power to operate the various machines shown. This feature was determined on after mature deliberation, and the management believes that by adopting this generous policy it will come in closer touch with the manufacturers.

Furthermore the Exposition company will endeavor to make the most favorable freight tariff possible with the transportation lines; it will place railway tracks to and within the principal exhibit buildings, furnish cranes and hoists when necessary for the expeditious and economical handling of heavy items and do in general whatever may be found proper for the comfort and convenience of its exhibitors, or for their protection against petty extortions by carting and transfer companies, or installation agencies.

Rates and Meters

The rates charged for electric current for lighting and power and the systems upon which rates are based are matters of live interest to every householder, storekeeper, factory owner and other users of current as well as to the central station manager and stockholders in the producing companies.

To the customer the rate and its base may mean either large or small bills or conditions so onerous as to drive him back to the use of oil, gas or coal.

To the electric company the question is vital. Sooner or later, unless an equitable system be adopted, custom will fail and the company be left without a paying business.

The deep interest felt in the matter of rates was manifested at the recent convention of the National Electric Light Association, where papers on the subject by Louis A. Ferguson, Henry L. Doherty, L. R. Wallis, Ralph J. Patterson, Samuel Scovil, E. L. Phillips and Alexander Dod were read.

When electric current first became an article of commerce the charge for its use was based upon either the actual amount of current used or upon the number of lights installed, whether the latter were used or not.

These methods have proved to be unsatisfactory.

Mr. Ferguson in his paper says, in part:

"The advocates of a uniform kilowatt-hour price advance the argument that electricity can and ought to be supplied on conditions similar to gas. It is very doubtful, however, if there is any other business carried on under conditions similar to those under which electricity must be supplied.

"The production and sale of electricity differ from any other business in that the supply company must manufacture its product only as it is required, and it cannot be commercially stored, consequently the company's plant and mains must be governed by the maximum demand made upon them at any time.

"Further, the customers will not wait for the supply and cannot be prevented from taking it whenever they desire.

"Such a uniform kilowatt-hour price requires the company to sell its product to some classes of customers at an absolute loss and prevents it from supplying its product to other consumers from whom it might obtain a profit at a price lower than the price required by the municipal or state law.

"This point is one that is universally lost sight of by legislators and by advocates of a uniform kilowatt-hour price, and to prove it we need only turn to the oft advocated gas analogy. The gas company, with its regulated and uniform price of $1.00 per thousand cubic feet, cannot compete with electricity produced by private plants in large establishments; in fact, it is possible in large mercantile establishments and factories, where the light is required for eight or ten hours daily, to produce electricity in a private plant at much less than cost of gas purchased at $1.00 per thousand cubic feet.

"The central station company manufacturing electricity and selling its product on an equitable basis, discriminating justly in its tariff between the profitable and unprofitable consumer, may extend the advantages of electricity to the entire community, selling its product at a high rate to the customer using the company's investment for a short period daily, and at a lower rate to the consumer using the company's investment for a long period daily. A central station company operating under such a system of rates is able to obtain a reasonable and fair profit from all classes of customers and does not exact an excessive profit from one class of customers to make up for the loss incurred in supplying the unprofitable class."

Mr. Ferguson then describes the methods of charging followed by the Chicago central station companies, with the effect upon their business.

For the first five years, he says, they charged a uniform rate per kilowatt-hour with discounts up to twenty per cent to the larger consumers. It was found necessary in the cases of many large consumers to increase this discount. Then the form of contract was changed to one where the customer guaranteed to the company a minimum monthly or annual payment, this amount approaching as nearly as possible to the anticipated sum of the net bills. This system satisfied large consumers and led to the abandonment of many private plants in favor of central station service, but it did not encourage business with the smaller consumers.

Experiments were then made with a system based upon a charge for the number of hours' use of the connected load, but the minimum guarantee per lamp connected prevented the installation of lamps in places where they might be used only intermittently and thus limited the advantages of the use of electricity, especially in the home.

In 1897, the Wright demand system was adopted in a modified form. Of this Mr. Ferguson says:

"To fill the requirements of American conditions the writer suggested the method of basing each monthly bill upon the customer's actual maximum in that month, and to charge the full rate of twenty cents per kilowatt-hour during each of the six winter months for all electricity consumed monthly until the consumption reached the equivalent of 45 hours' use of the maximum number of lamps lighted simultaneously as indicated by the Wright demand meter, and to charge ten cents per kilowatt-hour for all electricity consumed in excess of that amount.

"During the six summer months, however, the full rate was charged for all consumption until it reached the equivalent of fifteen hours' use of the maximum number of lamps lighted simultaneously, and for all electricity in excess of that amount the rate of charge was ten cents per kilowatt-hour.

"The net rate obtained from this method, with the rates employed, would of course, be too high for large consumers and a wholesale discount was offered, the discount being taken only from the low rate portion of the bill, the amount of this wholesale discount ranging from 5 per cent to customers whose low rate portion was $100.00 and increasing by 5 per cent for each $100.00 of the low rate portion, making the maximum discount 50 per cent in the case of a customer whose low rate portion was $1,000.00.

"We have within the last year simplified our method of charging by abandoning the difference between the summer and winter rates. We now charge the full rate of 20 cents per kilowatt-hour for the equivalent of one hour's daily use of the maximum demand throughout the year, our reason for the change being that we found it objectionable to increase the rate of charge by the increase of hours in the fall months, just at the time when the consumer was beginning to use a larger quantity of electricity.

"The method of charging for power business is as follows: The full rate is 10 cents per kilowatt-hour for the first thirty hours' use of the maximum power per month; 8 cents for the second thirty hours' use; 6 cents for the third thirty hours' use; 4 cents for the next 450 hours' use; 3 cents for the next 180 hours' use.

"The low rate portion of the bill is subject to the following discount: From $20 to $40, 15 per cent; from $40 to $60, 25 per cent; from $60 to $80, 30 per cent; from $80 to $100, 35 per cent; from $100 to $200, 40 per cent.

"These rates for power give a range from 10 cents to 2.88 cents per kilowatt-hour as a minimum.

"Since the system was put into effect in 1897 we have kept very complete statistics showing the income at the different rates of discount. We have in use in Chicago at the present time a total of 13,022 Wright demand meters and 15,633 recording meters, the income from the customers using Wright demand meters being $986,560.00 for the fiscal year ending March 31, 1902. The average discount from the list is 35.1 per cent for light and 49.1 per cent for power. Of the Wright demand meters 94 per cent are 25 amperes and under, showing that the bulk of our business on this system is with relatively small customers.

"The load factor for the Chicago companies for the last fiscal year was 27.1 per cent, showing an average daily use of the system's maximum of six and one-half hours.

"Criticism has been sometimes made of the method used in Chicago on the ground that the company might do a large amount of unprofitable business, owing to the fact that there was no guarantee to the company that the consumer would pay for at least one hour's daily use of the maximum demand. An analysis shows that of our total income from Wright demand business, only 8.6 per cent of the total comes from customers using the equivalent of their maximum demand for less than one hour daily, and further, that the ratio of gross bill to full rate lamp hours of these shortage customers is 57.3 per cent, so that the actual amount of business which falls short of using the maximum demand, one hour per day, is only 3.67 per cent, which I think may be considered small enough to be unworthy of criticism."

Mr. Henry L. Doherty thus describes the system used by his company in Denver:

"We now refuse to entertain new applications except for a period of one year, and this contract expressly states that the consumer shall pay a fixed charge for readiness to serve, which is determined by the maximum he may wish to demand. Every consumer must contract to pay us twelve dollars per consumer, plus six dollars for each meter more than one, plus $1.80 per lamp connected, plus five cents per kilowatt for current. From these prices we allow a discount of fifty and ten per cent.

"Immediately upon the adoption of this rate scheme and cutting prices, our output and maximum demand began to increase. From April to January our connected load increased eight per cent; our maximum demand increased thirty-two per cent, and our output increased seventy per cent; the increase in output being confined to, approximately, fifty per cent of our consumers, some of whom have increased their consumption as much as 400 per cent. We attribute the increase in consumption largely to the adoption of lower rates, and not particularly to the system of charging; but we feel that if we had adopted a system of charging based solely on consumption, our average rates would have had to be very much less to have attracted the same increase in output."

Mr. L. R. Wallis said, in part:

"Since July 1, 1901, all the customers in the territory supplied by the company with which the writer is connected, comprising a population of thirty thousand people within ten miles of Boston, have been charged upon the Foresee (4-C) system, contracting with the company for a period of one year, agreeing to pay for the 'capacity' demanded in sixteen-candle-power lamps, or their equivalent, at the tariff rates established plus 'current' as shown by meter at six cents per kilowatt-hour.

"The legality of this method was questioned by certain consumers, and an appeal was taken to the State Board of Gas and Electric Light Commissioners, who after thorough investigation rendered an opinion favorable to the plan."

Mr. Ralph J. Patterson described the system used in Waterville, Me., where the rate scheduled for sixteen-candle-power lamps for residences begins with a charge of eighty cents a month or $9.60 a year for one lamp, and decreased to $3.52 a month or $42.20 a year for twenty lamps. Above that number the charge is seventeen and one-half cents a month for each lamp.

Mr. Patterson admits that this system is only adapted to the plants run by water power, as is the one at Waterville, and would be out of the question for a steam-driven plant.

Mr. E. F. Phillips described the development of another system which began with a reduction of price from twenty cents a kilowatt-hour to sixteen cents. He continues:

"This brought about quite a considerable increase in the output, and a small increase in the net revenue, yet it did not cause much of an influx of new business.

"It was then decided to make a radical departure in the matter of rates, and a system was adopted whereby the consumer was required to pay at the rate of sixteen cents per kilowatt-hour for the first two hours per day, or sixty hours per month of his connected load; all current used in excess of this to be paid for at five cents per kilowatt-hour, total bill to be subject to discount if paid within ten days from date of bill. This departure had the effect of widening out the curve of the peak load and brought quite a noticeable amount of new business. The net earnings per kilowatt-hour of output fell off somewhat, yet the net earnings to the company for the year showed a healthy increase. During this time the regular rate for power service had been put at ten cents per kilowatt-hour; this was changed to ten cents per kilowatt-hour for the first thirty hours per month per kilowatt connected, excess current at five cents per kilowatt-hour. Within a year the power rate was changed to ten cents per kilowatt for first thirty hours of 'maximum demand' instead of 'connected load.' This brought about a very noticeable increase in power service and a corresponding change in the light-load curve. In the meantime, the two-hour per day rate had been applied to the residence service, and produced general satisfaction; the method pursued was an arbitrary one, and based on the average use, this to form the maximum demand at the sixteen-cent rate, with excess current at five cents, and minimum bill at one dollar per month. The average earnings per kilowatt output in the residence district showed a decided drop, yet, notwithstanding this radical departure, the net earnings showed an increase, thus demonstrating that we were on the right track. This rate is the one still in use for residences.

"The next move was the inauguration of the one-year contract on the 'maximum demand' plan, and the change to one hour per day at the sixteen cents per kilowatt price, excess current at five cents per kilowatt; the maximum-demand contract, however, to cover all electric service used by the customer.

"This has proved the most popular of any plan yet inaugurated, and is the one in general use by the company at the present time for all service except residences; but it is optional with the customer as to whether he shall take the open order at sixty hours per month of connected load or thirty hours per month on maximum demand. In the case of arc-lamp service, however, the customer is required to take the maximum-demand contract for one year. This maximum-demand arrangement necessitated the installation of the Wright demand meter in all cases where the connected load was known to be in excess of the demand. This form of contract also carries with it a minimum bill per month of sixteen cents per kilowatt-hour for the first thirty hours per month of the maximum demand. In the case of incandescent service or combination service, the customer is given the privilege of stating his tract is written on that basis with provision that demand meter or meters shall be installed, and should the maximum demand, as indicated by the demand meter, exceed the estimated demand, the former shall be used as base for amount of current to be paid for at the high rate, and a consequent raising of his minimum rate, thereby making the fixed base automatic in its operation.

"To show how our plan would compare with the 'Foresee' system, I submit a few examples. In the case of a customer whose connected load was sixteen-candle-power lamps, besides quite a number of show-case lamps, a demand meter was installed which showed a maximum of fifty-seven amperes at 120 volts, making a miximum demand of 6.8 kilowatts, and for thirty days 205 kilowatts as demand base. The customer's consumption was 742 kilowatt-hours; therefore, we have

205 units at 16c	$32 83
537 " " 5c	26 87
	$59 70
Less 15 per cent discount	8 95
Net bill	$50 75

with minimum bill of $32.83. From the above customer it can be seen that the average price for current received by the company was .0683. The same customer with maximum demand on the 'Foresee' system would get the following result: 57 Amp.; 114 16-cp. lamps, approximately. 114 cp. lamps at $1.50 per year = $171.00 (capacity charge), or $14.33 per month.

"Consumption:

742 at 6c	$44 52
Capacity charge	14 33
Giving a net bill of	$68 85
Average price for current	.0806

"In a recent application for current we found the following condition: The customer desired to use one hundred and twenty-five sixteen-candle-power lamps thirteen hours per day, and on the yearly-demand contract we should arrive at the following result: One hundred and twenty-five sixteen-candle-power 50-watt lamps thirteen hours per day for twenty-six days would show a total consumption of 2,112.5 kilowatt-hours. Thirty days of maximum demand of 6.2 kilowatts for one hour per day would make a base of:

186 K.W. hours at 16c	$29 76
1926 " " at 5c	96 30
Total	126 06
Less 2 per cent	25 21
Net bill of	$100 85

"With minimum monthly bill of $29.76, average price the customer would pay for his current .0477 per kilowatt-hour. The same customer on the 'Foresee' system would be required to pay a capacity charge of 150 times $1.50 or $187.50 per year or $15.62 per month, and for his current 2,112.5 kilowatt-hours at six cents, $126.75; making a total of $142.37 per month as against $100.85 on the demand contract agreemant. Our plan was taken into consideration, whereas the amount that he would have had to pay for his current on the above plan would have been so high that it would have precluded the possibility of our getting so desirable a customer."

IMPROVEMENTS DESIRED IN METERS.

Closely allied to the question of rates is that of meters. This was treated in papers prepared by Robert Ferris and Clifford A. White.

Mr. Ferris says, in part:

"Perhaps the greatest improvement would be that which would eliminate the possibility of a meter's being stopped when it should be in motion. The success of a meter depends largely upon the friction of all moving parts being reduced to a minimum. Anything that would replace to advantage the pivot and jewel, without sacrifice, would be an improvement; for if we can keep a meter in motion, it should be easy enough to keep it in calibration.

"The efficiency of meters is something of importance, yet a meter should have plenty of torque. While it is possible to save considerable by having efficient meters, it is also possible to lose considerably more by having meters that will not stand up on light loads.

"A few suggestions might be made that would at least furnish something for the engineers to work on.

"They are: A universal meter in size and style; a blackboard for meters, of a standard pattern, which could be adapted to meters of any make on the market; a registering dial that would read directly in dollars and cents, or if not that, then the adoption as a standard of direct-reading dials and a simple tell-tale hand on clock for calibrating purposes; a meter that would take the place of the combination of watt and discount meters, having the effect of registering at different rates of speed, which would be governed by the load that was passing. To illustrate: If we had, say, a 100-volt wattmeter of twenty-five-ampere capacity, instead of showing a straight line from five per cent of its capacity to full load, the meter speed would represent at full load accurate registering, and as the load dropped the proportional rate of registering would be a certain per cent slow or fast."

Mr. White makes a plea for a meter dial which shall be intelligible to the general public. He says, in part:

"The electric-lighting business is full of mysteries to the general public with whom it has to deal, and, consequently, anything not easily understood arouses suspicion immediately.

"The meter dial should read direct in kilowatt hours, thereby eliminating the use of the constant and the use of two terms, kilowatt-hour and watt-hour; there should also be a hand on the dial for testing purposes.

"The new meters now being placed on the market register in watt-hours, which is a great improvement over those that required the use of a constant; but a direct-reading dial should be designed to replace those now in service having constants. This does not seem a mechanical impossibility, and if the cost were reasonable it would be generally adopted. The constant has always been a perpetual source of annoyance and error. Its use makes a great deal more work in the bookkeeping department, and complicates the rendering of bills correctly, consequently creating a continual and unnecessary expense in the office. It is next to impossible to make the average customer understand its meaning, and it should be returned to the laboratory whence it originated, never to be resurrected."

Storage Battery Regulation

By Cary T. Hutchinson

It is well known that the e.m.f. of a storage cell changes with the condition of its charge; when freshly charged and connected to the line, each cell gives a pd. of approximately 2.1 volts; after complete discharge the pd. will fall to 1.8 or 1.7 volts. On beginning to charge the cell, the pd. will rise quickly to about 2.1 volts, and will continue to rise as the charge increases until it has reached 2.5 or 2.6 volts, at which point the charge is considered complete. There is then a variation in the voltage required in using a storage battery, of from 2.5 to, say, 1.8 volts per cell, a range of .7 volt, equivalent to about thirty-five per cent of the average voltage.

Various plans are in use to regulate the charge and discharge of a battery; most of them involve what is known as a booster, that is, of a generator connected in the battery circuit with its field strength controlled either by hand or automatically, to make up for the variation of battery voltage. In other cases, a certain number of cells are cut into and out of the circuit as the voltage of the cell varies, that is, as the state of charge or discharge changes.

This discussion points out a means of providing automatically for the control of the charge and discharge, and in such a way that the battery is never called upon for more than the amount of current essential to the work, and always receives the maximum of the current not necessary for the work to be done; that is to say, it gives as little as possible and takes as much as possible, thus making the duty on the battery a minimum.

The two causes of variation of the voltage at the battery terminals are the current passing through the cell, which changes the voltage of the cell on account of the different loss of voltage in the internal resistance of the circuit, and the variation of the e.m.f. of the cell, due to the different conditions of the cell. The first of these depends upon the load, and may cause rapid fluctuations in voltage. The second is a slow change and is independent of the current passing through the cell, depending only on the condition of the cell, which varies gradually with time.

Each cause of variation should be allowed for; the battery should be arranged to have the same compounding curve as the generator or feeder to which it is connected. This necessitates two additional electromotive forces in the battery circuit, one to compensate for the variation of battery e.m.f., and the other to compensate for the varying loss in the resistance of the battery circuit.

I shall first discuss this problem mathematically, and then point out the application of the results indicated.

Let a storage battery be connected to a circuit having a pd. $=V$, and be in series with two additional sources of e.m.f., as indicated in Fig. 1.

Let

V = Line pd.
E_1 = e.m.f. of battery
E_2 = e.m.f. of one source
E_3 = e.m.f. of other source
I_2 = Current to the battery
I = Current from the battery
I_1 = Current in the battery circuit
R = Resistance of the battery circuit.

Also assume

$$V=V_0+kI \qquad (1)$$

that is, assume pd. at battery terminals to increase from a constant value V_0 at no load to a value V_0+kI for load current equal to I. If the pd. at the battery is constant, then $k = o$ and $V = V_0$.

Then,

$$I_1 + I_2 = I; \quad (2)$$

$$E_1 + E_2 + E_3 - I_1 R = V_0 + kI. \quad (3)$$

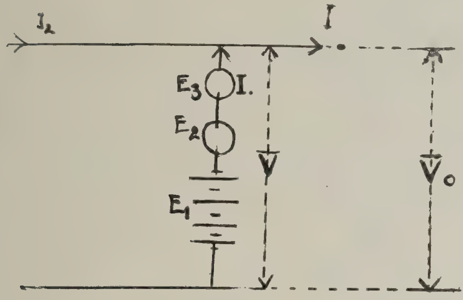


Fig. 1

Suppose the battery is to discharge or charge the difference between the load and the feeder (or generator) current—that is to say, suppose the feeder current I_2 to be constant, then

$$E_1 + E_2 + E_3 - R(I - I_2) = V_0 + kI$$

and

$$E_1 + E_2 + E_3 + R I_2 = V_0 + I(k + R). \quad (4)$$

In order that this equation may be satisfied, two conditions are necessary and sufficient, viz.:

$$E_1 + E_2 = V_0 - R I_2 \quad (5)$$

and

$$E_3 = I(k + R) \quad (6)$$

That is, if the sum of the battery e.m.f. E_1 and the e.m.f. E_2 be kept constant, and E_3 be varied with the load, then the battery will give and take the difference, and the feeder current will be constant.

E_1 varies only with the condition of the battery, and not with the battery current; it is a function of time and not of current, hence E_2 can be so varied that the sum is constant by varying the field strength of a separately excited generator, in accordance with the indications of some device showing the sum $(E_1 + E_2)$. The variations of E_1 will be gradual, hence the regulating apparatus need not be adapted to sudden changes. E_3 can be made proportional to I by using a separately excited generator, with its field connected in the load current.

To get an indication of $(E_1 + E_2)$: referring to Fig. 2:

Let S_1 represent a small resistance equal to, say, n % of the resistance between the points M and A; let CS_2 be a high resistance coil connected as shown; then, if a point P be chosen so that the resistance PS_2 of the part of the coil included is n % of the total, and a voltmeter be connected between M and P, the indications of the voltmeter will be proportional to $(E_1 + E_2)$.

Let this voltmeter be provided with contacts adapted to closed circuits when the needle is deflected in either direction; the circuits to be closed may be any controlling circuits adapted to vary the strength of the field of E_2. For instance,

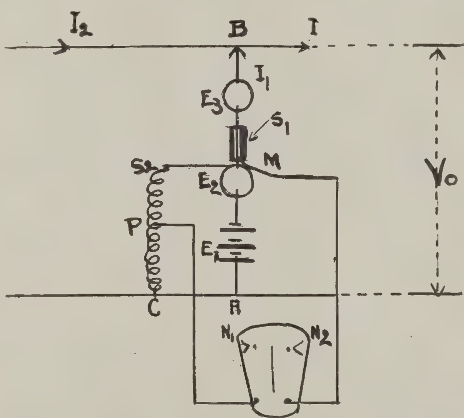


Fig. 2

the field-magnets of a small pilot-motor may be closed in one direction or the other and the motor may vary the resistance of the field circuit by revolving one way or the other. Equivalent devices are easily designed; a compound wound electro-magnet may be used instead of the voltmeter with its contacts.

This arrangement then keeps the sum $(E_1 + E_2)$ constant, and at the particular value determined by the zero adjustment of the voltmeter.

I have assumed that E_2 and E_3 are entirely separate sources of e.m.f. This is necessary only in order that an indication of the sum (E_1+E_2) may be obtained,

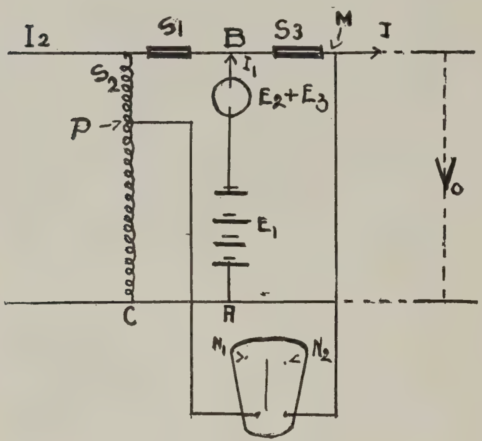


Fig. 3

and that the value of E_2 may be suitably adjusted.

But

$$E_1+E_2+E_3=V+I_1 R \qquad (7)$$

and $$E_3=I\ (k+R); \qquad (6)$$

hence: $$E_1+E_2=V-R\ I_2-kI \qquad (8)$$

This equation shows that any indication which is proportional to

$$(V-R\ I_2-kI) \qquad (9)$$

will be proportional to

$$E_1+E_2.$$

Referring to Fig 3:

Assume the resistances S_1, S_2 and S_3 be fixed at the same proportional parts, e. g., n %, of R, V and k; then a voltmeter connected as shown will give indications proportional to (E_1+E_2) and may be used to control the field of a compound wound generator whose series-field is in the load current. That is, one generator may be used in place of two, and when so controlled the battery charge and discharge will adjust itself to constant generator current.

The assumptions thus far made determine the battery current to be the difference between the load current and the feeder current. Suppose, however, that the battery current is to be kept constant. Equation (3) then shows that the following two conditions must be fulfilled:

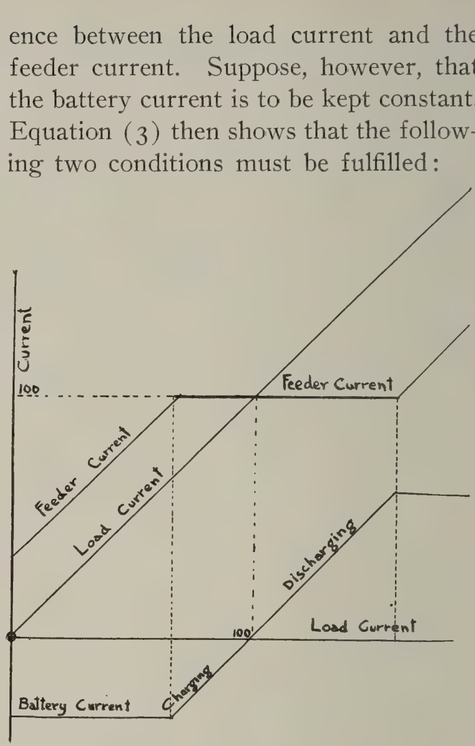


Fig. 4

$$E_1+E_2=V_0+I_1 R; \qquad (10)$$

$$E_3=kI. \qquad (11)$$

The first condition is met by connecting a voltmeter in the manner just described, but making the zero point of the voltmeter to correspond to

$$V_0+I_1 R.$$

The other condition is met, as before, by connecting the field of the generator in the load current.

In practical operation, it may be necessary to limit the charging current of a battery connected directly to the line. The combination of the conditions outlined will permit the battery to charge at any current until the difference between the load and generator currents becomes equal to the maximum safe charging current and then to continue charging at this maximum charging current, and to discharge at any current within its capacity.

This can be accomplished by the use of two voltmeters, both connected as shown in Fig. 3, the first having the zero adjusted to the value determined by equation (5), and the second having the zero adjusted to the value determined by equation (10). A circuit-changer is to be connected in the battery circuit so that when the charging current becomes equal to the maximum permissible value, the first voltmeter shall be cut out of circuit and the second cut into circuit, and at the same time a shunt is to be closed around the terminals of the series-field of the source E_3, so that the e.m.f. E_3 shall be made proportional to kI instead of to I (k+R).

The current in the battery, in the feeder and the load current are then shown in Fig 4. The feeder current remains constant until the load current falls to such a value that the battery is charging at the maximum permissible rate. The circuit-breaker then shifts the voltmeter connections and the feeder current decreases as the load decreases.

It is easily seen that the addition of a third voltmeter in the battery circuit, properly connected, can limit the discharging current when it reaches a certain maximum value, but this limitation is not necessary in practice.

City Threatens "Unused Car Tracks"

A legal fight which promises to be of great interest to street railway men in all parts of the country appears to be about to develop between the Metropolitan Street Railway Company and the city of New York, over what are declared to be "unused" tracks in various streets of that city.

When these lines passed into a single control and many of them converted to under-trolley traction, it became possible to rearrange the service on broader principles, and this was done. As a consequence there were many portions of the old lines which were for the time useless, and for all practical purposes these bits, here and there, have been abandoned.

An agitation against having these tracks left in the streets, which is said to have been begun by a former officer of the Third Avenue Company, was taken up by the Merchants' Association, and this resulted in Borough President Cantor asking for an opinion on the subject from Corporation Counsel Rives.

Mr. Rives rendered his opinion on June 19. In it he says, in part:

"What constitutes an abandonment is a question of fact, and must be shown in unequivocal acts, but it is difficult to imagine acts more unequivocal than the deliberate discontinuance of service, and the substitution of other routes between the same termini. A general intention at some future time, when it shall prove profitable to resume the operations of the road, cannot avail to prevent this conclusion. The city holds the streets in question in trust for the public, and upon proof of the abandonment of the right of way over them, unquestionably has the right to resume its dominion over them. The railroad company acquires no fee in the street. It has simply a license to operate a railroad. The operation of the railway is not exclusive. The public has the right to use the street, subject only to the reasonable use of the same by the company operating its road. * * *

"In some instances the company is running one car a day over the otherwise abandoned route. There is a popular impression that the running of one car or train a day is an exercise of a franchise technically necessary to and sufficient for its preservation. I can find no authority for such doctrine, and I do not believe it is sound. The franchise confers a right to operate a road for the convenience of the public, and a street railroad, I believe, necessarily implies frequent running of cars at all times of the day. The running of a single car is, however, some evidence of an intention not to abandon the route, and when such intention is a material circumstance it is possible that the court might regard it as sufficient to save the rights of the company."

Mr. Rives advises that it is the duty of borough presidents to tear up such tracks. Any attempt on the part of the city authorities to take up these tracks would undoubtedly be strenuously resisted.

The large number of changes which has been made in the old routes in New York by the management found necessary to meet the public needs, and the bits of track which are threatened are both shown by the list of "unused" car tracks which Mr. Rives appends to his opinion. These are as follows:

Battery place, from Broadway to Greenwich street; two of the four tracks are not in use. Vesey street, from Broadway to West Broadway; from Church street to West Broadway; single track. Barclay street, from Broadway to Church street. Park place, from Broadway to West Broadway; from Church street to West Broadway is single track. Church street, from Barclay street to Canal street. Broome street, from Broadway to West Broadway. University place, from Fourth street to Fourteenth street; from Fourth street to Eighth street is single track. Burling slip; stand at East River. Thompson street, from Bleecker to Fourth street. Sullivan street, from Bleecker to Third street. Waverley place, from Christopher to Bank street; this is single track. Greenwich avenue, from Bank street to Eighth avenue. Thirteenth street, from Eighth avenue to Thirteenth avenue. Thirteenth avenue, from Thirteenth to Fourteenth street. Eleventh avenue, from Fourteenth to Twenty-third street. Thirty-second street, from Fourth to Lexington avenue. Thirty-third street, from Fourth to Lexington avenue. Eleventh avenue, from Thirty-fourth to Forty-second street. Thirty-fifth street, from Lexington to First avenue. Thirty-sixth street, from Lexington to First avenue. One car only runs all day from Thirty-fourth street ferry to Forty-second street depot. Sixty-sixth street, from Third to Second avenue; unused single cable track. One Hundred and Ninth street, from First to Pleasant avenue; single track. Pleasant avenue, from One Hundred and Ninth to One Hundred and Tenth street; single track. Allen street, from Houston to Grand street; single track. First avenue, from Houston to Fourteenth street; single track. Crosby street, from Howard to Bleecker street; single track. Bleecker street, from Crosby to Greene street; single track. West Broadway, from Third to Fourth street. Fourth street, from West Broadway to Thompson street. Waverley place, from Macdougal to Christopher street. Bank street, from Waverley place to Greenwich avenue. Horatio street, from Greenwich avenue to Eighth avenue; single track. New Bowery, from Chatham square to Pearl street. Pearl street, from New Bowery to Peck slip; single track. Peck slip, from Pearl to Water street; single track. Lenox avenue, from One Hundred and Tenth to One Hundred and Sixteenth street; horse car tracks. Lispenard street, from Canal street across Broadway to Church street; single track. Beekman street, from Park row to South street; single track. Eighty-sixth street, between Amsterdam avenue and Riverside drive.

The Manufacture of Glow Lamps

From the London Electrical Review

How many glow lamps are there in use in the United Kingdom? The question does not admit of a reply which can be trusted within any respectable degree of accuracy; but at least we can make an attempt at a solution. From our statistical tables issued early last month, it will be found that the total capacity of the electricity supply stations at work is roughly 400,000 kw. Assuming that fifty 8-c. p. lamps are installed for every kilowatt provided, this corresponds with an equivalent lamp connection of twenty millions. Allowing for the facts on the one hand that a very large proportion of the lamps are of sixteen or higher candle-powers, that motors are included in the "equivalent lamp connection," and that many stations are by no means so fully loaded as their owners would wish, while, on the other hand, no regard is taken in these figures of the enormous number of lamps supplied with power from isolated plants, we may put the actual number at between fifteen and twenty millions. We are open to correction at the hands of those who prefer to make their own guesses.

Remembering the enormous capital expended in generating and distributing plants for electric lighting with glow lamps — the proportion to be deducted for motors and arc lamps being inconsiderable—it is curious how little public attention is given to the manufacture of the lamps, which are the very foundation of the industry. Perhaps it is because the individual lamps are not in themselves imposing or impressive, unlike the generators which serve their needs; nevertheless, the process of building up a glow lamp from the raw materials is one of the most interesting and beautiful that the electrical industry has to show. In the following pages we have endeavored to place before our readers a detailed account of the manufacture of the Robertson lamp, which is carried on at the works of the Incandescent Electric Lamp Company, Limited, at Brook Green, Hammersmith, under the joint management of Mr. C. J. Robertson and Mr. C. Wilson.

It is a remarkable fact that the actual processes involved in the manufacture are practical identical with those in vogue seven years ago, when we gave a brief description of the works, which at that time, however, were relatively small compared with the present extensive premises. Then the annual output was but half a million lamps; now it is more than two and one-half millions per annum, and is rapidly increasing.

The parchmentized cotton process of Swan, formerly so popular, has given way to the solution of cotton wool in zinc chloride, now practically universally in vogue. Pure cotton wool is employed, and is dissolved in a hot solution of zinc chloride, the relative proportions of the raw materials, the strength of the solvent, and the temperature being carefully regulated to obtain the best results. The product resulting from this process is a dark brown viscous fluid. It is highly important that this should be entirely free from bubbles; in order to avoid these, the fluid is drawn out of the mixing vessel into glass flasks, by producing a partial vacuum in the delivery tubes, air-pumps being provided for this purpose.

After standing for some time in the tanks, the liquid is converted into solid filaments by a most simple and beautiful process. A number of tall glass jars, nearly filled with alcohol, are surmounted by a system of tubes connected with the tanks; a tube drawn out to form a nozzle with an orifice of definite diameter dips into the alcohol in each jar, and the liquid is drawn from the tanks and squirted through these nozzles by means of compressed air. The effect of the alcohol upon the emergent liquid is to immediately solidify the latter, so that the liquid jet becomes a solid filament, which gathers in coils at the bottom of the jar; so regularly does the process take place that in the case of the thicker filaments each turn lies exactly upon the preceding one, and a slightly conical turret is gradually built up, forming a remarkable and pretty object.

After this process the newly formed filaments are washed for a long period in trays of running water, until every trace of the reagents employed has been removed.

The next step is to dry the filaments; for this purpose they are loosely wound on drums covered with thick velvet, which posseses the double advantage that the long pile provides an elastic and yielding bed for the filaments, while at the same time it permits of the access of air to all sides of them, so as to insure uniformity in drying. The filaments at this stage are uniform, smooth and perfectly cylindrical threads, of a yellowish color (the brown hue disappears at the moment of formation of the filament when the jet comes in contact with the alcohol); the thread is weak, and somewhat brittle, so that it has to be carefully handled. In course of drying the filament diminishes enormously in thickness — about two-thirds—and shortens also (hence the advantage of the velvet covering on the drums).

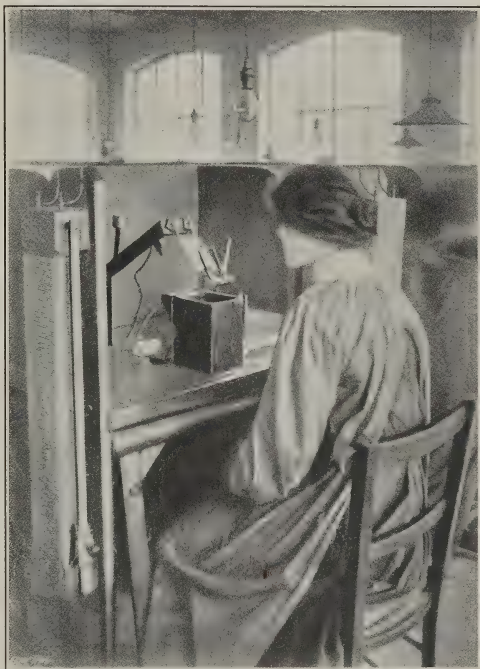
The next process is that of winding the filaments on carbon formers, in preparation for carbonization. Taking a bunch of cut filaments, the operator fixes the ends on the carbon block with melted wax; by clever manipulation, the bunch is quickly flattened out into a single layer, and is then formed into a horseshoe shape by bending over the rounded edge of the block, or into a spiral by taking one or more turns round a carbon rod attached to the former, after which the free ends are fastened down with wax as at the commencement. Several bands are wound on each former in this way.

The wound formers are then packed in a mass of carbon dust in a crucible, which is raised to an intense white heat in a furnace, care being, of course, taken to prevent access of air to the filaments. After baking for several hours, the crucible is slowly cooled—the whole process of carbonization occupying the better part of a day. During the operation, a further shrinkage, both in length and diameter, takes place, the former being rendered possible by the softening of the wax, which allows the ends of the filaments to retract.

The filaments are now extremely hard and elastic—hard enough, in fact, to scratch glass; they consist of practically pure graphite. There are few more remarkable products of human handiwork than glow lamp filaments; in purity, structure and shape they are marvelously near perfection, and form a striking contrast with the soft white filaments from which they are composed.

The next step is to attach the platinum leading-in wires to the ends of the filaments. As is well known, platinum is the only metal which has a coefficient of expansion as small as that of glass, and its use is, therefore, obligatory in order to secure a durable vacuum and to avoid fracture of the glass; but it is a very costly material, and therefore the wires are, naturally, neither longer nor thicker than required to carry the current to the filament. Having been cut in short lengths, one end of each wire is flattened in a little mill, and the wire is then drawn through a circular die, which converts the flattened end into a tube. The filament having been cut to length by gauge, each end is inserted into one of these tubes, and the latter is flattened so as to grip the filament with a pair of forceps.

Up to this point no tests have been mentioned, as none are necessary; but here commences the long series of tests of which every lamp and filament has to run the gauntlet—indeed, the manufacture of the lamp may almost be called a series of tests. The diameter of every filament is now measured by means of a simple micrometer, those which fail to pass this test being discarded.



Mounting the Filaments

The next process is perhaps the most interesting of all, namely, the mounting. One of the greatest obstacles in the path of the early lamp makers was the joint between the carbon and the platinum, and numerous ingenious devices were adopted to effect the junction. The method which has proved itself the fittest to survive is the deposition of carbon upon the joint by heating the latter to whiteness in a fluid hydro-carbon. This process is in itself a triumph of ingenuity, and the result attained by means of it is most admirably adapted for its purpose, consisting of a hard, dense sleeve of pure carbon adhering closely to both the platinum wire and the carbon filament. Almost any fluid hydro-carbon is applicable to the process, whether liquid or gaseous, but the best results are obtained with benzine. This is a most inflammable substance, and, although there is no danger so long as the white-hot joints are wholly immersed in the liquid, there is certain to be a blaze if the heated parts are above, or very near, the surface. This was always a grave drawback to the use of benzine, until the Robertson Company took the matter in hand; they, however, devised a system which meets all objections, and has been specially adopted by the inspectors of the London County Council as a standard for use in all glow lamp factories under their control.

The "mounting room" operators work at slate benches, which are divided into compartments by sheet-iron partitions. In each compartment there is a tank about nine inches deep, and eight by four inches in plan, made of iron, to contain the benzine; this is provided with a hinged lid, which can be closed instantly in case of a flare-up, so as to extinguish the flames. Close against the back of the tank is an air duct, through which a constant down draught is maintained by means of pumps; by this means the vapor which is constantly rising from the surface of the benzine is removed. Beneath the bench is a system of iron pipes connected with each of the benzine tanks; by opening a valve at the side of the room, the whole of the tanks can be instantly emptied of their contents, which are discharged at a safe place outside the building. The building itself in which these operations are carried on is isolated from the main buildings, access being gained by a covered bridge. Lastly, each of the operators is provided with a fireproof apron, which is treated anew every week so as to maintain its incombustible qualities unimpaired.

That these precautions are by no means superfluous will readily be understood; that they are effectual may be gathered from the fact that though from time to time "flare-ups" occur, there has never been any serious accident in connection with this department.

The apparatus used for the mounting process consists of a counterbalanced pivoted lever, which carries at the outer end a pair of grips for the platinum wires; the grips are connected with a circuit maintained at a suitable voltage. A metal bar is carried on an insulating arm, which is hinged in such a way that the bar can be made to press lightly against the two legs of the filament a short distance from the joints, the legs being supported by a corresponding bar at the back; by this means the filament is short-circuited, the current being confined to the joints. Having clamped the filament in position, the zine; a small current is then switched on, and brought up to the required strength by means of a sliding rheostat, as shown on the left of the view. The process can be watched and regulated throughout; when it has been carried far enough, the operator first cuts off the current, and then removes the filament. The current strength required is considerable, as much as ten amperes being used for an 8-c. p. 200-volt glow lamp; but no ammeter is considered necessary, as the current required varies according to the size of filament, temperature of the bath, etc.

The next step is the flashing of the filament. Although the carbonized filaments have a hard smooth surface and are very nearly homogeneous, a still better result can be obtained by depositing carbon over the whole length of the filament. The deposit has a very low specific resistance, so that it can be used as a means of regulating the resistance of the filaments; it also gives a very hard surface, of low emissivity and greater durability than the unflashed surface.

The filament is clamped in terminals on a flat plate, upon which a bell glass can be lowered. The air is then removed from the interior of the glass by pumps. When a sufficient vacuum is attained, benzine vapor is admitted to the glass, at a very low pressure, by means of a three-way cock, and the filament is raised to incandescence by passing a current through it. During this operation it is viewed through a blue-tinted glass, to avoid dazzling the eyes of the operator. The latter is able to judge of the effect produced by the degree of incandescence, and is also able to make actual measurements of resistance by means of a bridge and galvanometer. Thus it is possible to obtain very uniform results in candle-power and efficiency. The apparatus is so designed, with counterbalanced bell glass, switches, rheostats, etc., as to facilitate, as far as possible, the carrying out of this important process. As only small quantities of inflammable vapor are used, and these are under control all the time, practically no danger is attendant upon the process.

The filament is now completed, ready for sealing into the bulb.

The operations of glassblowing are fascinatingly interesting to watch, but their charm disappears when reduced to black and white. Suffice it to say therefore that such bulbs as are hand-made are blown from tubes of flint glass, of a special composition, suitable for uniting with platinum. Only special and odd sizes of bulbs are made at Brook Green, which is not a glass-works, the bulk of the bulbs being blown in molds at another factory.

Each bulb on receipt has a small tube attached to the top end of the bulb, which serves as a handle, by means of which the glassblower manipulates it; the neck of the bulb is deftly prepared, the filament inserted in its correct position, and the neck pinched down upon the platinum wires. This sounds easy, but it is, in fact, one of the most crucially important operations of all. Unless the seal is permanently air-tight, both when hot and when cold, the vacuum will deteriorate, and the lamp will go off in a decline; cheap foreign made lamps are defective especially in this particular. The best British lamps, however, are provided with a very long seal, so as to quite do away with the risk of leakage. In this lies one of the chief reasons why good British lamps cost more than the cheap and inferior importations frequently met with; not only is a greater amount of platinum required, but the operation of sealing-in takes many times as long as the less efficient method.

Flashing the Lamps. A Screen Hides the Lamp from the Operator's Direct Vision.

Briefly, the process is as follows: The end of the neck is opened by heating it and blowing into the bulb; the filament is then inserted, and the wires held against the edge of the opening while they are heated to redness, when they adhere. The glass is then further heated, and pinched down round the wires so as to grip them tightly, and the seal is finished off with deft manipulation of the blow-pipe. To hold the cap on, two little lugs of glass are welded on at the sides of the seal. Directly the process is finished the lamp is placed in a red-hot crucible, forming one of twenty mounted on a frame, which can be rotated so as to bring any one of them over a Bunsen burner. As each lamp is finished and placed in the hot cup, the next cup is moved over the burner, and the newly finished lamp is left to anneal as the cup slowly cools.

From this operation the lamp pass to the pump room, where they are connected in groups of five to the pumping apparatus. Each lamp is separately sealed, by means of the attached tube, to a glass "fork," using a tiny blow-pipe flame for the purpose. The greater part of the air is then exhausted by means of mechanical pumps, after which the vacuum is raised to the necessary degree by means of Sprengel pumps. As the latter work in the partial vacuum of the mechanical pumps, they are of the shortened form, which suffices for completing the exhaustion. Each filament is raised to incandescence during the later stages of exhaustion, in order partly to drive off occluded gases, and partly to more completely carbonize the filaments, thereby driving off other gases and diminishing the liability to injury through possible overrunning in actual use. To insure this result, the lamps are at this stage run up to a pressure fifty per cent higher than that at which they are to run eventually. To drive off the film of air which adheres to the inner surface of the glass, an asbestos box is lowered over each group of lamps, and a Bunsen burner is lighted beside them, so as to maintain them at a high temperature. The usual chemical means are adopted to dry the air in communication with that in the bulbs.

At the conclusion of the pumping process the lamps are removed by fusing the glass at the tip of the bulb, which at the same time seals up both the lamp and the tube connected with the pump. The lamps are next tested by hanging them on contacts arranged in rows, and running them up to fifty per cent above their rated voltage. The experienced eye of the operator readily detects any important defect in the filaments or in the vacua. The latter are further tested by means of an induction coil, each lamp, held in the hand, being momentarily applied to one of the terminals of the coil. If the vacuum is bad, a blue glow will appear throughout the interior of the lamp; if good, no glow at all will appear.

Having passed this test, the candle-power and efficiency are measured. This process is carried on very quickly, thanks to constant practice. Every lamp is tested at a standard efficiency of four watts per candle, the candle-power and voltage at this rate being marked in ink on the bulb; the lamps are afterward sorted into their respective classes. The photometer used is a simple Joly screen, with a direct-reading scale; the standard is a Vernon-Harcourt pentane flame with Methven screen. The operator is seated with the photometer head before her, and makes the necessary adjustment by means of a rack and pinion, which moves the lamp under test. The scale of the photometer and that of a wattmeter are close together in front of her, and near the screen, so that she can readily ascertain the candle-power and compare it with that corresponding to the power absorbed. If the candle-power is not four times the watts, the operator varies the voltage until the two values are in agreement; an assistant then reads the voltage, and marks it, together with the observed candle-power, on the bulb. The lamps are carefully hidden by means of screens from the direct vision of the operator, so as to affect her sight as little as possible; one of these screens is absent from our view on page 819, which represents the interior of one of the many photometer rooms, specially lighted up for the purpose of taking the photograph.

Having passed this test, most of the lamps now go to the capping room—the demand for "bottom-loop" lamps is insignificant, and even the Admiralty, which preferred to use this type with spring holders to prevent injury from vibration when firing heavy guns, is now specifying capped lamps.

All the high voltage "Robertson" lamps are capped with vitrite; the remainder are fitted with brass caps, mainly of the bayonet joint type. The only feature of this process calling for special mention is the cement employed for attaching and filling the caps. Ordinary plaster of Paris is open to many objections; it is neither damp nor heat proof, and if not carefully used is apt to retain moisture, leading to disastrous consequences. The Incandescent Electric Lamp Company uses a cement which is the antithesis of plaster of Paris, except, perhaps, in color; it sets slowly, and is improved by heating; it is extremely hard when set, quite damp proof, and an excellent insulator. Its manipulation seems to be very similar to that of plaster.

The last operation upon the lamp, exclusive of packing, is another test—an optical test, to detect any defect which may have escaped notice in previous examinations, and to weed out lamps which may have been accidentally packed with others of a different voltage. After this the lamps are cleaned and dried, wrapped in paper and packed in cardboard tubes, which are assembled in boxes and placed in store. Glow lamps are things which must not be delayed in delivery; hence an enormous number has to be kept in stock, amounting in the case of the Brook Green Works to as many as three-quarters of a million. It may interest readers to know that approximately 2,000 different classes of lamps are necessary to make a lamp-maker's stock anywhere near complete.

A certain proportion of obscured lamps are asked for; these are prepared by means of a sand blast, as lamps obscured in this way give better results than those roughened with acid.

British Progress in Electric Traction

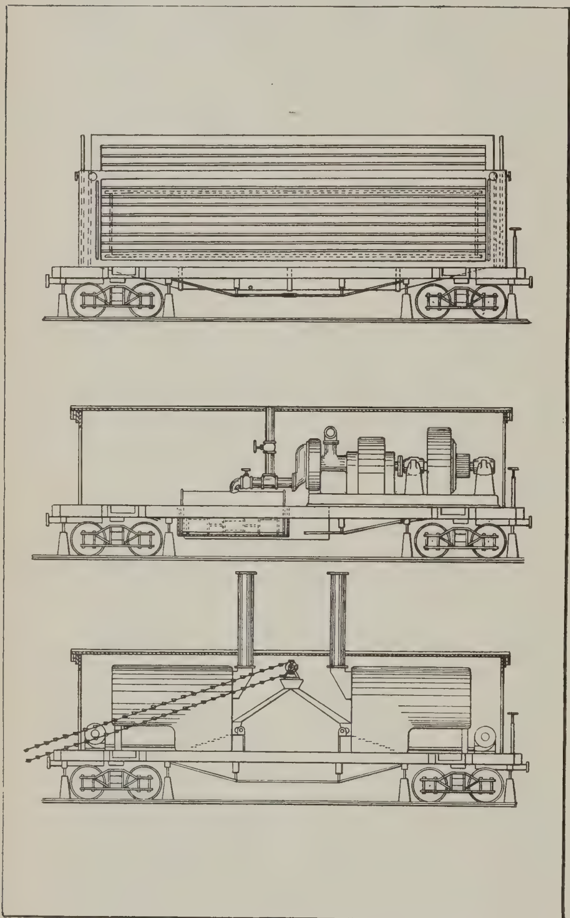
The beginning of progress in English electric traction matters dates back only to 1895. In 1896 the total capitalization of all the electrical undertakings in the British Isles was about $30,000,000, and at that time no financial company is known to have invested any money in traction schemes pure and simple. Last year private companies were represented by a total investment exceeding $200,000,000, while the municipalities had paid in about $55,000,000, making a total investment of $255,000,000. A large number of the companies formed for power distribution will undoubtedly supply current for electric traction purposes, and it is believed that for all the power distribution and traction plants now in process of construction or completed, the total investment reaches nearly $500,000,000. The total capacity in kilowatts now available throughout the United Kingdom for traction and lighting purposes reaches a grand total of 500,000, and 150,000,000 are being installed. In London itself the total kilowatt capacity is not much over 100,000 kilowatts, while New York has nearly 250,000. It is of interest in this connection to note the capitalization per mile of route of some of the more important of the British traction companies. Of the various companies having the heaviest capitalization, the Central London is the most important, being capitalized for £3,550,000, or £546,000 per mile. Next in order comes the City and South London with £2,081,000, or £347,000 per mile. The Liverpool Overhead stands third with £790,000, or £318,000 per mile. The longest line is the Manchester, capitalized at £900,000, or £12,000 per mile for each of its seventy-five miles of length. Next longest is the Liverpool, with sixty-six miles and a capital of £1,084,000, making £6,000 per mile.

Tables recently printed, showing the approximate cost of various parts of the electric traction systems, rolling-stock, track-laying and overhead work, show that the average cost of the power plant, including buildings, ranges between £2,500 and £3,500 sterling; the cost of single track four feet eight and one-half inches wide, between £5,500 and £6,500.

The Central Station and the Culm-Heap

By Charles A. Lieb

For the past fifteen years, during which electricity has grown to be one of the most important of industrial factors, its principal source of generation has been through the consumption of coal.



Elevation, Portable Central Station; the Units Are Generator, Cooling Device and Steam Boiler, Showing Fuel-Conveyor, which is Motor-Driven.

Coal represents about seventy-five per cent of its total cost. Lately water-powers have sprung into great favor, especially since the improved methods now in use permit of transmitting electric power over long distances, with safety and economy. This is notably the case in California, where there are lines in operation over circuits of 220 miles furnishing economical power where coal is sold at prices of $5, $10, or even $12 a ton.

Niagara's power, 435 miles from New York, seems for the time to be out of the question for use in this city. This leaves New York, the largest consumer of power probably in all the world, still at the mercy of King Coal.

Texas oil, as a fuel, is attracting the attention of power manufacturers here because of what seems to be an inexhaustible supply at low prices. Contracts are offered at the well in Beaumont, at one cent per barrel in quantities of 5,000,000 barrels by some of the well owners, but this means little, because of a lack of pipe-lines or other means of transportation. There is no doubt but that this transportation question will be solved in time, but meanwhile New York and other great cities must depend upon other sources of power.

Water-powers, when favorably located, will always be the sources of cheap and satisfactory power, where Providence has so arranged matters that a fairly constant supply may be depended upon. Most of our great cities, however, which are the heavier consumers of power, and which would use still more if the price were reduced, have not been favored by nature with water powers in their back-yards; consequently, they burn coal, the transportation of which costs more than the coal itself, delivered on cars at the mine.

Not until within the past year or two has it been possible for the engineer to satisfy the financial interests that it is cheaper in several important cases to manufacture power directly at the mines and transmit the current over wires, than it is to bring the coal to the cities and use it there.

This scheme is so bold that capital for the first large installation will be timid. The most important consideration in carrying out a scheme of this sort is that the mine at which the station is to be located should belong to the manufacturing company. An obstacle even then is the possibility of the mine giving out, or of operations being interrupted by a strike of the miners. Coal could be stored against strikes, but the interest-charge would count against the cost of manufacture. These and other uncertainties have no doubt prevented this idea from being realized.

The great coal mines of Pennsylvania are within a radius of about one hundred miles from New York City. They are even nearer to Philadelphia and many other cities and towns which are large consumers of power. The mountains of culm in the Pennsylvania coal region can be had at a nominal price. It is true that as compared with a good quality of steam-coal, the culm has only a little more than fifty per cent efficiency, and that, therefore, just twice the bulk of material would have to be handled, and the comparative boiler capacity increased. The use of the culm-heap as a source of fuel would, however, eliminate the striking coal miner as a disturbing factor. In several respects the plant might have its weak spots, but, considered as a whole, it is believed that the proposition is a sound one.

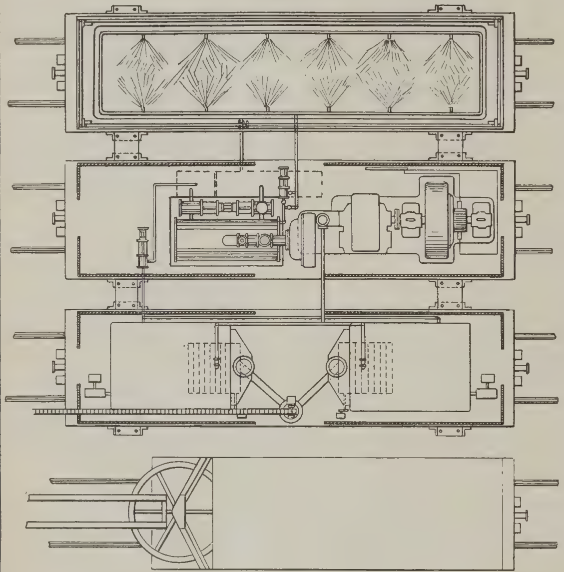
To meet all the conditions that make for success, both financial and commercial, it is proposed to build a portable station which can be moved towards the culm-heap as fast as the latter is consumed. At a small cost the station could be transferred to entirely new regions without interfering with its service qualities. In other words, the factory would be moved to the fuel instead of the fuel to the factory. Thereby a large proportion of the cost of current—the heavy freight expense—would be practically eliminated.

Plans in detail for such a plant have been carefully worked out; and short of an actual demonstration there seems nothing needed to assure its success. The portable station is designed to be built in five-hundred-kilowatt units, each consisting of three parts, namely: a generator, driven by a compound turbine and switchboard on one car; a specially designed condensing apparatus, in place of the usual cooling tower, on a second car, and on a third car a specially designed marine type of induced draught boiler, fired from the side.

All the cars, as well as all the parts of the complete station, would be interchangeable, and thoroughly standardized apparatus used in order that repairs might be quickly effected. In addition to this the cars should be of standard size and weight so as to conform to the requirements of the railroads over which they would have to travel.

The methods of operating such a plant would be first to build a three-track extension from the nearest railroad line to the side of the culm-heap. On this three-track system the central station can be run, preceded by a steam-shovel, and the tracks extended as the machine eats its way into the fuel deposit. The station would consist of as many 500 k. w. units as might be thought desirable. On arriving in place the cars would be jacked up and supported on the roadbed consisting of heavy rails secured to concrete foundations and then bolted to each other, and a temporary covering erected over the whole plant.

The power produced would be transmitted to New York, Philadelphia and all the intermediate points where there is a market for it. The plant can be moved about and be used throughout all the coal-producing regions. Were it not for the turbine, the steam-shovel and the automatic coal-feed, such an apparatus would be impracticable. The ashes and slack produced could easily be sold for road-making.



Plan View, Portable Central Station, Showing the three Main Units Bolted Together, and the Power Shovel.

The boilers should be so connected as to make it possible to cut them out one at a time without interfering with the dynamo set to which each one belongs. From estimates made, the cost of the turbines and generator set has been found to be about one-half the cost of a standard steam-engine. The dynamos should cost much less to operate and less for oil supplies and repairs than in the stationary plant, while insurance and taxes fade into insignificance.

There seems to be no reason why such a system should not prove itself superior to the methods now in use, and it is hoped that an experimental plant will be in operation before the end of the year.

The reorganization plan of the New England Gas and Coke Company, prepared by Kidder, Peabody & Company and J. & W. Seligman & Company, provides for the organization of a voluntary association to take over the property after foreclosure sale in order to avoid double taxation. Three million dollars cash is provided to acquire the outstanding notes of various subsidiary companies and to pay for additions and improvements. The name of the new association will probably be the Massachusetts Gas Company and the trustees will be Charles Francis Adams, second; Walter Cabot Baylies, Samuel Carr, Robert Clarence Pruyn, Joseph Ballister Russell, Frederick Elmer Snow, Charles Augustus Stone, Albert Strauss, Christopher Minot Weld and Robert Winsor. The plan contemplates the issuance of $15,000,000 common and $15,000,000 preferred stock. The latter will be tax exempt in Massachusetts, and will pay four per cent cumulative dividends.

New England Telephone and Telegraph Company stockholders of record July 1, have the right to subscribe at par until July 26 for $3,604,700 new stock at the rate of one new share for every five held.

Stevens's New President

Alexander C. Humphreys, of the firm of Humphreys & Glasgow, consulting engineers, of this city, has been made the new president of the Stevens Institute of Technology, succeeding Dr. Henry Morton, who died on May 9 last.

Mr. Humphreys is the New York representative of his firm and is one of the best known men in the gas world. Born in Edinburgh in 1851, Mr. Humphreys came to the United States while still a boy of eight and lived in the city of Boston until his sixteenth year, when he moved to New York and took a position with the Guarantee and Indemnity Trust Company, rising in two years to receiving teller At eighteen he went to Bayonne, N. J., and became the secretary of the Bayonne & Greenville Gas Company, a year later being made the superintendent, although at the time he had no practical knowledge of the business. It was while still holding this position that he entered the Stevens Institute, graduating at the age of thirty. He then became the chief engineer of the Pintsch Gas Company, being the first American citizen to hold this important place. Three years later he went to the United Gaslight Company, of Philadephia.

Alexander C. Humphreys, President, Stevens Institute of Technology.

In 1895 Mr. Humphreys joined partnership with Arthur G. Glasgow to carry on the business of consulting and constructing engineers. This business has grown rapidly to universal proportions, and the installations of the firm's gasworks in Europe have the immense total capacity of 130,375,000 cubuc feet daily. The feature of the business is the double superheater invented, by Mr. Humphreys, and the apparatus installed by the firm is called the Humphreys-Glasgow carburetted water gas system.

Mr. Humphreys has been instrumental in effecting the consolidation of the gas companies in New York, as it was on his reports that the New Amsterdam company bought up the Central Union and Equitable, afterward being itself bought by the Consolidated.

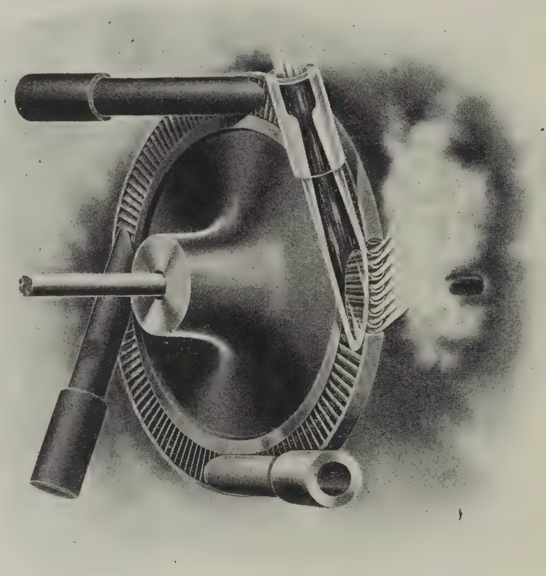
In 1873 Mr. Humphreys was married to Miss Eva Guillaudeu, a sister of Mr. W. L. Guillaudeu.

Efficiency of De Laval Steam Turbine

By J. Emile Coleman, M.E.

At the invitation of the DeLaval Steam Turbine Company, Mr. C. A Lauderdale, M.E., and myself made a series of tests in April of a 300-horse-power De Laval turbine engine at the works of the company at Trenton, N. J.

The tests were the first to be made in this country of any of the larger sizes of the De Laval turbine engines. The results, as will be seen by an appended table, show a high degree of efficiency, and there were some conditions attending the tests which, had they been changed, would undoubtedly have given even better figures.



De Laval Turbine and Steam Nozzles

The measurement of efficiency was made through the work done by electric generators whose rated speed is 750 revolutions a minute. These were run at a speed of only 740 revolutions a minute. It would have been quite safe to have run them at 760 revolutions. Had this been done it is probable that the economy of the turbine at full load would have been reduced to nearly fourteen pounds an hour per brake horse-power.

The turbine tested is of European make. It is one used in regular service at the Trenton works, supplying power to the company's shops.

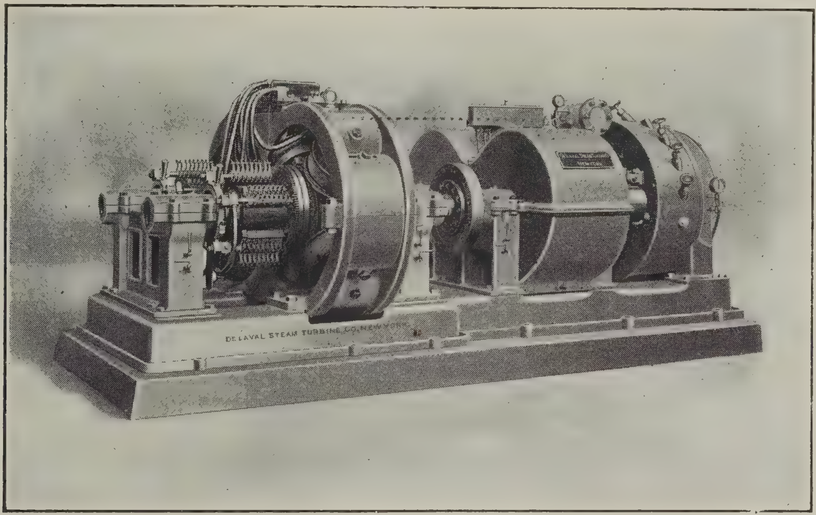
The working parts of the De Laval turbine are simple. They consist of a flat wheel with buckets or rather vanes along one surface, just within the outer edge, and a set of nozzles which direct the steam against the vanes.

The novel features of the machine are found in the form of the nozzles, designed to give a perfect adiabatic expansion of the steam; a flexible shaft on which the turbine wheel is mounted, enabling it to rotate steadily on its true center of gravity, and double helical spur gears which connect the turbine shaft with the working shaft.

Without the flexible shaft, the rapid speed at which the turbine wheel is driven might result in injury to the apparatus. If it could not center itself it would probably shake the whole structure to pieces. The helical gears with their sets of teeth set at right angles to each other take the end thrust of the turbine shaft and prevent its having any end play.

Theoretically, in order that the wheel might absorb all the energy of the steam, the jet must be completely reversed in its direction and leave the wheel with zero velocity relative to the nozzles. To accomplish this the velocity of the wheel where the jets strike should be one-half the initial velocity of the jets, and the jets must lie in the plane of the rotation of the wheel. These conditions are never obtained in practice. To enable the steam to leave one vane without interfering with the next coming into play, the nozzle is placed at an angle of twenty degrees to the plane of rotation. This reduces the efficiency at once to 88.4 per cent. The steam leaving the wheel will still retain thirty-four per cent of its initial velocity, and the wheel will have a peripheral velocity of forty-seven per cent of that of the jet. When a nozzle of divergent section is employed, such as that of the De Laval turbine, so that the total work of expansion is converted into kinetic energy, the velocity acquired by the steam in expanding from an initial pressure of 200 pounds per square inch down to one pound back pressure is about 4,000 feet per second. Forty-seven per cent of this is 1,880 feet per second, or nearly twenty-one and one-half miles per minute. It would be unsafe to rotate a wheel at such a speed as this. In practice the peripheral speed of the wheels is never more than 1,400 feet per second, and is usually considerably less than this.

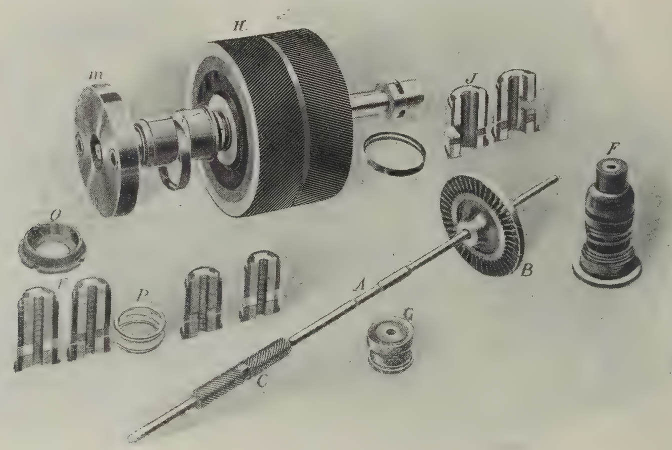
The De Laval turbine not only makes use of complete expansion from the higher to the lower pressure, but obtains almost perfect adiabatic expansion; that is, expansion where no external exchange of heat occurs. It is more nearly perfect in another respect. It does not ooze out heat and waste it as the ordinary engine does. Steam turbines in general are also worthy of notice because of low first cost, cheapness of erection, and the small floor space which they require, and because with no reciprocating parts they require no heavy foundations.



Three-hundred-Horse Power De Laval Steam Turbine and Electric Generator.

The steam turbine is preëminently suited for operating alternating current generators in parallel, since its rotative force is continuous. In the turbine tested the diameter of the wheel was about thirty inches. Eight nozzles supplied the steam. Any of the nozzles could be closed at will by means of cocks. If the engine is to run steadily at one-half load only four nozzles would be used. A modification of the fly-ball governor on the shaft of one of the gears regulates the speed by throttling the entering steam. The pinion of the reduction gears meshes with two gears, to the shaft of which is directly connected a General Electric current generator, each rated at 50 kilowatts. The engine is connected to a jet condenser. There were two Babcock & Wilcox water-tube boilers, one of which was fitted with a superheater. The piping was arranged so that either of these boilers could be used to supply the turbine with steam, while the other supplied the feed pumps and other auxiliaries. As it was not convenient to measure the exhaust steam when a jet condenser is used, it was decided to supply the turbine with steam from one boiler only and to measure the feed water. The boiler with the superheater was used for this purpose. The water was weighed in barrels on platform scales. Two barrels were used for this purpose; these discharged into a third barrel, from which the water was fed to the boiler with an injector. The load applied to the turbine was obtained from the electrical output of the generators. The efficiency value of the generators was obtained from the manufacturers.

A series of four runs was made—one ten-hour run with full load on the engine and three four-hour runs each with three-quarters, one-half and three-eighths loads respectively. The load applied to the generators was composed of the regular shop load, and a water-rheostat connected in parallel to it. The generators were connected in series. The current was read with an ammeter in series with them. The voltage of each machine was taken separately.



Working Parts of De Laval Steam Turbine.

Pressures of the entering steam both above and below the governing valve were observed. The temperature of the steam above the valve was taken with a thermometer in an oil-cup. A mercury manometer was used to obtain the amount of vacuum. A calorimeter was also placed above the valve. The loss through the calorimeter was computed by Napier's formula.

A separate boiler leakage test was made with the boiler under like conditions to those during the engine trials. All the instruments were carefully adjusted to read correctly, or calibration curves were made by comparing with standards, by which the observed data were afterward corrected.

The results of the tests are as follows:

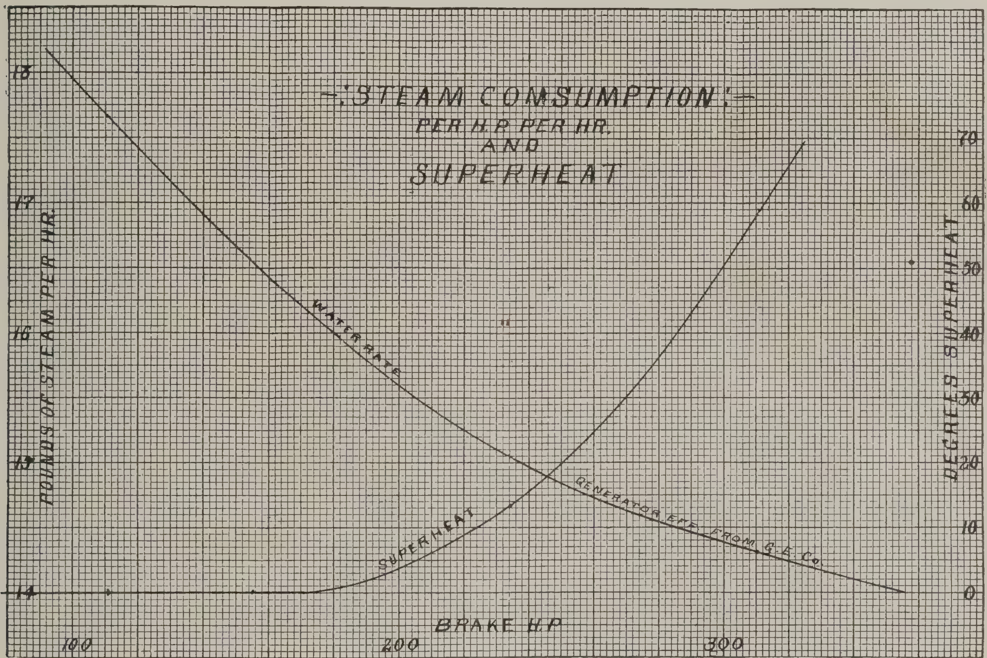
RESULTS OF TURBINE TEST

	Full Load.	¾ Load.	½ Load.	⅜ Load.
No. of nozzles	8	6	4	3
Steam press. above valve, gauge	198.19	195.55	198.1	196.25
Press. below valve, gauge	184.33	186.46	163.13	189.78
Vacuum, in Hg.	27.08	27.69	27.53	27.97
Degrees of superheat, F.	59.66	13.43	0	0
R. P. M. of dynamo	736.9	731.1	730.	731.3
E. H. P.	281.32	209.38	131.31	91.85
Brake H. P.	311.87	234.53	154.53	112.7
Steam per H. P. per hr., lbs.	14.33	15.04	16.57	17.66

heated throughout as it was for the full-load run.

The lack of superheat with the lighter load is due to the fact that the superheating power of a boiler falls off with its load. This is probably because the fire is not forced when there is but a light load to carry, and this allows the water-heating surface to cool the furnace gases so much that they can impart no further heat to the steam.

To compare the economy as given per B. H. P. with that per I. H. P. as given for reciprocating engines, multiply the former by .88, which is a fair value

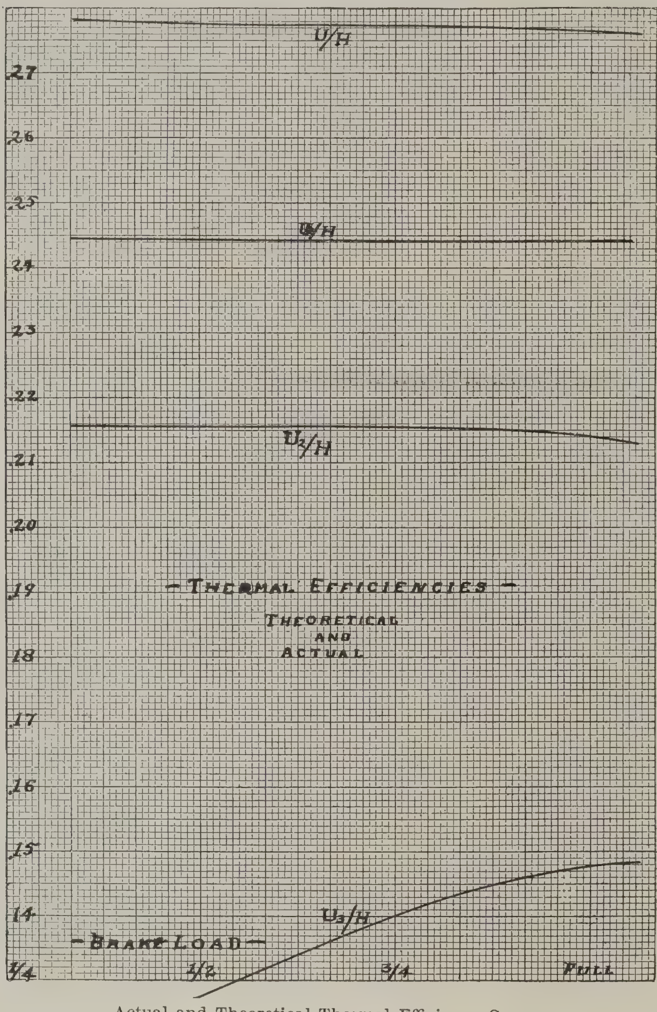


Superheat and Steam Consumption Curves

Curves in figure show the variation of steam consumption per brake horse-power per hour, and the degrees of superheat of the supplied steam. The steam consumption at three-eighths load is about twenty-three per cent greater than that at full load; this variation is not large, and it is safe to say that it would have been much less if the steam had been super-

for the mechanical efficiency of reciprocating engines in good practice. This gives a steam consumption for the turbine of 12.5 pounds per I. H. P. per hour at full load. Some of the modern reciprocating engines rated at as much as 8,000 I. H. P. have a guaranteed economy of only thirteen pounds per I. H. P. per hour. Considering the size of the turbine, the economy obtained is remarkably good.

To know the real value of an engine, however, one should know its thermal efficiency, that is, the per cent of the heat supplied that is converted into useful dynamic energy. Let H equal the total heat in a pound of steam supplied, in B. T. U. Let U_1 equal the energy absorbed by the wheel, in B. T. U., when it is rotating with a peripheral velocity of forty-seven per cent of the velocity of the jet of steam. Let U_2 equal the work, in B. T. U., per pound of steam absorbed by the wheel when running at its actual velocity; U_3 equal the work in B. T. U. per pound of steam as actually developed by the engine. Then U_1/H equals the ideal efficiency of the engine, U_2/H equals the efficiency the engine should have if it were not for friction losses, and U_3/H equals the actual efficiency of the engine. U equals the total dynamic energy of the jet of steam; therefore U/H equals the maximum possible efficiency obtainable by an engine working with this cycle. It is purely theoretical, and can only be approached and never attained. These values have been computed for the several cases of this test, and are given as curves on figure. From these curves it is seen that the actual thermal efficiency of the turbine at full load is 14.8 per cent, which is extremely good for a steam-engine. The distances between curves V/H and U_2/H show the loss due to running the wheel at a slower peripheral speed than forty-seven per cent of the initial velocity of the jet. The loss shown by the distance between curves U_2/H and U_3/H is the largest and is due to various frictions, the greatest of which has been shown by experiment to be that of revolving the wheel in the comparatively dense medium of water vapor. This loss can be reduced in two ways—



Actual and Theoretical Thermal Efficiency Curves first, by maintaining a high degree of vacuum, and secondly, by superheating the steam supplied. The steam should be superheated enough so that the exhaust steam will be at last just dry, because one drop of water between the wheel and casing could cause a most tremendous loss. It would take a considerable degree of superheat to accomplish this result, however, with such a large ratio of expansion as is used with turbines.

When initially dry steam is allowed to expand, doing work, and no external exchange of heat occurs, part of the steam is condensed, as the work done requires more heat than is given up by the steam in its fall in pressure alone. This condensation, as shown by Rankine's formula, amounts to about twenty-four per cent when steam expands from a pressure of from about 200 pounds per square inch down to one pound per square inch. Part of this condensed steam will be re-evaporated as it leaves the wheel by the energy due to the velocity of the steam, which is reconverted into heat as the steam comes to rest.

For practical reasons, it was not convenient to ascertain the quality of the exhaust in these trials, so it is not possible to say that results from Rankine's formula would hold true in this case.

The steam turbine is particularly well adapted to the use of highly superheated steam, as there are no moving parts subjected to the steam under pressure, which removes the difficulty of lubrication under high temperatures, so troublesome with the reciprocating engine.

Since making the tests, I have received from Mr. E. Meden, the engineer of the De Laval Steam Turbine Company, the following letter:

"Mr. J. E. Coleman:

"*Dear Sir*—I have yours of June 3, contents of which I have noted. I inclose herewith a sheet giving various readings of the generator and its commercial efficiency. You will here recognize several of the readings taken while you were here.

"As I have said before, the generator is in considerably better shape now than at the time you made the test, and for this reason it would be only fair to at least accept the efficiency as given on this sheet.

"You will see that the efficiency is a maximum at somewhat less than one-half load, which corresponds with the efficiencies you figured out, although I think your efficiency somewhat too low.

"Trusting this will give you all the information you need, I am

"Yours truly,

"De Laval Steam Turbine Co.

"E. Meden."

The table of efficiencies inclosed would modify the steam consumption as follows:

STEAM CONSUMPTION, PER B. H. P. PER HOUR.

	By G. E. Eff.	By Meden's Eff.
Full load	14.333	14.110
¾ load	15.039	15.050
½ load	16.586	17.500
⅜ load.	17.659	19.300

The reciprocating steam-engine, although to-day competing successfully with all other heat motors, is both thermodynamically and thermally a very imperfect machine. In the best practice to-day it converts only about ten to fourteen per cent of the total energy contained in the steam into dynamic energy. Used as a steam engine alone, there is little hope of greatly improving this efficiency. By using the exhause steam to heat a lighter fluid, which will in turn operate another engine, the thermal efficiency of the whole can be improved. Some experiments have been made in Europe along this line in which remarkable results have been obtained.

The Turbine Equipment of The Metropolitan Railway

A London publication of recent date gives the following outline of the Parsons steam turbine equipment for the Metropolitan Railway of that city and of its guaranteed efficiency:

"At a meeting held recently the directors of the Metropolitan Railway Company, of London, decided to award the contract for the machinery necessary for the electrical working of the line to the British Westinghouse Company. The following is a brief outline of the nature of the machinery which will be supplied: There are to be nine boilers, with a total normal continuous evaporating capacity of 160,000 pounds of water per hour, with a temporarily much-increased power. The guaranteed thermal efficiency is seventy per cent. The pressure worked at will be 160 pounds per square inch, and the steam will be superheated 180 degrees F. above the temperature of the steam at this point. There will be three combined steam turbines and three-phase alternators, the turbines being constructed by the Parsons Steam Turbine Company. The output of each combined set is to be 3,500 kw. as a normal load, and for short periods an output of fifty per cent in excess of this figure. They will run at 750 r. p. m., and a ninety per cent vacuum is guaranteed. The efficiency of the combined sets is to be seventeen pounds of steam for each kilowatt delivered at full load and twenty and one-quarter pounds of steam for each kilowatt delivered at half load, the power factor being .85. The alternators will deliver three-phase current at 11,000 volts and at twenty-five alternations per second. There will be three separate exciters driven by small ordinary steam-engines. These will be capable of delivering either three-phase or direct current. Two of the three main sets only will be run at a time, the third being for spare, and the boiler power is only for driving two of the sets. It is understood that more boiler power over and above that in the contract will be provided."

The Conductor and the Half-Dime

So few silver coins of the five-cent denomination are to-day in circulation, that a conductor on one of the electric street railroads in Greater New York was recently considerably perplexed on receiving from one of his passengers a half-dime in payment for fare. The passenger tendering the coin was a middle-aged gentleman of eminently respectable appearance, sober, and evidently anticipating a protest. He carefully handed the diminutive piece to the official, who looked at it with considerable suspicion and then regarded his passenger with a sour expression. "What's this?" he said.

The passenger was busily engaged in watching an interesting child across the car, and apparently did not hear.

"I say—'tain't good," said the conductor. "You wouldn't take it, now, would you?" But the passenger refused further payment, and the conductor put the coin in his pocket with a gesture of profound disgust and went on up the car collecting his fares with a funereal expression. He evidently believed that it would be necessary for him to fail to ring up one fare in order to bring his day's work to a successful finish.

Digest

Engineering Literature of the Month

Four Electric Power Articles.

In the June issue are four descriptive articles dealing with the Quebec Railway, Lighting Power Company, the Quebec-Jacques Cartier Electric Company, the Canadian Electric Light Company's water power development at Chaudière Falls and the electric installation for the Soulanges canal.

In the first of these articles, which is illustrated with seven engravings, the hydraulic development, machinery, switchboards and general data are described. The installation in question is located at the falls of the Montmorency river, which has a head of 267 feet. The falls are seven miles distant from the city, and a dam has been built in the river close to them by the Quebec & Levis Electric Lighting Company, which has since been absorbed by the newer organization. The dam is 265 feet in length, the gate-house being at its left side; a wing dam extends 325 feet upstream, enclosing on its shore side the head-race. This dam is built of cribwork eight feet wide at the top and twenty feet wide at the bottom, along which are seven apertures varying from twelve to twenty feet in length and all having a height of seven feet. These are to prevent any rubbish from entering the head-race. Frazil, or needle-ice, sometimes causes the river to become as thick as pea soup, but this ice is carried off by the wing-dam, thus leaving the head-race free and clear. The entrance to the intake is by the gate-house, being nine feet in diameter at its upper end and eight feet at the lower end, where it joins the pipe-line, which is built of steel and is 2,609 feet long from dam to power-house. The power-house is of stone, two stories high, and measures forty by one hundred and fifty feet. The turbines are Victor high-pressure wheels, five in number, and have a capacity of 1,000 horse-power at a two hundred foot head, and giving at the official test an efficiency of seventy-eight per cent. Three six-hundred and one seven-hundred-and-twenty kilowatt, two-phase, S. K. C. alternators deliver current at a frequency of sixty-six cycles direct to the line at 5,500 volts. A fourth machine was built in Montreal, and the fifth is a Westinghouse generator delivering direct current at 550 volts from one end and two-phase alternating from the other. The direct current is used for the St. Annes railroad, which passes the power-house, and the alternate current is transformed from 480 volts two-phase to 11,000 volts three-phase and transmitted to a sub-station at Beaupré, where it is again transformed from 11,000 three-phase to 385 volts two-phase, afterward passing through a two-hundred-kilowatt rotary converter, coming out at 550 volts direct current, whence it goes to the trolley on the St. Annes railroad. Two direct-current generators are separately driven as exciters. At the sub-station in Quebec the equipment consists of fourteen one-hundred-kilowatt S. K. C. transformers, ten being oil-cooled and four air-cooled. These reduce the line voltage from 5,000 to 2,000 volts and may be connected in banks of three in multiple or each separately on each phase by means of the transformer switchboard. For arc lighting there are four one-hundred-and-twenty-five-light Brush arc machines. Five separate switchboards are installed in this sub-station, the instruments on them being of the Whitney, Thomson and Bristol types. Besides the street railway, the company operates a thirty-mile road passing the Falls and the Shrine of St. Anne, the cars being fifty-five feet long and geared for a speed of fifty miles an hour, each car having air-brakes.

The second article shows the rapidity of the development of the Quebec-Jacques Cartier Electric Company and describes the power-house, sub-station, distributing switchboard, and the future extension of a plant. The installation consists of the usual hydro-electric machinery, having a connected load of over 2,250 kilowatts. The transmission line proper consists of two three-phase 22,000 volt lines, eighteen miles long, of No. 4 hard-drawn copper, strung eighteen inches apart. The second part of the transmission, two miles long, is of two two-phase, 2,200 volt lines of No. 00 wire and extends from the step-down transformer-house to the switchboard in the center of the city. New apparatus to be installed in the near future will consist of two main units of 200 horse-power each, giving current at 2,000 volts, and a third of 100 horse power, with one arc dynamo. An eight-panel switchboard will control this apparatus. Contracts have also been filed for an auxiliary steam-plant of 1,800 horse-power capacity, which will be located outside the city limits near the step-down transformer-house.

In the third article is described the plant at the Chaudière Falls, which have a flow of 35,000 cubic feet per minute with a head of eighty-five feet, and another drop at the rapids of eleven feet, in a distance of about 1,000. When impounded above the falls a working head of 114 feet is obtained from the water, developing 6,000 horse-power at the turbine-shafts, with eighty per cent efficiency. A concrete dam 826 feet long lies above the falls and is connected to the east shore by a six-foot concrete abutment carried well into the clay bank. The western end of the dam terminates in two heavy sluiceway piers, the sluice shafts being twelve feet wide. The piers are joined to the bulkhead by a wing-dam extending down stream one hundred and fifty feet, forming the eastern boundary of the head-race. The gates are constructed in two parts, the upper section being elevated first to balance the pressure on both sides. The penstocks are seven in number, each being eight feet three inches in diameter; only one is in operation at present. The power-house measures fifty-two by eighty-two feet outside, the whole building being fireproof. The two turbines already installed are McCormick wheels, thirty-three inches in diameter, each being mounted in a nine-foot wheel-case, and having steel shafts twenty-one feet long. Two three-phase, revolving field generators, rated at three hundred and fifty kilowatts, with a normal potential of 10,500 volts at a frequency of sixty-six and two-third cycles at 400 revolutions per minute, capable of delivering twenty-five per cent over-load for four hours, and fifty per cent over-load for one hour without overheating, complete the equipment. The transmission line, which extends from the falls to Levis, a distance of nine miles, is of No. 2 hard-drawn copper. The sub-station in Levis measures twenty-two by forty-two feet and is equipped with a two-ton traveling crane. Oil-switches receive the transmission line twelve feet from the floor, connecting each line to a set of 10,000 volt bus-bars. A nine-panel switchboard takes care of the nine banks of transformers, being equipped with ammeters for each phase. The board is eighteen feet long and seven feet high. The company is now transmitting between Quebec and Levis, through a submarine cable laid across the St. Lawrence, seven hundred and fifty kilowatts at 2,500 volts. The length of the cable is 4,350 feet; it is composed of four No. 2-0 B. & S. gage standard conductors, and four No. 14 gage wires, the outside of the cable being armored with thirty No. 6 B. W. G. galvanized steel wires.

The Soulanges canal, fourteen miles long, connects Lakes St. Louis and St. Francis, the level of the latter being eighty-two feet higher than that of the former. Between the two levels five locks are interposed, the first having a twenty-three foot lift, the fourth twelve and the last two. As good water power was available on the canal, it was decided by the operating company to install an electric plant to work the locks, sluices and bridges, and to light the entire length of the canal; alternating current was adopted on account of the length of the line. The hydraulic equipment consists of two pairs of Victor turbines on one horizontal shaft, operating under a twenty-foot head at 225 r. p. m. To each of these units is coupled a three-phase, revolving field, sixty cycle generator of 264 kilowatts capacity at 2,400 volts. Two fourteen pole exciters are attached, each having seventeen kilowatts capacity at one hundred and twenty-five volts. The power-house is lighted by sixteen candle-power incandescent lamps set at an angle of forty-five degrees, each lamp having a reflector. The transmission lines are No. 6, No. 4 and No. 2 B. & S. bare copper wire, respectively, and run from the upper entrance at Coteau landing to the lower entrance at Cascades point, and for the arc lighting system. Across the canal are five electrically operated bridges, the motors and controlling apparatus being contained in cabins set on the side of each bridge. Each motor is of two horse-power capacity and operates at two hundred and twenty volts, being geared to the bridge-turning mechanism; each bridge weighs something over one hundred tons and will open or close within ten minutes. The locks are two hundred feet long and forty-six feet wide, being built of concrete. The largest gates are over forty feet high and twenty-eight feet broad, weighing more than seventy tons apiece. To operate these lock gates and sluice valves, three-phase, two hundred and twenty-volt, constant speed, induction motors are connected to them with friction pulleys and a brake lever in order to facilitate the operation of the canal; communication between all the locks, bridges, offices, and the power-house is maintained by a telephone system. It is stated that since the operation of the system by electricity a saving of labor equal to fifty per cent has been effected.—*Canadian Electrical News.*

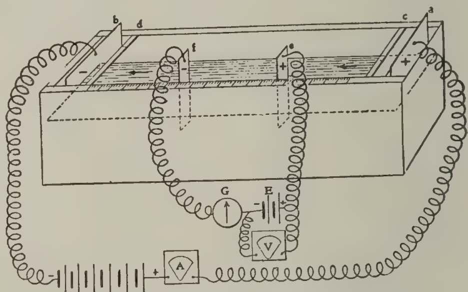
St. Paul's Cathedral Electrically Lighted.

An interesting article is presented in a recent number descriptive of the new electric lighting apparatus in St. Paul's Cathedral, London. Mr. C. J. Scott superintended the installation, which was an extremely difficult matter, having been in progress for three years, in which time about 12,000 lights have been wired for and connected up at a cost of about $50,000. Current is supplied at two hundred volts from two separate companies, by which means a duplicate supply is obtained, thus preventing a total failure of the system in case of the breakdown of either company. From the main switchboards, which are fixed near the supply terminals, a number of main circuits are run to distribution boards throughout the building. All the wires are laid in iron pipe, most of which is entirely concealed, none of it going across any tomb or places which may be hereafter required for interment purposes. In the construction of the cathedral Sir Christopher Wren left vertical shafts in a number of the main pillars, which have been utilized to carry the leads into the roof. A current intensity of two hundred and fifty amperes per square inch is said to have been adopted to prevent any appreciable drop in the voltage. Some idea of the magnificence of the electroliers may be gathered from the fact that the fittings suspended from the whispering gallery of the dome weigh a quarter of a ton each. The great weight of the hanging fittings is sustained by a stranded steel armoring around the conducting wires, the outside diameter of the armoring being almost one inch. The nave is lighted by standards from the floor, each one being built of bronze; the lamps are carried in basin-shaped glasses, which serve to diffuse the light, the glass being of a special texture. The general appearance of the glass is not unlike that of hammered metal. Mr. J. P. Morgan, of New York city, is the donor of the lighting system.—*London Electrical Engineer.*

Determination of Electrolytic Resistance by the Liquid Potentiometer.

A method of computing electrolytic resistances by means of direct current instruments has recently been propounded by Carl Hering, who had the following problem presented for solution in the course of his regular practice:

A number of electrolytic tanks was connected electrically in series. But for filling, circulating and emptying they had to be piped to a common tank; these pipes practically connected in multiple all the liquids in the tanks; hence the tanks being connected simultaneously in both series and multiple, were all short-circuited. The conditions were such that the usual methods of breaking the continuity of these columns of liquid in the pipes, by means of air-bubbles, stop-cocks, successive filling, etc., were, by their nature, excluded, and the only thing left was to make the resistance of the columns of liquid in the connecting pipes so great that the loss by the leakage current through them would be negligible. This is always possible, even for a given rate of flow of liquid in the pipes, and given mechanical pressure, because the mechanical resistance to the flow of liquids in pipes decreases more rapidly with an increase of diameter than the electrical resistance; or, in other words, for a given electrical resistance, the flow of liquid with the same head increases with the diameter of the pipe. In this particular case, however, nothing but lead pipes could be used, and when the fall of potential in the liquid column was made relatively great, the current would naturally leave the high-resistance liquid, pass into the low-resistance pipe and back again at the other end of it; the object of giving the column of liquid a high resistance



Construction of the Liquid Potentiometer.

would thereby be lost. This was overcome by breaking the electrical continuity of the lead pipe with insulating joints, and the question then arose at what intervals must these joints be placed so that the drop of voltage in each section was just below that required to pass from the liquid to the pipe and back again, as the lead pipe, although an excellent conductor, compared with the electrolyte, would then act like a pipe of insulating material, and confine the current to the electrolyte. In making tests to determine this maximum drop of voltage an apparatus was devised which incidentally led to the interesting fact that the principle of the potentiometer can, with certain precautions, be applied to liquids also, and that such an apparatus may be used, among other things, for measuring the resistance of liquids with direct current, and with only a simple direct-current ammeter and voltmeter or galvanoscope, besides a cheap improvised apparatus.

This instrument, shown in the accompanying cut, is described as consisting of a rectangular tank built of some dielectric material and having a scale at one of the upper edges. This tank must be accurate in dimension so that cross sections of the electrolyte will be uniform. Suitable electrodes (*a* and *b*) are inserted at the ends, and to prevent the products of decomposition from altering the nature of the liquid, the porous partitions *c* and *d* are interposed between the body of the tank and the electrodes. The fall of potential at these electrodes and the resistance of the porous cups do not affect the quantities to be measured, and they need, therefore, not be known, and can be quite high. A suitable direct current is then passed through the column of liquid by means of these electrodes; it should be constant and must be measured in amperes. Not considering the ends of the tank, there will then be a regular drop of potential along this column of liquid, as in a potentiometer wire. If this drop could be measured in volts, between any two points, then the resistance of the column between those points could be determined by Ohm's law, and from this and the known cross section and distance between the points, the specific resistance of the liquid could easily be calculated. The difficulty lies in determining this drop of potential without introducing a large and unknown or variable error. The only correct way is to have absolutely no current flowing in that circuit. To do this the cell *E*, of known e. m. f., is inserted into the local circuit. Care must be taken to see that the cell is properly connected with respect to its polarity. *G* indicates the galvanoscope, which is then inserted, after which *e* and *f*, the two auxiliary electrodes, are moved further apart or closer together until the current in that local circuit is zero. For various reasons gold was found best adapted as the material for these electrodes. The writer used the apparatus only for obtaining results sufficiently accurate for practical purposes, and therefore is not able to say whether it could be used also as an instrument of precision for research work. For practical work it answers very well, and has the advantage that the ordinary direct-current instruments usually at hand can be used, the only special apparatus being the tank, which, for most liquids, can readily be made of wood, coated on the inside with asphalt varnish. The resistance of liquids determined in this way agreed very well with those recorded in tables.—*Abstract of paper read before American Institute of Electrical Engineers.*

Braun-Siemens and Halske Wireless Telegraph System.

A technical article gives in detail Dr. Braun's description of his system of syntonic telegraphy and that of Dr. Slaby and Count d'Arco, who recently sold out to the Allgemeine Elektrictäts Gesellschaft, which is being sued by Siemens & Halske. The principal feature of Dr. Braun's system is the entire absence of earth connections of any kind. Another clever arrangement takes advantage of the persistent oscillations of the closed circuit and the radiating qualities of the open-circuit oscillator. By a similar construction of the receiver, the transmitter sends out waves of a certain definite length only, and waves of this length only may be received. This harmonization between the two sets of instruments is so carefully planned that the system requires no earthed connection, although that has been found necessary in all others heretofore invented. Since the earth is charged to the opposite sign to the electrified upper strata of air, it is really the cause of atmospheric disturbances in wireless telegraph apparatus. The supposition that a system in which the earthed connections are eliminated would be free from such untoward influences is claimed to have found abundant justification in experiment and practice with Dr. Braun's invention. The article further describes the system at great length and is illustrated with views of Prof. Braun's stations at Cuxhaven, Germany, and on the island of Heligoland, in the German ocean. The system is said to have been severely tested in all kinds of weather and answered the fullest expectations.—*A. F. Collins in Electrical World and Engineer.*

The Mt. Beacon (N. Y.) Cable Railway.

This incline railway has a grade of sixty-five feet to a hundred in length at various points on the line, which is something less than half a mile long. In the construction of the track heavy mudsill timbers were placed crosswise six feet apart and carefully ballasted with rock. To these mudsills are bolted heavy six by ten inch yellow pine stringers thirty to forty feet in length, and the ties are spiked to these stringers, the track rails and guard rails being fastened to the ties in the usual way. The guard-rails are made up of two pieces of four by six inch yellow pine timber, breaking joints to make a continuous rail. At two places the grade was so steep as to make fifty-foot trestles necessary in order to insure stability, and these were constructed of heavily framed ten by ten inch yellow pine timbers. The truck construction on the cars is unique. To permit the wheels to cross the cable at the ends of the turnout, where the ascending and descending cars pass, the road being a single track line, the wheel on one end of each of the axles is without a flange, perfectly flat of face, although it runs on ordinary T-rail. The wheel at the other end of the axle is double flanged or grooved, to straddle the rail, serving as a traction guide, the cable running on pulley wheels in the center of the track, as in other cable railways. Twice the power actually needed is used to operate the cable, two seventy-five horsepower motors being directly geared to the cable-driving machinery. To guard against accident every possible precaution has been taken, and provision against derailment is made by using emergency traction guides of steel, which straddle but do not touch the heavy wooden guard-rails. — *Street Railway Journal.*

Electric Waves and Human Brains.

Mr. A. Frederick Collins, in a copyright article, describes at length, assisted by a number of good illustrations, the effect of electric waves upon the human brain, and presents in detail the results of experiments made by himself last September, for the purpose of proving just what relationship exists between electric storms and persons who are afflicted with certain nervous diseases. The author explains that he was led to experiment by observing an elderly gentleman who suffered acutely with an advanced neurosis (the disease being already in his system) during thunderstorms. Hertz, Calzechi Owsti, Edouard Branley, and Larroque also gave hints to Mr. Collins by means of their research and discoveries in regard to electric waves and coherers. "In view of these facts," says Mr. Collins, "it seems reasonable to believe that the electric waves emitted by lightning might affect existing pathological conditions, and it was to demonstrate if possible a change or an effect in the physiological tissues that these experiments were undertaken." The results of the various tests made on inert human brains and on the brain of a live cat showed that cohesion of the brain cells takes place in mammals as well as in human beings under the influence of the electric wave, both before and after death. During the tests made on a human brain the operator attempted to make a final measurement of its resistivity, but the arms of the testing bridge refused to balance. A peal of thunder showed the reason; an electrical storm was approaching, and for twenty minutes the galvanometer pointer swung back and forth from the + to the — end of the scale. On inserting a telephone into the apparatus the sounds of lightning discharges were distinctly audible and it was afterwards learned that the lightning had struck a house a quarter of a mile distant.—*London Electrical Review.*

Postal Automobiles ni Rome.

Roman experiments with an electric automobile have convinced the postal authorities there of the utility and economy of such vehicles for the use of the postal service. The van in question was used for collecting letters, and accomplished as much work as two of the old wagons. A trial of the same system will be held in Milan, and if the tests are as successful as those held in Rome, the system will probably be employed by the postal authorities throughout all the larger Italian towns and cities. Full details of the tests are not now available.—*L'Elettricita, Milan.*

A Substitute for Gutta-percha.

A patent has been secured by A. Gentzsch, Vienna, for an invention relating to the manufacture of gutta-percha substitute—by mixing and kneading, with or without the addition of oils, caoutchouc with wax of a high natural melting point, or the melting point of which has been raised artificially by a special process. Instead of wax, rosin, asphalt, tar, or pitch may be mixed with caoutchouc to make the gutta-percha substitute, if these substances have been treated according to the special process, whereby the melting point is raised and the inspissation of the tar and pitch enhanced. In practice one of these substances, or a mixture of them, is heated in a suitable receptable either directly or indirectly, at a temperature of from 210° to 420° F. To the substance thus melted water is added, alone or with a mixture of salts such as carbonate of lime, magnesium carbonate, or others, taking care that the temperature does not fall below 210° F. The substance now becomes viscid, and when the required degree of viscidity is attained caoutchouc is added, and, if desirable, suitable oils, such as cotton seed or mineral oil, at a temperature which is low at first but is slowly raised. This process is preferably carried out in a kneading apparatus which can be heated.—*Trade Journals Review, Manchester.*

A 50,000-Volt Transmission System

About twenty miles east of Helena, Mont., the Missouri River Power Company has located its new 50,000-volt power plant and transmission system. The location is the town of Canyon Ferry. It was about ten years ago that the project was first taken up, and the present plant is the result. At the canyon's mouth a 480-foot dam has been thrown across the Missouri river and gives a working head of thirty feet, the canyon varying from 400 to 700 feet in width; it is about half a mile long. There is sufficient water in the river at all seasons to develop a minimum of 10,000 horse-power. About four years ago the plant was begun, and it then consisted of four 750-kilowatt, 550-volt, two-phase generators with two 90-kilowatt exciters, the capacity of the plant being 4,000 horse-power. In the fall of 1900 the present plant began to take shape, the idea being to enlarge the old one to a capacity of 10,000 horse-power. Six extra 750-kilowatt generators, with the proper accompaniment of exciters, transformers and other apparatus, were therefore installed, to be driven by forty-five-inch turbines. All generators in the power-house are direct-connected to the wheels, flexible couplings being used throughout. With the new generators there was also installed a 225-kilowatt, 150-volt exciter, driven by a separate wheel, and a 115-kilowatt, 150-volt exciter, driven by an induction motor. To sum up, the power plant now consists of ten 750-kilowatt direct-connected generators, with four exciters, of which two are 90-kilowatt machines, direct-connected to separate wheels, one a 225-kilowatt machine, with a separate wheel, and one a 115-kilowatt, motor-driven generator. To make the plant uniform throughout, the four old generators have been overhauled and changed from two-phase to three-phase. Power is sent to Butte at 50,000 volts and to Helena at 10,000. Among the customers of the power company are both mining, smelting, lighting and power companies in Helena, East Helena, Anaconda and Butte.—*Exchange*.

A Florida Disenchantment

Down in Florida a few years ago at one of the famous summer resorts was a small street railroad—a little affair that did not amount to much but was supposed by its proprietors to be sufficient for all ordinary purposes. One day in the course of a discussion the owners were accused of being old fogies and behind the times. "Why don't you get together and be up to date?" they were asked. "You really ought to have a modern equipment for a place of this character, instead of an old road of mule-drawn cars that date back to the flood."

After considerable deep meditation and with many misgivings the road was ordered changed to an electric line, and an eighty-horse power equipment was ordered. The outfit arrived and was installed, but for some reason failed to operate properly. An outside expert was then called in to examine the plant and locate the trouble. At a special directors' meeting he reported that the rated efficiency of the plant was eighty horse power and that eighty horse power were being used for the actual operation of the road. At this one of the directors jumped up and exclaimed excitedly: "My God! eighty horse-power for what we used to do with six mules? I guess we had better go back to the mules."

Current Engineering and Scientific Notes

ABSTRACTS FROM THE FOREIGN PAPERS

Power Transmission in Spain.

Revista de Obras Publicas.

At the falls of the Jamara river an interesting station has been lately built, to utilize the 3,000 h. p. of the falls, and also a gas-producer plant from which power is sent to Madrid. A head of sixty-seven feet is obtained at the fall and the flow of water is about 325 cubic feet per second. Three three-phase generators furnish the main supply of power at 10,000 volts, and a fourth machine is always in readiness for emergency purposes. Each unit consists of a 750 h. p. turbine, direct-coupled to the generator, which is of the same size. The storage-battery feature of the plant is also of interest. It has a capacity of 2,000 ampere hours and moves through a rotary converter either forward or backward on the circuit as the case may require. On reaching the company's sub-station in Madrid, the current is lowered from 10,000 to 3,575 volts, being distributed in the city at that potential. The prices charged are just about one-fifth of what was formerly asked for power delivered from stations in the city, and amount, respectively, to two and one cents, American gold, for current for lighting and for motive power. These prices are the lowest on the continent for electrical energy.

French Cable Insulation.

Bulletin: Societe Internationale des Electriciens.

M. Hall Charpentier, at the recent meeting of this society, contributed a valuable paper on cable insulation. M. Charpentier considered the total actual loss through the insulating sheaf of the cable, and afterwards the cable's safety and durability. The writer believed that the resistance value of cable insulation should be based on the first consideration, where consistent with the second. Such a system, he concluded, would lead to a considerable reduction in insulation resistance and a consequent proportionate reduction in price. Taking a specific instance of a 1,000-kilowatt station feeding a 525-volt network 120 kilometres in total length, and allowing a loss of energy through the cable insulation equal to one one-thousandth of the total output, the insulation figures out from 60,000 to 100,000 ohms per kilometre, a figure some 5,000 or 6,000 ohms less than the average guarantee. The modification of usual practice suggested by this consideration the author believes to be entirely consistent with the safety and durability of the cable. He considers that the best method of measuring insulated resistance is the direct-deflection method, but he believes that the ordinary two minutes' application is too short, as during this time the capacity current still superposes itself upon the conductivity current. Readings should be taken not sooner than five or ten minutes. M. Picou, who, it will be remembered, was chief engineer of the Exposition Universelle, agrees with M. Charpentier, that insulation resistances ordinarily specified are much too high. He thought that in addition to the usual high-pressure tests at twice the working pressure, tests of insulation resistance should be made simply to see that the cable is fairly homogeneous in quality.

Metallizing Textiles.

London Electrical Engineer.

A method of metallizing textiles electrically, which is said to afford the possibility of impregnating the thickest piece of cloth, either thoroughly or only on its surface, with any kind of metal, has been invented by Dr. K. Donilowsky, of Russia. The object is attained by an electrical process of separation of the different salts from a given metal and by accumulation of the separated metal in a cathode. From an interesting account of the process we gather that for metallization there can be used copper, iron, silver, nickel, and, in general, any metal which can be separated from its salts by electrolytic manipulation. Before the process of metallization the textile has to go through a preparatory treatment, which consists in impregnating the cloth with a solution of the salt of a certain metal—for instance, with sulphuric acid of copper or oxide of silver, etc. After the cloth has been impregnated it is submitted to a certain treatment with oxidized sulphur, which causes the metal to be separated from the solution in a sedimentary mass, which, being very fine, intrudes the cloth, uniting closely with its fibers, and also settling down on the surface of the cloth. When the cloth is thus prepared it is ready for the process of metallization, and for this purpose it is put into an electrolytic tub filled with a solution of the salt of the kind of metal in which the cloth shall be metallized, and brought in contact with the positive surface of an electrical device. The power of the current, as well as the contents of the tub, has to be regulated for each case respectively. The result which is claimed for this operation is a cloth perfectly impregnated throughout its thickness as well as on its surface, with a certain metal in crystallized or in any desired form, which has so uniformly united with the substance of the cloth that the latter is perfectly metallized.

Direct Current Armatures for Alternating Current.

Elektrotechnische Zeitschrift.

A recent edition of this paper contained an article by Herrn Fleischmann and Orgler, with many illustrations, on the properties of ring armatures fed with single or polyphase currents through the commutator by stationary brushes. The article first deals with a ring armature which takes single-phase alternating current from two exactly opposite brushes which revolve synchronously (i. e., with the vector speed of the current). The alternate motive force induced in the windings and hence in the reactance of the ring is absolutely independent of the rotatory speed of the brushes, the magnetic flux varying at all points on the ring with the double frequency of the alternating current applied, the flux waves being pulsating waves. A series of diagrams shows the variation of the flux over the armature throughout a complete period. The ring armature is next considered when supplied with two-phase alternating current through two pairs of brushes separated by ninety degrees. When they rotate synchronously, the flux has a constant value at each point of the ring and the reactance of the ring is zero, while when the brushes are fixed and the armature rotates synchronously, being supplied with two-phase alternating current, the field is fixed in the iron and revolves in the space displaced by the separation of the brushes. It is thus possible to supply two-phase current through a commutator which has the same effect that is obtained with the rotating field of a synchronous motor when direct current is used by means of slip rings. When such an armature is brought to synchronism in a revolving bipolar field produced by two-phase alternating currents, the armature runs as a synchronous motor after the alternating current excitation has begun. By moving the brushes the relative positions of the stator and rotor poles may be varied.

If, according to Heyland's method, the commutator segments are connected together by large non-inductive resistances, the armature revolves in a revolving field by itself and it is doubtful whether when loaded it will attain sufficient synchronism to run as a synchronous motor.

Volumetric Copper-Determination.

Le Moniteur Scientifique

M. F. Repiton, in an article on this subject, recommends the use of potassium ferro-cyanide, instead of potassium cyanide. A N-10 solution is added to a neutral boiling solution of the copper as sulphate, until test drops show up blue with ferrous sulphate. The application of this method to other metals is being investigated by the author, who is continuing his experiments and going into the matter exhaustively. Exact results may also be obtained if a neutral solution of the copper as sulphate, chloride, or acetate is precipitated with an excess of a standard solution of oxalic acid. Let this mixture be set aside for three hours, then add a little sulphuric acid and titrate the excess of oxalic acid with a permanganate solution of known relative value, the amount of oxalic acid combined with the copper being calculated by difference. The value of this, in terms of copper, is decided by repeating the process on copper solutions of known strength.

Plant Electricity.

La Revue Scientifique.

In a recent issue of the *Revue,* M. A. D. Waller reports the results of his researches into the matter of plant-generated electricity. M. Waller finds that on wounding or injuring a plant an electric current of about 0.1 volt is at once established between the sound and the hurt parts. This current diminishes later on. It is not, however, always necessary to make an actual wound in the plant, for mechanical excitation, like light, on plants such as begonia, tobacco or iris leaves, will be found to produce an electro-positive current of approximately .02 volt, which flows from the part of the leaf which has been illuminated to the dark part. A definite relation is noted between the vigor of the plant and the electrical reaction, for the stronger the plant the more pronounced the current; but this current effect is not always seen in the petals of the plants named. M. Waller also discovered that plants grown from fresh seeds show better results than those obtained from old ones; consequently, a bean one year old gave a current of .0170 volt, while one five years old could give only .0014 volt, the reaction in both being regular and in inverse proportion to the age of the seed from which the plant grows. Fatigue, temperature, changes and other matters characteristic of reactive changes in animal tissues are similarly observed in vegetable fibres.

Jaubert's Oxyliths.

La Nature.

M. J. F. Gall contributes a most interesting article to a recent issue, describing at length M. Jaubert's new method of producing fresh oxygen without pressure and in such a manner that the consumer can have exactly the quantity desired at the time it is wanted, instead of being compelled to buy it in heavy cylinders, compressed to a dangerous density. Metals like potassium, sodium, and their alloys or combinations are capable of fixing the oxygen of the atmospheric air, when heated in an air current, without combining with nitrogen. In this manner various oxides are obtained, some dissolving in water by simple hydration, and others, mostly the higher oxides, decomposing in cold water with the accompaniment of a violent liberation of the oxygen in a practically pure state. M. Jaubert calls these latter oxides oxyliths, or oxygen stones. A company has recently been formed, with a factory capacity of 5,000 horse power, to manufacture the product. The oxylith is a whitish, lumpy substance, like the calcium carbide used for generating acetylene—and when water is poured on it oxygen is at once liberated, but the gas is generated only during the actual pouring on of the water. There is, accordingly, no over-production or pressure. M. Jaubert's generator is a perforated vessel, in which, for laboratory or experimental work, where small quantities of gas are required, the water is forced upon the oxylith from below. Experiments on renewing the air in submarine boats led M. Jaubert to make his discovery, and he claims that a pint of his substance will keep the air in a submarine respirable for an hour, and a few ounces will keep a single man supplied with clean air for the same length of time.

Acetylene Black for Pigments.

Canadian Engineer.

Lampblack may in the near future be displaced as the chief ingredient of dark pigments by acetylene-black, which possesses the advantage of freedom from grease. It is specially adapted for use in printing inks. Its introduction is barred by its high cost, but cheaper methods of manufacture will come. It is at present obtained by decomposing acetylene by an electric spark.

Bleaching of Rosin.

Trade Journals Review, Manchester.

The brownish coloration of commercial rosin has often been found an undesirable characteristic, preventing a more universal application of rosin. The French patent issued to M. Arledter-Dobler refers to a process for eliminating the objectionable pigment without any change in the chemical composition and other characteristics of the original substance. The process consists in melting one volume of the rosin in three volumes of water at a temperature not exceeding 200° C., and stirring in a small quantity of caustic soda, potash, ammonium carbonate, or other alkali. On the addition of cold water to stop boiling, the rosin precipitates, whilst the pigment remains dissolved in the alkaline solution. By the introduction of carbonic acid into the apparatus at the moment the rosin commences to melt the air is expelled, the object in view being to prevent oxidation and resultant coloration of the purified product, any double compound of alkali and rosin formed splitting up into acid of rosin and alkaline carbonate. A still paler shade is obtained by employing a vacuum, and redissolving at a low temperature.

An Electrical Mouse-trap.

London Invention.

A German has invented a mouse-trap which electrocutes its victims. Two plates connected with an electric current are placed just before the bait in such a manner that the mouse is obliged to touch both in attempting to reach it. The connection is, of course, instantly made, and a smell of singed hair announces the demise of the unwary rodent.

The Electrical Age

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"To look at an incandescent lamp and realize that its luminous efficiency is at the most only three or four per cent of that theoretically possible, ought to take the conceit out of any engineer who feels complacently satisfied with what even the last decade has done."—Louis Bell, Ph. D., in Ten Years' Progress in Electric Lighting.

How to adjust the rates to be charged for electric current so as to encourage its widespread use and still to bring in a fair profit to the central station owners was one of the live questions discussed at the late meeting of the National Electric Light Association at Cincinnati.

So long as it is true that "The production and sale of electricity differ from any other business in that the supply company must manufacture its product only as it is required and it cannot be commercially stored," and the companies must be prepared at every moment to meet a maximum demand, it must manifestly be impossible for them profitably to supply current at flat meter rates as gas is supplied.

Should a gas company endeavor to supply gas in a like manner, making and distributing it only as it was consumed, the result would be disastrous. To work without gas-holders would alone require such an extension of the producing plants and increase of working expenses as to ruin the companies if the gas were sold at anything like the present rates.

It must also be manifest that until the general public can install electric lights and other electric conveniences without having to pay a heavy penalty for that part of their outfit which is not for customary use, that for household uses at least, electricity can never compete in popularity with gas.

A gas company does not ask a customer whether he has one burner or one hundred, except for the purpose of adjusting the meter and pipes to meet his possible needs. The charge for the gas is at the same rate whether he burns a hundred feet a month or ten thousand.

The average demand upon their works remains the same, and the gas-holders meet the fluctuations.

With the electric companies the situation is very different. A customer may want to use one or two lights on an average, but for convenience may wish to instal a hundred.

The central station must be ready at all times not only to meet the demand for this customer's hundred lamps, but at the same time to supply current for every other lamp or motor connected with its power-house.

The moral of this seems plain. The electric companies must provide themselves with a storage capacity equal to that of the gas companies. How this could be done commercially is a question. Gas companies find it necessary to provide holders equal in capacity to at least sixty or seventy per cent of the maximum day's output of the works. The cost of the holder is, roughly, one-third part of the entire cost of the works, excluding the cost of land.

That the charge for "capacity," or the readiness to serve, is not inequitable is evidenced by the fact that many leading gas men have at times advocated a like charge to gas customers.

Aerial Electricity

Another machine, "so simple that a child can use it," has been invented, this time for extracting electricity from the atmospheric air. The discoverer of this remarkable apparatus is Señor Clemente Figueras, who is engineer for woods and forests in the Canary Islands, and who has also been for some years professor of physics in the College of St. Augustine, in Las Palmas. Professor Figueras refuses to explain his apparatus, but claims that it consists mainly of a generator by which he can collect electricity and afterwards apply it to general manufacturing and industrial purposes. The component parts of his mechanism were built in Paris, Berlin and Las Palmas, and the German firm which constructed its share is reported to have been sufficiently curious as to send an emissary to ascertain what the machine was to be used for. Press dispatches report that large sums have been offered for the invention, both in Germany and in Spain, but that all such offers have been refused. It is also stated that the professor has a rough apparatus by which he obtains a 550-volt current, which is used to light his house and to drive a twenty-horse power motor. The professor expects shortly to arrive in London with a perfected working apparatus. He will be awaited with interest.

The Education of the Electrical Engineer*

By H. W. Buck

Electrical engineering is probably the youngest of all the professions, for it has hardly been recognized as a regular profession for more than fifteen years past. As a result, the men who have reached prominence in it to-day have attained their positions from widely differing courses of preliminary training; many of them are men who started life in other lines of work and afterward turned to electrical pursuits on account of the sudden growth and importance of the business. In consequence of this, all methods of preliminary education are represented and their relative values can be estimated.

The argument runs largely between two classes of men, one represented by the so-called "practical man" and the other by the theoretical electrician; the graduate of the machine shop and the graduate of the university. Both of these types have attained success, but the correct answer to the argument will probably be found in a proper combination of the two types. In the past, some of the most successful electrical engineers have belonged distinctly to the class of practical men with little theoretical training, but the conditions have changed. In the early days of the profession, there was little theory or pre-determination of results and work was carried on largely by guesswork or by cut and try approximations. At the present time, however, such a state of development has been reached that exactness of result is essential to success and work based upon exact theory becomes imperative.

In a stationary condition of an art a man with practical experience only may become very familiar with all the existing types of apparatus and, knowing their various applications, may qualify, to an extent, as an engineer. But the extraordinarily rapid growth of the electrical arts places electrical engineering apart from all the other engineering branches, for new discoveries and theories make radical changes from year to year in the construction and operation of electrical machinery. The engineer whose education is based only upon practical experience cannot keep up with the progress and change resulting from it, and falls behind; whereas, the man with knowledge of the theory, and a mind trained by the theoretical studies and scientific reasoning, easily grasps the theory of the change and readjusts his mind to the new without difficulty or delay. Many instances can be cited of men who have been prominent as electrical engineers, who have been dropped out of place in the course of the rapid progress which has been made, on account of a lack of theoretical foundation in their knowledge.

In its present state electrical engineering is the most scientific of all engineering professions. A man must be to a great extent a physicist, a chemist, and a mathematician, as well as be familiar with machinery and its design, in order to be a worker in the broadest field. Many of the problems connected with other branches of engineering can be solved by common sense and by one's sense of proportion as guided by experience and by

* Paper presented at the nineteenth annual convention of the American Institute of Electrical Engineers, Great Barrington, Mass., June 21, 1902.

the eye. But most of the problems in electricity are invisible, so to speak, and can be understood only through their expression in the form of symbols.

Probably no one will dispute to-day that the preliminary education of an electrical engineer demands a special training in those theoretical branches, mathematics, physics, chemistry and mechanics, sufficient to train his mind into accurate methods of thought and reasoning and to supply him with the actual technical information which he will need in the practice of his profession. But theory alone is not all.

The best course of training for an electrical engineer would seem to be a broad course of education in general subjects at the preparatory school before entering college, with practical work, if possible, along lines of simple mechanics, such as carpentry, in order to train the mind into a sense of proportion and the relations of parts, which is the basis of all engineering.

Next a college course with general subjects the first year, and afterward, for the remaining years of the course, those general and theoretical subjects which have a direct bearing upon the practice of the electrical profession, such as mathematics, mechanics, physics, chemistry, theoretical electricity and magnetism and thermodynamics. This should be supplemented by actual daily practical work with machinery operating by the principles covered by the theory studied, and demonstrating all the phenomena incident to the theory.

After graduation an apprentice course should be pursued in some large electrical manufacturing establishment where the commercial relations of the knowledge acquired in college can be clearly set forth.

After a few years of this training, specialization may begin along the lines selected for the life work, but preferably not before. A man makes a mistake to consider himself a qualified electrical engineer after he has been graduated from college, for he is not one. His mind has been trained into a condition where he can readily absorb the principles of the electrical profession, but that is all, and the subsequent apprentice training is as important as the college course, in order to acquire the broad view-point from which to make the correct start in the direction in which a man is best fitted.

But theory and practice are not the only elements necessary for the successful engineer. There are many qualities required in common with other professions; executive ability, business knowledge, presence of mind and ability to handle men, nerve and resourcefulness in handling machinery in times of emergency, are all necessary to the successful engineer. These elements cannot be acquired in the study of theory and practice alone, and many men who have stood high in their college courses have failed afterward in the practice of their profession because of a lack of these qualities.

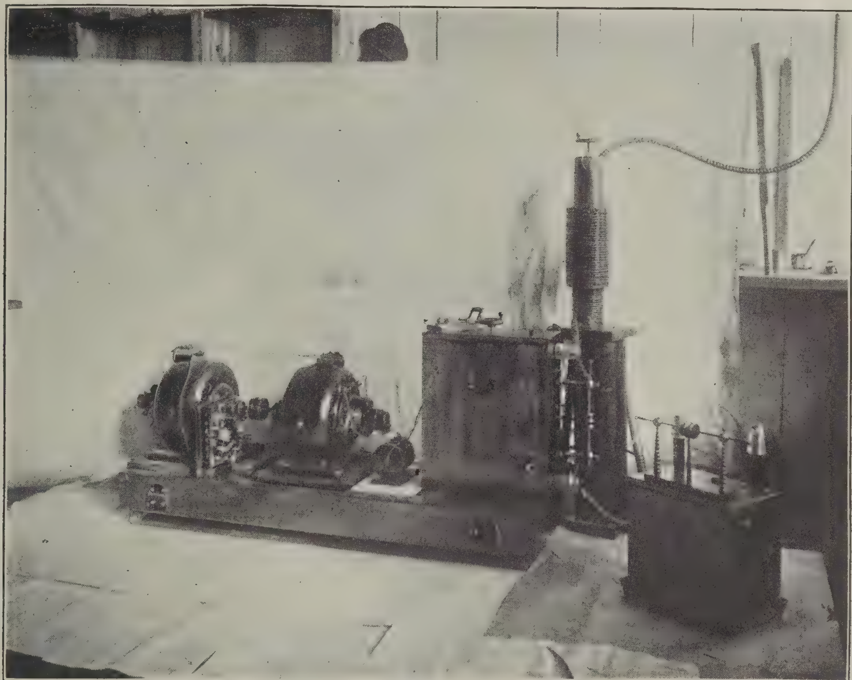
The study of chemistry becomes more and more important as the profession advances, for the branch of electro-chemistry is rapidly developing and is likely to become one of the largest fields in the application of electrical science.

And almost above all comes a training in the English language. No man who cannot express himself clearly and concisely in writing or in conversation can hope to attain a prominent position in his profession.

The education of an electrical engineer, however, must never be considered as completed. The art advances so rapidly that constant study is necessary, even to keep up with the progress of the times. But an electrical engineer should be willing to do more than this. He should study to keep ahead of progress and do his share toward the instruction of

The De Forest Wireless Telegraph Station at Coney Island

Situated at the western end of Coney Island, where its base is washed by the high tide, stands the tallest wireless telegraph pole in the United States. This pole bears the sending and receiving wires of Dr. Lee De Forest's new system of wireless telegraphy, which is stated by its promoters to be a considerable advance over other systems and to have in it features that bring it more nearly to a state of comparative perfection.



Sending Apparatus, De Forest System of Wireless Telegraphy.

Dr. De Forest, who is a graduate of Yale University, and Mr. Edwin H. Smythe, a Chicago engineer, worked together inventing the receiver of the new system. Mr. Smythe's experience of ten years in the telephone field was specially valuable on one side of the problem, while Mr. De Forest's three years' graduate work at Yale in studying Hertzian waves fitted him for his after-work in wireless telegraphy. Professor Clarence E. Freeman, of the Armour Institute of Technology, developed the sending apparatus, and it is curious to note in this connection that the ideas which were embodied in both sender and receiver —or, as it is called by Mr. De Forest, the "responder"—were worked out separately by each of the inventors, and it was discovered only after they had been completed, that by the use of these two instruments an entirely new system was possible, by means of which the coherer at the receiving station might be entirely done away with and the induction coil in the sending station rendered unnecessary.

Mr. De Forest's name of "responder"

for his receiving apparatus was suggested some time ago by the London *Electrician* as being suitable for any resistance apparatus sensitive to electrical radiations. This responder is not an anti-coherer, for although the action of the electric waves causes a sudden increase in the resistance, similar to that observed with the arsenic or lead-peroxide coherer, the effect is stated to be due to an entirely different action, full details of which are not as yet public property because the patents for the apparatus are still pending.

The entire apparatus is extremely sensitive and is automatically self-restoring, thus permitting the use of an induction coil and a Wehnelt interrupter with an adjustable platinum anode for the sending instrument, by means of which, when the instrument is in operation, a curious series of harmonious sounds like a musical scale are produced; when one listens in at the receiving apparatus the same scale or siren note is heard. It is claimed by the operators that the automatic restoring quality of this responder permits of a speed in transmitting messages which is limited only by the telegrapher's ability to read them. Contrary to usual practices, the receiver is connected with a telephone instead of a Morse sounder on account of the greater simplicity of the former. A special key very like the ordinary Morse key has been devised, with a view especially to high speed work. The make-and-break is under oil, and the operator is fully protected from contact with high voltage wires.

The key also automatically switches the upright conductor, or antenna, from receiver to sender, so that the operator is enabled instantly to "listen in" after sending, and at the same time it is impossible to close the primary circuit while the receiver is connected to the antennæ.

By virtue of the automatic quality of the responder it is possible to use a telephone circuit with the device, and the employment of a relay is rendered unnecessary. By this means it is asserted a speed of forty words the minute can be obtained, and under ordinary circumstances a speed of twenty-five to thirty words is regularly accomplished. One hears in the telephone as it were the sound of the sending spark, be this a high or low frequency, in dots and dashes. An ordinary Morse operator can learn to read with the new apparatus with a few days' practice. The sending requires no special knack other than a firm touch, with dashes clean cut.

Although, as the illustration shows, the operator reads from the head telephone, a relay or recording device can be substituted therefor; only there is always this condition, it is asserted, that inasmuch as the responder, unlike the coherer, is a quantitative device, and the telephone and ear the most sensitive signaling device known, at the extreme range messages can be clearly read which are altogether too weak to operate any relay. Thus, through the extreme sensitiveness of the responder an operator with head telephone can receive messages many miles further than a coherer (all other arrangements at transmitter and receiver being the same) can record them.

In proof of this is cited a test made on February 22, when it is said that signals from the *Etruria* were heard at the Jersey City station, from a mast but thirty feet above the roof, when the steamer was fully ninety miles distant.

The Coney Island station mast stretches up two hundred and ten feet into the air and is guyed solidly to braces seventy-five feet above the base of the pole, which is sunk sixteen feet into the sand. The mast itself consists of four heavy poles set in crosstrees and fids and guyed in the usual manner, except that the guys are hemp rope to within about one hundred feet of the ground, where

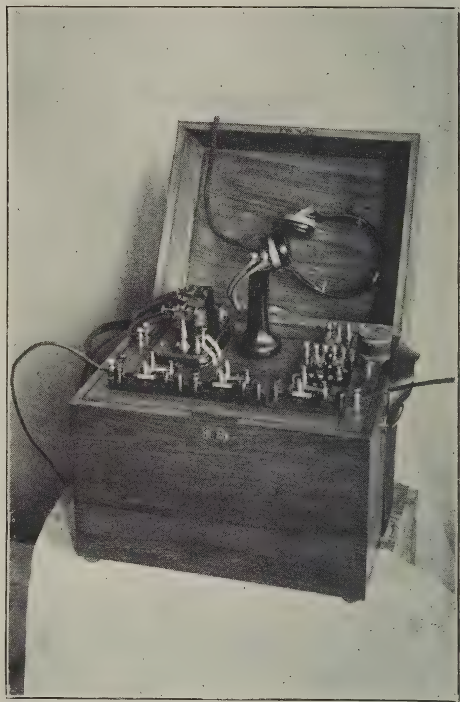
Coney Island, New York City, Mast and Station, de Forest Wireless Telegraph Company. Height of Mast, 210 feet. The Antennæ Descend from the Yard-Arm to the Small House which Contains the Station.

they are spliced to wire rope which in turn is strapped through deadeyes at the braces. This arrangement of hemp and wire ropes was adopted in order that the insulation might be maintained if contact were accidentally made between the guy and the two antennæ which descend from the small yard-arm at the top of the pole. The base of the mast is twenty-seven inches in diameter and the top six inches. Inasmuch as the poles were set in a small space, and where there were no high buildings or other means of getting a hold on the upper sticks to hoist them into place, the main pole itself was used and a pair of shears lashed to it. Heavy scaffolding was then erected, and between the shears and the scaffold the upper masts, three in number, were whipped up into place, each one as it was erected receiving the shears and being used to hoist the others.

This station is supplied with sixty cycle alternating current, at one hundred and ten volts, from the Edison mains. This is stepped up in two transformations to twenty-five or fifty thousand volts, as desired, and applied direct to the spark terminals. These latter are of special construction and connected with the condensers give a spark of exceptional clearness and power.

On June 14th, the first day the Coney Island station was operated, the first communication with a vessel equipped with the de Forest system was also established. On the Ward liner *Morro Castle,* bound for Havana, moderately high (sixty foot) antennæ had been rigged, and transmitter and receiver installed. M. F. Stires, secretary of the company, and Mr. Barnhardt, chief operator, were aboard, and messages to and from ship and shore were exchanged, until the vessel was fifty miles from port. The Staten Island station kept up a lively exchange of messages until the boat reached the Narrows, the Coney Island station picking her up.

Previous to this test the Staten Island station had maintained communication with the Hamburg-American liner *Deutschland* on her last trip east up to a distance of seventy miles. The *Deutschland* was equipped with the Saby-d'Arco system, but there was little trouble in effecting communication between the two systems, save that the German operator



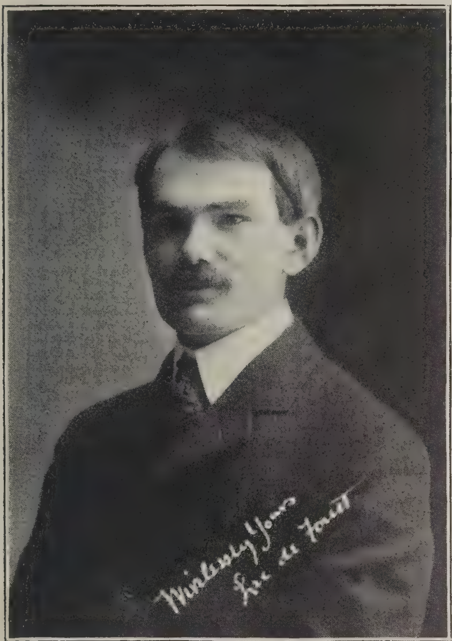
Receiving Apparatus with Telephone Attachment.

sent so slowly that his signals were difficult to read by ear.

Dr. de Forest, the inventor, claims that his patents do not infringe on those controlled by Mr. Marconi, and the financiers who have examined the former's proposition carefully are reported as being sufficiently pleased with it to have taken the matter up. These gentlemen have now in contemplation the erection of several stations along the Atlantic coast, notable among which will be those at Rockaway, Fire Island, Montauk Point and Atlantic

City, these stations being already in process of construction.

Mr. de Forest, in speaking of his responder, declared its principle diamet-



Dr. Lee de Forest.

rically opposed to that the Marconi coherer, in which the current is ordinarily broken by the film of air or gas which surrounds the filings. When the oscillations are intercepted in their passage through the air by the upright wire, they pass through the coherer and the local circuit is thereby established, that condition remaining until some external mechanical force breaks up the chains of filings by shock. In his automatic responder, Dr. de Forest claims that the principal feature is the closed-circuit device, the local current ordinarily flowing through it, energizing the magnets of the telephone or the relay in the circuit, the normal resistance of the responder being about fifty ohms. When the oscillation permeates the responder the wave's action instantly increases its resistance, thereby opening the circuit, and by this means the click in the telephone or relay is produced; but the moment the oscillating wave has passed, the action of the local battery is to close the circuit at the responder, which immediately restores itself to its original condition, the circuit being again closed.

Reference to the accompanying engravings will show the receiving apparatus or responder with the telephone connected in, the sending apparatus with its two motors and spark-gap, and a view of the station at Coney Island showing the pole with its pendent antennæ.

During the last month a regular station and school for operators has been opened by the de Forest company on the roof of the Cheeseborough Building, 17 State street, New York. Here is a house built of glass over an iron frame, and fully equipped with sending and receiving apparatus. The antennæ here are sixty feet in height.

The laboratories and work-shop of the company are in Jersey City. Here a force of seven men is employed in experimental work. The de Forest company builds its own receivers, high-voltage condensers, and some other apparatus, but for the

Interior of a de Forest Wireless Telegraph Station.

transmitting mechanism employs motor-generators and transformers built by others. The de Forest transmitter does away with the induction coils, all interrupters, and make-and-break devices, the apparatus being simple and compact.

Better Tracks for High Speeds

By a Track Expert

There is a lesson of the highest importance to all railroad men in the story of the failure of the German engineers to attain the high speeds expected in their recent experiments, as told in the report of Consul Mason, which was printed in the June number of The Electrical Age.

The failure was due, not to the electricians, but, as was anticipated by practical trackmen on this side of the ocean, to defects in the primary factor for high speeds—the track.

At this distance and in the absence of further details, the cause of the German failure would seem to be one of ties and their surfacing. We can only surmise as to the weights of the motors and cars, but it is probable that in their tests the axle loads did not exceed ten or twelve tons. The rail weight is given as about sixty-five pounds per yard, a section upon which we have attained high speeds with axle loads of twenty to twenty-five tons. Maintenance of way officials and finance committees have, however, come to realize, though slowly, that the results of sufficiency in rails as against insufficiency is greater than the interest on the increased first outlay, and a good beginning has been made.

This opinion as to the prime weakness developed in the track is corroborated by the described swaying motion of the train. This is recognizable by trackmen as due not so much to a weakness of the rail as it is to the metal ties, or, more definitely, to their insusceptibility to uniform surfacing (tamping), a condition conclusively reported upon with illustrations at a session of the Verein für Eisenbahnkunde as long ago as 1892.

This is a drawback to which the wooden-tied track is almost equally subject. We adhere to the traditional method by which uniformity of tie-support is practically unobtainable, yet it is known that the force that demoralizes and destroys the work of the tamping pick or bar, viz., train gravity, can be utilized to secure perfect uniformity in the track surfacing instead of destroying it.

It costs $90,000,000 or more a year today for labor alone for the steam railroads of the United States to keep their tracks in the condition in which they are kept.

With the incoming of higher speeds on electric roads the managers of these lines will have to face the same serious problem.

In Europe the conditions and limitations as to track supervision are similar to those existing here, more importance being attached to the interchange of opinions in convention than to practical participation in the routine work. For more than thirty years they have been struggling there with the track problem, and now have nearly forty thousand miles of steel-tied track, upon a part of which these tests were conducted. In the designing thereof, an inspection of the illustrations in Mr. Tratman's report to our Government—Bulletin No. 4, Forestry Division, Agricultural Department—is an object lesson in the avoidance of mechanical laws by grotesqueness of structural design.

Hence, as it would appear from the report of Consul Mason, the track failed. A curious feature of the report is that relating to the prizes now offered to German designers for designs for motive power and rolling stock capable of maintaining and enduring a movement of 93.7

miles per hour, with a prohibition of improved track conditions.

The assertion, not infrequently made, has not been successfully contradicted, that one department of railroad mechanics, the prerequisite to rapid and economical transportation—track—has not advanced beyond the practice of Stevens and George Stephenson, and it is not long since that so eminent an authority as the *Engineering News* said that nothing therein had advanced since the publication of the work of Holley and Colburn in 1856 and 1858.

The operation of a railroad is a purely mechanical matter, with no element therein of conventional civil engineering, and the construction and maintenance of track are preëminently so. Being unavoidably a dirty, greasy task, with long hours under constant exposure to the elements, it results in a gulf of demarcation between the operative and the supervisor, and the first factor of economical success in mechanical matters, that of personal supervision, is eliminated. The supervisor relies upon "the best accepted theories of engineering" and believes that the cheapest men obtainable who can handle the pick and shovel are good enough for the work. An ever-present maxim is: "We must accommodate the device to the intelligence of the force employed."

In other lines of industry or in other departments of railway operation such a theory and practice could have but one result. What that result is on the railroad the statistics of the Interstate Commerce Commission at least suggest:

The Commission reports that for the year 1900 our railroads paid for "Maintenance of Way": Rails, $10,500,000; ties, $28,500,000; to the men who are to keep the tracks in condition for train-bearing, $101,500,000.

Bessemer made possible a cheap and serviceable rail, but it does seem incongruous to pay nearly three dollars for ties to one dollar for rails and then pay more than ten dollars to keep the four dollars' worth of ties and rails in condition for service, excluding any charge for supervision. How would this impress one if it were true of any other known form of foundation?

The following extract from a report made in 1901 by the committee on track of the American Railway Engineering and Maintenance of Way Association is a frank and suggestive admission:

"That ballasting is of great importance, when considered from an economical standpoint, can be readily shown by a few figures taken from the report of the Interstate Commerce Commission. In 1899 $522,967,896 were paid out in wages to the officers and employees of the railways in the United States. Of this amount, $79,264,280, or a little more than fifteen per cent, was paid to trackmen alone. *Assuming* that forty per cent of this amount was paid for lining and surfacing, you have the immense sum of nearly $32,000,000 paid out for labor in keeping up the line and surface. Of this $32,000,000, or *$168 per mile* of road (or nineteen per cent of the total maintenance of way and structure expenditure), was on account of line and surface. When we consider how much of this great outlay was probably due to inadequate ballast, *we feel that the subject is well worth careful and exhaustive study.*"

The statistics of the Commission for 1900 give the maintenance force—excluding supervision—as 260,000 men, with a payroll of about ninety millions. This includes the cheap labor—eighty-eight cents per diem—of the badly kept roads, and the better paid men of the others, but gives no hint as to the cost of maintenance on the latter; the foregoing report is equally defective.

Engineers from the schools are rarely

proficient in the mechanics of this department, but this report is believed to have been prepared by one of high rank and exceptionally well informed; nevertheless, it seems to have fallen upon barren ground, nothing having been heard of the subject since. The forthcoming statistics of the Commission for 1901 are expected to show figures which will exceed those of 1900 fully as much as the latter exceeded those of 1899.

The conclusion reached by our consul in his report, that the revenues now derived from traffic at low speeds will not be diverted toward the improvement of track to a condition permitting the high speeds sought, even if the authorities know how to do it, would seem to indicate that the efforts of the electricians were at an end in that country, and the offer of award before referred to may well be withdrawn.

Twenty Hours to Chicago

A twenty-hour train service between New York and Chicago over both the New York Central & Hudson River and the Pennsylvania railroads, which was begun on June 15, will mark that date as a momentous one in the annals of railroading.

The import of this new departure is not to be read in the mere matter of the time reduction. So far as the physical operation of trains between the two metropolitan cities is concerned, that could have been accomplished twenty years or more ago.

But the question would have been: Will the public ride in the trains?

Successful railroading requires three factors—speed, comfort and safety, and of these comfort comes first.

Twenty years ago comfort would have been impossible in a train making a twenty-hour continuous trip over a distance but little short of 1,000 miles. Such railroading is possible to-day on but few railroads in the world. On the Chemin de Fer du Sud in France, a train like the Empire State Express was operated over a run of 480 miles, but the attempt was abandoned recently because the people would not use the train. It was not comfortable. To keep passengers comfortable in a train for twenty hours at a stretch involves supplying them with all the comforts and accommodations of a first-class hotel, and carrying them over a road-bed which neither shakes them up nor tosses them about. The new twenty-hour trains meet these conditions.

The service on the two roads is practically alike and was entered into through a mutual agreement such as has marked the close association of the Vanderbilt and Pennsylvania railroad interests for several years past.

On the New York Central each train consists of a buffet-library-smoking car, dining car, three drawing-room and stateroom sleeping cars and an observation compartment car.

The smoking car contains a spacious smoking room, seating thirty persons, equipped with luxurious easy chairs, two sections being provided for those who desire to play cards; a library equipped with standard literature and all of the best class of periodicals, a completely appointed barber shop and bath room, a writing desk with suitable stationery, and a buffet from which light refreshments and wines are served.

The dining car has five double tables, seating four persons each, and five single tables, seating two each. These cars are very attractive, being finished in choice

Santiago mahogany. All the equipment, linen, silverware and crockery, was manufactured to order.

The sleeping cars contain twelve sections and a drawing-room and a stateroom, the rooms being connected by folding doors, so that they may be used separately or *en suite*. Ample toilet facilities are provided for both men and women. These cars are finished in vermilion wood and marquetry.

The observation car has eight compartments, finished in mahogany, Circassian walnut, satinwood and prima vera. The large observation room is finished in vermilion wood and equipped with comfortable chairs and sofas and a writing desk. A large observation platform affords an exceptional opportunity for viewing the scenery *en route*.

Such a train weighs at least twice as much as did a first-class train of a similar number of coaches twenty years ago. To make it possible the railroad has had to undergo improvements in every part. First in road-bed and bridges, next in the coaches themselves and finally in motive power.

The history of the twenty-hour trains began with the opening of the Columbia Exposition in Chicago in 1893. Mr. W. K. Vanderbilt conceived the idea, not as a special advertisement for his own road, but as a practical exposition to our foreign visitors of the perfection of American mechanism. When the scheme was first broached it met with opposition from the other trunk lines. The matter was left to arbitration and this resulted in permission being granted to run the train under condition that $6 excess fare be charged on it and that it should be promptly withdrawn at the end of the 180 days of the fair.

The significance of the new service doee not end with the mere shortening of the time between Chicago and New York. The scheme is further reaching. It is part of a round-the-world plan. The Chicago-New York trip is but a link in the chain. Within eighteen months the trunk lines west of Chicago have reduced their time to the Pacific coast by twelve hours. Beyond that, provision has been made for fast steamer service to Asia by several lines. New York at this end of the round-the-world trip is the one port where all of the passengers must come. To this port and to this one only come all the record-breakers of the ocean fleets. It is but fitting, therefore, that the passengers should be sent westward from there on the trains which bear the same comparison to others that the twenty-three-knot steamers bear to their work-a-day sisters.

Danger in the "Clear" Safety Signal

By Joseph E. Ralph

Electric railroading with speeds above one hundred miles an hour is one of the developments which the near future is certain to bring forth.

With the coming in of this new era in transportation there must be a radical re-adjustment in the devices to insure safety in operation. Foremost among these is the signal light.

Failures rightly to read these signals and consequent disasters are but too frequent with steam trains running at present speeds, and when this speed is increased to one hundred and fifty feet a second or more the danger of mistaking signals will be vastly increased.

During a long experience in railroading I have found that one of the most dangerous features of the present system is the use of a clear light for safety. Any ordinary lantern or an outside light is of the same character as the clear light now used for a safety signal. The use of the clear light is contrary to the spirit of the book of rules also; it says that "white" is the signal for safety. The flags used for day signals are made of bunting dyed in colors that are strikingly fair examples of the colors called for, and the white is a bunting without color tint—as a sheet of unprinted paper. The night signals are just as good repesentations of the colors, except the "white," which is commonly represented by a flame protected by a clear glass globe or lens.

In my own experience I have demonstrated clearly that the substitution of a true white light for a clear light adds much to safety. The manner in which this was first brought home to me was startling. I was then a newly appointed trainmaster on the Pennsylvania Railroad. We had a signal tower located on a curve on a river bank, just outside a town, to govern trains running between the main line and a branch line junction at the other end of the town. The distance to the two junctions was about three-quarters of a mile from the tower in either direction.

The night signals on the tower under my predecessor had not been successful, and one of the first jobs I had in hand was to improve them. I ordered two locomotive headlight lamps and reflectors from the scrap heap at Altoona and remodeled them so that they would fit in the little cupola on top of the tower. Being enthusiastic in the demonstration of the strength of my new lights, I did not wait to post notices of the change of lights before putting them into service.

That night about two o'clock the whole town was awakened by such a shriek as can be given only by a locomotive whistle when the cord is pulled by a man in mortal terror.

I heard it and leaped out of bed, landing in the middle of the floor. As I grabbed for some clothing there came across me a sudden realization of what had occurred, and I fell back upon the bed in a fit of laughter. I could see before me the picture of what had happened as clearly as I knew it afterward from the official and personal reports.

James Lilly, engineer, rotund and jolly, was at the throttle of engine No. 806 on his way from the branch junction. As he left the town and came suddenly in range of the tower he saw in front of him what he naturally supposed was the headlight of another engine dashing down upon him head on. He pulled the whistle for down brakes, shut off steam and jumped. His fireman went off on the other side. Fortunately neither of them was hurt, and by the time the train stopped realized their mistake. Lilly took his train in, but was so upset by his experience that he could not work for two days afterward. I covered that signal light thereafter with a white muslin screen, and it proved to be a great success.

That is the moral of what I wish to urge. The tendency up to now has been to build signals with increasingly intense light and powerful lenses.

The necessity for the perfection of such signals and increasing of their range of efficiency was laid down by a New York technical railroad journal some time ago in language about like this: "The rapidly increasing speed of railroad trains and the many duties incumbent upon the engine-driver make it more important than ever that signals should be devised that can be seen at as great a distance as possible, that the driver may have foreknowledge of the conditions that he is approaching, and time to consider carefully and prepare to meet them intelligently." The language was very suggestive of the lecture room of some polytechnic institute, and seemed to avoid such ordinary occurrences as curves or the availability of distance signals. This also fails to provide against such dangers as were brought out in part of the testimony taken before the State Railroad Commissioner in the case of the fatal disaster in the Harlem tunnel of the New York Central & Hudson River road last January. It was shown there by official reports that trains had run by signals repeatedly, and in several of these instances both the engineer and fireman had reported that they got a "clear" light from the distance signal, when, as a matter of fact, the light was set at "caution" and was green.

The explanation of this is simple and was pointed to by expert witnesses at the same examination, who testified that it was not desirable to use too powerful a light behind the green lenses, because if it were done the glare of the light would show through the green. This expert testimony is a further corroboration of my experience with the tower signals. I had the greatest difficulty in finding a green textile that would impart a color to the light passing through. Most of the fabrics tested acted like fine wire screens, and seemed simply to strain the light. I finally procured two scarfs of soft silk, of the proper hue, that gave fairly good results. That straining through was what happened in the tunnel. The light, partially obscured by fog, failed to carry the green color, and the clear glare of the light behind it was mistaken for a clear signal.

This brings me to the second portion of my recommendation for night signals. They must be of large area and lighted all over with light of moderate power. To show how inefficient the best signals of to-day are when exposed to the worst tests, it is only necessary to refer to another bit of testimony brought out at the tunnel investigation. This was given by an engineer of such long experience that he declared that he could tell within one hundred feet of where he was in the tunnel at any time whether he saw a signal or not. He testified that, within a week of the inquiry, in running through a thick fog he became convinced that he was near a signal station, although he could see no signal. He stopped and his conductor got down to find out where they were. The conductor could find nothing; as the engineer stepped off his engine to look also he ran into the signal post. The light was burning brightly, but it was practically invisible. This was one of the signals which, according to expert testimony, "cannot be improved" except by substituting ground lenses in place of those made by pressing. The latter are made to throw powerful rays of light in almost parallel lines and over only a small area. Once the engineer is out of the line of their small beam of light he can see nothing of them if the air be obscured.

In place of such signals I would substitute signals of large area placed at the level of the engineer's window, and with the larger surface forced toward the train. It would be as impossible for a man to get by such a glowing signal as it is for an engineer to escape seeing the sky openings in the Harlem tunnel. It was by means of these that many engineers testified that they kept run of where they were and where they ought to find regular signals.

There is a harmony of thought and perhaps of reason in this observability of a large surface of low-power light and the well-known ability of many blind persons to appreciate even a minimum of light, and to know the direction from which it emanates. Light is often—perhaps always—of a complex nature, and it is easy to believe that a diffused light may develop more of an "X-ray" nature than an intense light. There are many other situations and conditions than are afforded by the exigencies of the Central tunnel, where developments of this suggestive nature may prove to be valuable and reliable additions to the present accepted forms of signals.

The predominance of testimony by practical railroad men is doubtless in favor of the use of a signal for a specific purpose—but that signal should be unmistakable. Not that very many and all manner of signals should not be used, but that the one selected to guard a certain spot or convey certain information should not be supplemented by others (as is argued) to insure against the failure of the first. The employee should be taught to look (or listen) for the signal at the right place, and, if there is a failure, to stop and find the facts.

"In case of doubt take the safe course," is the first law of railroading.

To-day the engineman running through a large yard at night sees myriads of small gleams of light, clear, red, green and blue, nearly all about of a size and intensity. At a very moderate distance the variation of height is hardly discernible; at a great distance absolutely no guide. The lenses on the ground switches, the high switch-stands, the tail-lights of trains, the signals on front ends and on the semaphore-posts are all practically alike to the man on the locomotive, and the idea that he will notice the variation in color of one of the million, more or less, is theory. He does not run his flyer off at an open switch, because interlocking appliances do not permit it.

The Otis Elevator Company announces the recent closing of contracts for more than fifty electric passenger elevators in New York city and vicinity, forty-five of which will be installed in New York city proper. Further recent contracts cover installations for elevators to be installed in Yokohama, Japan; Melbourne, Australia; and Buenos Ayres, South America. Among the buildings to be equipped are the twenty-four-story office building now being erected for the Farmers' Deposit National Bank, of Pittsburg, which will have ten high-speed passenger elevators and several small ones for freight and special service; the twenty-story office building being erected for the Corn Exchange National Bank, of New York city, which will be equipped with nine high-speed passenger elevators, and the twenty-story office building now going up for Kuhn, Loeb & Co. at No. 54 William street, New York city.

Gas-Engines for Central Station Work

By A. E. Boardman

The advantages of gas-engines for central station electric works were ably presented by Mr. Charles H. Williams, of Madison, Wis., in a paper read by him at the recent Cincinnati meeting of the National Electric Light Association. It would be difficult to add to the force of his argument or to present statistics more convincing. The subject, however, is of very great importance, especially in the many cases where the gas and electric works have been consolidated under one corporate management; and to aid in keeping it before the engineers and directors of these enterprises is the object of this paper.

Mr. Williams states that in the Madison gas-engine plant 20.8 per cent of the heat units in the coal fed to the producer was utilized, which is about three times as much as was utilized in the use of steam-engines for the same work. He also calls attention to the extra economy which a gas-works is thus able to secure by reason of the reduced cost of the gas sold to its customer because of the larger quantity manufactured. This in the particular case cited amounted to eight cents per 1,000 feet. This is a considerable part of the cost of gas in the holder, and should make a profound impression on the managers of joint enterprises.

The gas-engine is particularly well adapted for the work required in generating electricity. Its constant speed under varying loads makes it very desirable, while its quick and close regulation of gas used for work demanded makes it very economical in its operation. The attendance is no more than is necessary for a steam-engine and requires no greater knowledge or skill. It is made in sizes to suit any unit of dynamo and at a price now which is not discouraging.

When it is remembered that the gas-engine will develop one indicated horse power per hour with a fuel consumption of less than one and one-quarter pounds of coal fed into the producer, it is astonishing that so many plants, after consolidation, should continue the use of steam for generating electricity.

It may be urged as an excuse for such a condition that generally the electric station at the time of the merger is fully equipped with steam-engines and boilers, and that the change would involve too great an expense. This is frequently the case, but, on the other hand, it is frequently thought best to move the electric plant to a point near the gas-works for economy in labor and convenience of supervision. Where that is done it would be true economy to sell the steam-engines and boilers and substitute gas-engines. Also, when the electric plant has to be "scrapped," as happens every six or eight years, it would be wise to put in gas-engines with electrical units large enough to be economically operated even in large stations, so that they can be retained and merely increased in number as the business grows.

The use of the gas-engine in central electric stations need not be confined to those where consolidation with the gas industry has been effected. The economy to be obtained in fuel and labor is just as great when the engine is operated with a good quality of producer gas. A gas-engine using "Mond" gas and coupled direct to a Siemens dynamo at Messrs. Brunner, Mond & Company's works in England, during the year 1898, gave the following results:

"Mond" gas used per i. h. p.-hour, in cubic feet	66.40
Slack coal fed in producer per i. h. p., in pounds	1.03
Thermal efficiency, calculated from i. h. p. in per cent	25.40
Average i. h. p. for the year	115.80

Producers can be obtained with a guaranteed yield of 10,000 heat units per pound of coal, and gas-engines, suitable for use with producer-gas, guaranteed to give one indicated horse-power on one and one-quarter pounds of coal. The installation of such a plant costs about the same as first-class steam-engines and boilers, while there is an entire saving of the costly smokestack necessary for steam-plants. The labor required in the gas-engine plant is not more than seventy-five per cent of that required for steam, and the repairs cost much less. The gas production can be at any reasonable distance from the engines and dynamos without entailing loss from transmission of power; hence cheap locations can be utilized.

When to the saving in fuel, by using gas-engines, is added the elimination of the smoke nuisance, and the ability to use at any place hard or soft coal, or slack, the advantages must appeal to the progressive man; especially in view of the recent experiences in our large cities during the coal strike.

Taking it all in all, this is a subject deserving the earnest consideration and study of both gas and electrical engineers.

The Guanajuato Power Development

A recent review of the situation in the Guanajuato, Mexico, mining district, by President Hine of the Guanajuato Power and Electric Company, shows that, after a careful study of the conditions prevailing there, a combination of the two factors of cheap power and the cheap milling of Guanajuato ores (at a cost of $2.25 gold per ton, with a recovery of from eighty to ninety per cent of the bullion content), the production of the next fifty years will be greater than it has been during the past three centuries, during which period the mines in the immediate vicinity of the city of Guanajuato alone have produced a total of over $2,000,000,000.

The financiers of the company argue that in view of the probability that the Colorado output of precious metals is at high-water mark, and that the maximum output of the South African gold fields is limited to about forty years, the Guanajuato district is one of the greatest mining regions now known. Before 1812 it produced about one-half the gold and silver of the entire world, and if the production of these wonderful mines in the past three centuries is to be duplicated or even approached during the coming fifty years, Mexico will become the most important economic factor in the world.

The company is capitalized at $3,000,000, and the gentlemen mainly interested in it are: Henry Hine, formerly of the Stanley Electric Company; John Hayes Hammond, the well-known mining engineer; C. C. Coffin, president of the General Electric Company; Leonard D. Curtis, an attorney-at-law, of Colorado Springs; Irving W. Bonbright, banker, Colorado Springs; E. Rollins Morse & Brother; J. F. Bartlett, of Boston; President Baker, of the Venture Corporation of London, and Darius O. Mills, New York.

Compliments for the ELECTRICAL AGE

EXPERT OPINION FROM A PUBLISHER

FRANK H. KNOX,
Publisher
The Power and Lighting Economist.
Troy, N. Y., U. S. A., June 18, 1902.

Editor, ELECTRICAL AGE:

Dear Sir:—Your very kind letter is at hand and also the halftone cuts. Permit me to thank you.

The *Economist* is a quarterly and has therefore room for only a portion of the matter offered, but we could not resist the desire to include this article (Power Transmission in California) even though all the composition was finished for the next issue and we must kill some to let this in. * * *

You are certainly issuing a model magazine and we sincerely hope its merits will be recompensed to you in the patronage we all seek. Very truly yours,

FRANK H. KNOX.

"A GREAT PERIODICAL" ON "PROPER LINES"

INTERNATIONAL POWER VEHICLE CO.,
757 Pacific Street.
Stamford Conn., June 23, 1902.

Editor, ELECTRICAL AGE:

Allow me to congratulate you upon the June number of the ELECTRICAL AGE. I have read it with the greatest of pleasure. I tell you that it is a great periodical, and you just hold right on to it. Yours very truly,

W. P. HATCH.

New York, June 18th, 1902.

Editor, ELECTRICAL AGE:

Dear Sir:—I beg to acknowledge receipt of your favor of the 17th inst., and under separate cover a copy of the new ELECTRICAL AGE, a magazine devoted to electric, gas, steam and allied interests.

You seem to have started out on the proper lines, and I wish you success.

Yours truly,

F. M. HAWKINS.

"A VERY EXCELLENT PUBLICATION"

OTIS ELEVATOR COMPANY,
71 Broadway, New York.

June 20th, 1902.

Editor, ELECTRICAL AGE:

Dear Sir:—I duly received the copy of the ELECTRICAL AGE referred to in your favor of 13th instant, and I think you have a very excellent publication in your line. * * *

Thanking you for calling our attention to your new line of work, I am

Yours very truly,

NORTON P. OTIS.

Street railway companies, electric lighting companies and gas companies which desire the ir reports to appear in the Financial Bureau of the ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Monthly reports are requested showing gross receipts and when possible operating expenses. Companies are also requested to furnish the highest and lowest prices for which their stock has sold in the market for the previous month.

STREET RAILWAY STATEMENTS

Metropolitan Street Railway Company

Report for Quarter Ending March 31

	1902.	1901.	Changes.	
Gross earnings from operation	$3,415,388.19	$3,283,208.08	Inc.	$132,180.11
Operating expenses (excluding taxes)	1,636,805.02	1,681,403.59	Dec.	44,598.57
Net earnings from operation	1,778,583.17	1,601,804.49	Inc.	166,779.34
Income from other sources	126,933.66	203,676.46	Dec.	76,742.80
Gross income	1,905,516.83	1,805,480.95	Inc.	100,035.98
Interest on funded debt	263,750.00	263,750.00		No change
Taxes on property	144,775.54	124,746.75	Inc.	20,028.79
Taxes on earnings and capital stock	81,850.27	74,718.98	Inc.	7,140.29
Other taxes	1,863.75	1,635.06	Inc.	228.69
Rentals	679,720.00	664,116.66	Inc.	15,603.34
Total	$1,171,968.56	$1,128,967.45	Inc.	$53,001.11
Net income	733,548.27	676,513.50	Inc.	57,034.77
Net income for preceding quarters for fiscal year	2,031,135.25	1,872,199.08	Inc.	158,936.17
Operating cost, per cent	51.21	47.91	Dec.	3.30

Metropolitan Street Railway Company

General Balance Sheet, March 31.

ASSETS.		LIABILITIES.	
Cost of road and equipment	$43,437,494.01	Capital stock, common	$51,995,200.00
Stocks and bonds of other companies	22,561,541.76	Scrip outstanding	4,800.00
New construction on lines owned to be distributed	7,144,405.23	Funded debt	21,750,000.00
		Bills payable	9,250,000.00
		Interest on funded debt accrued	137,524.99

	1902.	1901.	Changes.
Supplies on hand........	78,633.28	Rentals accrued	324,361.64
Improvements, additions and betterments charged to leased lines.........	15,687,633.31	Dividends unpaid	909,916.00
Cash on hand...........	5,221,393.90	Coupons due, not presented	398,539.15
Bills receivable	266,409.29	Bond proceeds to Cr. of Met. St. Ry. lessee 3d Ave. R.R. Const. cost..	4,304,655.77
Office furniture	19,937.64	Profit and loss (surplus).	5,342,450.87
	$94,417,448.42		$94,417,448.42

Brooklyn Rapid Transit System (All Companies)

Comparative Statement of Operations for Month of April, 1902 and 1901

	1902.	1901.	Changes.	
*Miles operated (single track)	489.3	488.9	Inc.	.40
Gross receipts	$1,041,706.38	$989,993.54	Inc	$54,712.84
Expenses, including taxes.	705,010.86	658,282.07	Inc.	46,728 79
Net receipts	$336,695.52	$331,711.47	Inc.	$4,984.05

For Ten Months Ending April 30.

	1902.	1901.	Changes.	
*Miles operated (single track)	489.3	488.9	Inc.	.40
Gross receipts	$10,468,072.25	$9,844,597.91	Inc.	$623 474.34
Expenses, including taxes.	7,489,909.89	6,522,732.80	Inc.	967,177.09
Net receipts	$2,978,162.36	$3,321,865.11	Dec.	$343.702.75

Third Avenue Railroad

General balance sheet March 31.

ASSETS.		LIABILITIES.	
Cost of road and equipment.	$24,957,767	Capital stock	$15,995,800
Stocks and bonds..........	10,455,290	Funded debt	40,000,000
New construction (to be distributed)	5,468,599	Interest on funded debt accrued	412,500
Supplies on hand...........	80,242	Due construction account....	96,034
Due by com's and individuals	9,517,659	Due for supplies...........	26,873
Cash on hand..............	347,305	Open accounts	118,312
Met. R. R. Co. construction account	4,304,656		
Prepaid insurance	3,308		
Open accounts	280,147		
Profit and loss (deficiency)..	1,234,545		
	$56,649,519		$56,649,519

Third Avenue R. R.

For the quarter ending March 31:

	1902.	1901.	Changes.	
Deficiency	$265,697	$218,116	Inc.	$47,581
Previous quarter fiscal year.				
	1902.	1901.	Changes.	
Deficiency	$318,033	$361,571	Dec.	$43,538

42d St., Manhattan and St. Nicholas Ave. R. R.

For the quarter ending March 31:

	1902.	1901.	Changes.	
Net income	$49,803	54,615	Dec.	$41,812

Brooklyn Rapid Transit

April report:

	1902.	1901.	Changes.	
Gross receipts	$1,041,707	$989,994	Inc.	$51,713
Net receipts	336,696	331,712	Inc.	4,984
July 1 to April 30:				
Gross receipts	10,468,072	9,844,598	Inc.	623,474
Net receipts	2,978,162	3,321,865	Dec.	343,703

Detroit United Railway

April report:

	1902.	1901.	Changes.	
Gross receipts	$282,742	$234,420	Inc.	$48,322
From January 1:				
Gross receipts	$1,292,278	$1,104,779	Inc.	187,499
May report:				
	1902.	1901.	Changes.	
Gross receipts	$290,280	$241,478	Inc.	$48,802
Net receipts	128,944	103,174	Inc.	25,770
From January 1:				
Gross receipts	1,299,816	1,111,837	Inc.	187,989
Net receipts	552,106	475,903	Inc.	76,203

St. Louis Transit Company

May report:

	1902.	1901.	Changes.	
Gross receipts	$567,614	$508,420	Inc.	$59,194
From January 1	2,447,474	2,276,096	Inc.	171,378

United Traction Company, Albany, N. Y.

May report:

	1902.	1901.	Changes.	
Gross receipts	$130,935	$73,152	Inc.	$57,783

Northern Ohio Traction Company

May report:

	1902.	1901.	Changes.	
Gross receipts	$60,747	$48,505	Inc.	$12,242
Net receipts	26,836	20,204	Inc.	$6,632
From January 1:				
Gross receipts	251,306	210,776	Inc.	40,530
Net receipts	102,534	78,442	Inc.	24,092

Cleveland Electric Railway

May report:

	1902.	1901.	Changes.	
Gross receipts	$217,563	$187,049	Inc.	$30,514

Harrisburg Traction Company

May report:

	1902.	1901.	Changes.	
Gross receipts	$46,156	$32,298	Inc.	$13,858
Net receipts	24,448	11,848	Inc.	12,600
From January 1:				
Gross receipts	171,454	136,886	Inc.	34,568
Net receipts	71,623	48,265	Inc.	23,358

Binghamton Railroad

May report:

	1902.	1901.	Changes.	
Gross receipts	$17,193	$15,678	Inc.	$1,515

American Railways Company

May report:

	1902.	1901.	Changes.	
Gross receipts	$97,701	$73,406	Inc.	$24,295

Metropolitan Street Railroad Company's Report.

The report of the Metropolitan Street Railway Company for the quarter ending March 31, which was filed at Albany early in June and the reports for the same period of the subsidiary companies forming the system contain some interesting and suggestive figures. As will be seen by reference to the tables printed elsewhere, the figures, as a whole, show a decrease in operating expenses of $44,598.57, although the earnings increased $132,180.11 over the like quarter of the preceding year, while the net income grew more than $57,000 to $733,548.27 in spite of the fact that the tax charge was increased more than $27,000 and rentals $15,603.34. The result, stated in another way, was that the cost of operation was reduced from 51.21 per cent of the earnings to 47.91 per cent, or when all payments are included for taxes, from 57.27 per cent to 54.50 per cent.

It is evident from the reports of the subsidiary companies that these gratifying results have not been contributed to by the portion of the system still operated by horse-power. These show actual losses of business. The Dry Dock, East Broadway and Battery lines report shows a falling off of income for the quarter as compared with the same period in 1901, from $133,385.80 to $133,016.09, and an increase of operating expenses from $101,013.79 to $123,392.40. The cost of operation rose to 92.76 per cent as against 75.73 per cent for the same time last year. The Fulton street line showed like results. Its income fell off from $8,791.35 to $8,004.75, and the operating expenses rose from $7,379.66 to $8,029.70, or from 83.92 per cent to 100.3 per cent of earnings. The Central Cross-Town line's figures and those of the Twenty-eighth and Twenty-ninth Street Cross-Town lines each show losses in gross income, but reductions of greater moment on the expense side of the accounts.

The Central Cross-Town line's income dropped from $132,850.85 for the like quarter in 1901 to $116,149.26 for 1902. Operating charges fell from $103,983.08 to $86,223.75.

The earnings of the Twenty-eighth and Twenty-ninth street lines were $41,065.20 for the quarter of 1902 against $42,149.20 for 1901. The operating expenses fell to $26.693.42 from $35,868.23.

The Thirty-fourth Street Cross-Town line seems to be doing better than before. This line is operated with storage battery cars. Its report shows an income from operation for the first three months of 1902 of $103,357.60 against $92,420.05 for the same time in 1901, with a decrease in operating expenses from $68,607.09 to $67,699.37. The percentage of cost of operation to earnings fell from 74.21 to 65.51.

Franchise Bureau

The ELECTRICAL AGE intends to collect for reference purposes copies of every franchise issued by the various states to electric lighting, street railway and gas companies, and particularly those granted by special acts of legislation. All persons who can do so are requested to send copies of such franchises to the "Franchise Bureau, ELECTRICAL AGE." Copies not returnable.

capital. Address Franchise Bureau, Electrical Age.

Pennsylvania

Wanted, to purchase the control, or all the interest in a trolley line franchise that has rights of condemnation, for inter-urban work in the northwestern part of the state of Pennsylvania. Would prefer to purchase small operating road with such franchise. Address Franchise Bureau, Electrical Age.

Parties having favorable charter and rights of way secured for a railroad in Central Pennsylvania, and having secured purchaser for one-half of the bonds, wish parties to joint them, taking the balance. For further particulars address Franchise Bureau, Electrical Age.

Tennessee

Valuable charter and majority of right of way secured, with valuable water-power property. Owners desire financial aid. Address Franchise Bureau, Electrical Age.

Texas

Gas and Oil. — Parties controlling franchises for supply of gas and oil at Beaumont, Texas, the great manufacturing city of the south, would like to interest parties financially. For further information apply to Franchise Bureau, Electrical Age.

Virginia

Parties controlling Potomac Western Railroad charter, granted by the legislature of Virginia, giving broad railroad rights, both electrical and steam, seek financial assistance. Copy of charter can be seen at the office of the Electrical Age, Franchise Bureau.

Financial Notes

Thirty and seven-tenths per cent of the gas plants of the United States are operated in conjunction with electric plants.

The General Electric Company has declared a stock dividend of sixty-six and two-thirds per cent payable July 1, in accordance with the plan announced in May, when the stockholders voted to increase the capital stock from $25,242,000 to $45,000,000. This dividend represents the forty per cent taken away from the stockholders in 1898, when the stock was reduced by that amount.

Predictions are made of lower prices for copper, based on the fact that the May production in this country was the largest for any month on record. John Stanton of New York, who announced the May figures of 25,763 tons, does not think prices are on the down grade, however, at least not permanently, and he points to the heavy export movement in the metal this year to prove that there is a world-wide demand for it. The May exports were 16,283 tons against 10,062 tons the previous May, when prices were artificially high, and 13,997 in May, 1900. He thinks the production for June will not be so large as it was for May. He said on June 23: "I have advices from various foreign countries which prove that more copper is being manufactured to-day than is being mined. Of course the labor troubles in this country complicate the situation, for a general coal strike involving the shutting down of manufacturing plants everywhere, would work intolerable injury to our business as well as to others. But if business resumes its normal condition within a month or two, I do not see how copper can continue as cheap as it now is."

President Wetmore of the North American Company, says in his report for the year ending May 31: "It is expected that in respect to the greater part of the stocks owned by the company, a dividend-paying basis will be attained during the present fiscal year. In that event the current income from investments, loans and cash balances is expected to be sufficient to establish and maintain dividends upon the stock of the company, irrespective of other profits." In conclusion after rehearsing the acquisitions of electric properties the past year, he says: "The company is in possession of cash and quick resources that enable it to avail of the opportunities now offering in the electrical field, which have never seemed more abundant or of greater promise than at present."

The Florida Railroad Commission, in its annual report for the year ended March 1, 1902, shows the total main track mileage of the nineteen railrods of the state to be 3,070 miles. Total passenger earnings for twelve months ended June 30, 1901, were $3,203,377; freight earnings $5,595,339; miscellaneous sources $380,418; total gross earnings $9,179,134, an increase over the previous year of $2,015,466, or 28.13 per cent. Total operating expenses were $6,915,296, an increase of $1,668,225 or 31.79 per cent. Tons of freight hauled amounted to 4,864,848 and tons carried one mile 457,680,762.

J. K. O. Sherwood, president of the Kings County Gas and Illuminating Company, is authority for the statement that Anthony N. Brady and Hugh J. Grant have purchased a large amount of the stock of that company.

The United Gas Improvement Company of Philadelphia, through its Rhode Island company, is succeeding in its efforts for the consolidation of the big light and power corporations in Providence. This is the Whitney-Widener concern which owns scores of plants in various cities throughout the country. The United Traction and Electric Company and the Pawtucket Gas Company were acquired recently and it is now announced that the Providence Gas Company has passed over to the new control. The only corporation of importance in that city not yet formally taken in is the Narragansett Electric Lighting Company belonging to Messrs. Pierce and Perry and their associates, and it is reported that this will go the way of the others as soon as a meeting can be arranged to pass on the question.

The Cosmopolitan Power Company, of Jersey City, N. J., has reduced its capital stock from $40,000,000 to $2,500,000.

The shareholders of the Oakland (Cal.) Transit Consolidated road have authorized the issuance of a new mortgage for $6,500,000, of which $3,500,000 is to be used for the retirement of a like amount of the outstanding bonds and the remainder for improvements.

The $11,000,000 four per cent one hundred-year refunding gold mortgage bonds of the Metropolitan Street Railway, for which subscriptions were received at ninety-seven and one-half by Kuhn, Loeb & Co. on June 25, is a part of the $65,000,000 recently authorized, of which $54,000,000 is reserved to retire $48,196,000 outstanding bonds of the Metropolitan and its subsidiary companies. President Vreeland says the refunding mortgage by which this issue is secured is the only mortgage of the Metropolitan Street Railway Company covering all its lines and leases.

Farson, Leach & Co., in the interests of a syndicate which recently purchased control of the Evansville (Ind.) Gas and Electric Light Company, have paid off the $225,000 five per cent mortgage on the property and made a new first refunding mortgage securing $1,250,000 five per cent, thirty-year gold bonds, of which $950,000 have been issued.

Stock Market Reports

Street Railway Stocks

	Bid.	Asked.
Albany (N. Y.) United Trac	106½	107½
Allegheny Trac. Co. (Pitts.)	50½	53
Am. Rys. Co. (Phila.)	45½	46
Baltimore United Ry. & Elec	16	16¼
Birmingham (Ala.) R. L. & P	71	72½
Bleecker St. & F. F. (N. Y.)	34	37
Boston El	165	166
Broadway & 7th Ave. (N. Y.)	249	252
Brooklyn City	248	252
Brooklyn Rapid Transit	67¼	68
California St. Cable (San F.)	170	—
Central Crosstown (N. Y.)	265	275
Central Park N. & E. River (N. Y)	208	220
Chicago City R. R	207	210
Chicago Union Trac. com	18½	19
Chicago Union Trac. pref	55	56
Christopher and Tenth Sts. (N. Y.)	185	195
Cinn. N. & C. Lt. & Trac. com	108	110
Cincinnati St. Ry	143	145
Citizens' Pass. (Phila.)	355	—
Citizens' Trac. (Pitts.)	69	70
Cleveland City Ry	105	109
Cleveland Elec. Ry	82	83
Cleveland, Elyria & West	70	80
Cleveland & East	31	33
Cleveland, Painesville & East	35	50
Columbus (O.) St. Ry. com	50	53
Columbus (O.) St. Ry. pref	105	107
Coney Island & Brooklyn	350	400
Consol Trac. (Newark, N. J.)	68	70
Cont. Pass. (Phila.)	152	160
Consolidated Trac. (Pitts.), com	23	—
Consolidated Trac. (Pitts.), pref	63	—
Dayton (O.) City Ry. com	168½	—
Dayton (O.) City Ry. pref	182½	—
Denver City Train	94	—
Detroit United Ry	73	74
Dry Dock, E. B. & Bat. (N. Y.)	120	130
East St. Louis Suburban	54	57
East St. Louis Suburban subs	112	115
Eighth Ave. (N. Y.)	400	410
Fair Haven & Westville (N. Haven)	47	49
Fairmont Park & Haddington (Phila.)	73	75
Fairmont Park & Trans. (Phila.)	—	—
Frankford & S. W. Pass. (Phila.)	445	460
42d and Grand St. Ferry (N. Y.)	410	425
42d St. and St. Nich. Ave. (N. Y.)	70	75
Germantown Pass. (Phila.)	146	150
Green & Coats St. (Phila.)	155	—
Hartford St. Ry	185	205
Indianapolis St. Ry	—	64
International Ry. (Buf.) subs	120	121
International Ry. (Buf.) pref	60	64
Lake St. El. (Chic.)	12½	13
Louisville (Ky.) Ry. com	124	125
Manhattan El	132	133
Market St. (San F.)	99	101
Mass. Elec. Co. (Boston) com	44	45
Mass. Elec. Co. (Boston) pref	97	98
Metropolitan Securities	112	114
Metro. St. Ry. (N. Y.)	148	150
Metro. West Side El. (Chic.) com	37	39
Metro. West Side El. (Chicago) pref	90	91
Nassau Elec. (Brooklyn) pref	83	85
New Orleans & Carrollton	90	93
New Orleans City com	33	34
New Orleans City pref	110	112
New Orleans City tr. recpts	110	112
Ninth Ave. (N. Y.)	200	210
Norfolk (Va.) Ry. & Light	13	14
Northampton (Mass.) St. Ry	190	205
North Chicago St. Ry	190	192
North. Ohio Trac. (Akron) com	32	33
North. Ohio Trac. (Akron) pref	—	84
Northwestern El. (Chi.) vot. tr	38	39
Northwestern El. (Chi.) pref	85	—
Philadelphia Trac	97	98
Philadelphia City	208	215
Pittsburg and Birm. Trac	49	50
Pittsburg United Trac. com	14	16
Pittsburg United Trac. pref	50	51
Providence Union Trac	117	120
Reading (Pa.) City Pass	—	161½
Reading (Pa.) Trac	—	32
Ridge Ave. Pass (Phila.)	307	—
Rochester Ry. com	64	67
Rochester Ry. pref	100	101
St. Louis Transit Co	31	32
St. Louis United Rys com	—	—
St. Louis United Rys. pref	83	84
St. Louis & Suburban	—	90
Savannah Elec. com. subs	30	32
Savannah Elec. pref	90	93
Second Ave. (N. Y.)	217	221
Second and Third Sts. (Phila.)	305	308
Sixth Ave. (N. Y.)	170	180
South Side El. (Chic.)	113	115
So. Ohio Trac. (Cinn.)	66	68
Springfield (Mass.) St. Ry	215	225
Syracuse (N. Y.) Rapid Transit com	25	—
Syracuse (N. Y.) Rapid Transit pref	—	68
Third Ave. (N. Y.)	—	130
13th & 15th Sts. (Phila.)	306	—
Toledo (O.) Rys. and Light	21	27
Twenty-third St. (N. Y.)	408	415
Union Trac. (Phila.) com	42	43
Wash. Water Power Co. (Spokane)	100	110
Wash. Ry. & Elec	15	16
Washington Ry. & Elec. pref	40	42
Washington Ry. & Elec. 4s 28-29	81	83
West Chicago St. Ry	96	97
West End (Pitts.)	34	35
West End (Bos.) com	96	—
West End (Bos.) pref	115	—
West Philadelphia	252	—
Western Ohio (Lima)	18	20

Electric Company Stocks

	Bid.	Asked.
Allegheny (Pa.) Lighting Co	—	—
Boston Electric Light	112	113
Buffalo General Electric	100	102
Buffalo & Niagara Falls	100	—
Central Light & Power (San F.)	2½	—
Chicago Edison Co	175	180
Columbus Edison Co. com	37	40
Columbus Edison Co. pref	107	109
Edison Elec. Ill. (Boston)	276	280
Electric Co. of America	7⅞	—
General Electric	310	322
Hartford Elec. Light	198	—
Kings Co. Elec. Lt. & Power	195	200
London (Can.) Electric Co	—	—
Lowell Elec. Light	106	—

	Bid.	Asked.
Minneapolis Gen. Elec. com	73	77
Minneapolis Gen. Elec. pref	110½	—
Narragansett (Prov.)	102	—
N. Y. & Q. Elec com	40	—
N. Y. & Q. Elec. pref	77	79
Niagara Falls Power	85	95
R. I. Elec. Protec	125	—
Salem Elec	140	150
Syracuse Lighting	15	18
United Elec. Lt. & Power (Balt.) pref	41	42
United Elec. of N. J	14	15
Westinghouse Elec. com	212	213
Westinghouse Elec. pref	219	220

Gas Company Stocks

	Bid.	Asked.
Am. Light & Trac. com	37	39
Am. Light & Trac. pref	92	93
Baltimore Consolidated	67	68
Bay State (Boston)	2	2⅛
Brooklyn Union Gas	235	239
Buffalo City Gas	14	15
Cincinnati Gas & Elec	103	104
Columbus Gas, Lt. & Heat com	92	93
Columbus Gas, Lt. & Heat pref	107	109
Consolidated Gas (N. J.)	15	17
Denver Gas & Elec	13½	—
Detroit City Gas	—	73
Elizabeth Gas Light	175	—
Essex & Hudson Gas	27	23
Hartford Gas Light	50	—
Hudson County Gas	30	32
Indianapolis Gas	75	85
Jackson (Mich.) Gas	74	76
Kansas City Gas	15	25
Laclede Gas com	88	90
Laclede Gas pref	105	110
Louisville Gas Light	117	118
Mutual Gas(N. Y.)	—	—
Municipal Gas (Albany)	300	305
New Bedford Gas & Edison	130	—
New Eng. Gas & Coke	4	4⅛
New Haven Gas Light	75	—
New Orleans Gas Light	121½	123
New Orleans Gas Light tr. certs	121⅝	123
Newark Consolidated Gas	65	66
Oakland Gas & Light	62	64
O. & Ind. Cons. Nat. & Ill	18	26
Paterson & Passaic	26	30
People's Gas (Chi.)	102	103
Pittsburg Consolidated Gas	44	45
Providence Gas	100	—
Rochester Gas & Elec. com	107	110
Rochester Gas & Elec. pref	106	110
Salem (Mass.) Gas Light	140	160
San Francisco Gas & Elec	44	46
Savannah Gas Light	22	23
Syracuse Gas	15	18
Troy Gas	160	—
United Gas & Elec. (N. J.) com	37	38
United Gas & Elec. (N. J.) pref	87	88
Washington (D. C.) Gas	68	69

Telegraph and Telephone Stocks

	Bid.	Asked.
Am. Dist. Telegraph	38	40
Am. Telephone & Telegraph	180	185
Bell Telephone (Buffalo)	108	110
Central & So. Am	100	104
Ches. & Poto. Telephone	65	67
Chicago Telephone Co	170	175
Cumberland Telephone & Telegraph	—	129½
Commercial Cable	165	—
Com. Union Tel. (N. Y.)	115	—
Empire & Bay State Tel	78	84
Franklin	47	55
Gold and Stock	120	123
Hudson River Telephone	106	109
Mexican Telephone	2¼	2⅜
New England Telephone	147	148
No. Western Telegraph	122	126
N. Y. & N. J. Telephone	175	178
Pacific & Atlantic	80	85
Providence (R. I.) Telephone	109	—
Southern & Atlantic	100	103
Tel., Tel. & Cable of Am	7	8
West. Tel. & Tel. pref	101	102
Western Union	90	91

Notes

Independent interests in Ohio have secured an option on $1,200,000 of the $2,000,000 common stock of the U. S. Telephone Company, which was one of the Everett-Moore properties. The plan calls for the sale of $200,000 six per cent cumulative preferred stock and an increase in the outstanding first mortgage fives from $1,865,000 to $1,900,000 by sale at eighty-five. Subscribers to one share of the preferred at par will receive also six shares of the common at twenty-five.

The city of Norwich, Conn., is negotiating for the purchase of the Norwich Gas and Electric Company.

The Aurora (Ill.) Gas Light Company has changed its name to the Fox River Light, Heat and Power Company and has added to its powers those of furnishing gas to other municipalities and operating electric lighting and power machinery. It is about to take over the property and franchises of the Aurora Electric Light and Power Company.

The United Gas and Electric Company, of San Jose, Cal., has acquired control of the Pacific Power Company's plant in San Francisco, which it will use for its own and the Standard Electric Company's benefit.

It's Morgan's

ADDITIONS MADE WITH APOLOGIES TO THE AUTHOR

I came to a mill by the riverside,
A half a mile long and nearly as wide,
With a forest of stacks and an army of
men
Toiling at furnace and shovel and pen.
"What a most magnificent plant!" I
cried;
And a man with a smudge on his face re-
plied:
"It's Morgan's!"

I entered a train and rode all day
On a regal coach and right of way
Which reached out its arms all over the
land
In a system too large to understand;
"A splendid property this," I cried;
And a man with a plate on his hat re-
plied:
"It's Morgan's!"

I sailed on a great ship trim and true
From pennon to keel, and cabin to crew;
And the ship was one of the monster
fleet—
A first-class navy could scarcely compete;
"What a beautiful craft she is," I cried;
And a man with akimbo legs replied:
"It's Morgan's!"

I watched men making electric light,
In a plant that hustled both day and
night,
To light a city and send away
More power to turn all night to day;
And as I thoughtfully weighed the thing
I heard a greasy old oiler sing:
"It's Morgan's!"

I found a cold-storage plant that cut
More ice than grows in Connecticut;
'Twas high and wide and neat as a pin,
And the soul of the winter breathed soft
therein;
I saw, and wondered aloud who owned
This modern plant, when the ice-man
groaned:
"It's Morgan's!"

I asked my broker if he could sell
To me for cash—and a share as well—
The finest gas-works that ever smoked.
The fellow fainted and nearly choked;
He mopped his face with his handker-
chief
And said: "I can't," with a doleful
sniff——
"It's Morgan's!"

I dwelt in a nation filled with pride,
Her people were many, her lands were
wide,
Her record in war and science and art
Proved greatness of muscle and mind and
heart.
"What a grand old country it is," I cried,
And a man with his chest in the air re-
plied:
"It's Morgan's!"

I went to Heaven. The jasper walls
Towered high and wide, and the golden
halls
Shone bright around. But a strange new
mark
Was over the gate, viz: "Private Park."
"Why, what is the meaning of this?" I
cried;
And a saint with livery on replied:
"It's Morgan's!"

I went to the only place left. "I'll take
A chance in the boat on the brimstone
lake,
Or perhaps I may be allowed to sit
On the griddled floor of the bottomless
pit."
But a leering lout with thorns on his face

Cried out as he forked me off the place:
"It's Morgan's!"

I knew that trusts were the proper thing,
But I wasn't prepared for that, by jing!
Forbidden heaven and thrust from hell—
There's nothing left—but you mark me well;
When Gabriel's final trumpet blows
One man will shoulder the whole world's woes—
"They're Morgan's!"

But still there's hope, for the famed trust king
Has gone to the ends of the earth to bring
The world of commerce to be our part,
A gift from the truest patriot heart
That beats to-day, and when Doom shall flame,
In blazoned honor shall shine one name—
"It's Morgan's!"

A Million Dollars in Dispute

The Rapid Transit Railroad Commissioner of New York is divided into two factions over a demand which has been made upon it by the Subway Constitution Company for $1,030,000 for building electric wire ducts in the walls of the underground railroad now under construction.

It is an interesting controversy. On one side are arrayed President Orr, with all the self-perpetuating members of the Board, Chief Engineer Parsons and Edward M. Shepard of counsel.

On the other side are the ex-officio members, Mayor Low and Comptroller Grout.

Comptroller Grout has declared that he will not pay the bill unless finally compelled to by the courts, even should every other member of the Board vote in favor of it.

The controversy turns upon the question of whether the electric ducts built into the walls of the tunnel are a part of the actual tunnel construction or a portion of the equipment.

Under the contract with John B. McDonald, the Subway Construction Company must supply every detail of equipment at its own expense. "Conduits" and other details are specifically mentioned.

When, a year ago or so, at the request of the contractor, electricity was formally approved by the Board as the motive power to be used, it was intended to string the wires from the roof of the tunnel. Upon more mature consideration this was decided to be dangerous. Then the contractors decided to put ducts in the walls. They went ahead and did so. There are 140 ducts laid in place. Seventy of these, Mr. Parsons reports, are needed for present use and the others to meet future needs.

Mr. Parsons reports that $1,030,000 is a reasonable charge for the ducts. Mr. Shepard has reported informally that the ducts must be legally considered as part of the structure and not part of the equipment. He bases his decision upon the fact that they can not be removed by the contractor.

The decision will be of greater importance to the contractors than to the city. Should it be decided that the city must pay it will have a million dollars less for the contractors to raise to pay for the $15,000,000 new power house under way at the foot of West Fifty-ninth street, and the rest of the equipment which they must have.

From the city's standpoint the money will be only lent.

American Institute of Electrical Engineers

Nineteenth Annual Convention

The nineteenth annual convention of the American Institute of Electrical Engineers was held in Great Barrington, Mass., June 19 to 21, and was attended by an unusually large number of the members, with their ladies and friends. A programme of unusual interest had been prepared, and a number of excellent papers were read and subsequently discussed.

The address of welcome was delivered by Mr. William Stanley, chairman of the local executive committee, the response being made by Mr. T. Commerford Martin, one of the editors of the *Electrical World and Engineer.*

The convention was held in the auditorium of the Berkshire Inn, with President Steinmetz in the chair. Following the usual custom of the Institute, the papers for the day were read in order, and the discussion of all followed after the reading. When the other papers had been presented President Steinmetz read by title only his paper on "Notes on the Theory of Synchronous Motors, with Special Reference to Surging."

In the afternoon a majority of the members visited the works of the Stanley Instrument Company, and the evening was concluded with a lantern slide entertainment at the town hall. A lawn party was also held at Brookside in the afternoon.

The second session was opened with Mr. A. H. Armstrong's paper on the "Heating of Railway Motors," which was afterward discussed at length.

Mr. B. J. Arnold followed with an important paper on the "Method of Ascertaining by Means of a Dynamometer Car the Power Required to Operate Trains on the New York Central & Hudson River Railroad Between Mott Haven Junction and the Grand Central Station, and the Relative Cost of Operation by Steam and Electricity."

Mr. Arnold judges that the alternating current railroad motor will certainly prove to be the most efficient for long-distance railway work where all the conditions are taken into consideration, and while it has failed so far to prove its ability to start under heavy load as efficiently or to accelerate the movement of a train as readily as a direct current motor, it will in the end prove the more valuable of the two. He recommends the direct current system in combination with the third rail main-line and overhead construction for the yards, but does not advise any great amount of experiment with the alternating current motor.

"Considering on the railway named that two men of the same skill as are at present employed on the locomotives, the figures for the cost of operating would be as follows:

	Steam.	Electricity.
Operating expenses per locomotive mile, exclusive of fixed charges, but including water, labor, cost of cleaning and repairing tunnel, and all other expenses of locomotive operation	23.05	15.80
Fixed charges per locomotive mile, assuming that it now requires 40 locomotives to perform the present service and that 33 electric locomotives could perform the same service	1.13	7.83
Total in cents	24.18	23.63

The paper continues by stating:

"From these figures it appears that while there would be a slight annual saving in operating expenses in favor of electricity, it is not sufficient to warrant its adoption on the ground of economy in operation alone, although its adoption can be justified on other grounds.

"These figures could be made more favorable to electricity were an optimistic view of many of its advantages taken, and the probability is that practical operation will show a somewhat greater gain than here indicated, but it has been deemed best by the writer to maintain a conservative view throughout the entire investigation." Other papers and discussions followed on Friday and Saturday, one of which, "The Education of an Electrical Engineer," by Mr. Harold W. Buck, of Niagara Falls, will be found in this issue.

The officers who have been elected for the following year, and who will take office on September 4, are as follows:

President: Charles F. Scott.

Vice-Presidents: C. O. Mailloux, Schuyler S. Wheeler, Samuel Sheldon, Bion J. Arnold, Michael I. Pupin and George F. Sever.

Managers: Townsend Wolcott, Ralph D. Mershon, John J. Carty, E. H. Mullin, John W. Lieb, Jr.; Charles A. Terry, Gano S. Dunn, Calvin W. Rice, W. S. Barstow, Samuel Reber, and W. E. Goldsborough.

Treasurer: George A. Hamilton.

Secretary: Ralph W. Pope.

Gas in Massachusetts

The *Progressive Age* prints the following interesting summary of the results of the operations of thirty-two gas companies in Massachusetts in 1901, as prepared from the official reports, by a correspondent.

Thousands of inhabitants.	Number of towns.	Average capital.	Average assessm't	Taxes per ct.	Average yearly total sales; cubic feet.	Number of meters.	Number of stoves.	Miles main, 3-in. and over.	Leakage; per cent.	Sales per meter per annum.
15 to 20	8	$80,000	$70,000	2.5	15.000,000	760	400	9.5	11	20.000
20 to 35	6	75.000	65.000	2	25,000,000	1,200	550	16	10	20,800
35 to 50	8	225,000	300,000	2	68,000,000	3,300	1,500	50	9	20.600
50 to 90	6	580.000	750.000	1.5	169,000,000	7,600	4,600	88	5 7	21,000
90 to 125	4	550,000	800,000	2 25	267,000.000	10,900	7,200	78	3	23,700

Thousands of inhabitants.	Average price of gas.	Capital and bonds.			Operating costs per 1,000 feet sold.					
		Per capita.	Per mile of main.	Per meter.	At works.	Distribution.	Taxes.	Incidentals.	Management.	Total.
15 to 20	$1.55	$7.58	$11,900	$150	$0.86	$0.105	$0.085	$0.01	$0.17	$1.23
20 to 35	1.46	4.80	7,500	100	0.70	0.12	0.07	0.03	0.26	1.18
35 to 50	1.28	7 70	6.200	96	0 70	0.13	0.07	0.03	0.11	1.04
50 to 90	1.08	9.30	8,000	92	0.56	0.12	0 065	0.015	0.09	0.84
90 to 125	1.03	6.30	8,800	61	0 51	0.12	0.07	0.015	0.075	0.78

BEST INDIVIDUAL RESULTS IN EACH CLASS.

Thousands of inhabitants.	Revenue per 1,000 feet sold.		Largest number of meters.	Least per cent leakage.	Most gas sold per meter; cubic feet.	Greatest issue of stock and bonds.
	From residuals	Total.				
15 to 20	$0.15	$0.[illegible]7	1,100	4	23,400	$176,000
20 to 35	0.16	0.44	1.700	1	27,000	195,000
35 to 50	0.15	0.39	5,500	2	24,900	444,000
50 to 90	0.15	0 39	11,800	3.5	25,200	1,040,000
90 to 125	0.12	0.37	13.200	1.5	27,700	825,000

Best water gas results per 1,000 made: Generator coal, 37 pounds; boiler coal, 12.3 pounds; oil, 4.4 gallons.
Nine coal-gas companies average 55 per cent of cost of coal from sales of residuals; ten companies average 45 per cent.

The Methods of Conducting a Shop Drawing Class

From the American Machinist.

The method employed in teaching mechanical drawing in the factory of the Cleveland Twist Drill Company was mapped out more with a view to teaching the employees to read drawings than to make draftsmen of them, but at the same time so that those who cared to follow the profession in the future would be able to use all the information and practice to good advantage. No originality in plan of teaching was attempted, but a combination of two methods might be said to have been used.

An admission fee of fifty cents is charged, with a view to making the pupils feel that they have an interest in attending regularly, and to partly pay for the drawing-boards, blackboards, light, etc. Each pupil purchased his supplies of the company at cost, and by buying a number of sets of paraphernalia they are enabled to get reduced prices.

The blowing of the whistle in the evening is the signal for class to assemble (after washing up) in the dining-room, where they are served with a light luncheon in shape of sandwiches, tea and coffee. One of the long tables at the other end of the dining-room constitutes the desks of the pupils; a large portable blackboard faces this within easy reading distance. The class consisted of twenty pupils who had been through fractions and percentage in arithmetic, but further than this knew nothing of mathematics, so that all subjects touched upon in class requiring a more extended use of mathematics had, of course, to be postponed until such time as they were ready to handle them intelligently.

Upon organization I found some had taken lessons previously in drawing, knew the use of different instruments and understood the ordinary geometrical problems occurring in drawing, while others were without any such previously acquired knowledge. This would have meant two or three classes, and as I could give one evening a week, I decided to teach by plates very similar to the correspondence schools, which enabled each one to be in a class of his own if necessary, and as very little drawing could be done in one evening in a class they were instructed to do all drawing at home. This gave the entire evening to oral work and lectures. Each pupil was furnished with a blueprint of instructions such as would be needed outside of class, and also a plate (blueprint) to copy from. These plates were drawn, then blueprinted, but to a scale of about ten inches to the foot, so that no copying by dividers could be done. The first four contain the ordinary geometrical problems, the next four projection, cylindrical and conical intersections, and developments; then came the simple machine parts to teach the correct placing of views, shading, etc. From this on the plates gradually get more intricate and complicated, but in all cases are taken from our own shop drawings or a machine in the factory, and more especially is a drawing of a jig or fixture used which may have given any trouble to the machinist to read. These drawings are then made at home and left in the drawing office, where they are corrected and marked, a record of the progress of the student being kept for reference.

Upon the opening of class the roll is called, and a certain portion of time is taken up each evening in answering any questions pertaining to any of the plates or work gone over. In the beginning of the term students were sent to the board and asked to show the projection, shade lines, etc., of a given piece with a view to ascertain if they understood the instructions and plates. Later they were given a little algebra in the shape of simple formulas, which, by the way, gave most of them some trouble until they got to handle the characters as though they had no value, or to treat them by the rules regardless of their value. One of the hardest things to get clearly fixed in the pupils' minds was to algebraically subtract a larger number from a smaller or from o. Of course, the time was so short that a thorough course in algebra was out of the question, therefore simple formulas with one unknown quantity were all that were attempted. When these were handled readily the solution of right-angle triangles by the use of trigonometrical functions, and practical applications of the same as used around the factory were taken up.

A short course in the practical laying out and working of gear problems came next, which gave very little trouble, as most of the students were more or less familiar with the subject.

This year's course in class closed with logarithms, and considering that I left the theory of exponents out of the question, taught them only the use of the tables and gave them rules to solve the different examples by, they handled the subject remarkably well. It was always evident to a visitor in the works that there was a school in progress, as the numerous blackboards in the dining-room were always occupied in the dinner hour by students working out different problems that occurred from day to day, and I was extremely well pleased to notice on the different boards the character of the examples chosen and the intense interest which the students seemed to have in the subject. Scarcely a day went by without a pupil inquiring why a view of a drawing was given this way, or what a certain line represented; showing that they did not merely copy plates, but were actually drawing the object with the plate as a help.

Of course, some pupils made more progress than others and better drawings, but this was to be expected, as some are more apt than others and every one has not the same time to put upon the lessons; but as a whole the class was a success.

I enclose to you Plate VI, the first one of machine parts, merely to give you an idea of the work, and would say this was the starting point of that part of the class which had been through the geometrical and development drawings.

Stanley Works Sold to Whitney

The Stanley Electric Manufacturing Company's plant at Pittsfield, Mass., was sold in June to the Whitney-Ryan syndicate, and an unofficial announcement has been made that it will be rapidly added to until it becomes one of the most important electrical works in the United States.

The basis for the large business which the works are to be made capable of doing is that already controlled by the Whitney-Ryan syndicate. Besides the immense aggregation of street railroads, which is controlled by Mr. Whitney and his associates, they control and operate one hundred and fifty lighting plants in as many cities and towns throughout the country. Each of these plants has its electric outfit. It is asserted that the total amount of business which the combination now gives out to the various electrical factories forms thirty-seven per cent of the whole electrical business of the country.

This, of course, includes everything from generators to motors and lamps, and if the policy of turning all of this business over to the Stanley works were carried out, it would give to that concern an enormous business as rapidly as room could be made to care for it.

Additions of great extent can be made to the works, with readiness. In laying out the present works Mr. Perrine made provision for their great extension without interfering with their operation. Bays were left for adding machine shops, which need only be of light construction, while there is also provision for adding to the power plant as more power may be needed.

At the present time the works are comparatively small. The company was was formed under New Jersey laws in 1900, and its authorized capital is $2,000,000, but only $1,000,000 of the stock has been issued. The stock was nearly all owned by F. W. Roebling, of Trenton, N. J., and the principal office of the company is in that city.

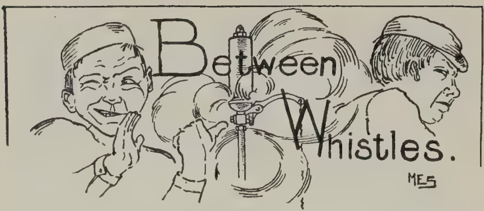
The Whitney-Ryan syndicate is also known to be in close touch with Ganz & Co., whose works are among the largest in Europe. This connection has been made to put the American syndicate in a position to take advantage of the movement which is now manifesting itself in many parts of the country to turn steam railroads into electric lines, either in whole or in part. Work of this sort is already under way.

A Friction Reducing Device

To enable railroad trains to attain a speed of one hundred and twenty miles an hour, a Massachusetts inventor has brought forward a means of reducing the friction of the car-wheels on the axles and also upon the rails, claiming that the increase of speed due to his invention will be nearly one hundred per cent, and that at one hundred and twenty miles an hour the vibration of the cars will be no more noticeable than at present, while stops and starts can be made with greater velocity.

An Automobile Speed Register

A speed-register for automobiles, which the inventor claims will readily answer the demands of all chauffeurs, has recently been brought forward. The instrument is constructed like a clock, indicating the speed in miles per hour on the dial. It can be placed in any convenient position. It also includes in separate divisions the functions of a clock and a cyclometer, showing the number of miles traveled. This should prevent excessive speeding.



Workmen who know the kinks of their trades, the tricks played by machines and tools, and ready methods for meeting shop emergencies, are invited to contribute to this department.

Apprentice: Say, boss, the old man must have been out last night; the Oil King wasn't in the storeroom this morning five minutes after the whistle blew when the old man wanted some lard oil, and he had to wait. The air was blue for more than a minute when his majesty did get in. He tried to work the gag that he was down in the basement for a long time looking for a pint measure, but the old man wouldn't have it and gave him the barrel; now he is rolling. But say——

Mr. Lathe: My son, oil as well as oily tongues has cost many a fellow his job, and what might have been a good machinist turned into a tank. But getting back to the crowned pulley that I was telling you about the other day; go over there and get a piece of chalk and I'll show you what I mean.

Apprentice: How will you have it, boss, white or black?

Mr. Lathe: Now this is a cross section of the face of a crowned pulley, and this represents the belt in cross section on its

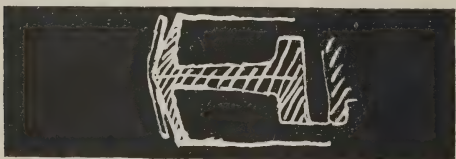


Fig. 1

face. You will notice that the belt does not hug the pulley its entire width, the extent of contact being governed by several conditions. If the belt is running at a high speed and is loose, the centrifugal force will lift the belt away from the pulley face considerably. If you will look at that 24-inch belt when it is running full speed you will notice that there is an open space

Fig. 2

of fully one-quarter of an inch between the edge of the belt and the face of the pulley.

Now you see that if you have two straight-faced pulleys, and one of them is out of line, the belt would lie nice and flat around one pulley, while only one edge would come in contact with the out-of-line pulley; and the belt, of course, would run down where there would be

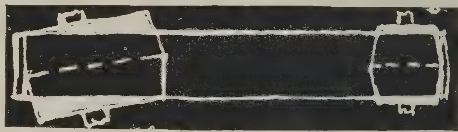


Fig. 3

the least resistance, thus disproving the theory that a belt will run to the highest part of a pulley.

Now I will show you why a belt will keep in place on a crowned pulley, the shafts being considerably out of line, and the extent of crowning governing, with-

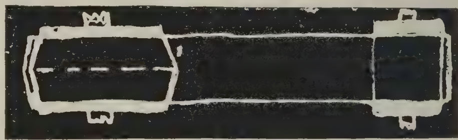


Fig. 4

in certain limits, the amount that your pulleys can be out of line with each other. You will notice that only one-half, or a little more, of the belt is doing all the work. As it is practically to keep shafting in line, because of changes in weights on floors, atmospheric changes and other conditions, it is necessary to divert for the theoretical pulley, and this sketch is what I believe to be the proper thing. Make your small pulley, be it driver or driven, straight-face, but always considerably longer to allow the belt to swing from side to side freely on account of the inequalities of the belt; crown the large pulley slightly and you have the best practical——

Apprentice: There goes that—— whistle.

Proper Test of Files

To the Editor of The Electrical Age:

Sir—Permit me to offer to your readers some suggestions on the use of files. The first use given to a new file should invariably be working brass, German silver, etc., as only a new file can be used for these metals. When no longer good for brass the file becomes excellent for steel, and at this degree of wear it is useful for a long time. Sometimes, however, it becomes necessary to use a new file for steel, and in such cases the file should be previously well oiled so as to prevent its filling up with steel filings. This lodging of the filing dust is frequently the cause of the breakage of the teeth of new files. The breakage is also easily caused by too heavy a pressure and this should be avoided as much as possible. Otherwise the extreme ends of the teeth which effect the filing will chip off. These broken, glass-hard chips of teeth, generally bury themselves in the metal filed, and thus altogether destroy the remaining teeth.

Again, use a file on one side only until the side is no longer effective and then use the other side. By this method you gain the advantage that you can always count on one sharp side in cases of emergency. Mechanics frequently use the same file alternately upon steel and brass. This is fundamentally wrong, however, because after a file has once been used on steel it is no longer good for brass.

If blue-hard steel is to be filed, as will occasionally occur, use an old worn out file for the first filing. You will invariably find some effective places on it, either at the point, tang end or sides, Many workmen take a pride in always showing a set of new files. This is an indication, however, that they do not understand how to wear their files out completely, and others boast of having performed certain pieces of work with worn out files. To say the least, they are not practical workmen, because the little they have saved by not purchasing new files was lost twenty-fold in the extra time consumed in doing the job. A good workman will not only have good files, but he will also have worn out files—a sign that he understands how to use them.

Adam Filer.

The Price and Value of Carburetted Water-Gas*

At the present time oil such as is fitted for making carburetted water-gas is fairly cheap, and an oil can be purchased for this purpose at from 4.5 cents to 5.5 cents a gallon, and for most of the big works around London 4.5 cents may be taken as the price. We will take, first of all, carburetted water-gas which shall have the same illuminating power as our ordinary coal-gas supply, that is to say, sixteen-candle water-gas. For this 2.25 gallons of oil would be required, and we will take the price of the oil at 4.5 cents. So that the price of the oil used for mak-

* Abstract from a lecture by Prof. Vivien B. Lewes.

ing 1,000 cubic feet of carburetted water-gas is, say, 10.12 cents. The fuel would consist of forty pounds of good coke, which would cost at the rate of $3.62 per caldron, 6.4 cents. The fuel used for raising the steam would be about fifteen pounds of breeze, which (as it would not run to more than eighty-five cents) we will take as costing 0.56 cent. Then purification may be taken at two cents, working on a large scale. Labor may be taken at another two cents, and wear and tear of plant at two cents, because there is a considerable amount of wear and tear in these generators. Supervision comes out at 1.4 cents, and water and stores at 0.5 cent. Now these are working figures taken over a long period of absolute practice, and they come out at twenty-five cents per 1,000 cubic feet of sixteen-candle carburetted water-gas. The advocates also tell you that there should be a deduction from this. There is the value of the oil-tar, which is fairly high on account of the benzine it contains, and the value of the tar obtained per 1,000 cubic feet of gas would be 0.72 cent, so this would bring the total cost down to 24.36 cents per 1,000 cubic feet for sixteen-candle gas, and at a cost of 3.5 cents more for oil (or close upon 28 cents in all) you can get up to twenty-two-candle-power gas.

Now when comparing the cost of illumination by carburetted water-gas with that yielded by oil-gas it is useless to take the cost of production, for the reason that we speak of London gas costing, say, seventy-three or eighty-five cents per 1,000 cubic feet. This means that the gas is delivered into your house at that price. while the cost of sixteen-candle coal-gas in the holder is probably about twenty-four to twenty-eight cents per 1,000 cubic feet. The difference between the two prices is made up of charges on capital, cost of distribution, profit and other factors. If you had a town supply of carburetted water-gas under the same conditions as a town supply of coal-gas the twenty-five cents in the holder for sixteen-candle gas would be about equivalent to the coal-gas you are at present getting on this side of the Thames. Therefore it may be taken that the amount of light obtainable from oil as an illuminant when utilized as carburetted water-gas, per unit of cost, is practically the same as ordinary sixteen-candle coal-gas at seventy-three cents per 1,000 cubic feet; that is, when used in the flat-flame, argand or regenerative burners. In the incandescent mantle (which is playing such an important part in illumination at the present day), it is not quite so good; at any rate its detractors say it is not. The reason for this is that if you take a sixteen-candle gas made from Durham coal you have a value of about 640 British thermal units, while on the other hand a sixteen-candle carburetted water-gas only gives about 520 British thermal units. But in the incandescent mantle the gas, whatever it may be, is burned with a certain supply of air, and where you have got a gas of lower thermal value it only means that you have not got quite so much material to burn up. If the air supply is regulated you find, as the air supply is reduced owing to the slightly poorer gas, you have not so much inert nitrogen of the air to heat up and to carry away the heat of the flame, so that as far as the photometrical results go, the same satisfactory results are obtained. From a theoretical point of view it is interesting to note the candle units per gallon of oil obtainable by gasification under the conditions existing in a carburetted water-gas plant; and a fair average over all the water-gas practice is 1,450 candle units.

With Our Foreign Consuls

Railways

Electric Railways in Malaga, Spain.—United States Consul Benjamin H. Ridgely reports from Malaga that the municipal council of Malaga has finally authorized the company operating the street-railway system of that city to apply electric traction to the several lines. The mileage of the company at present in operation is comparatively insignificant, consisting of only about eight miles, but concessions have been granted for various other streets, and the system is sure to expand considerably at no distant day. The company owning the system is a joint-stock society, with headquarters in Brussels, Belgium. The corporate name is "Tramways of Malaga." The directors are Messrs A. de la Hault, P. Hammebeath, Charles A. Lucas, Paul Mayer and Max Ryndzunsky, all of whom reside in Brussels. It is said to be the intention of the company to go to Germany for its entire electric equipment. It is possible, however, if the matter were thought to be of sufficient importance, that enterprising American agents might interfere with this plan.

Electric Lighting on German Railways.—Consul Frank H. Mason sends from Berlin a long and detailed report on this subject, making reference to a former statement regarding the methods in use by the Prussian State Railways for lighting both passenger and postal cars. Since that report fifteen months have elapsed, during which time the Prussian engineers have continued experimenting. Herr Weichert, says Consul Mason, delivered a lecture recently before the Association of German Mechanical Engineers in which the results of these experiments were carefully summarized. In his report, Herr Weichert traversed descriptively the experience of the Prussian administration with the several methods of car lighting, from candles to electricity, and then entered in detail into the advantages and difficulties which had been found in practice with the different systems of current supply, whether by storage batteries charged at permanent stations, generators located in each car and worked from an axle of its running gear, or one such generating plant located in a baggage car and serving an entire train by means of conductors connecting the different carriages.

From the standpoint of the engineer, the axle-driven dynamo, located in each car and making it an independent unit, always ready and capable of a run of any length or duration, is the ideal system. It requires, in addition to the dynamo, only a small auxiliary storage battery to feed the lights while the car is at rest, and a regulator to equalize the current during the different rates of speed attained by the train. But this system has three defects: (1) The power which it borrows from the axle, repeated in each car of a long train, increases very perceptibly the already heavy load upon the locomotive; (2) the space occupied and dead weight added by the dynamo, regulator, and accumulator; and (3) the jarring, grinding noise of the dynamo, which has not been reduced to a point where it ceases to annoy and awaken nervous passengers.

The second method, which has been carefully tested by the Prussian administration, is that of large storage batteries, located in each car and fed from electric plants at terminal and other principal stations. This system has the advantage that it does not consume any power from the locomotives and makes no noise or vibration to disturb passengers. Its serious disadvantages are that the storage batteries of sufficient capacity to carry a current supply for a long run are heavy and costly, and the process of charging them at terminal or intermediate stations requires special apparatus and involves delay and technical difficulties which form in the aggregate a serious defect in the working value of the system.

For all these reasons, the Prussian State railway administration, after elaborate and thorough experiment, has settled upon a compromise between all the foregoing methods, namely, a system by which a steam-driven dynamo is placed on the locomotive, under control of the engine driver, which supplies current to a small regulating storage battery in each car of the train. This renders each separate car of a vestibuled train an independent and separate lighting system, in which the lamps are fed from its own accumulator, which derives its supply from the generator at the head of the train. According to the statement of Herr Weichert, this system meets more perfectly than either of the others all the requirements of simple, economical, and efficient construction, maintenance, and attendance in regular service. The first practical tests in this method have been made in the so-called Swedish express, a high-class vestibuled daily train between Berlin and Stralsund. It has proved so efficient and satisfactory that other trains are being equipped with similar apparatus, and all appearances indicate that the State engineers feel that they are at last on the right road to a successful and satisfactory lighting system for passenger carriages. In the distribution of lights, each compartment in a first or second-class car has a ceiling lamp, controlled by the attendant, and four reading lights on the sides, which can be turned on or extinguished at will by the passengers.

The dynamos, conductors, storage batteries, and lamps for this purpose have been specially designed by Chief Engineer Wichert and his associates, who exhibited models and drawings of the entire equipment as practical illustrations, with the address, which is accepted here as marking a definite epoch in the history of railway-car lighting in Germany.

Auto-Trolley Line Between Nice and Upper Monte Carlo.—His Britannic Majesty's Consul McMillan, of Nice, reports that a British contractor has obtained a concession from the French Government for installing an auto-trolley line between Nice and Upper Monte Carlo. The line will be twelve miles long, and the gradients will in some places reach ten to eleven per cent. The hydro-electric power will be furnished by a French company which already supplies the Nice Tramway Company. The cars are built for the accommodation of sixteen persons, twelve seated and four standing, and their weight with full complement of passengers is not expected to exceed four tons. The wires will be suspended from wooden poles in the country, and from iron poles in the town. No tram-rails are required to be laid down under this system, and the cars can deviate to right and left at will, crossing and recrossing the road with as much freedom as an ordinary omnibus, and this independently of the overhead connections to the trolley wires. A small three-phase motor is suspended between the two conducting trolley-wires, which are set twelve inches apart; a flexible cable leads the motor current from the main line to the car, and the three-phase current from the car to the little trolley motor, which runs a little in advance of the car itself, in order that the flexible cable may have its proper tension. The trolley-motor and all its accessories weigh not more than forty pounds. The pressure on the trolley lines will be 500 to 550 volts, the 10,000 volt three-phase alternating current being transformed through rotary converters installed in three sub-stations, one in the middle and one at each end of the line. It may be added that lines are now being constructed on this system in Marseilles and other places. The estimated cost of the twenty kilometers of line, including all sub-stations, twelve cars and all other material for the working of the line, will not exceed £40,000.

Projected Electric Railway in Spain.—A royal decree of March 7 grants a concession to Don Teodoro de Mas y Nadal to construct, within the next six years, an electric railway between the towns of Vich and Amer, in the province of Gerona, says Consul-General Julius G. Lay, of Barcelona.

The capital of 9,000,000 pesetas (about $1,200,000), which is estimated as necessary to build this railway, has not yet been subscribed; but if Señor Mas is as successful in securing capital from foreign countries as other promoters of electric railways have been, it will only be a short time before the road is in operation.

I have obtained a memorandum of this project, showing in detail the estimated cost of construction, material required, water power available, cost of maintenance, receipts, etc., and plans and longitudinal profile.

Contracts for this road will, of course, not be thought of until the capital for its construction is subscribed. I will then report the names of chief contractors, but in the meantime I would advise our manufacturers of electric-railway equipment to keep in touch with Señor Teodoro de Mas, of Vich, Spain, and correspond with him in Spanish.

Pullman Cars in Kieff.—Consul Samuel Smith reports from Moscow that the City Electric Railroad Company, of Kief, has lately received two Pullman cars, which were ordered by the municipality as an experiment. The cars were shipped from Berlin in separate parts and are now being put together at the Kief City Railroad Works. They are of the double-truck type and have four electromotors of twenty-five horse-power each. The cars at present in use at Kief have two motors of twenty-five horsepower each. The new cars are equipped with all the latest improvements, including electric brakes and electric lights.

General Information

Harbor Works at Dalny and Port Arthur.—Consul H. B. Miller reports from Niuchwang:

The Shanghai *Mercury* says that "the Russian Ministry of Marine has voted £600,000 ($2,917,000), to be expended during the present year on the construction and dredging of harbors in the Far East." This money is to be spent mostly in improvements at Dalny and Port Arthur. Orders have already been given to proceed with the construction of the second dry dock at Dalny, which is to be the largest on this side of the Pacific and able to accommodate the greatest vessel that floats. Out of this fund there is also to be constructed a large naval dry dock at Port Arthur, and extensive dredging is to be done to improve and enlarge the harbor, which is now too small.

Brazil's Rubber Crop.—Consul K. K. Kennedy, of Para, says in his last report to Washington that the shipments of rubber from the Amazon valley were, up to April 30 last, a few hundred kilograms in excess of the entire crop of the season of 1900-1901. The total increase, however, will not be known until the remaining shipments are made in May and June. The best informed rubber buyers here estimate that it will amount to at least ten per cent of the previous crop, and that the total yield will be about 30,000 tons.

Owing to hard-times, low prices, and certain unfavorable local conditions, there are various opinions as to whether the steady increase in the output of rubber during the past few years will be maintained in 1902-3. It is generally believed, however, that the rapid development of the new rubber districts on the upper Amazon and its affluents will more than make up for any falling off from these causes. I am informed that already many large bands of rubber gatherers are organizing, and that preparations on a large scale are being made for harvesting next season's crop.

American vs. German Gas Retorts

A competitve test between gas retorts of American and German make, the results of which should prove of interest to all illuminating gas manufacturers, is about to be made at the works of the Central Union Gas Company in New York city.

These works are part of the plant of the Consolidated Gas Company, and that company is now having erected the necessary retorts for the test. Both the American and German styles of gas-making devices will be represented by six benches of retorts, each bench containing nine retorts. The set of American retorts is being put in by the Laclede Fire-Brick Manufacturing Company, of St. Louis, Mo. Both sets are as near alike as it is possible to have them, so as to make the competitive tests upon equal terms, except that they differ in capacity. Each is typical. The American set is of American design and material. The retorts are set at an angle of thirty-two degrees and are twenty feet long each. They measure eighteen by twenty-five inches at the charging end, and eighteen by twenty-eight inches at the discharging end. The inside width of the arches is eleven feet ten inches, and the total dimensions of the six benches are ninety-two feet long, sixteen feet eleven and a half inches wide, and thirty-seven feet three inches high. The outside generators for each bench measure nine feet in length, eight feet seven and a half inches in width, and twelve feet in height. The two stacks will go into one building. The German stack contains the same number of retorts as that with which it will compete, and the retorts are also inclined. Its estimated capacity is 1,000,000 cubic feet per day, while that of the American plant will be 1,500,000 cubic feet per day.

Personal

Mr. Joseph C. Moulton has recently identified himself with the Fort Wayne Electric Company, and will have his office at 44 Broad street, New York. He has the good wishes of his many friends, who hope for a continuance of his past success.

Mr. H. F. Sanville, for some years secretary of the Morris Electric Company, is about to resign his position with that company, and purposes establishing an agency in Philadelphia to represent several manufacturing companies.

Prof. H. T. Bovey, LL.D., in recognition of his admirable work in applied science, civil engineering, etc., has been elected a Fellow of the Royal Society. Prof. Bovey is an honorary member of the National Electric Light Association, and has a host of friends in scientific, educational and electric circles in the United States.

Mr. Charles F. Scott, chief electrical engineer of the Westinghouse Electric and Manufacturing Company, was elected president of the American Institute of Electrical Engineers at its nineteenth annual meeting, which was held on May 20. Mr. Scott succeeds Mr. Charles P. Steinmetz.

Yale University is the recipient of a beautiful building to be known as Kirtland Hall, in memory of the late Prof. Jared Potter Kirtland, and will be used for the departments of mineralogy, geology and physiography.

Boylston Hall, chemical laboratory of Harvard University, having been very much overcrowded for the past two years, will soon have a wing added to it which will be eighty-three by thirty-three feet, and will be used by the elementary classes until a new building is constructed.

Col. Albert A. Pope, who some months ago resigned from the directorate of the American Bicycle Company and sold his stock because of differences with the management, has now repurchased an interest in the company and will, with Mr. John D. Rockefeller, dictate its policy. His position is now stronger than it was before, and he will be the practical working head of the concern.

Prof. Menschutkin, professor of chemistry in the University of St. Petersburg, and Prof. van Geer, professor of mathematics in the University of Leyden, have retired.

Mr. John Fitch, who is claimed to have been the first to apply steam to the running of a boat, has had a beautiful memorial dedicated to him in Warminster, Pa., by Edward Longstreth, which bears the following inscription: "John Fitch here conceived the idea of the first steamboat. He ran a boat by sidewheels by steam on a pond below Danisville in 1785."

Mr. Joseph E. Schwab, brother of Mr. Charles M. Schwab, is featured for the presidency of the American Steel Castings Company, which will be backed by Shearson, Hamill & Co., of New York.

Prof. John H. Kineally, professor of mechanical engineering in Washington University, St. Louis, has resigned, and will go into business in Boston.

Mr. James Swinburne has received the nomination for president of the Institution of Electrical Engineers of Great Britain. Among the other nominees are the following well-known English engineers: Major P. Cardew, Mr. S. Z. de Ferranti, Mr. John Gavey and Prof. O. Lodge, vice-presidents, and Prof. W. E. Ayreton, honorary treasurer.

Mr. C. S. Colton, assistant manager of the Westinghouse Electric and Manufacturing Company, Cleveland, has resigned that position to accept a very responsible one as assistant to Mr. F. S. Drake, general manager of the Union Elektricitäts Gesellschaft, of Berlin. Mr. Colton will make his headquarters at the works at Charlottenburg.

Mr. Maynard W. Hamblin, for three years past manager of the Milwaukee office of the Western Union Telegraph Company, has been transferred to New York to succeed Mr. E. M. Mulford, Jr., who recently came from Chicago to New York to become superintendent of the New York offices. Shortly after his arrival there he was made superintendent of the first and fifth districts of the eastern division. Mr. Hamblin will be succeeded in Milwaukee by Mr. F. V. Moffitt, of Sioux City, Iowa.

Mr. E. H. McHenry, who was formerly chief engineer of the Northern Pacific, has accepted the appointment of chief engineer of the Canadian Pacific Railroad, succeeding Mr. P. A. Peterson, who lately resigned.

Mr. James Blackburn, a Truro, N. S., engineer, has charge of the tunnel under the Hudson river. He engineered one section of the tunnel under the Thames, the largest of the three great spans over the Frith of Forth, and was superintending engineer in the construction of the London underground railway.

Prof. Charles L. Griffin, formerly of the Pennsylvania State College, has been appointed professor of mechanical engineering at the new college of applied science at Syracuse University. With Prof. Griffin, head of the mechanical engineering department, will be several associates. The department will be extended, probably within the year.

U. S. Senator Nelson W. Aldrich, long president of the United Traction Company, of Providence, R. I., has resigned; his successor is Benjamin A. Jackson. The United Gas Improvement Company, of Philadelphia, has absorbed the traction company and will merge it, if possible, with the Rhode Island Company and the Providence Gas and Electric Lighting companies, with a capital of about $20,000,000.

Mr. F. C. Calderwood has decided to devote his entire time and attention to the subject of operating expenses of the Brooklyn Rapid Transit's system. Mr. Calderwood is assistant to President Greatsinger.

Mr. J. C. Breckinridge, general manager of the Brooklyn Rapid Transit Company, will hereafter be known as chief engineer in charge of the construction and maintenance and way department, the office of general manager having been abolished.

Mr. George B. Francis, having resigned his position as chief engineer of the Providence, R. I., street railway system, has accepted one as civil engineer with Westinghouse, Church, Kerr & Co., New York.

Mr. W. J. Jones has resigned his position with the Gas and Electric Company of Bergen County, N. J., and has taken charge of the Denver, Co., offices of the Stanley Electric Manufacturing Company.

Mr. Charles T. Malcolmson has been appointed superintendent of power and transmission exhibits at the World's Fair at St. Louis, where he will go directly from the Charleston Exposition, where he was chief of the bureau of power and lighting. He was assistant director of machinery and electricity of the American section at the Paris fair.

Incorporations and Franchises

Illinois

Chicago.—The Illinois Western Telephone Company, Macomb, has increased its capital from $60,000 to $300,000.

Springfield.—Pleasant Ridge Telephone Company has been incorporated by Messrs. I. S. Caster, W. H. Clark and S. L. Viely, with a capital of $1,000.

Gilman Electric Light and Power Company with a capital of $25,000 has been incorporated by Messrs. Robert W. Parker, Emil C. Wetten and Clyde A. Morrison.

New York

Albany.—The Niagara Falls Power Company recently certified that its capital has been increased from $6,500,000 to $9,500,000. The portion of the capital actually issued is $3,331,000.

The Gold Car Heating and Lighting Company was incorporated recently with a capital of $1,000.

New York.—The National Telephone Company, with a capital of $3,000,000, was recently incorporated in Delaware.

Rochester.—The Rochester and Eastern Rapid Railway Company has filed a notice of extension, the intention being to extend the road from Perinton to the easterly line of the village of Fairport; also from the intersection of Church street to Mill or Canal street; also from John street to the easterly boundary line of Fairport.

Utica.—The Utica and Mohawk Valley Railway Company (formerly Utica and Mohawk) has filed a notice of extension to cover points in the village of Frankfort, Herkimer county.

Floral Park.—The Floral Park Light and Power Company, for lighting streets and public buildings in towns located in Hempstead and North Hempstead, Nassau county, has filed articles of incorporation. The capital sctock is $50,000, and the directors are: John Lewis Childs, John F. Klein and Arthur H. Goldsmith, all of Floral Park, Queens county, where the business office is to be located.

Middletown.—The Union Electric Company, of Middletown, Orange county, has been incorporated to furnish light, power and heat. The capital stock is $40,000 and the directors are: Joseph J. Cunningham, Ira E. Miller, and Clarence W. Lisner.

Brooklyn.—The Queens Borough Gas and Electric Company has been incorporated. The capital stock is $2,000,000 and the directors are: John L. Lockwood, Jr., H. Julian Lockwood, Frederick P. Delafield, Lewis L. Delafield, John J. Reedy, Charles E. Wilson, and Thomas Ferry. The company is to operate in Hempstead, Freeport, Rockville Center, Lawrence, New York city and in the counties of New York, Queens and Nassau.

Utica.—The Electric Light and Power Company has been merged with the Utica Gas and Electric Company, the new corporation being known as the Equitable Gas and Electric Company of Utica.

Salamanca.—Articles of incorporation of a new electric railroad company to be known as the Salamanca and Little Valley Traction Company have been filed. The road is to be fourteen miles in length and the capital stock is $400,000. It is to extend from Salamanca to Little Valley with a branch. The directors of the company are: A. E. Darrow, Elmer E. Kelly, Tint Champlin, Hudson Ensley, Edward Boland, Carey D. Davie, Edward B. Vreeland, John J. Spencer, John S. Rockwell, C. W. Hammond, and D. J. Bissell.

Kingston.—A corporation with a capital of $700,000 has been formed in this city to manufacture gas and electricity for lighting and heating the streets, public and private buildings, parks in the city and the towns of Ulster, Esopus, Hurley, Woodstock and Kingston; in addition to this it will supply gas for fuel for manufacturing, domestic and other purposes. Name not stated.

Missouri

St. Louis.—Stockholders' meetings have ratified the merging of the Imperial, City, Seckner and Citizens' electric lighting companies into the Union Electric Light and Power Company, with a capital of $20,000,000. It is expected that Julius S. Walsh will be elected president of the combined interests. An issue of $10,000,000 each in stock and bonds will be made. Only $4,000,000 of the bond issue will be used at the start, the rest being held in the treasury.

The West St. Louis Water and Light Company has been incorporated with $80,000 capital. The incorporators are Thomas W. Crouch, Edward S. Lewis and others.

New Jersey

Trenton.—The New England Consolidated Ice Company, which was recently incorporated to consolidate a number of ice companies in New England, lately filed a certificate increasing its capital from $125,000 to $14,000,000.

Ohio

Columbus.—The Cincinnati, Dayton and Toledo Traction Company is a consolidation of the Southern Ohio Traction Company and the Cincinnati Northwestern Railway Company, both practically owned by the Mandelbaum syndicate of Cleveland, Ohio. The capital of the new company is $5,000,000, of which holders of stock in the Southern Ohio Traction Company are to receive $2,000,000 and those of the Northwestern $1,000,000, the remaining $2,000,000 to remain in the treasury to be sold as the directors may decide. The officers of the company are: William Christy, president; M. J. Mandelbaum, vice-president; Otto Miller, second vice-president; H. C. Long, secretary; F. T. Pomeroy, treasurer.

The Barberton Belt Line Railroad, the Cleveland, Barberton and Western Railroad and the Barberton, Alsson and Eastern Belt Line Railway have been consolidated with a capital of $900,000 .

Canton.—The Canton-Akron Electric Railway Company has increased its capital from $600,000 to $1,600,000 its purpose being to assimilate the Canton-Massilon electric line and to complete the Navarre extension south to New Philadelphia.

Pennsylvania

Harrisburg.—The Roscoe Electric Light Company has been incorporated with a capital of $10,000.

Altoona.—The Citizens' Electric Light Company has been incorporated by S. S. Reighard, Ferdinand Bendheim, Earl Olmes, Charles Moore, I. C. Neishler, W. W. Murray, C. E. Wolfe and T. M. Biddle with a capital of $150,000.

Delaware

Dover.—The Louisville Home Telephone Company has increased its capital stock from $1,000,000 to $1,500,000.

Maryland

Baltimore.—The Kingsbury-Samuel Electric Company has been incorporated with a capital of $5,000. The directors of the company are: Francis G. Boyd, Robert A. Regester, Myer Rosenbush, Gebhard Leimbach and William Hofmeister.

Wisconsin

Madison.—Marion Northern Telephone Company has been incorporated for $25,000, by W. R. Binkelman, Frank Leake, N. W. Engler, C. H. Zellmer, L. M. Goldberg, Charles Engel and J. D. Laughlin.

The Sparta-Melrose Traction, Light and Power Company has been incorporated for $25,000 by Robert W. Parker, Emil C. Wetten and Clyde A. Morrison.

Indiana

Anderson.—The Emporia and Anderson Telephone Company has increased its capital from $5,000 to $20,000.

California

San Francisco.—The Stanislaus Water and Power Company has been incorporated by W. F. Bierce, W. Gregg, Jr., J. E. Green, H. P. Veeder and H. G. Veeder. Capital $2,500,000.

Los Angeles.—The Kern County Electric Company has been incorporated at Los Angeles with a capital of $2,500,000. The incorporators are: V. McQuigg, S. A. W. Carver, G. E. Somarindyck and others.

Minnesota

St. Paul.—The Union Manufacturing Company has been incorporated with a capital of $10,000,000.

Argyle.—Argyle has voted $12,400 in bonds for an electric light plant.

Texas

Dallas.—Electric Light and Power Company; $700,000. Incorporators: J. B. Adone, C. A. Keating and others.

Ennis.—The Ennis Light and Power Company has been incorporated with a capital of $20,000.

West Virginia

Belington.—The Belington and Alston Light and Water Company under its new incorporation will furnish electric light, heat and power; capital $100,000.

Oklahoma

Guthrie.—The Lawton and Craterville Electric Railway Company has been incorporated by T. W. Brewer, C. L. Smith and others with a capital of $500,000.

The Blackburn Improvement Company. Incorporators: M. W. Rhodes, C. H. Schultz and others; capital $10,000.

Kentucky

Louisville.—Louisville and Mount Washington Railway Company; capital $10,000, with privilege of increase to $400,000. It is purposed to connect the two places named by an electric line, later extending it to several other points.

Paducah.—Paducah City Railway Company; $300,000. This company will absorb the Paducah Street Railway and Light company, and bonds amounting to $1,000,000 will be issued for improvements and extensions.

Iowa

Mitchellville.—An electric franchise has been granted by the city council to the Interurban Street Railway to run a line from Mitchellville to Des Moines.

Muscatine.—Citizens' Railway and Light Company; $600,000; Martin A. Devitt, Harry W. Huttig, incorporators.

Tennesee

Memphis.—The purchasers of the Equitable Gaslight Company and Memphis Light and Power Company will expend $100,000 in enlarging and improving the plants. The improvements will include the laying of forty miles of additional pipe.

Utah

Fountain Green.—The Big Spring Electric Company, which has recently been incorporated, will erect a plant to furnish light and power to Fountain Green, Maroni and other adjacent towns. Capital, $25,000. George Carter, president; A. J. Aagard, Jr., secretary and treasurer.

Nevada

Carson City.—The Nevada Construction Company; $100,000. Incorporators are: W. E. Sharon, C. A. Lux and J. N. Gardner.

Canada

Montreal—Sunlight Gas Company; Dominion charter. Incorporators: I. C. McRae, Thos. Harling and others; capital $50,000.

Victoria.—The British Columbia Cold Storage, Ice and Produce Company; B. C. charter; capital, $50,000.

D'Israeli.—The Chaleurs Bay Mills has been incorporated with a capital of $150,000 by John Champox and others. It is purposed to carry on lumbering, to construct mills, water works, electrical works, etc., and to manufacture pulp-wood, pulp, paper, etc.

Toronto.—Consolidated Electric Company; Ontario charter; to absorb the Dominion Electric Company; $100,000.

Cornwall.—Cornwall Street Railway, Light and Power Company; S. H. Ewing and others, incorporators. Capital $200,000.

Ottawa.—The Ottawa and Rideau Lakes Rapid Transit Company; Ontario charter; $25,000 capital stock.

Ottawa.—The Empire Electric and Manufacturing Company. Incorporators: Dr. C. W. F. Gorrell and others; capital, $40,000.

Arkansas

Little Rock.—Ice Plant. The City Ice Company has been incorporated with a capital of $11,000 by R. W. Walker, president; J. W. Walker, vice-president; C. T. Walker, secretary-treasurer.

Booneville.—Ice Factory. Booneville Ice Company. Capital, $9,000; incorporated by F. B. Coleman, Robert Young, A. G. Cochran and others.

Kentucky

Somerset.—Electric Light Plant and Ice Factory. H. C. Hubbell, of Xenia, Ohio, has purchased a controlling interest in the Somerset electric plant and will reorganize the company, and install an entirely new plant and an ice factory in addition.

Louisiana

New Orleans.—Ice Plant. The Washington Ice Company has been incorporated for the manufacture of ice, and will erect a building 155x36 feet and install a plant of thirty tons capacity per day.

South Carolina

Florence.—Ice Factory. O. G. Weston and H. C. Moshell of Georgia will erect an ice factory at Florence.

Indian Territory

Haileyville.—Ice Plant and Electric Light Plant. The Choctaw Ice Company, South McAlester, I. T., is erecting a twenty-five-ton ice plant at Haileyville which will be operated under the name of the Indianola Ice, Light and Power Company, with a capital stock of $50,000. C. W. Dawley, of St. Louis, Mo., is president of the company. The company will also install an electric lighting plant.

Guthrie.—Ice plant. The Ardmore Ice Company has been incorporated, with a capital of $50,000, by William J. Lemp, A. Rheumelli, Henry Suber, H. E. Foster and others.

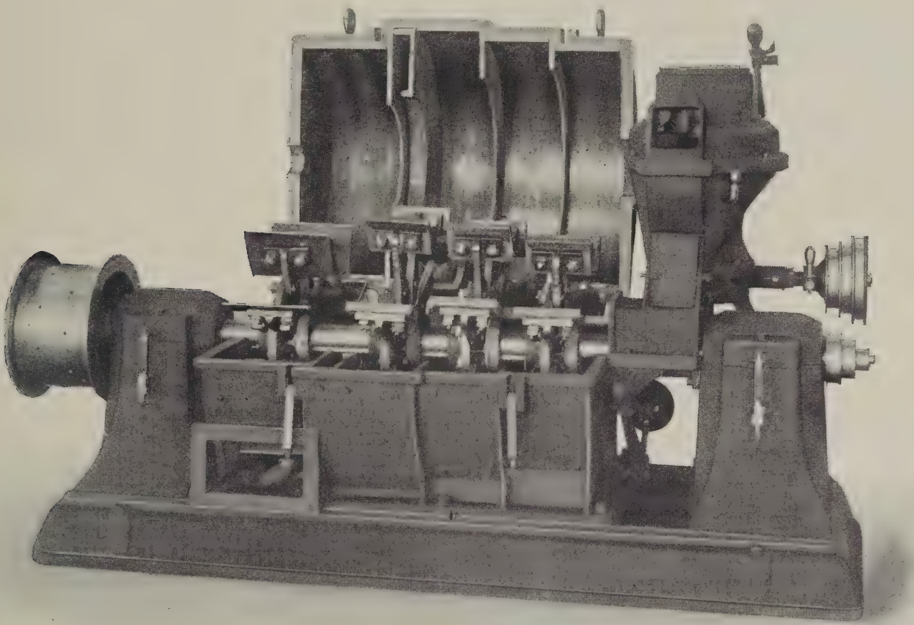
Florida

Mohawk.—Electric Plant and Ice Factory. E. Shook, of Mexico, Fla., will erect an ice factory and electric light plant at Mohawk.

Economy in Coal Combustion

By Gen. E. O. Eaton, U. S. A, Retired

Experts in the practice and theory of the combustion of coal have been of the opinion for years that the ideal way of obtaining the heat units contained in the fuel would be most surely attained by problem. This machine receives coal as it comes from the mine or car, and without preliminary drying, pulverizes it, mixes it with the requisite amount of atmospheric air, and delivers the mixture



The Aero Pulverizer. Open View.

burning the coal in a finely pulverized form with each minute particle of coal surrounded by an envelope of air just sufficient in quantity to produce perfect combustion. It is well known that during the last quarter of a century experiments innumerable have been made to perfect such a method. The idea itself seemed feasible, but the practical obstacles encountered were many.

The Aero Pulverizer Company, New York, is now bringing forward a machine which seems to have solved the

at the point of combustion, all by what is practically one operation.

The coal, before being fed to the machine, is first crushed by rollers, so that it will all pass through a one-and-a-half-inch ring. This is necessary so that the automatic feed when set for the delivery of a certain number of pounds per hour may do its work uniformly. One set of rolls will supply a large number of machines with coal crushed to an inch and a half diameter.

Each machine will deliver into the

combustion chamber any quantity of powdered coal desired up to 2,000 pounds per hour, and with the feed and air register once set, its action is entirely automatic, it being only necessary to keep the large hopper of the machine supplied with coal. The power necessary to run the machine is 15 h. p. The saving in fuel of twenty per cent or more over all other systems of combustion is claimed for the machine. One attendant can look after and care for many of these machines.

This particular system of combustion has had long continued tests made of it by the Illinois Steel Company, of South Chicago, Ill., where these machines have been in practical use for two years or more. The results have been so satisfactory that the company has recently placed an order for additional machines.

A successful machine of this kind has a very large future in the firing of stationary, marine, and locomotive boilers, the firing of rotary kilns in cement plants, the burning of brick and clay products of all kinds, as well as the manufacture of glass, and in many other fields where fuel is an important factor.

Rackarock Admitted to City Use

Rackarock, a comparatively new but well-tried composite explosive, which was shut out of use in New York under a ruling of former Fire Commissioner Scannel, has recently been admitted to use there, and is fast becoming a favorite with blasting contractors.

Rackarock belongs to that group of high explosives which depend for their explosive qualities upon having their chief component parts mixed together just before they are to be used for blasting. Up to the time of the mixing each of the ingredients is non-explosive, and perfectly safe to handle or store. Former Commissioner Scannel refused permission for the use of rackarock on the ground that the mixing of the two ingredients by the blaster came under the head of "manufacturing an explosive within the city limits," which is prohibited by law.

Commissioner Sturgis has not only reversed this decision, but has informed the manufacturers that so long as the ingredients are kept separate he does not consider it necessary for permits for their storage to be taken out from the Bureau of Explosives.

The general ingredients of this new explosive are a volcanic potash and a hydro-carbon in the form of an oil. The two are mixed by pouring the oil over the solid and letting it soak in. When mixed the mass is plastic and is easily forced into every crevice of the blasting hole. There is no danger in tamping, as nothing short of the effect of a powerful primer will cause the mixture to explode.

As the rackarock is of the nature of a gunpowder, and not like dynamite it requires that the charge be tamped to get its effect. It is asserted by the manufacturers that the rackarock does not lose its explosive qualities by being exposed to low temperatures and that the smoke resulting from its combustion is free from the irritating qualities complained of in many other explosives. The United States government uses large quantities of rackarock on public works.

Bushing a Cylinder in Record Time

Steamer Mohegan Laid Up but Twenty-Six Hours for a Job Which Other Machinists Had Estimated Would Take at Least Nine Days

By W. Christy

From many cases of undue wear brought to my notice of late, it seems to me that the manufacturers of engines are not as careful as they were of old in the selection of the grade of iron to be used in their cylinders. The effect of this is noticeable to a marked degree, not only in stationary engines, but also on marine work. It produces results which necessitate the frequent boring and bushing of cylinders which have given out in two or three years, where older makes which were working under practically similar conditions have lasted fifteen years or more before needing such repairs.

This excessive wear of cylinders is partially accounted for because of the general adoption of the expansion piston ring and the use of increased steam pressure as now practiced in many cases. The major part of the trouble lies, however in the use of soft cast-iron for the cylinders. The whole situation is further aggravated by another modern conception, viz., that a cylinder does not need any oil.

With a soft cylinder wall, a hard expansion ring, no lubrication and a constant over-load, it is not surprising that the cylinder is a hospital patient at just about the time it should be in the prime of life.

Moral: The iron in a steam cylinder should be as hard as it is possible to work it, or as an alternative the cylinder should be bushed when new with a very hard shell which would promptly, from wear, become as smooth as glass. The bushing would have the further advantage that it could be readily replaced in case of need.

But my story was to be about a record-breaking job of bushing a cylinder on board the Sound steamer *Mohegan.* The *Mohegan* arrived at her pier, East River, New York, on March 2 at nine A. M. Of course, steam was up, and everything was hot. Nevertheless, we tackled the job at once, by disconnecting the high-pressure end of the engine. The engine was of the triple expansion Roach type.

The cylinder to be repaired was twenty-one inches in diameter. The piston-nut on this pattern of engine has to be taken off before the piston can be removed. This always causes considerable delay. This done, we dropped the piston and the connecting rods were dropped into the pit. Then taking off the cylinder head and other trimmings we left the cylinder ready for boring.

The boring was done with a specially designed steam driven device. Two cuts were necessary, because the cylinder was so badly worn. The tool took out about one-quarter of an inch off each side. Accurate gaugings were then made and the lining, which had been previously prepared and was already in the lathe, was turned to fit the cylinder. The lining was made to fit the entire length of the cylinder, as I do not favor the idea of having it fit only on the two ends.

After the lining and cylinder padding were completed at the shops, they were taken to the steamer and, with special hydraulic machinery, the lining was forced into the cylinder; the necessary trimming up was done and we had what was probably a much better cylinder for wear than it was when it was new. All that remained was to assemble the engine, which was completed ready for business at eleven A. M., March 3, thus making the entire operation complete, including cartage from the steamer to the shops and return in the phenomenal time of twenty-six hours. The very best time promised by others was nine days. To tie up a steamer in the busy season for that length of time, means the loss of big money. The writer feels justly proud of the fact that the work was not slighted in any particular because of the rush.

Electric Lamps and Microscope Illumination

To be available for use with a microscope, a lamp must possess brilliancy and whiteness of light and be able to distribute its illumination evenly over a considerable surface. Ordinary incandescent bulbs are too small to serve unmodified as a source of light for microscope illumination, and the light itself is too yellow. Two simple devices, however, have practically overcome this objection, and a light which is nearly white is obtained by using forty-volt lamps on a fifty-volt circuit. While this gives much more perfect incandescence than the ordinary lamp adapted for the voltage used, the lamps burn out more quickly. Of such lamps in use in one specific laboratory, about twenty-five per cent have to be renewed annually. If the rating of the lamp is increased by five volts and used on the fifty-volt current, the lamp wears much longer and does not give such a white light, though for ordinary purposes it is good enough. To obtain an evenly illuminated surface a ground glass bulb is used which softens the light, which is then mounted in an ordinary reading-globe with mirror back and ground glass front, these mirror-backed globes being preferable to those having painted backs. While the light thus obtained is not perfectly white, it is enough so to prove satisfactory, and has been used in preference to daylight in the demonstration of minute structures. The essential feature of this plan is the diffusion of the light, as explained, and has bulbs adapted for a voltage of from five to ten volts less than that of the current in use.

While in a general way this makeshift has answered the purposes of the college where it is installed, and is considerably better than anything designed up to date, there seems to be a decided need for some practically white light for use in connection with microscopes. Inasmuch as laboratory work bears an important relation to the actual results achieved, it is easy to see how small a matter may be of importance, and it is only a question of time and attention when this matter will have a satisfactory solution. That there are also almost countless other uses for small and brilliant soft white lights is unquestionable, and the perfecting of such an illuminating device is a matter which should have the attention, not of an isolated engineer in some institution of learning, but rather of the fraternity at large.

Thomas A Edison

Edison

Ho ! Wizard of the Wire,
Stand forth and let us size you up,
The contents of the glory cup
You certainly have drained,
And that you are
The lightning pointed star
Of science needs not here be said,
But we will go ahead
And say it just the same.
Your name,
Upon the scroll of Fame
In letters of electric light,
Has turned the night
Into effulgent day,
And shown the way
To greater things than could be done
Had science had no Edison.
Although your ear
May have its dullness, you can hear
What no man hears,
Save you—the voices of the spheres
That whisper low
Their secrets to you for the world to know ;
And your incessant enterprise.
Brings from the skies
The power that man may utilize
To meet his million needs.
There may be critics, scoffers, too :
But what are they to such as you ?
What you have done
Successfully, Tom Edison,
Is quite enough
To meet their bluff.
The world, amazed,
Has followed in the way you blazed,
And, satisfied,
Will always point to you with pride
As leader who
Does what no other man can do.

Veritas.

Edison: A Character Sketch

By Francis F. Coleman.

Thomas A. Edison will always remain pictured in my mind as I first saw him, tilted back in a wooden chair on the uncovered stoop of the bare dry-goods box patterned office building at the Ogden mine in the mountains of northern New Jersey, his head uncovered, a big black cigar between the fingers of his left hand and a straw hat which had seen many years of service capping his right knee.

He was dirty and happy. He was dressed in linen. The straw hat and the linen suit may have been the same ones Mr. Edison wore in the sixties when he walked into Boston in the middle of winter looking for a job and carrying in his pocket the plans for the duplex telegraph with which he was soon to startle the world.

It certainly was to all appearance the identical suit which Mr. Edison wore last week when I sat with him in the library of the Edison laboratory at Orange, N. J.

The coat and trousers were of gray, the waistcoat of a yellow, tinted like the yellow pad upon which this article was written. All bore the stains of labor, and Mr. Edison's thick, strong hands were grimed with the dust and oil of the shops.

The sun shone on Mr. Edison's bared head, bringing into strong contrast his fresh-complexioned, boyish face and his thinnish locks of gray.

He was listening to two men who sat beside him on the piazza. They were each attired in spotless summer flannels and gayly ribboned, wide-brimmed straw hats. Their gay hose and smart shoes were in strong contrast to the dust-covered foot-gear worn by the inventor. All three displayed their foot-gear conspicuously as they sat tilted back against the office wall.

The train which had taken me to the Ogden mine was to return in fifteen minutes. As I approached the group, Mr. Edison's visitors arose.

"All right," I heard him say; "you may send it, and if it does what you say it will I will pay you for it."

The visitors were there to sell to Mr. Edison some new machinery for his now famous experiments at the Ogden mine, in crushing and electrically concentrating the iron ores of New Jersey.

The smile which accompanied Mr. Edison's farewell to his earlier visitors and his greeting to me was the most frank, open and charming that I ever saw. It reveals the character of the man. I had made the visit to get the data for a newspaper article about the work which Mr. Edison was doing at the mine.

For seven years he had been pouring money into the plant. Sundays were his favorite days to visit and inspect the plant. Mrs. Edison went with him. "He would pull down more work in a Sunday than we could build in a week," one of his workmen said, in describing those visits. One set of machines after another had been put into the mill, only to be replaced by still others. There were so many of these that a shed covering thousands of square feet had been built especially to store the discarded devices.

Mr. Edison had partners in the enterprise at first. After several years of constant expense and no apparent results, they began to complain. "How much have you got in this?" asked Mr. Edison. They mentioned the sum. Mr. Edison wrote out his check for it and assumed the whole venture himself.

Mr. Edison did not tell me these things. I gathered them from the workmen and the conductor of the train. Every man of that community felt as deeply anxious for the success of the Ogden plant as if his own money were invested in it.

Mr. Edison walked to the train with me and stood by the rear platform and continued our talk until the train left.

The experiment had been under way seven years at the time of my visit. An experimental run had just been made, which demonstrated that new and more powerful machinery would have to be installed to do what Mr. Edison required.

"They say it can't be done," said Mr. Edison, referring to the attitude of the iron masters of the country toward his experiments. "That is the best of reasons for doing it."

That is the keynote to Mr. Edison's character. To do the thing which others have declared impossible is his delight. To search six months for an oxide of iron for his storage battery cell without getting a single answering test was no more discouraging to him than if the time had been but an hour. This is the true spirit of the invention. To do the thing is his incentive. He may delude himself with the idea that his incentive is to make money out of his inventions, but he deceives no one else.

His is the true inventor's mind. Those who know Mr. Edison intimately declare that he has the faculty of absolutely blotting out from his mind the entire past history of any subject. Thus he is able to go at his inventive work unhampered by all that has been done and free from the prejudice of custom.

With a task accomplished he is satisfied. His mind turns then to new problems. But there can be no let-up until the task is done.

It was so in the old days at Menlo Park. Often, when some particular task was to be accomplished and the men were kept working day and night, Mr. Edison would call in an organ-grinder, whose music would keep the men awake. When the task was done he would hire a fishing schooner and take all hands on an excursion to the fishing banks.

Mr. Edison's heart is in his shops. There, surrounded by the men and materials which make all things possible, he is happy. Money making is with him an accident. Had he not fallen into the hands of the astute money makers of the old Western Union crowd, it is doubtful if he would ever have had a dollar. They made a slave of him and made him rich. But he was never really happy until he was able to break his chains, build a great laboratory for himself and breathe freely.

He refused a salary of $150,000 a year to be free.

Then he began to play. As a result we have the moving picture machine. Mr. Edison's original conception of this was in a combination where on a theatre stage a whole drama might be enacted by the figures in the moving pictures, while the phonograph would fill out the performance by reproducing the language of the players and the music of the orchestra. The making of the phonograph had been an easy task. A rough drawing put into the hands of one of his assistants brought forth the next day a machine which recited "Mary Had a Little Lamb," and all that remained was to perfect the machine mechanically.

To make the machine "fool proof" had been the harder task. Few who use the phonograph realize that it is a machine which requires the most exact adjustment. Making it "fool proof" meant the making of these adjustments automatically so that any one could use the machine.

The moving picture problem was greater. It brought Mr. Edison into the realm of chemistry, and perhaps fitted him for the problem he has just solved in the storage battery.

Pictures must be made so quickly that when they were thrown one after another on a screen the eye cannot take note of the changing. Thirty to sixty a second were necessary. Mr. Edison found there were no photographic plates which would work fast enough for his purposes. He equipped himself with a library on photography. He set for himself the task of learning all that had ever been done in photography and then going beyond it. In a few weeks the task was accomplished.

"They say it can't be done; that's the best reason for doing it."

Life Sketch of Edison

Thomas Alva Edison is now fifty-five years old. He was born at Milan, Ohio, on February 11, 1847. On his father's side he comes of Dutch stock. John Edison, the first of the family in this country, came to New York in 1737 and became a banker. His mother, Nancy Elliott, was of Scotch descent, but was born in New York state. Edison never went to school. His mother taught him to read and thereafter he read all the books he could get hold of. Among those which helped to form his mind was that admirable forerunner of the modern encyclopedia, Ure's "Dictionary of Arts, Sciences and Mining." Edison began life for himself at the age of twelve by selling newspapers on the trains of the Grand Trunk railroad. Encouraged by success he bought a lot of old type and printed the "Grand Trunk Herald," which he sold with his other papers.

In the summer of 1862 he saved the life of a child of J. A. Mackenzie, agent at the Mt. Clements station, and Mr. Mackenzie taught him telegraphy as a recognition of the act. At Port Huron, Cincinnati, Memphis, Nashville and Louisville he was employed and finally drifted back to Port Huron. Here he devised a way to use a single submarine cable for two circuits, saving the Grand Trunk railroad $5,000 and in recognition of this got a pass to Boston. As a telegraph operator in Boston he began the study of the duplex system, which he afterward developed into the quadruplex system. He arrived in Boston just after his twenty-first birthday and left in his usual impecunious condition about September 1, 1869, for New York. His career began on Black Friday, September 24, 1869. The Laws Gold Reporting Company's ticker service had broken down at a critical part of the day and six hundred brokers were fairly howling for quotations. Edison drifted to the door of the Wall street headquarters at that moment. "I guess I can fix it," he said. He did so. The next day he was engaged as superintendent of the company at $300 a month.

A little later he made a ticker of his own and got $40,000 for it. He fitted up shops for himself in Newark and was retained thereafter at a large salary to develop telegraph ideas for the Western Union and Gold Stock telegraph companies. That was in 1873. In this same year he married his first wife. She was Mary E. Stillwell, one of his employees. In 1874 the quadruplex telegraph was patented and put into use. In 1876 Edison moved to Menlo Park, where he became known as "The Wizard." By this time he had perfected forty-five inventions and received about $400,000 for them.

Among the inventions which followed where the micro-tasimeter, the odoroscope, the megaphone and aerophone, the phonograph, the harmonic multiplex telegraph, the pyro-magnetic generator and the electric pen.

The most important invention of the Menlo Park period was the carbon filament for the incandescent electric lamp and the system of lighting known by Mr. Edison's name. In December, 1879, the first exhibition of the system was given at Menlo Park with 700 lamps in use. In 1882 Mr. Edison came to New York to superintend the introduction of the lighting system in that city.

In 1886 he built the Orange laboratory. His forty-second birthday was celebrated by his staff by the handsome fitting up of the library at the laboratory where Mr. Edison now receives visitors.

At the Orange laboratory the kinetoscope had its birth, and here Mr. Edison has been working, developing his great ideas regarding ore-concentrating, the utilization of the heat energy of coal, and finally the production of his new storage battery.

Edison's First Invention

It was a lazy boy, tired of standing by an engine and working its valves back and forth at each stroke, who invented the eccentric and rod movement to work the valves while he went off for play.

Thomas A. Edison, liking to roam about at night when duty should have kept him in a telegraph office, invented the forerunner of the callbox for the district messenger and the fire alarm box, and Edison was then filling his second place as a telegraph operator at Stratford, Canada. It was a rule of the service that the night operators should signal the main office every half hour. Edison's call was "six." That half-hourly call worried him. He wished to be abroad. After thinking out the matter, he fixed up an attachment to the office clock to give the signal call "six." How long this method of evading duty would have lasted is but a matter of conjecture. Mr. Edison's recollections of his leaving Stratford are vivid. It was a rule of the road that when trains were to be stopped by the operator that he should stop them first and then notify the train despatcher that he was holding them for orders. Edison tried another way. He notified the train despatcher first and took chances on catching the trains. One day a train got by him. By good luck no accident resulted, but the general manager at Toronto threatened to make an example of him and send him to jail. Edison took advantage of the entrance of some visitors and fled. He caught a train for the United States and never went back. His salary for the time he worked at Stratford is still owing to him.

The First Incandescent Filament

Out of the thousands of people who nightly view the brilliant little incandescent lamps burning practically everywhere, how many are there who give even a passing thought to the invention of that most wonderful of all recent electrical triumphs? The circumstances that led up to its invention, and the extreme difficulties that the inventor, Thomas Alva Edison, met with in bringing it to a state of even comparative perfection are all so truly remarkable that they are worth telling, even to the *n*th time.

The "Wizard," as he is sometimes affectionately called by those who know him best, had just finished up the experimental work on his carbon button telephone when the electric light "bug" seized him. It was very fortunate for the world that he was at leisure at the time, for he at once began to look into the matter and started to work with the remorseless energy which is his most prominent characteristic.

Grosvenor P. Lowry was the man who, perhaps, after Mr. Edison himself, was the one most responsible for the incandescent lamp, for it was he who had the faith that the inventor could solve the problem of successful illumination by electric light. Mr. Lowry accordingly acted as the backer of what was destined to become the miracle of the nineteenth century. Without a moment's hesitation Edison tackled the problem, and as he has said himself of it:

"It was easy. All you had to do was to subdivide the light. The arc lights were too big; they gave too much light. It was also easy enough to see that the subdivision could never be made unless all the lights were made independent, each one free from the other. They could not, therefore, burn in series. They must burn in multiple.

"What did I do first? Why, I went out and got some very fine platinum wire; I think it was made in London. But it would not stand; we couldn't get it to work. Then we mixed iridium with it—about ten per cent—but we couldn't force that high enough without melting it, so we had to give it up too. You should have seen the stunts we did after that. We tried everything that fertile brains could possibly think of. At last we tried coating the wires with cerium oxide; then we fussed around with a lot of the things the Welsbach company uses now, but none of them were any good. Finally, as a last resort, I took a cylinder of zirconia. Then I wound it with about one hundred feet of the wire, which had previously been coated with magnesia from the syrupy acetate, my idea being to get a high enough resistance. The lamp burned: yes, and it short circuited itself! The oxide developed the same freaks that Nernst has run up against, but I did not know then what he does now.

"After that came a long period of wild experimenting with stuff like silicon and boron and fooling with things that could never have been of any advantage to us in spite of the delicate way we handled it. Queer thing that I never thought seriously of the carbon filament at that time. We had pretty good vacua, but I supposed the carbon would be N. G. because it was so susceptible to oxidation. At last, however, we determined to try it and see if the darned thing *would* work for us."

The old inventor's eyes snapped as he told his story, and the memories of twenty years ago warmed him up as he went on to tell of how the first filament was made, and how eagerly the anxious watchers in the little Menlo Park (N. J.) factory strained their eyes to see how long it would burn. Those forty-five hours in the laboratory when no one slept, but all watched the lamp, were the turning point in the history of the incandescent lamp, for when the test was over, and the filament had turned from yellow to dull red and then slowly faded away into the silence of ashes, the triumphant inventor said calmly to his associates: "If it will burn forty-five hours I know I can make it burn a hundred!"

"Well," went on Mr. Edison, "we got some ordinary cotton thread and carbonized it, made the filament, built the lamp and lighted it. It burned: how it did burn! None of us breathed for a few moments. We had no time to breathe; but we did measure its resistance, and we found that it gave 275 ohms, which was all we needed. There was the problem solved! Then we sat down to watch the thing burn. And we sat there for forty-five hours. Anxiety lessened as time passed, but no one could think of bed, and at last, when the lamp burned out, we got up and stretched our legs with a sigh of satisfied elation. Our dream was realized. I think that the longer that lamp burned the more fascinated we were. I was, anyway. That was October 21, 1879. I shall never forget the date as long as I live.

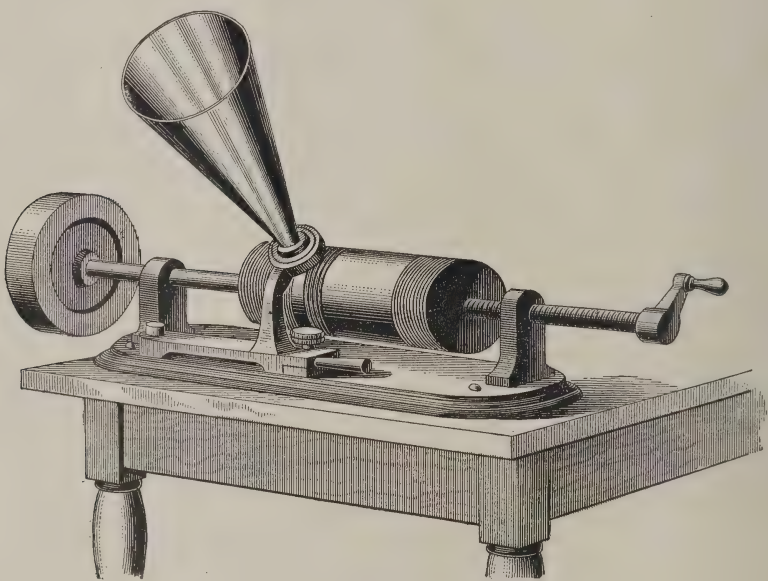
"That bit of cheap cotton thread settled the problem for us once and for all. I saw that carbon was what we wanted; but what kind of carbon? That was the question, and we tried all sorts of things until I finally carbonized a strip of the bamboo of a Japanese fan. It worked bully! That was the thing we were looking for, and I started in to get more of it, and better, at once. There was a fellow teaching school up in Orange that I knew I could trust, and I sent him to Sumatra. I've forgotten his name now. Then I sent another chap up the Amazon, and he got stuck there, but finally got clear and worked his way back through Bolivia. But though all these bamboos were good I was after something better and finally sent William H. Moore to Japan. That was where the real thing was; and he got it. He found an old Jap over there who did some fancy fertilizing and cultivating until he got the exact fibre we wanted. I understand he made quite a fortune out of the thing."

Something over a year ago Mr. Edison said in an interview that he believed the achievements of the twentieth century would far surpass those of the nineteenth, and when asked for his reason replied that there are now more expert electricians to work, and that they know more to start with than their confrères knew, "but," he added, "none of us knows anything about anything. We have only just got started. The achievements of the past century are only a starting point, and you know that in electricity 'impossible' is an impossible word."

With Edison at Menlo Park

By an Assistant

These were very busy years for Mr. Edison. His method of working was to come to the laboratory about seven o'clock in the evening and look over all that had been done during the day. His favorite resort was in the upstairs laboratory, which had numerous large tables around the room. One of his favorite positions was to sit on the edge of the table with his head bowed down and swing his legs. He would sit in this position for hours sometimes. Then he would reach out his hand for a blank book. The laboratory was strewn with letter paper and note-books. Mr. Edison would make with a few clear lines a sketch of what he wanted made. In the art of conveying with a few lines a comprehensive view of the apparatus or experiment in his mind, Mr. Edison was never excelled. The drawings were as clear as the free round script in which he described the material to be used.



The Phonograph of 1877

Always between twelve and one o'clock the midnight lunch was served, brought up in baskets and spread on one of the tables. Then all the assistants knocked off work for an hour and helped themselves, and this was the time for skylarking. About one o'clock we all settled down to work for the rest of the night. If any of the assistants had found difficulties in his working or anything unusual had occurred in the high vacuum carbonizing or chemical department, they would go to Mr. Edison, and he would take up the matter, making out a schedule of experiments or sketching out new devices to get around the troubles, and the "old man" hit the trouble nearly every time. There was a spirit in the laboratory which required that when an assistant found any difficulty he was to keep right at it until he got at the bottom of the trouble; if it was a physical difficulty, Mr. Edison was with him. I recall one occasion when a peculiar phenomenon occurred in a lamp, due to the action of what is known as Crook's radiant matter, and I remember well staying by this experiment night and day for seventy hours and finally discovering that the trouble arose from having too high a vacuum in the lamps.

The scope of Mr. Edison's work at this period covered the whole range of the physical sciences, from measuring the heat transmitted by the stars by means of an instrument which took the form of the tasimeter, to experimenting with the microphone, which would record signals from circuits whose resistance was greater than that of a No. 8 telegraph wire girdling the earth; mercury vacuum pumps which would produce a vacuum higher than ever before attained; hydraulic presses which would produce pressures beyond 1,000 tons per square inch, besides glass-blowing machines, signals, dynamos, underground conductors and traction experiments. Thus he accomplished the practical utilization of what had before been used only in refined laboratory research.

As the result of these things accomplished, billions of dollars of capital are invested, and thousands of men are engaged in the operation and construction of systems, the underlying principles of which were reduced to practice by this master mind, Edison.

This was not accomplished by the forced genius alone. Edison has coupled with his genius an indomitable will and an intensity of purpose which penetrates the mysteries of physical phenomena, conquers their idiosyncrasies and adapts them to become the necessary agents in the economical progress of the arts and industries.

The story of the successful inventor is that of one whose confidence in his creations cannot be shaken by the opinions of others, and whose faith and pluck gives him the fortitude and endurance to overcome all obstacles and establish the value of his invention before the people. To Edison this applies with the greater force as the opposition which he had to overcome was great and the discouragements met with seemed as if they would be interminable in the early days of '79 and '80.

The Edison Storage Battery

When Mr. Edison undertook to make a new storage battery cell he set for himself the task of finding material for plates which should possess the following qualities:

Absence of deterioration by work;

Large storage capacity for the weight of the mass;

Capability of being rapidly charged and discharged without injury;

"Fool proof";

Cheap to make.

It is well known that in any battery cell where the electrolyte is acid the other materials of the plates are attacked and destroyed. It was evident then, to Mr. Edison, as it has been to other inventors along this line, that the ideal battery must be one which used an alkaline solution. Then, by a process of reasoning which has been followed by others as well as by Mr. Edison, came the elimination from consideration of all metals for the plates excepting steel and nickel.

Mr. Edison had considered this matter once before, years ago, but at that time had only gone far enough into the subject to decide that, "if God Almighty had wanted the people to have a storage battery He would have made it of platinum."

The story of the long and intricate researches by which Mr. Edison produced his new storage battery will undoubtedly be told by him in due time. It is known, however, that when he began his search for the oxides of iron and nickel which he finally discovered, there were none of either known to science which would give the necessary reactions. Satisfied in his own mind that somewhere in the range of the combinations of oxygen with these metals the needed oxides could be found, he undertook an elaborate system of experiments, trying in succession each grade of oxide in turn. After months of endeavor he hit upon the necessary oxide of iron, and this accomplished, he continued the quest until he found the nickel oxide which he had to have to go with the first.

The Edison storage battery consists of grids made from plates of steel of about the thickness of ordinary tin plate, each grid carrying a considerable number of steel boxes containing the oxides. The plates made for automobiles each contain twenty-four of these boxes of oxides, each box measuring three inches in length by one-half an inch in width. The boxes are made of a crucible steel and are finely perforated on either side. The positive and negative plates look exactly alike when they are finished. Except for the difference in material, the method of manufacturing them is the same. The oxides are each mixed with about an equal volume of a specially prepared flaked graphite, moistened with a material which tends to stick the parts together, and are then made into briquettes by pressure. Each briquette is then enclosed in one of the steel boxes, which are then put into the openings in the grid and fastened into place by being subjected to a high pressure. To protect the plates from rusting when exposed to the air, each part is nickel plated. The electrolyte employed in the cells is caustic potash.

According to Dr. Arthur E. Kennelly, who has officially described the Edison cell, the action of the cell while being charged and discharged seems to involve no chemical change excepting the transference of oxygen from one plate to the other. During the charging, the oxygen goes over to the nickel side, and returns to the iron side during the discharging process. Although Mr. Edison still refrains from expressing any opinion as to the success of his new battery, it is fair to assume that he thoroughly believes in it from the fact that he has a factory for its manufacture all built and ready to operate so soon as the last tests of the battery, which are now under way, are completed. These tests consist of the operation of five heavy motor-cars, each to be run over common roads for a distance of 5,000 miles. They will not be finished for perhaps two months. As a preliminary to the endurance tests, Mr. Edison has already tested his batteries in the laboratory and in automobiles, trying their qualities by rapid charging, rapid discharging and in various other ways. It is declared that the batteries have withstood all of these tests without injury.

Dr. Kennelly, in his tests, found that although the normal period for charging or discharging the Edison cell was six hours, they could be charged or discharged within an hour, and this without suffering injury. The capacity of the cell is given as one horse power for 53.3 pounds of battery.

The Storage Battery

Perhaps the most remarkable thing about the storage battery is that it does not store electricity. Electricity can no more be stored than can the ripples raised upon the water's surface by a summer wind. Each is but evidence of power. Although each is capable of transmitting that power and of making it manifest, yet in neither does there reside any original force.

Persons who aim to be exact in their language no longer speak of the "storage" battery; some of them style it a "secondary" battery, while others who are still more exact denominate it "reversible" battery. Yet nothing is more natural than to call it the storage battery, and that term will undoubtedly be retained in common use indefinitely. To one who watches the operation of "charging" a storage battery, the name seems entirely appropriate. You see the operator connect his wires to the battery and turn in the electric current exactly as if he were turning into the battery a supply of gas or liquid, or some other material thing. Bye and by the battery begins to "boil" and the operator declares that it is "full." If the current be permitted to continue beyond this point the boiling will become much more violent, and strong acid fumes will be emitted; the operator says the battery is "overcharged."

Now the wires are disconnected from the charging source and connected to an electric motor, and there flows forth from the "charged" battery a current almost equal in volume, strength and quantity to that supplied from the original source. Truly, it seems as if the electric force had been "stored" within the battery and was now being withdrawn exactly as if it were compressed air, while, as a matter of fact, this is in no sense true.

The storage battery differs only in a slight degree from the simplest of simple primary galvanic batteries. In the simple galvanic cell, the electric current is produced by the gradual dissolution of one or more elements. If we take the simplest form of this cell, for example, where a copper plate and a zinc plate are immersed in an acid solution, the zinc plate is dissolved as the current is produced and finally, when the battery is "run down," nothing remains of the metallic zinc; it is all in solution. If it were possible with such a battery to restore the zinc and the acid solution to their original conditions by sending another electric current through the battery in a reverse direction, then we should have in this cell a storage, secondary or reversible battery.

The first person who succeeded in making a cell of this description was Gaston Plantè, in 1860. Today the Plantè type of plate remains the most satisfactory of all those in the market for general use. Plantè's battery consisted of two thin plates of lead, separated one from the other by a piece of felt, and then rolled in a spiral about a core of wood. The plates were immersed in a dilute solution of sulphuric acid, and the active material consisted of a coating upon the plates of peroxide of lead, or as it is commonly known, red lead. The steps which led up to the making of the Plantè battery were begun almost from the moment that the simplest form of galvanic battery was known. In 1800 Volta discovered the galvanic battery. In 1801 Gautherot found that if platinum and silver electrodes were connected after having a voltaic current passed through them, a secondary current would flow from them for a short time. Ritter, in 1803, observed a similar result with gold wire, and he constructed the first storage battery of which we have any record. His battery was made of plates of gold, separated by cloth discs moistened with ammonia.

Schoernbein, in 1837, found that the peroxide of lead gave similar results, and a little later Sir William Grove discovered that metal plates with a layer of oxide on them gave a better action than plain metal plates. Wheatstone and Siemens found later that the peroxide of lead used in this manner gave the best results. Michael Faraday, while experimenting with the electrolysis of a lead acetate, found that the peroxide was produced at the positive pole and that metallic lead was at the same time produced at the negative pole of the bath. These discoveries led naturally to that of Plantè, who found by passing a current through his lead plates that upon one of them would be produced a coating of peroxide, which in turn would be partly decomposed and produce a primary current when the battery was disconnected from the original source of energy. It was found, also, that by reversing the charging current from time to time the strength of the battery was greatly improved.

In fact, with this type of cell, an energy efficiency of seventy-two per cent has been obtained, with a capacity of 11.239 foot-pounds per pound of lead.

The next type of storage cell produced was that of Faure, who used perforated or grooved lead plates and filled in the perforations or grooves with the peroxide in the form of a paste. These plates have the disadvantage that it is difficult to prevent their shedding the paste. Another type of storage battery cell is that which uses an alkaline solution in combination with lead peroxide or copper.

Many improvements have been made in the mechanical forms of these various types of plate. Most of these improvements have been directed toward giving a larger active surface to the material in the plates or to give to the plates a firmer grip upon the active material. The "chloride accumulator" plate made by the Electric Storage Battery Company of Philadelphia is one of, perhaps, the most satisfactory plates now in the market. This plate consists of a grid of alloy containing for one element square perforations, and for the other circular perforations. The square perforations are filled with masses of spongy lead produced by the chloride process which gives the battery its name. In the circular perforations through the other plate are spiral coils of thin strips of lead, each strip crinkled for its whole length before it is bound into the coil. The purpose of this is to render the coil porous to the acid solution in which the plates work. Upon the surface of these crinkled coils of lead the active peroxide is produced by constant charging and recharging electrically exactly as Plantè produced his original plates.

The action of the storage batteries described above is simple upon the face of it but extremely complex in fact. When the batteries are charged oxygen is carried over to the peroxide of lead plate through the medium of the acid solution and when the batteries are being discharged the oxygen goes over to the spongy lead plate. The galvanic action ceases, or the battery is "run down" when the two plates each contain similar amounts of oxygen.

That the storage battery plates of commerce are meeting a great need is best proven by the millions of dollars' worth of them now in use. Electric lighting companies and street railway companies use batteries in enormous quantities for equalizing the demand on their generating stations, while thousands of isolated plants use them for lighting and other purposes. The disadvantages of the lead storage battery are also well known; to preserve them and to get good commercial results from their use they require most careful and intelligent treatment. If they are overcharged or discharged to a point within twenty-five or thirty per cent of their limit, or if they are charged or discharged with great rapidity, they are likely to be seriously injured or rendered absolutely useless by the shedding of the active material from the plates. Like results are also apt to occur where the plates are subjected to a vigorous shaking up in the cells. The lead plates also have the disadvantage of their weight.

In practice, a horse power requires for its production from one hundred and twenty-five to one hundred and eighty-five pounds of the lead storage battery. Many styles of the lead plate have been made which give a larger output than this for the weight, but these lighter plates lack durability.

It is to overcome these various disadvantages that many successful inventors are working.

The storage battery business of the United States amounts to about $5,000,000 a year. By far the larger part of this business is done by one company, the Electric Storage Battery Company, of Philadelphia. This company alone has installed up to this time in central stations, railway service, on yachts and in government plants, batteries with a total capacity of 249,387 kilowatt hours. This is equal to more than 330,537 horse power hours. Outside of these installations, the same company has furnished batteries equal to 50,000 kilowatt hours for laboratories, car lighting and like purposes. Besides these are still others, of which no separate record has been kept, used for central telephone station batteries amounting to something like $300,000 a year, batteries for fire alarm systems and for telegraph and railway signal service. Of the plants using this battery whose number has been tabulated there are 210 railway lighting plants, sixty-nine central lighting station plants, 448 isolated lighting plants, one hundred and eleven yacht lighting plants and 126 plants used in the government service.

His First "Big Money"

Edison himself has told the story of how he got his first "big money" and of his astonishment at the sum.

After serving the Laws Gold Reporting Company for a time, Mr. Edison had joined the service of the Gold & Stock Telegraph Company, then under the presidency of Marshall Lefferts. Furnished with ample facilities for his work, Mr. Edison then began turning out stock printing and other devices in great numbers.

A committee of the directors was finally appointed to wait upon Mr. Edison and negotiate with him for the purchase of some of these inventions.

Mr. Edison knew they were coming, and also knew their purpose. Wild visions of wealth swept through his mind. He has acknowledged since that he hoped to get as much as $5,000 for the inventions, but as he needed money badly he had made up his mind to take whatever was offered.

"Well, Mr. Edison, how much do you want for your devices?" asked one of the committeemen. It was a critical moment. Mr. Edison hesitated.

"I do not know what they are worth," he said. "Make me an offer."

"How would forty thousand dollars strike you?" asked the committeeman.

Edison was so nearly upset that for a moment he was speechless. Then he accepted the offer. But the more he thought over the matter the more sure he became that there was some trick about it, and that he would never get his money. Two days later he signed the contract and received a check for $40,000. The check was on a bank at Wall and William streets. Mr. Edison had never been inside a bank. He went down to the bank building with the check in his pocket. He hung around to see what people did in a bank and then he went in.

He took his place in line and in due time arrived at the paying teller's window.

"When my turn came," Mr. Edison said, "I presented the check and the teller yelled out a lot of jargon to me. I did not understand him on account of my deafness.

"Again he roared something at me, but I did not understand it. I took up my check and passed on."

Mr. Edison was now sure that he would never see that $40,000. He sat down on the steps of the bank to think it over.

Then he went back to the company's office and told a clerk about it.

"They wanted you to be identified," said the clerk.

With that $40,000 Mr. Edison opened the first shops of his own.

Edison's Laboratories

Edison's first laboratory was in a baggage car on the train where he sold newspapers. Fired by his readings in Dr. Ure's dictionary of the arts, sciences and mining, he had invested money in a lot of chemicals and was trying experiments in analytical and qualitative analyses. The joggling of the train shook a cork out of one of his bottles one day and resulted in setting fire to the car. That was the end of Edison's occupancy of the car.

The great inventor's next laboratory of his own was in Newark. Here he had fair facilities for carrying on original work, but nothing as compared with what he needed. Nearly all of the 300 men employed there were engaged in doing purely commercial work.

Not until Mr. Edison went to Menlo Park did he have anything like the facilities which he had longed for. At Menlo Park the laboratory was one hundred feet long by thirty-five feet wide and an eighty horse power steam-engine drove the machines. Edison had been gathering books all his life before, but now he gathered around him the beginnings of the complete and well-selected library which is now at Orange.

The Orange laboratory is many times the size of the old one at Menlo Park. The main building is three stories in height and measures two hundred and fifty by sixty feet on the ground. Four other buildings, each one story high, and one hundred by twenty-five feet in area, complete the group. In the same enclosure, but not belonging to the laboratory group, are large factory buildings devoted to the making of phonographs, phonograph records and some other things.

The great mill and mine at Ogden, N. J., where Mr. Edison has carried on his extensive experiments in concentrating iron ore, and the cement factories at Stewartsville, N. J., to be opened this month, are, however, almost strictly parts of Mr. Edison's laboratory.

The Ogden Mine and its Lessons

The problem which Mr. Edison set for himself when he bought the Ogden mountain and began his experiments at the Ogden mill was: How can the iron business of the country be brought back to New Jersey? In the mountains of New Jersey there is more iron than there is in all the rest of this country, Mr. Edison has declared, and for bessemer steel-making its quality is the best in the world.

"I have iron enough in this one mountain to supply the entire needs of the United States for the next 250 years," Mr. Edison exclaimed one day, as he stood watching his miners at work.

Only a generation ago New Jersey was the center of the iron industry of the country. Then came the discovery of the richer ores of the west and south and her mines and furnaces were practically abandoned.

"No furnaceman can to-day afford to put into his furnace ores of less than forty per cent iron, and our ores only average fifteen or twenty per cent," Mr. Edison said. "What I intend to do is to crush the rock into fine sand, drop it down a tower, draw the iron and its adherent sand to one side by magnets and sell this concentrated ore to the furnacemen after sticking it together and pressing it into briquettes."

Mr. Edison's problem was one purely of cost. He must be able to mine and concentrate his ore so cheaply as to deliver it to the furnaces at a cost in competition with the western ores. New methods had to be initiated right from the start.

"I found," said Mr. Edison recently, "that the ore was costing me $1.50 a ton delivered at the mill. I have reduced that cost to fifteen cents a ton at the mill. There is the same energy in a ton of coal as there is in a ton of dynamite. The only difference is that in the one case the energy develops quicker than in the other, but each is capable of doing the same work. A ton of dynamite costs $280—a ton of coal $2.80. I found that the miners were breaking out the ore by drilling a row of holes three feet back of the face of the rock. The holes were twelve feet apart and twenty feet deep. Into each hole they put twenty-five pounds of dynamite. The result was that for each charge we got 720 cubic feet of rock. It is true it was nicely broken up, and ready for the ordinary crusher. But it was expensive.

"I had the men drill their holes twelve feet back of the edge, twelve feet apart and twenty feet deep. Into each of these we put the same twenty-five-pound charge of dynamite. It split the rock off just as surely, only we had it in big chunks instead of little ones. Instead of 720 cubic feet, we had 2,880 cubic feet.

"Now, how should we handle the five-ton chunks of rock? I put in a steam shovel that takes those chunks up as if they were gravel and loads them into cars. At the mill I have crushers that seize chunks of rock as big as a dry-goods box and crush them into fine bits as if they were crackers.

"It looks astonishing, but it isn't. It's really a shame to take men around and astonish them with the sight. It's a fake. It doesn't take any more pressure to the inch to crush a big piece of rock than for a little piece. It's the impact that does the business. It takes eighty horse power to run those rolls when they are doing no work. It only takes eighty five to run them when they are grinding up the rock."

Nobody but Mr. Edison knows what

the experiment at the Ogden mines has cost him, and the process there has not been a commercial success.

"They say it is a failure," said Mr. Edison, continuing, "but my agents have just found without any trouble a $5,000,000 company to carry on the process abroad. Stoppages made the process cost too much at the Ogden mill. The mill was meant to run almost automatically and with but few men, but even their wages run up if your mill stops. We could only run about seven hours at a time instead of twenty-four. Then something would break down. The sharp dust from the crushed rock got into our bearings and cut them out. But we are using the same methods in my cement mills, only our new bearings are all protected with stuffing boxes."

Brickmaking at a Gas-Works

FROM A PAPER BY FREDERIC EGNER

The most all-round interesting gas-works ever seen by the writer was the Crystal Palace district station of the South Metropolitan Gas Company of London. George Livesey is the presiding genius of the company, while Sydney Yarrel Shoubridge is the very efficient engineer in immediate charge of that work and district. Here they have inclined and horizontal retorts with West's stoking machines, water-gas, sulphate works, complete shops for making and repairing meters and gas-stoves, machine shops and foundry and a brickyard. They are building a new retort house for inclined retorts with brick made by the otherwise idle retort house stokers, from clay dug from what is going to be a new gas-holder tank, which the company proposes to possibly erect next year. The brick-making machinery is driven by a gas-engine, and as there is a great outside demand for the quality of brick made by Mr. Shoubridge, they sell all they can turn out and do not require themselves, at a net profit of $2.40 per 1,000. They make red and yellow brick and also all the fire-brick, blocks and tiles they need. An old disused horizontal retort stack of arches has been converted into very good brick kilns. They have not yet essayed the making of retorts, but Mr. Shoubridge seriously thinks of doing it, but the block and fire-brick made in the works will bear comparison with those made and obtained through the regular channels from elsewhere. Another novelty seen there was a pressure-regulating valve, the invention of the foreman of the shops. This valve does absolutely and accurately hold the pressure at any point for which it is set, from a few tenths water pressure up, while the initial pressure may vary, and rapidly, too, from the low point desired to 100 pounds, or 180 pounds per square inch. This the writer has seen tested on the spot, and it seems to be quite simple and inexpensive in construction. Its application to high-pressure gas mains where a reduction afterward to a very low pressure service main is desired seems easy.

The New East River Bridge, New York City.

Cable-Making for the New East River Bridge

By Wilhelm Hildenbrand, C. E.

Engineer for Cables of the Bridge.

The construction of a bridge has at all times and among the majority of people created a certain wondering interest, considerably greater than is caused by the erection of a building, probably because the interior forces working in the former, to hold its parts together, seem mysterious to the uninitiated, while he can readily understand the stability of a building by seeing, on a solid foundation, stone on stone, or brick on brick laid, even to a great height, as long as each wall appears to have an ample base to stand on. While harmony of proportions, architectural beauty and practical usefulness are the principal objects admired in a building, it is in a bridge either its massiveness and strength, or its graceful lightness, but, especially, its length between supports, which excites the admiration of lookers on. The longer the span and the lighter the bridge appears to be, while it visibly carries heavy weights, the greater the wonder with which the structure is viewed, and the greater the interest or curiosity to know how such a bridge is put together to make its standing in the air possible.

Of the different types, the longest spans are attained by wire suspension bridges, which are also distinguished for their airy, lace and web-like construction, and graceful outlines. The erection of such a bridge differs notably from that of stone or ordinary iron bridges. While the latter, during the time of building, are resting on heavy timber frames, called falseworks, the former are built, almost invisibly, in the air without intermediate supports between the end abutments. A few tiny wire ropes with a narrow footpath laid over them, and several light platforms swinging from them on which men can be seen moving up and down, leaning forward or backward, are all that from below can be observed of the construction of the wire cables which are to sustain a great bridge weighing many thousands of tons.

Such cable construction has, for a number of months, been going on at the new East River or Williamsburg bridge.

To the observer below this work appears to make no progress. For days and weeks he sees nothing new, though every day hundreds of wires are added to each cable, which fact remains unnoticed, because, even in their finished condition, the cables are so small (only eighteen or nineteen inches in diameter) that they look, at that great height, like threads, which are lost among the web of wire ropes and timberwork of which the temporary working bridge is composed.

In order to understand how cables are made, it is necessary to go on top, to examine all machinery and accessory structures, to take a walk over the footbridge for following the cable from end to end, and to watch the silent but diligent work of hundreds of skilled mechanics and laborers who, divided into a number of gangs, obey the directions of their respective foremen. Before taking this trip on paper and explaining the various operations of cable-making, it may be of interest to give a short historical review.

The process of cable-making, as hereafter described, dates back to 1844, when John A. Roebling built the cables for an aqueduct over the Allegheny river at Pittsburg. Roebling is the inventor of the "spinning in the air" method which, up to the present day, has not been surpassed by any better method, and which, substantially in the same way as sixty years ago, is used for the construction of the cables for the new East River bridge. The improvements made in cable-building, since Roebling's time, do not refer to the principle, but are merely those of details, or due to the general progress in the efficiency of machinery and the quality of material.

John A. Roebling built, between the years 1844-1850, after the Pittsburg aqueduct pattern, six other bridges over the Monongahela, Delaware, Neversink and Susquehanna rivers. In 1854 he built the famous Niagara bridge, which was the first, and, up to the present day, has been the only railway suspension bridge in the world. In 1860 he began, and finished in 1866, the great bridge over the Ohio at Cincinnati, which, for many years, was the longest span bridge in the world, until it was surpassed by the Brooklyn bridge, finished in 1883, which was planned by the same engineer, but built by his son, Washington A. Roebling. After the completion of the Brooklyn bridge there was a long interval in the construction of cable-bridges. No bridge of this kind was built until the above-mentioned Cincinnati bridge was reconstructed and enlarged by the writer, who, for this occasion, constructed a new pair of cables by the "spinning in the air" process in 1896. Another interval of six years, in which no cables were built, elapsed between the construction of the new Cincinnati bridge and that of the new East River bridge. The cables for the latter bridge are the largest ever made, and their construction has just been completed after the plans and under the superintendence of the writer, as engineer for the John A. Roebling's Sons Company, of New York, under the direction of C. G. Roebling, the youngest son of the original constructor of wire cables.

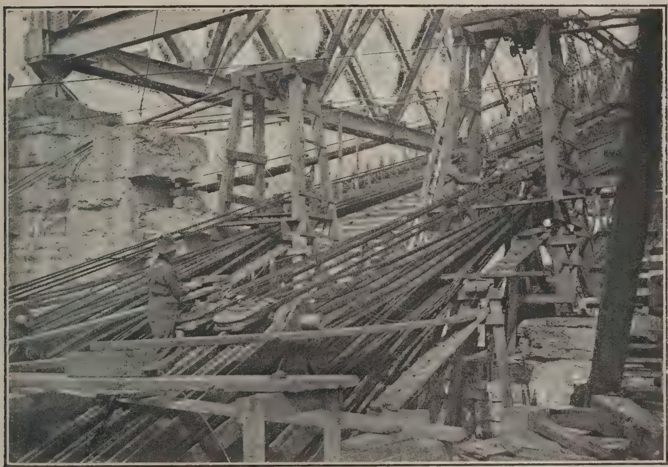
From the foregoing historical sketch it appears that the number of cable-bridges is very limited, and that the art of cable-making has, so far, been confined to only a few engineers.

While a description of the construction of the new East River bridge cables will not materially differ from what it would be if written twenty years ago for the old Brooklyn bridge or any other cable, it will probably be a little more interesting, not only on account of the great size of these cables and the exceptional material they are composed of, but also on account of the remarkably short time in which they were constructed and the means applied to accomplished that end.

The beginning of cable-making consists in the erection of some auxiliary structures and of the cable-spinning machinery. Of course, it is understood that the towers on which the cables rest, and the anchorages to which their ends are fastened, are in place before the temporary structures can be built.

At the old Brooklyn bridge and other bridges the auxiliary structures consisted of one narrow footpath for facilitating intercourse between the shores, and of two or three light cross-bridges called "cradles" for places of observation while regulating the wires, all suspended from four or five single wire ropes.

At the new East River bridge a more stupendous structure was erected with the idea of giving access to the cable as a whole and to each strand singly at all points from end to end, which, it was supposed, would facilitate and hasten several operations necessary in cable-making. The result corroborated the correctness of this supposition, as will be seen later on. The auxiliary structure in this case was nothing less than a large temporary suspension bridge consisting of four double-deck footways or working platforms, one for each cable and directly under the same. To understand the object of a double deck, it may be explained in advance that the total mass of wires in one cable is subdivided into separate bundles called "strands," which are manufactured in a higher position than that which they ultimately occupy. The upper deck of the foot bridge, hangs three feet under the strand while it is manufactured, and the lower deck is about two to three feet under the strand in its final position.



Cable-Shoes in Position While the Cable is Being Made.

The difference between the upper and and lower position of a strand is fourteen feet in the middle of the span, running out to about two feet at the towers on top of the saddles. The foot bridge is suspended from four lower and four upper cables. Each of the lower cables consists of three two and a quarter-inch steel wire ropes, and each upper cable of a single two and a quarter-inch rope. The combined strength of these sixteen wire ropes is 3,328 tons, while the total weight of the center span of the foot bridge amounts to five hundred tons. From the accompanying pictures of the foot bridge structure it will be noticed that it really consists of two separate bridges, about sixty feet apart, connected by a number of cross bridges, which serve not only as a convenience for communication but also as stiffeners and lateral struts in order to guard the bridge, in conjunction with four inverted storm-cables, against excessive side swaying and vertical oscillations.

A novel method for erecting this bridge was adopted. Three of the large wire ropes, coiled on drums, were placed on a scow in front of the New York tower. The ends of the ropes were lifted over the tower and carried back to the anchorages, where they were secured to special anchor girders. The scow was then towed across the river and the ropes, paying out from the drums, were allowed to sink to the bed of the East River, whence they were afterwards hoisted into position. This was done by taking the ends of the ropes over the Brooklyn tower and connecting them with powerful tackle blocks and quick-acting machinery, which accomplished the raising from the river's bottom to a point high above the highest shipmasts in about five or six minutes. During this operation navigation had to be interrupted, and, as a whole, it was in some respects a hazardous undertaking, because a rope might have been caught under a rock, or sunken wreck, which would have been followed by the rupture of the cable or a break of the machinery and be the cause of much loss of time and money, if not also of life. Fortunately all the cables were raised without delay or accident, but it was a great relief to the engineers and all connected with the work, when the last rope swept the surface of the water, raising a long streak of white foam, and a minute later was seen swinging in the air, one hundred and sixty feet above, covered with seaweed and debris from the depths of the great waterway which the new bridge was to span, destined to form the second connecting link between the cities of New York and Brooklyn.

A second important auxiliary structure for making cables is what may be called the "spinning apparatus." It consists principally of a moving endless wire rope to which a wheel is attached that carries the wires from one end to the other. The rope passes around end-sheaves, located on the anchorages, one of them being driven by a steam-engine with appropriate gearing. Between the anchorages the rope is supported by rollers on top of the towers and at several points on timberframes erected on the foot-bridge. The attachment of the wheel to the rope is made by a contrivance called a "goose-neck," which enables the rope and wheel to pass over the supporting rollers without impediment or violent shocks. In the case of the new bridge there are two endless ropes, stretched a little above the line of the main cables, with four carrying-wheels attached, one for each cable, which, by traveling forward and backward, supply the wires for the four cables. The traveling rope has a diameter of three-quarters of an inch and it requires an engine of fifty horse-power to drive the apparatus, while each wheel carries two wires, with a speed of four to five miles per hour.

Beside the foot-bridge and traveling rope, it requires a number of other machines and tools for a complete cable-making outfit, of which mention will be made while describing the different operations.

It has already been stated that the whole mass of wire in one cable, for convenience of regulating and of making end attachments, is subdivided into separate bundles or strands. The number of strands may be chosen arbitrarily, but in order to obtain a cylindrical cable by squeezing the strands together, it is necessary that they should be laid up in the form of a regular hexagon, which requires either 7, 19, 37, 61 or 91 strands. Mr. L. L. Buck, the designer and chief engineer of the new East River bridge, decided on thirty-seven strands, each to contain 208 wires and to be three inches in diameter. For attaching the chosen number of strands to the anchorage, the end of the anchor chain was arranged in four tiers, each consisting of three groups of eyebars with four bars in each set, connected by a single seven-inch pin.

The end loops of each strand pass around a horseshoe-shaped steel casting called a cable-shoe, which fits in the space between two bars and is held there by the same seven-inch pin. All groups of anchor bars are arranged for three strands, with the exception of the center group in the second tier, which has four strands.

In describing the foot-bridge it was mentioned that the strands are manufactured in a higher position than they will occupy in the cable. This difference in height is obtained in two ways: First, the cable-shoe, instead of being at once connected with the anchor-pin, is temporarily located several feet back of the pin on a casting called the "leg," which abuts with its front end against the anchor-pin, and has at its rear end a lug over which the cable-shoe is placed, flat side up.

In this position of the shoe it is easy to put the bight of a wire, as it is taken from the traveling wheel, into the groove of the shoe, which would not be possible if the shoe were on the anchor-pin between two eyebars.

A second way which helps to raise the strands above their normal position consists in supporting at the towers the strands on rollers, placed on top of the saddles, whence they are afterwards lowered into their final position in the groove of the saddle.

Partial View of a Pier, Showing the Anchorage and the Traveling Wheel.

The combined operation of lowering the strands from the supporting rollers into the saddles, and of letting the cable-shoes go forward from their seat on the leg to their final position at the anchor-pin, causes the strand to drop in the center of the main span fourteen feet, or equal to the difference in height between the upper and lower deck of the foot-bridge. One picture shows the anchor chain with a number of finished strands, and two shoes in position on the leg with partially finished strands. Another shows the saddle on top of the towers, with the rollers which support the strands during the time of their manufacture. The long wooden rollers across the saddle support the running wire suspended from the carrying-wheel when it travels from one end of the bridge to the other.

The erection of the auxiliary structures is not the only thing which must preceed cable-making. Of not less importance is the theoretical work for determining the exact location of the saddles on the towers, and the deflection of the strands, so that the latter will hang in their proper height and the saddles stand in the centre of the towers after the bridge is finished. It requires long and laborious calculation, with application of the higher mathematics, for solving the problems in question. All these scientific labors, in addition to inventing and constructing many special appliances for spinning and handling the unprecedented number of thirty-seven strands in the shortest possible time, had to be performed by the contractor, who, in accordance with the articles of the contract, must be responsible not only for the quality, but also for the theoretical correctness of his work. From this circumstance it follows that such a contract for cable construction can not be compared with an ordinary stone or earth contract, where the speed of the work merely depends on the number of men and tools employed, but that it should be treated with a certain respect due to its scientific nature by acknowledging that brainwork as well as practical constructions, which are subjected to delicate adjustments and must be executed with the utmost exactitude, can not be whipped into quicker action by threats or faultfinding. The writer makes this remark because, on account of an impossibly short time for building these cables, as stipulated in one paragraph of the contract, having been exceeded, some people in authority as well as the combined daily press, not exempting several scientific papers, have found more fault with and heaped more abuse on the company building the cables of the new East River bridge than on any other contractor within the memory of a lifetime. It seems like an epidemic; somebody started the vague and unproved imputation that this contractor is guilty of "inexcusable delays," and everyone repeats it in word and print, without knowing anything about it and without making the least effort to find out whether the blame is true and justified or not. As a matter of fact it is not justified, because there was not only no delay, but actually these cables were constructed in one-third the time of any previous record for such work.

The actual cablemaking begins with suspending the "guide-wire." This is an ordinary wire stretched from one tower to the other and accurately adjusted in accordance with the results of the theoretical calculations. The object of this wire is to serve as guide for suspending all the other wires of one strand. Every wire in a strand and in the whole cable is supposed to have the same tension, which is the case when all wires have precisely the same deflection and hang parallel with each other. In the construction of former cables all wire, wound on large drums, was located on one side of the river, but in the present case it was divided and placed on both sides. There were four drums, each containing four tons of wire, located behind the shoe and along the anchor-chain of each cable. As the total weight of one strand is about thirty tons, the eight drums of wire, four at each end, were just sufficient for making one half strand; but, as soon as one drum was empty it was replaced by a full drum, hence the spinning of all the strands was continuous without any other interruption than was necessary for the manipulations of the strand itself.

Apparatus for Transferring the Shoes from their Temporary to Permanent Positions.

The end of the wire from one drum is fixed to one side of the shoe; then the wire passes around the back end of the shoe and the bight of the wire, formed between the shoe and the drum, is placed around the traveling wheel, which, in its trip across the river, carries two wires from one anchorage to the other. This is illustrated in Fig. 3, showing men in the act of placing the bight of wire on the wheel, which is ready to start. It is evident that the wire running from the shoe to the wheel is without apparent motion, and, therefore, called the "standing wire," while the wire running from the wheel to the drum must move with twice the velocity of the working rope and is called the "running wire." When the wheel arrives at the other end, the bight of the wire is taken from the wheel and placed over the shoe in such a way that the running wire comes on the side of the shoe which is in line with the fixed end of the wire at the other end.

Suppose the first trip of the traveling wheel was from Brooklyn to New York, then the regulation of the wire is done in the following way: a man stationed on the foot bridge halfway between the Brooklyn anchorage and Brooklyn tower gives signals to men on top of the Brooklyn tower for tightening or relaxing the standing wire until it hangs parallel with the guide-wire; then three men standing on the foot bridge in the middle and in the quarters of the centerspan signal to men on the New York tower to pull the standing wire to the deflection of the guide-wire; then a man on the New York landspan of the foot bridge signals to men at the New York anchorage for adjusting the wire to coincide with the guide-wire. The whole standing wire is now regulated and the same operation begins in the opposite direction for the running wire. It is first adjusted in the New York landspan by men on the New York tower after receiving the signals of an observer stationed on the New York landspan of the foot bridge;

then in the centerspan and last in the Brooklyn landspan, precisely in the same manner as described for the standing wire. The standing wire is always regulated in the same direction as the wire moves when carried across the river, and the running wire is regulated in the opposite direction.

While this regulation of the two wires goes on, the traveling wheel returns from New York to Brooklyn with two wires taken from a drum standing on the New York anchorage and placed around a second shoe of the same cable, in the same manner as was described for the first shoe for which the wire was taken from the Brooklyn wire drums. When the wheel arrives, on its return trip, at the Brooklyn end, the regulation of the first two wires for No. 1 shoe is already finished. The running wire is laid alongside of the original end of the wire; then it is passed around the end of the shoe to the opposite side of same, and the new bight, formed between the shoe and drum, is placed again on the traveling wheel, carrying the wires across, which are regulated in the same way as the first two wires.

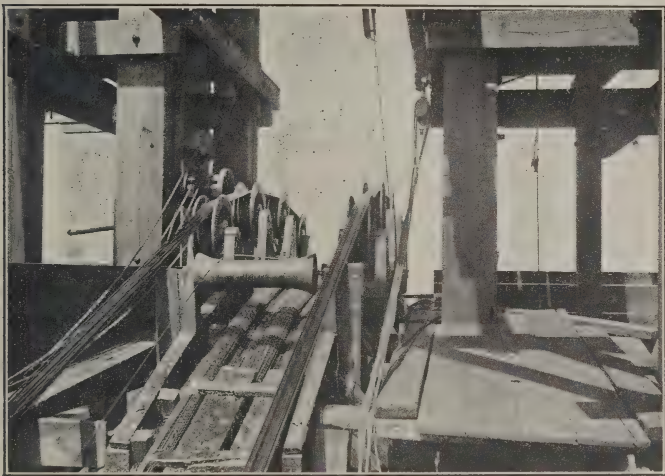
While the wheel carries the second two wires for No. 1 shoe from Brooklyn to New York, the first two wires for No. 2 shoe are regulated, and in the same order it goes on until one hundred and four bights, or two hundred and eight wires, have been placed in each shoe, which finishes two strands of the cable. It is obvious that by this method of carrying wires across from each end, two strands can be spun in the same time as is required for spinning one strand, for which the wire can be taken from one side only.

After one strand is finished, it is squeezed with tongs to a cylindrical shape and wrapped every ten or fifteen feet with a few turns of annealed wire. The time required for this squeezing and wrapping is, thanks to the foot bridge which makes every point of the strand accessible, only a few hours, while on former occasions, where the wrapping had to be done by men standing on a suspended "buggy" which ran on the strand, it required several days.

The next operation consists in placing the strand in its final position. First the shoe is relieved from its seat on the leg and let forward to the anchor-pin. As the tension on one strand is about twenty-five tons, it requires a strong apparatus for doing this work safely. The so called "letting off" apparatus, specially designed for this purpose, is shown in the cut. It consists of a couple of steel plates and steel bars which take hold of the shoe and which are connected with a four-inch ratchet screw that is anchored to a strong wire rope. The ratchet was worked by an engine with which the whole operation of taking the shoe from the leg and letting it go forward for a distance of three feet was performed in twenty minutes. Simultaneously with "letting off" the strand, the latter was also lifted from a roller on top of a casting, located in front of the anchorage, and lowered into the hexagonal groove of the same casting, which serves as a temporary resting place for the cable. The object of this intermediate support of the strands, which is precisely at the height the cable will occupy when the bridge is finished, is to confine the change of curvature in the land cables, caused by the forward motion of the saddles, to that portion of the cable which is clamped into a cylindrical form, and to leave the lower end of the cable undisturbed for the last twenty-six feet, in which the strands spread in all directions toward the cable-shoes.

After the centerspan of the bridge is completed, the land cables rise sufficiently to clear those supporting castings and the latter are removed.

One more operation is necessary before the strand is ready to be regulated, namely, to lower it from the supporting sheaves on the saddle into the saddle itself. This is done with an apparatus consisting of a steel beam about fourteen feet long, to which the strand is lashed with wire at eight or ten points. The beam is suspended at its center of gravity from a three and a half-inch screw-bolt about seven feet long, which hangs from a timber frame and rests with a roller-bearing nut on a ball-and-socket jointed casting, so that the screw-bolt can swing in any direction without being subjected to bending strains. The roller-bearing nut makes the screw work very easily, and four men can lower a strand in ten minutes. The strand is now ready to be "regulated," which means that its length is to be tested in response to the guide-wire, when it is the first strand, or with previously made strands, when it is one of the later strands. Theoretically, no regulation should be necessary, as the strand is supposed to have the exact length of the guide-wire, but, practically, such perfection is only reached accidentally. Some inaccuracies creep in through sudden changes of temperature and through the difficulty of exact observations in more or less windy weather. The general tendency is to make the strands too long. For the purpose of adjusting the length of a strand, the shoes are provided with oblong holes or slots, about seven inches in excess of the pin's diameter, which allow the shoes to be moved on the pin in either direction by taking out some "liners," previously put between the back of the shoe and the back of the pin, or by putting in more liners. The latter operation shortens the strand and the former lengthens it. The forward or backward motion of the shoes is performed with the "letting off" apparatus. Generally the length of a strand does not differ more than two or three inches from what it should be, but occasionally it happens that nearly the whole range of possible adjusting becomes necessary in order to get the strand right. Without such means of regulating each strand, no cable could be constructed properly. It is well to claim that with proper care one strand could be made like the other, but practical people know that it is impossible to measure, even on level ground, several wires, each 3,000 feet long, and get them all of the same length. How much less it is possible for hundreds of wires, spun through the air and measured merely by observation in all kinds of weather, must be apparent to every thinking person.



A Glimpse of the Cable Strands on Top of the Saddles.

After all strands are finished and correctly adjusted, the temporary wrappings are removed and the whole mass of wires is squeezed with powerful clamps into a cylindrical form of a diameter determined by calculation or by experiment. To facilitate the final squeezing process in cables so large as those of the new East River bridge, it is advisable to divide the labor and, first, to unite the seven center strands by squeezing and wrapping into a core of about eight inches diameter. This operation is illustrated in Fig. 6. By imagining larger squeezers and a larger cable, the same picture would not differ from one that would show the final process of squeezing and clamping. While the former cables, made on the Roebling method, received a continuous wire wrapping, those of the new East River bridge will only be clamped together every twenty feet by the cable-bands, with three short intermediate wrappings between the bands. For protecting the cables from atmospheric influences, which is one object of a continuous wrapping, they will, in this case, be enveloped by a sheet-iron covering, fitted between the cable-bands. This is something new, and whether it is better than wrapping can only be proved in course of time. As far as present experience goes, the wire wrapping protection was perfect. Cables, examined by the writer, after forty years of exposure were found free from all oxidation under the wrapping, and the only rusty wires were found on the saddles and at the anchorages, where there was no wrapping.

In conclusion, it may be interesting to give some additional data about this great bridge.

Its span from center to center of towers is 1,600 feet. The height of the towers is 332 feet above high water. The width of the bridge will be 118 feet, and it will carry two railroad tracks for suburban trains, four trolley tracks, two roadways for wagon travel, two sidewalks and two bicycle paths. The land-spans are six hundred feet long, but they are not like those of the old Brooklyn Bridge, suspended from the cables. The space is bridged over with two trusses resting on an intermediate pier, and the cables serve merely as backstays for the cables of the main span.

Each cable is composed of 7,696 No. 6 wires, each wire having a strength of 6,000 pounds, corresponding to 200,000 pounds a square inch. The combined strength of the four cables, therefore, is about 96,000 tons, for supporting a dead weight of 12,000 tons and a total dead and estimated live load of 16,000 tons. The maximum tension in the cables, produced by those loads, is 24,000 tons, hence the cables are four times stronger than their maximum stress, or, as it is technically expressed, they have a factor of safety of "four." This is precisely the same factor of safety as that of the old Brooklyn bridge for its own weight and the live load it carries, showing that the latter bridge, though absolutely weaker, is relatively just as strong as the new bridge, and that all fears about its safety, as rumored during the past year, are unfounded. If the engineer of the new East River bridge had shared such an apprehension, he would certainly not have made the same supposed error, and he would have constructed the new bridge with a larger factor of safety.

The construction of the foot bridge began on April 9, 1901, and was completed in three months. Three months more were required for placing the cable machinery in position, adjusting the guide-wires, etc., and the first cable wire was run out on November 27, while the last wire crossed the bridge on June 27, 1902. Hence, the total cable-spinning has required seven months, which is three times faster than the record for the old Brooklyn bridge. At the latter structure the greatest quantity of wire spun in one day amounted to nineteen and a half tons, while the maximum at the new East River bridge was seventy-five tons, and the average thirty-five tons.

Squeezing and Binding the Core of the Cable in Midair

These are figures which prove, better than any argument, that all appliances used in the construction of these cables worked successfully and, for the object of making time, were vastly superior to those formerly in use. The time elapsing between the first rope stretched and the first cable wire spun was ten months at the Brooklyn bridge, and at the new East River bridge only seven months. These figures, and the fact that all work was done without a single accident, show also that the imputation of "inexcusable delays" is founded either on misunderstanding or on intentional misrepresentations.

It is expected that the process of squeezing the cables, putting on the cable-bands, suspenders and cable-covering will require three months, and that the whole bridge will be completed and open for traffic in about two years from the present date.

The Welsbach Mantle

On the coast of Brazil is a large deposit of monazite sand, resembling sea sand, but somewhat more yellowish and brownish, which contains several per cent of the oxides of thorium and cerium, says the *Gas World*. This sand is shipped principally to England and Germany, where these elements are extracted and sold as nitrates which are soluble in water, and with them mantle manufacturers make solutions into which the knitted cotton fabric is dipped, subsequently dried and the cotton burned, leaving a network of oxides of thorium and cerium in the proportion of 99 parts of the former to one of the latter. To protect this delicate fabric from breakage it is dipped into collodion, which upon evaporation stiffens the mantle and is readily burned off after the mantle is put in place upon the burner.

New East River Bridge Statistics

The new East River bridge, legally known as the Williamsburg bridge, will, when finished, be the longest and largest suspension bridge in the world. It is expected that it will be finished about September 1, 1903.

Its dimensions are as follows:

	Feet.
Length between terminals	7,200
Main span, center to center of towers	1,600
Main span, clear, from tower to tower	
Width of bridge	118
Clear height of roadways above mean high water at pier heads..	122
Clear height for 200 feet each side of center of river-span........	135
Height of masonry foundations above high water	23
Height to center of cables at tops of towers above high water....	333

Total height of towers, including cables ....335 feet

Size of caissons ....70x60 feet

Size of foundations (coping)..63x47 feet

Weight of steel towers, each..3,000 tons

Size of main members of towers (legs) ....4x4 feet

Length of cables, each......2,900 feet

Diameter of cables........18¾ inches

Number of wires in each cable....7,696

Size of wires....No. 8, about 3/16 inch

Weight of cables and fittings..4,500 tons

Weight of suspended structure ....7,500 tons

Pressure of cables on top of each tower ....7,500 tons

Stress of cables on anchorage, total ....20,000 tons

Size of anchorages, at the ground, about ....150x180 feet

Material of anchorages, ...limestone with granite facing

Weight of anchorages, about ....100,000 tons each

Total weight of steel in bridge, about ....45,000 tons

Total cubic yards of masonry, about, ...200,000

Total amount of timber, feet board measure 10,000,000

Total number of barrels of cement, about 200,000

Depth of foundations below high-water mark: Manhattan side, north caisson, 56 feet; south caisson, 66 feet. Brooklyn side, north caisson, 115 feet; south caisson, 90 feet.

Total estimated cost	$15,000,000.00
Estimated cost of land.	9,000,000.00
Oct. 28, 1896.—First contract let: for Manhattan tower foundations, work begun Nov. 7, 1896; completed September, 1898; cost ..	373,462.71
Sept. 30, 1897.—Brooklyn foundations begun; finished March, 1899; cost	485,082.75
Oct., 1897. — Manhattan anchorage begun; cost.	797,770.00
Jan., 1898.—Brooklyn anchorage begun; cost...	771,778.00
Feb. 21, 1899.—Contract let for steel towers and end spans; cost.......	1,220,726.60
Dec., 1899.—Contract let for cables and suspenders; cost	1,407,440.00
Nov. 7, 1900.—Contract let for steel and masonry approaches:	
Manhattan side to cost..	1,488,200.00
Brooklyn side to cost...	947,000.00
May 8, 1901.—Contract let for steel suspended structure to cost	1,123,400.00

The bridge will carry twelve separate roadways of one sort or another, arranged in three decks. Eight of these will be on the main deck. Next to the outer edge of this deck on either side will be a carriage road twenty feet wide between curbs; next, on either side, will be two sets of trolley car tracks nine and three-quarter feet from center to center and within these two footpaths, each ten and one-half feet wide. On the deck above, which will be of the same width as the two footpaths, will be two bicycle paths and still above these, on the upper deck, of like width, two sets of tracks for elevated railroad trains. The bridge begins on the Manhattan side at Norfolk street between Delancey and Broome streets and extends to Havemeyer street in the Williamsburg district of Brooklyn, between South Fourth street and Broadway. Beyond each end of the bridge are to be plazas, each two blocks long and two hundred feet wide. The main towers stand, one at the foot of Delancey street in Manhattan and the other at the foot of South Sixth street in Brooklyn.

Action of Light on Gems

At the last meeting of the Academie des Sciences de Paris, M. de Lapparent summarized a report of M. Chaumet relative to the action of light on precious stones. The speaker observed that violet light developed a fluorescence in the diamond, and that this fluorescence presented a much greater intensity with diamonds of the greatest commercial value, says an exchange. The speaker further observed that a yellow diamond cut in facets, which gave forth golden reflections, did not manifest its fluorescence after having been submitted to the violet light, or at least that this fluorescence ended with the red illumination at the border of the facets. Several hours later, however, the diamond turned brown and lost its material value, but this alteration was only momentary, and the diamond quickly regained its natural yellow tint. The action of violet light is not restricted to diamonds; it may be exercised on rubies to such a degree as to be of great assistance in determining values. Thus the rubies of Siam and Burmah represent a very different market value, and yet it is very difficult to distinguish them. Violet light, however, produces on the first but a feeble fluorescence, whereas it excites an intense fluorescence on the second—the rubies from Burmah.

Gold Milling in Arizona

Down in Santa Cruz county there is, according to Professor Blake, of the Arizona School of Mines, a sticky clay gouge which is so refractory that the usual methods of mechanical separation, amalgamation or concentration failed absolutely to extract the gold from the clay. After practically every known method had been tried and had failed, the ingenious scheme of drying the gouge thoroughly, afterwards beating it vigorously with a club, was adopted with complete success. This novel plan is a curiosity in the mining methods of to-day, but it may be seen regularly in Santa Cruz county. The extraordinary tenacity of the clay has not been as yet explained.

Iron, the Touchstone of Civilization

By the Hon. Abram S. Hewitt

[The following paper was read before the American Geographical and Statistical Society by Mr. Hewitt on February 21, 1856. It is remarkable as a study of an industry which was but just beginning the enormous strides which have since been so astounding. With incisive, reassuring and prophetic mind, Mr. Hewitt saw deeply into the future and made predictions regarding the growth of the iron industry of the world, which even challenged his own courage to announce. The accuracy of these predictions up to the present day is startling. The forces whose workings Mr. Hewitt saw so clearly are still virile and active and the paper stands today as it did in 1856 as a prediction and a prophecy.—Ed.]

Mr. President and Gentlemen of the Society:

One of our poets has told us that Basil, the blacksmith, was

"A mighty man in the village, and honored of all men;
"*For,* since the birth of time, throughout all ages and nations,
"Has the craft of the smith been held in repute by the people."

How far this feeling of respect for my calling has weighed with you in honoring me with a request to prepare a paper on iron, I know not; but it is quite certain that from the earliest days there has been a peculiar charm about the business which has left its traces in the myths of the ancients, and in those mystical legends of the middle ages that have survived the decay of empires and feudal institutions, and even to this day delight the young at the Christmas fireside.

In one of the earliest treatises on alchemy, we are told how the "Sons of God," who first fell from their high estate through love for "the daughters of men," imparted to their giant offspring the secrets of extracting the metals from the earthy calx; and who of us have forgotten with what intense interest our childhood was absorbed in those wonderful stories of King Solomon, in which this race of genii are represented as toiling, imprisoned in the bowels of great mountains, to produce the metals which enriched the wise king, and enabled him to build the Temple of God, "so that there was neither hammer, nor axe, nor any tool of iron heard *in* the house while it was in building."

Nor is it strange that to the young or the ignorant, the idea of magical power should attach to those who, penetrating into the depths of the earth, shatter the mighty rocks with explosive power, rivaling the thunderbolts of Jove, and by the combined action of earth and air, and fire and water, reduce from the dull ore the glowing vivid metal, till then

"In stony fetters fixed and motionless."

It is a perpetual struggle against resisting nature, and the victory is only won by turning her own gigantic powers against herself, so that the ancients called in the aid of Gods to account for the triumph; and for the gift which, Æschylus has it, "has shown itself a teacher of every art to mortals, and a great resource," made the unhappy Prometheus expiate the offence in fetters on the rude Caucasian rock.

But in our day the interest which attaches to the production of iron rests upon a better appreciation of the difficulties to be surmounted; and upon a full knowledge that iron is the mainspring of modern civilization, Locke has told us that "he who first made known the uses of iron may be truly styled the Father of Arts, and the Author of Plenty;" and in our own day, Hood thus wittily sums up its multifarious applications:—

"The universality of the employment of iron is so manifest, especially in this country, that if any period has deserved the title of the Iron Age, to none can it be so characteristically applied as to the present. The seas are traversed by iron ships; the land travelled over by iron carriages upon iron roads. We have iron engines employed for nearly every mechanical purpose. Water is brought along our streets by iron pipes, and all our thoroughfares illumined by means of gas conveyed to us through a similar channel. Many of our houses have iron floors and iron roofs, whilst the windows are closed with iron shutters. In short, from the gigantic steamer which crosses the Atlantic, to the smallest of ornamental shirt buttons, this metal has become so prevalent, that the country ought to be ticketed, like a laundress' window, with 'Ironing done here.' But the wealth and comfort arising from this state make it equivalent to the much more lauded advantages of the Golden Age."

The hand that penned these characteristic words was scarce cold in the grave before that great temple of industry, reared like a creation of magic, had been opened in the metropolis of the world, to receive the products of every clime, and exhibit the fruits of human ingenuity to admiring thousands. Fond enthusiasts dreamed that the reign of universal and perpetual peace had been inaugurated, and that the material which had been used for dealing out death and destruction was now forevermore consecrated to human progress, and a higher civilization. But scare had the last notes of the national anthem died in the ears of the heterogeneous mass of hearers who were assembled from all nations and tongues of the earth to witness the magnificent closing of the most magnificent spectacle which mankind has ever seen, when the rude alarm of war burst upon astonished Europe; and all the energy, skill, and genius of the world were called into play to devise new methods of applying iron to the work of destruction. Steamers hurried masses of men and supplies with a speed which throws the achievements of Napoleon into the shade. A railway is constructed from the sea to the beleagured city; the steam-whistle shrieks its wild requiem over the dead and dying as it conveys them by the carload to hospitals, sanctified by the holy and heroic presence of woman. The telegraph carries the swift messages of death, from the entrenched camps to the cabinets of ministers, a thousand miles away. The tidings of victory or defeat are heard by a listening world before the great cannon have ceased to roar. For days and weeks together, the mouths of these gigantic monsters vomit forth iron hail, until walls are battered down by the resistless shock of twenty thousand tons of cannon balls; and the stern old Russian, who had stood unmoved while he lost his thousand men a day, is compelled to retire before what he graphically describes as "the fire of hell." It is the terrible energy with which iron has been employed in this contest, rather than any skill in strategy or diplomacy, which now enables the world to felicitate itself with the prospect of peace after the lapse of two short years, instead of having to endure all the miseries of a struggle protracted for thirty years, as in all former European contests. But my limits on this occasion do not permit to trench on the domain of the moralist, nor even of the man of science. My investigation will have reference solely to the statistics and geography of the production of iron; and if, as I fear, the results be found dry, and lacking in originality, my apology must be found in the name and objects of this Society, and in the consideration, so well stated by another, "that statistics are far from being the barren array of figures ingeniously and laboriously combined into columns and tables, which many persons are apt to suppose them. They constitute rather the ledger of a nation, in which, like the merchant in his books, the citizen can read, at one view, all the results of a year, or a period of years, as compared with other periods, and deduce the profit and loss which has been made in morals, education, wealth or power."

And first, I shall attempt to give you a succinct account of the growth of the business. Iron was known to the ancients; but being the most difficult of the metals to reduce, it came into use after the other metals were well known. Tubal Cain is admitted to have been the first manufacturer; but on so small a scale was his business established, that even in the days of Homer, a piece of iron which a single man could throw was offered as the most precious prize at the games in honor of the death of Patrocles.

"Let him whose might can hurl this bowl, arise:
Who farthest hurls it, takes it as his prize."

When Porus came from the land of gold and pearls and diamonds to propitiate the conqueror of the world, it is recorded that his most precious gift to Alexander was a piece of Indian iron weighing forty pounds. In the days of Pliny it had come into more general use; and he is equally eloquent in describing its application in the arts of peace, as he is indignant at its perversion to the purposes of war. But it was not until long after the Christian era that its production was aided by any mechanical appliances worthy of the name. It is exceedingly doubtful whether cast-iron (carburet of iron) was known until the 13th century after Christ. Previous to this time, iron was made by simply placing the ore and charcoal in layers in a rude oven, and smelting it by a blast forced in by a common bellows, worked by the hand of man.

We are accustomed to regard the crusades purely as an outburst of religious enthusiasm at a time when the civilization of the world afforded no outlet for the pent-up energies of men, and to attribute to them no other practical result than the impoverishment of the nobles, and the consequent liberation of the serfs. But it is probable that the returning crusaders brought back with them the knowledge of the manufacture of cast-iron, thus identifying the birth of modern civilization with the birthplace of that divine religion which has accomplished for the moral elements of our nature what the use of iron has for the practical progress of the race.

The knowledge thus acquired was soon put to use throughout Europe; but it surprises the inquirer to find that in the year 1740, only 116 years ago, the total production of iron in England amounted to not more than 17,350 tons, made by fifty-nine furnaces, giving an annual production of 294 tons to each furnace. At that time I am satisfied that the total production of Europe did not exceed 100,000 tons, of which 60,000 tons were made in Sweden and Russia, and one-half of this was imported into England. The annual consumption of iron in England was, therefore, 15 pounds per head of population, and in Europe did not exceed 2 pounds per head. The destruction of wood, caused by this insignificant product, was so rapid, that the business of making iron was likely to be extinguished, when, as is the universal rule, the evil which was dreaded gave birth to a remedy which imparted new life to the production, and has enabled it to reach its present gigantic proportions. This remedy was the substitution of pit, or *mineral* coal, for charcoal. To Dud Dudley, an Englishman, is due the merit of this discovery, or at least of its practical application; and to him, more than any other man, belongs the title of the "Father of the Iron Trade." But his discovery made little progress for the period of 100 years. In 1750 it came into general use; and in 1760 the first blowing cylinders were erected by Smeaton at the Carron Iron Works. A single furnace was there made to yield 1,000 tons per annum, or three times as much as the average of charcoal furnaces. This wonderful result agitated the whole industrial world, so that even the poet Burns came to see the grand spectacle; and being refused admission, gave vent to his indigation in these rather indiscriminate lines:—

> We cam na here to view your warks,
>   In hopes to be mair wise;
> But only lest we gang to hell,
>   It may be nae surprise.
> But when we tirl'd at your door,
>   Your porter dought na bear us;
> So may, should we to hell's yetts come,
>   Your billy, Satan, sair us.
>
> [A. D., 1797.]

The total production of Great Britain, in 1788, had reached 68,300 tons, making an increase of 50,950 tons in 48 years, *i. e.*, 300 per cent. At this time Watts' great invention of the steam-engine was introduced; and emancipating the iron works from dependence on sites where there was water power, produced so great an increase in the business, that in 1796 the production had reached 125,079 tons, and in 1806, only 10 years later, it had increased to 258,206 tons, each furnace making an average of 1,546 tons per annum; but the average of the best constructed was 2,615 tons per annum, or nine times as great as the charcoal furnaces only 60 years before. At this date, only 50 years ago, I am satisfied that the annual make of the whole world did not exceed 500,000 tons, one-half of the present annual production of the United States. The annual consumption of iron per head in Great Britain had reached 40 pounds, showing conclusively a wonderful progress in the arts of civilization—the consumption having nearly trebled in less than 60 years.

These were the results of the inventions of Dud Dudley and of Watts. But in 1783 and 1784, Henry Cort, also an Englishman, inaugurated a new era in the iron business, by his invention of the process of puddling (*i. e.*, of converting cast-iron into wrought-iron in reverberatory furnaces), and of reducing the rough masses thus obtained into finished bars, by grooved rollers. The history of this great benefactor of his race is an instructive one. Born to a competence, well educated in the science of his day, attracted to the iron business by an enthusiasm which no obstacles could daunt, he devised two improvements, so essential, that it is not too much to say that the iron business could not exist without them—that railroads would be impracticable—that iron ships could not be built—because the wealth of the universe would not be adequate to the production of iron on a scale now rendered essential by the wants of civilized life. He expended $250,000 in putting his invention into practice; he proved its merits; he built works for himself and others, which were eminently sucessful; he had licensed a production which would inevitably have produced to him one of the largest fortunes which human ingenuity has ever achieved, when his associate, a deputy paymaster in the navy, was proved to be a defaulter to the extent of £27,000; the patents were seized by the British Government, but instead of being prosecuted, were kept tied up with the usual red tape, in the office of some government official, "without the slightest benefit either to the state or the patentee," so that the fruits of a life of honest labor were lost, and Cort was reduced to beggary—a monument of the sad results, on one hand, of a breach of official trust, and on the other, of official routine and delay. William Pitt finally accorded to him a pension of £200 per annum, which he lived to enjoy for six years, dying broken-hearted, and the British iron trade generously raised £1,000 for the relief of his widow. And this was the temporal reward of one, the immediate results of whose inventions have been summed up by an abler hand than mine, as follows:—

"In 1782, the total quantity of British hammered iron exported did not exceed 427 tons. In 1854, the total quantity of pig iron exported was 293,074 tons; puddled and rolled iron, 883,237 tons; to which, if one-third be added for waste in conversion, the real quantity exported will be 1,177,649 tons—total British iron exported, 1,470,723 tons.

"In 1782, the total make of British hammered bar iron did not amount to 10,000 tons—too inferior in quality for exportation beyond 427 tons. In 1853, the total make of puddled and rolled iron was very little short of 3,000,000 tons, which, at the cost of foreign iron previous to 1783 and 1784, averaging, exclusive of duty, £40 13s. 4d. per ton, would not be less than £92,000,000 sterling; whereas, by puddled and rolled iron, at the average cost not exceeding £10 per ton at the most, it has cost only £30,000,000 sterling, thus saving in one year £62,000,000 sterling, as compared with foreign bar iron; being all made out of materials previously useless, and by British labor. For the last 66 years, including money less paid to foreign countries for bar iron, and more received from them for 8,000,000 tons of British puddled and rolled iron, besides 17,000,000 tons for home consumption, extra profits to the iron manufacturer, £37,000,000 sterling, and profit to the mineral owners at least £12,000,000 sterling, the whole saving to the country is equal to £300,000,000 sterling, besides feeding and clothing four generations of workmen and their families, or more than 600,000 people for sixty-six years. These are the services of Henry Cort."

I have detained you too long from the main subject; but less I could not say, without being treacherous to the memory of a man to whom justice has never been done.*

Since the time of Cort, with the exception of the introduction of the hot blast, in 1829, and of the use of anthracite coal in 1837, of which I shall have occasion hereafter to speak, no material improvement has been made in the modes of making iron, and in 1806 all the processes were in use which now prevail in the best constructed works. The growth of the business was thenceforth very rapid, limited only by the consumption of product.

In 1818, the product of Great Britain was estimated at	300,000 tons	
In 1820	400,000 tons	(Mushet)
In 1823	452,066 tons	(official)
In 1825	581,367 tons	

At which date the yield of each furnace averaged 2,228 tons, being an increase of 45 per cent in 19 years, chiefly due to improved machinery, larger furnaces and better blasts.

In 1830, the annual make was 678,417 tons. The use of the hot blast now enabled raw coal to be substituted for coke, by which the consumption of coal was largely reduced, *i. e.*, from 8 tons 1¼ cwt. to 2 tons 13¼ cwt. for making one ton of pig iron in Scotland, to whose ores and coals it was found to be chiefly applicable. As the present make of Scotland is now over 800,000 tons, the annual saving in coal is nearly five millions of tons, or about the quantity mined on the Atlantic slope of the United States. It

*I have since learned that a subscription is on foot in England for the benefit of Cort's descendants.

is worthy of note that Neilson was compelled to enforce his patent by legal process against the combined strength of the trade; and it was only after years of vexatious delay that his patent was affirmed on appeal to the House of Lords, and that he received the reward of his great discovery. It is recorded that the Bairds, the princely proprietors of the Gartsherrie Works, and who, from being day-laborers in a coal mine, have achieved their present position as the makers of over 100,000 tons of pig iron per annum, and as the richest manufacturers in the world, settled Neilson's damages for infringement, by a check on the Bank of England for £150,000 sterling. So marked was the effect of this discovery, that

	Tons.
In 1836, the make amounted to	1,000,000
In 1839	1,248,781
In 1840	1,396,400
In 1845	1,512,500
In 1847 (*official*)	1,999,608
In 1852	2,701,000
In 1854 (*Truran*)	3,585,906

Made by 599 furnaces, giving an average to each of 6,000 tons, being over 2½ times the yield of each furnace in 1825. This incredible product was achieved by the direct labor of 238,000 men, and 2,120 steam-engines, of an aggregate power of 242,000 horses, and the value of the gross product was $125,000,000. If you will pause to consider the infinite variety of uses to which this iron has been applied, for it was all consumed at least six months ago, you may perhaps be able to form some idea of the millions of human beings whose labor it has absorbed, and to whom it has given bread, especially when I tell you (I quote the *British Quarterly*), "that a bar of iron, valued at $5, worked into horseshoes, is worth $10.50; needles, $55; penknife blades, $3,285; shirt buttons, $29,480; balance springs of watches, $250,000;" all of which increase in value is given by the application of human labor.

To make this product, and reduce rather more than half of it to bars, there were dug from the bowels of the earth, and consumed—

12,346,000 tons of iron ore,
2,450,000 tons of limestone,
20,146,000 tons of coal.

Tons 34,942,000

A sum total before which the imagination stands appalled.

I am inclined to believe that the production for 1855 did not materially exceed the figures for 1854. Even the British lion pauses to take breath; but it is rather from the difficulty of providing materials on short notice, than from any unwillingness to supply the world with all the iron which is wanted for its annual consumption. I shall now endeavor to ascertain what that amount is, by succinctly stating the make of other European countries, as nearly as I can ascertain the same.

Date.	Tons.
England, 1855	3,585,906
France, 1845—438,900 tons est.	650,000
Belgium, 1855	255,000
Russia, 1849-'51—191,492 est.	300,000
Sweden, 1850-'52—124,169 est.	157,000
Norway, 1855	22,500
Austria, 1847—165,776	200,000
Prussia	400,000
Balance of Germany	200,000
Elba and Italy	72,000
Spain	27,000
Denmark and balance of Europe	20,000
United States	1,000,000
	6,889,406

The present annual production of the world does not, therefore, exceed 7,000,000 tons, of which Great Britain produces rather more than one-half.

(*Continued in September.*)

Protecting Pipes from Electrolysis

Some valuable suggestions regarding the saving of gas mains in streets from damage by stray trolley currents through electrolysis were brought out in a discussion before the Western Gas Association at a recent meeting as to whether wrought or cast iron pipes best resist such damage.

The Progressive Age reports this portion of the proceedings as follows:

Mr. Brownell: I would suggest, so far as I am concerned, I would not put any wrought iron pipe in the ground. I do not believe, after some years of experience, that wrought iron pipe should be used to convey gas unless some method is used like that of the Grand Rapids Gas Company, and they have less electrolytic action than any other city in the United States. That means a great deal. Current flowing through a pipe line will remove from sixteen to twenty feet of the iron per year, depending upon the oxide of the iron. Cast iron leaves a residue which is electro-negative, such as silicate-oxide, which is not carried away by the chlorines which are set free by the electricity, and hence the residue which is left is enough to enable the cast iron to still convey the gas, but the loss of the iron is great. In other words, it may be completely destroyed, but still be able to convey the gas. In the case of wrought iron there remains only a small percentage, probably from 0.25 to 0.5 per cent carbon left.

Mr. McIlhenny: You mentioned the practice of the Grand Rapids plant. Can you tell us what that is?

Mr. Brownell: Mr. Doty, I believe in the city of Grand Rapids about two years ago, they put all their service pipe in the soil and poured a mixture of sand and tar around it. By this means there can be no escape of current from that service pipe into the earth, or from the earth into the service pipe, and when there can be none, consequently, of course, there can be no electrolytic action.

I wish to add further one word, that gas companies using wrought iron pipe and using it in the manner which they have, will some day have to face the problem of contributory negligence. Where the companies have put down the pipes without protecting them, the question of contributory negligence will have to be faced. The courts will hold that you could have protected your service pipes. I believe there is not a man in the audience today who will deny the statement that he can protect his service pipes, and in answer to the question as to the use of a preparation by the Grand Rapids Company, it seems to me their course in encasing their service pipes in an effective preparation of this kind is the thing.

Mr. Graves: I would state that we have 122 miles of pipe in the city of Buffalo which we have succeeded in protectting perfectly by the use of insulated joints.

Electro-Pulverization

In pulverization by the electric furnace, the metal is heated to volatilization and forced into the collecting chamber by a jet of air or inert gas. Among the useful powders produced in this way are those of bronze, tin and aluminum; of litharge, or lead oxide; and of chrome steels, used as abrasives. Variations of the process give such compounds as white lead.—*Invention, London.*

Fixation of Nitrogen from the Atmosphere

At Niagara Falls is located a plant in which atmospheric air is decomposed by electric arcs and the nitrogen contained therein is fixed. This process is in a general way an outcome of the experiments of Priestley in 1785, and later of those of Cavendish. Since that time the matter has been one of continual research, and the present installation, which is the property of the Atmospheric Products Company, is claimed to be the first successful solution of the problem on a commercial basis. The importance of nitrogen to animal and plant life is well recognized. Without it practically no vegetation could exist. For more than a century it has been known that the oxygen and nitrogen of the atmosphere could be combined in the presence of moisture with the formation of nitric acid by passing a series of electric sparks through a small quantity of air enclosed in a glass tube, but the quantity thus formed was so small and the expense so heavy as to make the process commercially prohibitive, its only value being as an interesting laboratory experiment.

Nature produces nitric acid in this manner during thunder storms. The acid is washed down to the earth by the rain and there it combines with natural alkaline substances to form the salts needed for promoting vegetable life. So nature keeps the earth from becoming barren.

Cavendish, in speaking of this experiment in 1785, says: "We may safely conclude that in the present experiments the phlogisticated air (nitrogen) was enabled by means of the electric spark to unite to and form a chemical combination with the dephlogistical air (oxygen), and was thereby reduced to nitrous acid, for in these experiments the two airs actually disappeared, and nitrous acid was actually formed in this room."

Since the time of Cavendish various workers have thought over and experimented with this method of forming nitric acid and other nitrogeneous compounds, but were unable to obtain any results sufficient to put it in the field as a commercial or even a practically possible source of nitric acid and its compounds.

Sir William Crookes, in his address to the British Association, discussed this problem in a broad, scientific way, and points out that unless some new source of nitrogeneous compounds is soon discovered, the practical exhaustion of the present sources is a certainty within the life of the present generation.

In the Niagara Falls plant the operating company, after a long series of expensive experiments, has been enabled to carry out Cavendish's original discovery and to obtain, as is asserted, so large a yield of nitrogen at so comparatively trifling an expense that a supply of almost infinite proportions is assured. Lord Kelvin, while in this country in April of this year, said:

"I have just come from Niagara Falls; I saw something there that I had never seen before; in fact, I regard it as the most interesting sight I have witnessed in America on my present trip. At the Atmospheric Products Company's works I saw the fixation of nitrogen. It has been the dream of the electro-chemical workers for years to produce results that should be of commercial value, and that result has not been accomplished. Over a century ago the discovery was made that nitric acid could be manufactured from air, but not until the plant was established at Niagara Falls has the discovery been utilized in a practical way."

Prof. Chandler, of Columbia University, New York city, after inspecting the works and conducting an experiment for the purpose of ascertaining exactly what the value of the work was that the company is doing, says in part:

"My particular object was to observe the working of the apparatus, to measure the energy consumed in a given time and to ascertain the product in order to form some basis for estimating the cost of the energy required to produce a given quantity of nitric acid or its equivalent.

"The apparatus which I found there is designed to effect the combination of the nitrogen and oxygen contained in atmospheric air and produce oxides of nitrogen which may be subsequently converted into nitric acid, nitrates and nitrites of the metals or such other products as may be found desirable.

"The apparatus consists of: A nitrifying chamber, which is a vertical cylinder provided with arrangements for maintaining a large number of electric arcs; a motor for causing the shaft in the nitrifier to rotate in order to produce the arcs; a motor-actuated blower for forcing a current of air through the nitrifier; a chamber in which the reaction between the gases is completed; an absorption tower which extracts from the air coming from the nitrifier and the chamber the oxides of nitrogen produced by the reaction, and a 10,000-volt dynamo driven by a 2,000-volt motor."

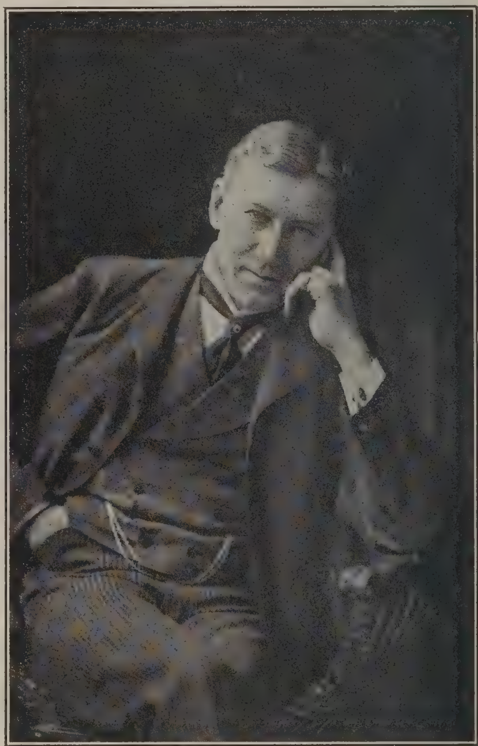
In the experiments which Dr. Chandler conducted he reports that:

"The absorption tower was thoroughly washed out and the dynamo was set in motion. A solution of caustic soda was allowed to trickle through the absorption tower, and the energy employed in producing the arcs was carefully measured.

"The experiment was continued for two hours, two and a half minutes, the energy consumed during this period being 12,500 watt hours, equivalent to 12.5 kilowatt hours.

"The product was carefully collected, measured and analyzed in order to ascertain the amount of nitric acid or its equivalent produced during the experiment.

"It was found that the product, which actually consisted of nitrate and nitrite of soda, contained the equivalent of one and one-quarter pounds of one hundred per cent nitric acid, equivalent to 1,785 pounds of seventy per cent nitric acid. (A common commercial strength of this acid.) Twelve and five-tenths kilo-



Charles S. Bradley, President of the Atmospheric Products Company

watt hours of energy produced therefore 1,785 pounds of seventy per cent acid. One kilowatt hour therefore produced 0.143 pounds. One kilowatt per year would therefore produce 1253.5 pounds of seventy per cent acid. Assuming the cost of energy to be twenty dollars per year per kilowatt, the expense for energy would be a little less than 1.6 cents per pound of seventy per cent acid. The current price of this acid at the present time is five cents per pound.

"At the rate at which the acid was produced in this experiment the yield of this unit of apparatus would be 8,766 pounds of seventy per cent acid per annum.

"With regard to the working of the apparatus, I may say that it was perfectly regular, extremely simple in its operation, and, so far as I could judge, admirably adapted to the purpose for which it was designed. These units could be multiplied indefinitely, would be inexpensive to construct, require very little attention, and would suffer but little deterioration in use.

"The product of the process can be marketed in a variety of forms to meet a variety of demands. For example, as:

"Nitric acid; nitric gases for the sulphuric acid chambers; nitrite of soda, potassa, lime, strontia, baryta, etc.; nitrates of soda or lime for fertilizing purposes, or mixed nitrates and nitrites could be furnished at a lower price and would be equally valuable as a fertilizer.

"Further, it has been found that certain slight modifications in the running of the apparatus would greatly increase its efficiency. As the applications for patents for these improvements are still pending, I prefer not to state in detail what these improvements are, but they seem to me to be perfectly logical, and the evidence of their value was exhibited to me.

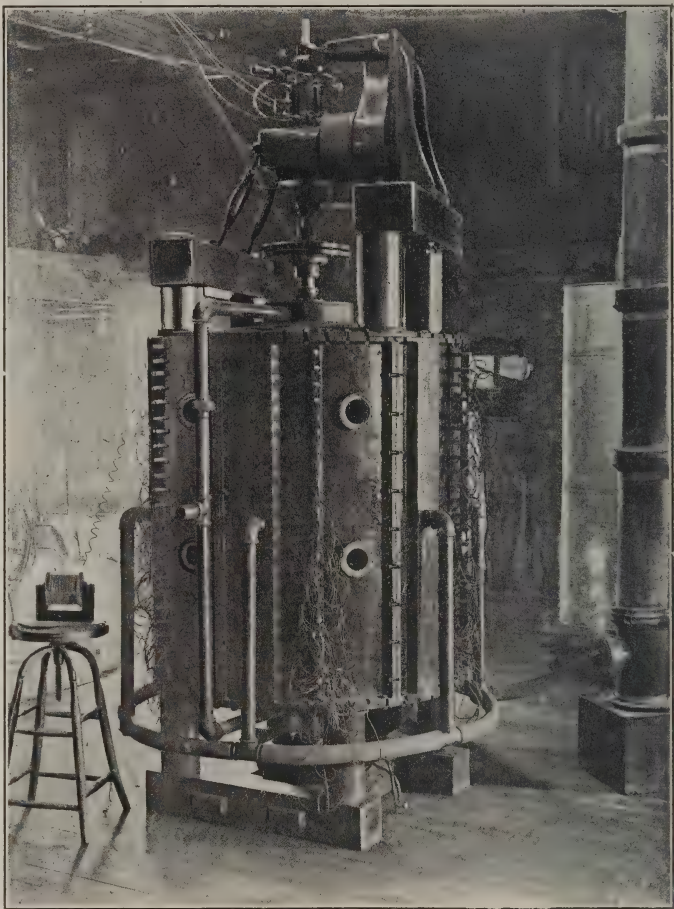
"In conclusion, after witnessing the operation of this apparatus, I have not the slightest doubt that the problem of manufacturing nitrates and nitrites from the atmosphere has been successfully solved, and that with this apparatus it can be carried out on any scale that may be desired and will yield products at a very moderate fraction of the present cost of similar products now on the market."

The nitrifying chamber, as will be seen in the illustration, is a cast-iron tank in which a vertical shaft revolves at three hundred revolutions per minute. On this shaft are contained one hundred and forty-four straight wires tipped with platinum. The centrifugal force causes them to stand out straight when the shaft revolves. Set into the sides of the tank in six upright rows are one hundred and forty-four other wires. These come from the generator. After they branch off from the main circuit each is equipped with an inductance coil, so that each one may produce an independent electric arc. The revolving wires with which the arcs are formed are not set directly one above another in rows on the shaft, but from the top to the bottom of the shaft each wire is set just a little in the rear of the one above it. This forms spirals of the wire tips, and the arcs beginning at the top of each row of wires run from wire to wire to the bottom and recommence at the top without losing an interval, as the top wire comes opposite the next row of fixed wires.

These wires are also tipped with platinum. The current used is direct and is supplied at a pressure of 10,000 volts. The arcs take on a sickle shape and vary between six and eight inches in length. The dimensions of the tank are three feet in diameter by six feet in height. The apparatus is operated by a 2,000 horse power motor. In front of each line of points in the interior of the tank is an air pocket; these pockets catch the air as the electric arcs decompose it, and pipes leading down to a circular tube at the bottom carry away the air and its burden of newly-formed acids to the absorption tower. Here a shower of water takes up the acids and carries them away to be recovered. The latter processes vary according to the uses to which the products are finally to be put. The intake for the air is around the bearings of the revolving shaft, both at the top and bottom of the tank. This is so arranged for the double purpose of keeping the bearings cool and to give a quick and free circulation of the air to the fiery arcs.

A curious feature of this apparatus is that the smaller the current used in each arc the greater is the efficiency up to one one-thousandth of an ampère, at which point the arc breaks. It must be remembered, also, in this connection, that these arcs are not disruptive, but are, on the contrary, steady and uniform in practise. They use from .005 to .002 of an ampère, as it has been found that this intensity produces the best general effect. In the picture which shows the chamber it will be noted that there are broad trays of inductance coils from which the wires are led into the interior of the chamber. As the plant which is working at present is the first installation and practically in the nature of an experiment, these inductances have not been arranged as they will be when the completed plant is arranged for commercial operation. At that time they will be placed under the floor and entirely concealed. The apparatus, it is asserted, converts about two and one-half per cent of the air forced into the chamber into acid, producing HNO_3.

The Atmospheric Products Company is a New York corporation, capitalized at $1,000,000. Its plans are to construct a plant which will utilize 100,000 horse power and produce nitrates and nitrites of sodium and calcium as well as the oxides and nitric acid for commercial purposes.



Nitrifying Chamber, Showing Loose Ends of the Inductances. Cooling Tower is Seen at Right.

The market for the various compounds of nitrogen is practically without limit, and is very constant. This is owing to the fact that the products do not depend upon any one industry for consumption, but enter directly or indirectly into a great many of the manufacturing arts. Nitric acid may be placed first in importance, entering, as it does, into the manufacture of so many widely consumed products. Upon it are dependent many of the coal-tar products; the high explosives such as nitro-glycerine, gun cotton, dynamite and the large variety of smokeless powders; it lies at the base of the celluloid industry and is used in the manufacture of the various metallic nitrates, such as nitrate of silver, which is so important to photography.

The total annual consumption of this

Arc Dynamo Used to Operate the Nitrifier.

acid in the United States exceeds 100,000 tons.

The consumption of nitrate of potassium is large. The imports to the United States in 1901 amounted to 21,000 tons.

Nitrite of sodium is used in the color industry to the extent of about 20,000 tons per annum.

Nitrate of sodium and nitrate of calcium are of the utmost importance to the fertilizer industry, which is already of great magnitude and which is becoming more important each year. An idea of the value of nitrate of sodium used as a fertilizer may be gathered from the trials made in England by Sir John Lawes and Sir Henry Gilbert on their experimental field at Rothamstead. "This field was sown with wheat for thirteen consecutive years, and yielded an average of 11.9 bushels to the acre. For the next thirteen years it was sown with wheat and dressed with five hundred weight of nitrate of soda per acre, other mineral constituents also being present. The average yield for these years was 36.4 bushels per acre, an increase of 24.5 bushels. In other words, 22.86 pounds of nitrate of soda produce an increase of one bushel of wheat."

The products obtained by the electrical process have the great advantage over those made by present methods, it is asserted, in that they are chemically pure, there being no crude raw materials to introduce impurities into them. All processes of refining are eliminated, with their attendant losses and expense, and the pure product is obtained at a minimum cost.

According to Prof. Chandler's figures, a kilowatt year costing not more than twenty dollars will produce a ton of commercial nitric acid, having a market value of more than eighty dollars. The other items of expense, such as labor, administration, interest and depreciation, altogether, it is claimed, will not exceed fifteen dollars, leaving a handsome margin of profit.

Prize Offer

The Electrical Age offers two prizes amounting to $50 for the best articles submitted before November 15, 1902, on subjects relating to the engineering arts and sciences, covered by this periodical.

A first prize of thirty-five dollars and a second prize of fifteen dollars are offered. All manuscripts will be judged by the editors of The Electrical Age; all manuscripts entered in this competition, whether successful as prize winners or not, will become the exclusive property of The Electrical Age.

The conditions governing this competition are:

All MSS. must be legibly written in ink, on one side only of the paper, and must be folded, not rolled.

Author's name and address, and the number of words in the article must be written at the top of first page.

Authors may choose their own subjects, but must treat them in a popular way; but technical accuracy is imperative. Strictly technical matter is not desirable in this instance.

Where it is desired that the author's name be withheld from publication, the article need not be signed; but all competing MSS. must bear the names and addresses of the authors as indicated above.

The contest closes November 15, 1902. The awards will be made at once and the result announced in the December number of The Electrical Age.

Any explanatory matter or letters regarding the MSS. must accompany the articles. Postal acknowledgment of all MSS. will be made upon their receipt. All MSS. must have postage fully prepaid. MSS. not thus prepaid will not be considered. Articles to be available must not have less than 1,800 words nor more than 6,000. Photographs or drawings for reproduction must bear the (1) name of the article, (2) the title of the picture, (3) the author's name and address.

A general idea of the kind of articles desired may be gathered by reading the article beginning on page 143 of the July number of The Electrical Age.

A contributor to a recent issue of the *American Machinist* says:

I wish to relate the following which took place in a barber shop and which may be entertaining and instructive to the readers of your paper. Among a number of men waiting in a barber shop for "Next" was an Irishman who saw the barber spraying and drying a customer's face with the compressed air. He was very much interested and after asking a few questions he said: "Begor, I think that is a good thing to knock the dirt out of an ould watch," at the same time handing his to the barber to clean. The barber saw that the watch was a cheap one, and would not amount to much loss if spoiled, so opened the back of the watch and turned on the air. The cleaning was done about six months ago, and about a week ago I saw the owner of the watch and the barber. The owner said the watch kept good time and gave no trouble, and the barber said that he had cleaned about half a dozen watches since. I am not posted enough on watches to say that this is a good way to clean a watch, but if you have an old cheap watch you can't be at a great loss to try it.

An "Isle of Safety" Electrolier

Lighted and ornamented by an elaborate electrolier, the design for which is herewith shown, an "isle of safety" is soon to be provided for the public at the intersection of Twenty-third street, Broadway and Fifth avenue, in New York city. The electrolier, which will form the central feature of this desirable city improvement, is to be a gift to the municipality from the Municipal Art Society of New York. It is intended to serve as an example for future work, and in order to secure a desirable design for the purpose, a design which should combine simplicity with beauty, the Society threw the subject open to competition, and offered prizes for the three best designs, and an honorable mention for the fourth choice.

The prizes were $500 to the first, $100 to the second and $50 to the third choice.

The competition brought forth forty-five designs and models, which were placed on exhibition from June 14th to July 14th, at the rooms of the Architectural League, in the Fine Arts Building in west Fifty-seventh street.

The design chosen, which constituted it the winner of the first prize, was modeled by Victor A. Ciani, and Henrick Wallen's design won the second prize, Wilkinson & Magonigle's the third, and honorable mention was given to the design submitted by Mrs. Edith W. Burroughs.

Prize-Winning Design, Modeled by Victor A. Ciani.

The "Isle of Safety" within which the electrolier is to stand will be twenty feet long and three feet wide.

The electrolier will be of bronze and will measure seventeen feet in height. A globe of glass, twenty inches in diameter, finishes the top of the shaft. In this will be the main lights, while a little below, held in the mouths of fancifully conceived fishes, will be four smaller globes, each containing lamps. The shaft will be enriched below by a frieze representing playing cupids, and four decorative legs with lions' paws partly supporting the base. On the upper moulding four rams' heads accentuate the corners. Above this the shaft rises from amid decorative acanthus leaves.

It may be said that the competion brought forth a number of most excellent models. Those to which the prizes and the honorable mention were awarded differed widely in design, but were all striking, though simple and handsome in their general effect.

Electric Companies Should Make Ice

By F. H. White

One of the questions which has come up before the thinking man in the electric light and power station is: "How can a plant be run most economically and a waste of power avoided where the load on the lines varies greatly at different times during the twenty-four hours run?"

If the plant be operated by steam power, the boilers must be designed to operate economically under the maximum load, which we will say is from 4 p. m. until midnight, and during the rest of the day, when the load on the generators is light, the boilers are very often run with considerable loss of economy.

One way of getting over this difficulty is by operating some other line of business in connection with the lighting plant, so that the boilers may always be run at full load and maximum economy. The question now is what business can be operated most advantageously in connection with a power plant. Authorities on this subject who have investigated the matter have reached the conclusion that an ice-factory adapts itself most readily to the situation for the following reasons:

During the summer months, when less electric power is used, more ice is required, and in winter, the reverse is true. With a well designed ice-tank, the machine need only be operated eighteen hours a day, except in very warm weather, so that during the time when the electric load is at its maximum, the ice machine can be shut down, and the full power of the plant used to generate electricity.

From the standpoint of the man in the engine-room, the operation of an ice-plant means very little extra work; no more, in fact, than would be entailed by an extra pump. One extra man is required night and day on a small plant for drawing ice from the tank. This is sufficient on plants up to say forty tons; two and sometimes three tank-men are needed for a large plant.

The ice machines are generally of the ammonia compression type. The smaller sizes are made to be driven by belt, either from electric motors direct, or from line shafting, and arranged so that they can be stopped and started at will. The brine-agitation and the power cranes required in the plants of above twenty-five tons output for handling the ice, are also arranged to be driven in the same manner, thus creating a demand for power, when the electric plant would otherwise be running at a considerable underload, and the ice is made from pure water obtained by condensing the exhaust steam from the electric generating plant. This steam is usually otherwise allowed to go to the atmosphere as waste.

From the standpoint of the investor, ice-making in connection with a lighting station is rather an interesting problem, the profit, of course, varying greatly with the locality, but the following figures may enable the reader to estimate about what can be done in any given locality.

The first cost of a belt-driven ice-plant, set up and ready for operation (including plant and buildings), with distilling plant for making clear hygienic ice, amounts to about $1,000 to $1,100 per ton of ice made in plants with capacities of twenty-five to fifty tons per day of twenty-four hours. On large plants, the cost of installation is considerably lower per ton, as the price per ton decreases as the output increases.

Let us take a twenty-five ton plant, for example, and see what the cost of production would be. The investment, including buildings and complete installation and connection to the main shaft of power house, would amount to about $27,000, this being $8,000 for buildings and the balance for machinery, tanks, and other appliances. The power required to operate such a plant with cooling water at 75° F. would be about eighty horse power under ordinary conditions. This would be divided up as follows:

Compres or	70 brake horse power.
Ice tank propeller	2 " "
Crane	4 " "
Shafting	4 " "

Taking the price of power at one cent per horse power hour, and figuring at runing twenty-four hours per day, the cost of power comes to $19.20 per day. Say that we have two tank-men at $2 per day, and two assistant engineers at $2.50 per day; tabulating, we have:

Power	$19.20
2 engineers	5.00
2 tank-men	4.00
Oil, waste and repairs	3.00
	$31.20

Say we operate 360 full days per annum; the total running:

Expenses		$11.232.00
Depreciation	5%	1,350.00
Advertising and office exp		2,000.00
Ammonia and salt		250.00
Total expense		$14.832.00
Sales average about twenty-five tons for 300 days—7,500 tons at $2.50 per ton		$18,750.00
Expense		14,832.00
Net profit		$3,918.00

Per annum, which amounts to about 9% of the invested capital.

The most unfavorable conditions have been purposely taken into consideration in the foregoing estimate, but any engineer can see where money can be saved on several of the items. The price of $2.50 per ton of ice is low, and applies only to the northern states where competition is met with first class natural ice. Throughout the South, the ice factories obtain from $4 to $6 per ton on the platforms, and we have known cases where as much as $12 per ton was received. Operating expenses would be about the same.

English Gas Companies as Supply Houses

The Gas Light and Coke Company, of London, has sent out a circular to its consumers, stating that it is prepared to undertake the maintenance and renewal of incandescent mantles and chimneys. The charge to be made for the maintenance and renewal of mantles of the ordinary size will be at the rate of eighteen cents per quarter per burner. Consumers having fewer than four burners will be charged for the maintenance of such smaller number a minimum rate of seventy-two cents per quarter, according to an exchange. Mantles of larger sizes will be maintained at somewhat higher rates. For the above charge the company undertakes to send, periodically, competent workmen who will (1) clean and regulate the burners; (2) replace any mantles which may be worn out or otherwise defective; and (3) clean the chimneys and replace any which may have been broken.

The great need now in the oil industry of California is crude oil that can be refined for illuminating purposes, says an exchange. The demand for this is far in excess of the supply, and one barrel of a good refining oil is worth five of the average fuel oil.

A neat paperweight has been recently sent out by the Chicago Fuse Wire & Manufacturing Company to its friends. The weight takes the shape of a roll of the wire, with a flat brass circular bottom, and the company says it has tried to make as good a paperweight as its fuse-wire.

New York's New Street Signs

New York, which has been a guideless wilderness for the stranger ever since the last administration put the Collis street lamps out of commission, is soon again to have ornamental and effective illuminated street signs.

The new signs are novel in design, and are the result of the combined skill of Borough President Jacob A. Cantor, of Manhattan; Charles R. Lamb, of the Municipal Art Commission; N. R. Spencer and Dr. Maltby.

Breaking away from old traditions, the new lamps will be three-cornered instead of square. The frames will be of sheet iron. In each of the principal panels will be glass, thirteen by nine inches, on which, in white letters on a dark blue ground, the street names or numbers will appear. In small panels at the corners will be other glass panels, on which will appear the names of the streets with which these panels lie parallel.

At the lower side of the lamp is a round collar, so designed that the lamps may be set on top of the old gas-lamp posts at street corners or placed midway up the taller poles of electric lights. When placed on the old gas light posts the signs will be illuminated by gas. When on the electric light poles they will be illuminated by trios of incandescent lights.

New Street Signs for New York City.

This lamp was designed particularly for use on the main thoroughfares where street car lines pass. It will be recognized at once that the three faces presented to a thoroughfare, as shown in the accompanying cut, will make it very easy for the passer-by to see where he is.

Two thousand of the lamps are to be ordered and placed at once. For other streets President Cantor will use metallic signs attached to the corners of the houses. It is estimated that the new lanterns can be built complete for \$2.50 each. President Cantor has assurances from the electric lighting companies that they will furnish the illumination of the 600 or 800 lanterns to go on electric light poles for about \$7.50 per year each. Those lighted by gas will cost about \$15 a year to light.

Fishing Schooners and Wireless Telegraphy.

It is reported, apparently on good authority, that several of the schooners hailing from Gloucester, Mass., have been equipped with Marconi instruments for the transmission of wireless telegrams, and one in particular, the schooner *Constellation*, recently started on a seining trip with a full outfit, in charge of a first-class operator, designed for sea service at a radius of one hundred and fifty miles.

Digest

Engineering Literature of the Month

Electric Station on a Farm

Mr. James Ben Ali Haggin, of Lexington, Kentucky, has an extensive stock farm near that city on which he has installed a complete electrical power house, transmission lines, lighting equipment and a twenty-five station telephone system. Doctors Louis Duncan and Carey T. Hutchinson of New York City designed and installed the plant. The power house contains a battery-room twenty-five feet square and an engine-room of the same dimensions. Two units consisting of fifty horse power, three-cylinder, gasoline-engines, each direct connected to a multipolar, twenty-five kilowatt, five hundred volt generator furnish the power. Only one generator unit is used at a time, the other being held in reserve. The engines are said to be remarkably even in their running and are started by compressed air, the pump for each being driven by a storage battery. The generators are compound wound and built to run at three hundred revolutions and carry a fifty per cent overload for three consecutive hours. The main house is wired on the three-wire system with four hundred and fifty volts between outside wires, while the neutral is grounded. The middle point of the storage battery is also grounded. One circuit runs to an elevator where motors are used entirely for power, and another circuit to the main house. The feeders are of No. 00 copper in duplicate strung on thirty-foot poles, and are a mile long. The third circuit is 1,000 feet long and consists of No. 4 wires, which run to the blacksmith shop and sawmill. A fourth line runs to the south entrance of the estate and the lodge. The cost of the entire equipment was between $35,000 and $40,000, and Mr. Haggin's dwelling, which cost $300,000, is said to be more elaborately wired than, perhaps, any other house in the United States. An automatic central was tried for the telephone system but it gave some trouble and was thrown out, a regular operator being substituted.—*Wisconsin Engineer.*

Asbestos

Certain specimens of asbestos, when exposed to sufficient heat lose water, and then begin to soften and to sinter, and finally melt to an apparently homogeneous material, soft, flexible, and weldable in a flame, and possessing the property of giving out a bright white and steady light in a flame; even in the less highly-heated parts of a flame. When cold the fibre is white, hard, and porous, and looks much like unglazed porcelain. It is found that this modified form of asbestos makes mantles which are somewhat unmanageable in an ordinary Bunsen flame, but are of great service in extremely hot flames, such as those of high-pressure gas systems of lighting, or of water-gas or acetylene. The various rare earths readily form a kind of alloy or solid solution with these fibres, and a fibre weighing one-third of a grain thus saturated with beryllia will give twelve and a half to thirteen and a half candles in an acetylene Bunsen using 0.35 cubic foot of acetylene per hour.—*Invention, London.*

A Musical Chandelier

When gas is burned in a cylindrical chimney of certain dimensions a singular musical note is produced, and a Chicago professor has taken advantage of this to provide a means of amusement for his friends. He has arranged in his reception room a chandelier containing thirty jets provided with glass chimneys of the size required to produce the chromatic scale through the range mentioned. An electric keyboard placed at one side of the room connects with the chimneys in such a manner that a slight pressure upon the keys causes the flames to sing. The result produced is musical and the notes are of an unusual and sweet timbre. The secret of the process is in the changing of the angles of the chimneys, for when the angle of position is changed, the note is effected or caused to cease.—*American Inventor.*

Hospitalier's Ondograph

This instrument registers directly in ink on a strip of paper, with regard to time, the curves representing periodically and rapidly changing phenomena like electromotive force, current, difference of potential, power, etc. The instrument consists of a synchronous alternating current motor worked by the electrical source of whose periodical variations it is desired to obtain the record; of a gearing which imparts to a revolving commutator an angular velocity equal to the number of revolutions of the motor, augmented or diminished by one; of an automatic commutator against which three brushes bear; of a condenser and measuring apparatus, and a cylindrical or uninterrupted registering device driven at a suitable speed by the motor. This motor consists of a cross of soft laminated iron moving between the arms of a U-shaped electromagnet whose yoke carries a winding which is traversed by a part of the alternating current to be studied. The motor absorbs from .2 to .3 ampere at one hundred and ten volts with a very low power factor. The condenser may be of any type and its capacity need not be exactly known. It is sufficient that it remain constant during experiments.

In the apparatus intended to trace the curve of instantaneous power, instead of the permanent magnet measuring apparatus, a Thomson meter is used, mounted as a wattmeter; the axis is submitted to the action of two spiral springs which bring the current to the movable coil, thus dispensing with the brushes. The main current traverses the fixed coils, and the movable coil of fine wire is connected in shunt once each period and for a very short time by means of the commutator and the brushes, with the difference of potential defining the power to be measured. For this purpose the rotating commutator consists of an ebonite cylinder in which is inlaid, parallel to the axis, a simple band of brass of convenient width. Under the influence of the successive impulses, which the coil receives, by the interaction of the intermittent currents which traverse it, and of the main alternating current, the bobbin makes with its position of equilibrium an angle proportional to the power at each instant of the period defined by the position of the commutator, and affects directly or indirectly the pen of the registering apparatus. This proportion results from the fact that the angle described by the movable bobbin about its position of equilibrium never exceeds 10 to 12° each side of zero; under these conditions the drum-winding of the wattmeter can be considered as not having undergone any sensible displacement with regard to the fixed coils, to give the system the inertia and damping necessary to the normal working of the apparatus. This normal working corresponds to the critical damping on the one hand, and on the other hand to a duration of oscillation comprized between the period of the phenomenon to be registered, and the duration of the registration of one period.

The ondograph is intended to trace a complete period by using 1,000 actual periods. The registering cylinder inscribes exactly three periods; the fourth superposes itself on the first and the fifth on the second, etc.; the superposition of the curves is a certain indication of the good working of the apparatus, apart from deviations resulting from a change in the rate of running supervening between the 3,000 periods which separate two successive passages of the same generating line of the registering cylinder under the pen.—*London Electrical Review.*

Moore Electric Light

Mr. D. MacFarlan Moore has had eight patents recently issued to him on his vibratory system in producing electric light. This brings the number of Mr. Moore's patents almost up to one hundred. From the time when he first exhibited his system, seven years ago, to the present, many changes have been made in the apparatus and now the dynamo is the most interesting feature of the system, as it was designed especially for producing what is said to be the most peaked wave ever obtained. The patent specifications state that:

"The object of this invention is to avoid the use of electric conductors for distributing the electrical energy to the lamp or light-giving portions of the system, and thereby to permit the illumination of buildings and contained areas without the presence of conducting wires or circuits of copper distributed through the building or the rooms thereof."

Briefly stated, the invention claimed by Mr. Moore consists of distributing or running a translucent tube or receptacle over areas, spaces or rooms to be lighted, the terminals of the tube being brought to a source of energy outside of the areas or spaces, or in a location where the terminals may be suitably protected against danger of contact or accidental interference, the tube containing a gas which is of such character or degree of rarefaction that by the application of electrical energy or current to the terminals of the tube it will be rendered luminous by the transfer of the energy from one terminal of electrode to the other. In the practical installation of the system the translucent tube of glass may be built up in the position it is to occupy while in use, or otherwise distributed as a tube of glass over the spaces to be illuminated and its terminals, which are provided with suitable energy transferring electrodes or caps, brought to a protecting cabinet or wall pocket, in which they may be connected to the two poles of the energy supplying devices, the latter being mains or wires leading direct from the primary generator of e. m. f., which might be the terminals of suitable transformers adapted to give the required secondary voltage. In practice alternating currents of greater or less voltage, as might be found desirable, would be used.

For illuminating the interior of a dwelling or structure, the portions of the glass tubing which contain the luminous column from which the effective illumination is obtained, would be distributed in any desired way throughout the whole interior of the dwelling or structure as one or more tubes, with the conducting caps or terminals thereof brought from within the illuminated spaces or areas to an exterior cabinet or receptacle where its conducting caps would be located out of harm's way, and in immediate connection with the source of energy. Or if desired, the energy might be carried into a building and suitable transforming devices located in sealed wall pockets within the same, the terminals of the tube being located in the same manner in the pockets, while the luminous portion of the tube would extend over or through the areas to be lighted, being distributed in any desired form or manner therethrough.

Mr. Moore claims that while his invention may be carried out with any form of lamp having the characteristics above described, namely, a translucent receptacle and energy supplying electrodes at the terminals of the luminous column, he prefers to use for the purpose a form of lamp consisting essentially of a translucent tube whose conducting terminals or electrodes are metal caps or carbon paste attached closely to the exterior of the tube, and transferring their energy by electrostatic action to the contents of the tube itself.

The many other advantages claimed over the present systems of electric lighting are the complete absence of fire risk, even where the lamp is operated at high voltages, and the absence of sockets, cords, cutouts, wires, conduits, etc.—*Electrical World and Engineer.*

A Locomotive's Load

A considerable portion of an engine's power is used up in dragging itself. An engine which in ordinary working would consume on an average, say thirty-five pounds of coal per train mile, would use from seven to ten pounds of this on itself—that is, about one-fourth of the total. Hence the great effort—apart from the question of wages, oil, etc.—which is at present being made to construct engines which will be able to work heavy trains unaided. Piloting, or "double heading," makes very expensive working.

Considering the power of the locomotive generally, it may safely be assumed, says Mr. R. Gordon Sharp, in "Fielden's Magazine" for April, that the maximum has been reached so far as this country is concerned. Engines cannot be made larger than some existing examples, unless the bridges, platforms, etc., be altered, which is very unlikely, seeing that these engines can pull trains which are quite as long as can be handled by the train staff without serious confusion and consequent loss of time at stations.

There are engines now running which can take a train of 300 tons, exclusive of the weight of the engine and tender, along a straight, level road at the rate of fifty miles an hour for as long a time as the supply of coal and water will hold out. This may not appear at first sight to be very remarkable, but it must be observed that this is no spurt, but a long sustained effort. The same engine is quite capable of developing over 1,000 i.h.p.—*Trade Journals Review, Manchester.*

Steam Production from Molten Slag

The generation of steam by the aid of the heat of the molten slag from the blast furnaces is a new and interesting idea successfully put into effect at the Cananea copper mines in Mexico. There is a double boiler arrangement into which the slag is run through a valve. From the smelter the slag runs into a large settler surrounded by non-conductive material to prevent loss of heat. When desired, the slag is run into the upper boiler through a valve, which avoids loss of steam. The slag goes first into a bucket, which is then inverted, letting the contents fall into the water and onto a grate. The slag is broken into fragments as it strikes the water. Most of the heat passes from the slag to the water in this upper boiler. From this boiler the material is dropped through a valve into the lower one, after which the water is pumped back into the upper boiler. From the lower boiler the nearly cooled slag falls through another valve arrangement into a car, which takes it to the dump. It is reported that the experimental plant demonstrates a large saving in fuel.—*Pacific Coast Miner.*

Life Saving Departments for Russian Central Stations

At a recent convention of the electrical engineers of all the Russias at Moscow one of the subjects of discussion was the method of rendering help in cases of electric shock. Eventually resolutions were adopted, declaring that each power station should have in future a special room which would serve exclusively as a life saving station, and which should contain all the necessary devices and instruments for restoring consciousness in case of accidents caused by contact with heavily charged electric wires. Rubber gloves and overshoes are also to be kept at the stations in the proper quantity and quality so as prevent as nearly as possible exposure to the ordinary risks of such an industry. The regulations also provided that the rubber goods should be subject every six months to a new test exposing them to a current three times as strong as that ordinarily generated at the station. These departments or life-saving stations are to be kept accessible to every person connected with the plant or likely to be called upon for help, and placards are to be hung in them containing plain instructions which tell how to proceed in the different cases of accident, and how, at the same time, each rescuer should protect himself. Every workman is to be schooled in this system, and it is believed that it will work out very satisfactorily and save life in many cases which would otherwise tend to have a fatal result.—*Ex.*

Combination Railway in France

A combination steam, electric and compressed air railroad is in operation in France between Paris and the town of Arpajon, distant about twenty miles. The company is not permitted by the city authorities to operate its steam locomotives in Paris during the day, and accordingly the passage across the city to the terminus at the Odeon is effected by the compressed air locomotive, which run as far as the suburbs, where the steam-locomotive takes up the train and carries it to Arpajon and back again. At the present time an electric motor-car is used over seven miles of the route, running as far as Antony and in Paris itself. The power house has been installed alongside the old compressed-air plant near the Orleans gate, and two generator sets are already in operation. If the company decides eventually to abandon the compressed air system, a third set will be added. The dynamos are ten-pole shunt machines of two hundred and twenty-five kilowatts capacity at five hundred to five hundred and fifty volts. To charge the batteries, which are operated in parallel with the line, requires seven hundred volts, and, as the generators give only five hundred and fifty, the balance is supplied by a booster, which develops from thirty to two hundred and twenty volts, and has the form of a multipolar motor and dynamo set, giving sixty kilowatts. When completely discharged, the battery requires three hours for recharging, but in practice it is recharged every day when only partially discharged. The electric-locomotives are an interesting feature of the system, being eight in number and weighing seventeen tons each. As the system is run at present, the steam-locomotives are used for the heavy traction and the long distance route to Arpajon, the compressed-air locomotives insideof Paris for a part of the day, and the trolley car, with or without a trailer, runs between Paris and Antony, while the electric-locomotives are operated inside Paris proper.—*A. de Courcy, in Western Electrician.*

Naval Illuminations for the Coronation

A correspondent of the London *Daily Telegraph* gives a very interesting account of the preparations for the illumination of the fleet at Spithead on the evening of the coronation, on the following evening and on the night of the great naval review. The arrangements were in charge of the commanding officer of H. M. S. *Vernon,* the torpedo schoolship, and to secure the success of the plan special officers were distributed throughout the British fleet. The illumination was to last three hours, from nine in the evening until midnight, the war ships using only white lights on the first night. Some idea of the imposing spectacle that would have been presented had King Edward been crowned may be gathered from the following table, which indicates the candle power and number of the lamps allotted to each class of ship:

Class.	100-c.p. lamps.	16-c.p. lamps.
"Majestic"	3	950
"Empress of India"	3	850
Second-class battleships	3	750
Third-class battleships	2	500
Four-funnelled cruisers	3	1,000
"Hawke" and "Narcissus" class	3	630
Second-class cruisers	—	550
Third-class cruisers	—	300
"Northampton"	4	700
Torpedo gunboats	—	260
Destroyers	—	150
Torpedo boats	—	65

The second night of the illumination was to have been distinguished by the use of arc lamps instead of incandescents, and the novelty would have been in the colors employed, the tints ordered having been red, green, blue and gold, each ship to have one color only, and the colors arranged down the line in the order named. For the first hour all searchlights were to be trained on the funnels of the ships abreast in the line on either side; during the following hour they were to be trained at the ships either astern or ahead in the line. As the lighting of steam is particularly effective, the lights were to be kept turned on the funnels and the ships would exhaust into the atmosphere, the various tints thus being projected into the columns of vapor.—*London Electrical Review.*

Swedish Steel-Smelting by Electricity

At the meeting of the Iron Manufacturers' Association (Brukssocieteten) at Jernkontoret, Engineer F. A. Kjellin and Mr. Benedicks gave some very interesting information about the production of electro-steel at Gysinge.

The problem of smelting steel by electricity has for a long time attracted the attention of inventors, and experiments had been made here. By the advice of Engineer Kjellin, Mr. Benedicks decided in 1899 to build at Gysinge an electric steel-furnace without electrodes.

In the latter part of February, 1900, the first furnace was finished and ready for trial, and after a few experiments the first ingot was produced. The steel was found to be of excellent quality. The problem was thus solved technically, but not economically; for, with the dynamo of 78 kilowatts used, not more than 270 kilograms (575 pounds) of steel were obtained in twenty-four hours, and in the furnace there was not room for more than 80 kilograms (176 pounds). A larger furnace was seen to be necessary, and this was completed in November, 1900, and proved to be a great improvement. In the second furnace, which held 180 kilograms (397 pounds), from 600 to 700 kilograms (122 to 134 pounds) of steel were produced in twenty-four hours. The Gysinge sulphite factory burned down on August 11, 1901, and it was decided to build steel works in its place and to use the water power available there. For the steel furnace there was utilized a turbine of 300 horse power, with direct-coupled generator. The new furnace is to hold 1,800 kilograms (3,970 pounds), and the production is estimated to be at least 1,500 tons a year if charged with cold raw material.

Engineer Kjellin said that the steel produced is of superior quality and characterized by strength, density, uniformity, toughness, and the ease with which it can be worked in cold, unhardened condition, even when containing a very high percentage of carbon. Compared with other steel it also has less tendency to crack or warp when hardened.

The reason why this steel in certain qualities differs from other steel, especially in its softness when unhardened, is considered to be its freedom from gases. The manufacture of special steel, with nickel, chrome, manganese, or wolfram, will, of course, not meet with any difficulties. The chrome steel and wolfram steel produced at Gysinge has proved to be excellent for lathe tools. When used for permanent magnets, the Gysinge wolfram steel has been found to give stronger magnets than other wolfram steel and has not warped in the hardening.

From estimates made, it has been ascertained that the furnace used at Gysinge, which is simple in construction and easily managed, has prospects of competing, as to cost of operation, with the furnaces heretofore used for fusion of steel, especially as it yields steel of a better quality.

For this country, with its good ores and large supply of water power, the electric method of smelting steel ought to be of great importance, and abroad, where blast-furnace gas is becoming a cheap source of power, it ought to come into extensive use.

After the lecture, Engineer Wahlberg made some statements concerning tests of steel ingots from Gysinge, which had been found to be uniform and homogeneous. Microscopic examinations had indicated that there was no difference between the electro-steel and crucible steel, which was so much more remarkable, as the electro-steel in other respects had different qualities.—*Trading and Shipping Journal, Gothenburg. Trans. by U. S. Consul R. S. Bergh.*

Acetylene Mine-Lamps Abroad

Acetylene is being somewhat extensively used on the Continent for the illumination of mineral mines, and even such coal mines as are known to be free from explosive gases. In some respects the gas has an advantage over electricity, owing to the greater portability of the lamps, which enables them to be shifted in the best positions in the workings, and also owing to the absence of conductors, which are occasionally liable to injury. The lamps will burn satisfactorily in a strong draught, as the gas issues from the generator at a higher pressure than oil from a wick; and they are stated to bear an atmosphere vitiated with carbon dioxide, or deficient in oxygen, better than those consuming rape oil, while they are certain to go out long before any dangerous quantity of methane can reach them. Of course, in explosive coal mines, electric lamps are far better; in fact, the best form of illumination of all; because the Davy lamp really gives a very poor light at the best of times and the heat evolved during the combustion of acetylene is so great that the gas does not lend itself to the construction of a safety lamp on the Davy principle—it tends to make the gauze red hot and so capable of starting an explosion, while its flame will not act as an indicator of marsh gas.—*London Electrical Review.*

Canada and Wireless Telegraphy

The agreement which the Dominion Government recently ratified with the Marconi Wireless Telegraph Company provides among other things that any lighthouse in Newfoundland is to be deemed a part of Canada, and that when the company is asked to do so it must provide at lighthouses or life-saving stations a complete installation or the Government may do so, the company being bound to supply the apparatus free of royalties. Such stations, when established, may be used for receiving and dispatching messages from and to vessels, each party collecting for its own benefit whatever charges may be made, but the company is not bound to accept messages in the United Kingdom for transmission to United States points via Canada.—*Canadian Engineer.*

Oil and Fog

Dr. Redwood, a leading English chemist, says that if oil were generally used as fuel, London's famous fogs would disappear. The fogs, says the doctor, are caused by unconsumed carbon, held in the air from the thousands of factory chimneys belching out smoke. There would be no carbon or ash from oil. The smoke nuisance on railways may ultimately be got rid of, not by the adoption of electric traction, but by the use of fuel oil. It has been used successfully on the North German Lloyd steamers and other vessels. The British steamship *Murex* not long since completed the longest voyage on record under liquid fuel. She left Singapore for Cape Town, whence she returned to the Thames, having completed a journey of 11,830 miles. Taking the voyage throughout, there was a consumption of liquid fuel of from seventeen to eighteen and one-half tons per day, while, had the vessel been burning coal, the corresponding consumption of Welsh would have been from twenty-four to twenty-five tons.—*Ex.*

Electric Incline in Genoa

There is now in operation at Genoa an electric incline with a length measured on the horizontal of 3,520 feet, and a difference of level of 615 feet, giving a mean grade of 17 per cent. The system adopted is known as the rack and binding system, the rack being in the middle of the single track. The ties are supported on a strong masonry bed to prevent slipping. The cars, which are self-propelling, are so arranged that the platforms are horizontal when on the incline. The wheels are loose on the main axles, and each axle carries in the center a large gear wheel, which engages with the track. The overhead trolley system is used, and each car is equipped with a direct current motor of 30 h.p., working at 500 volts, which drives it by a set of reduction gears. The car descends the incline from the Piazza Principe by its own weight, and the motor acts as a brake by varying the resistance and regulating the descent at will.—*London Electrical Engineer.*

Interesting if True

Microscopic particles in the atmosphere of Chicago have been proved to have come from the recent eruption in Martinique. Large quantities of dust have fallen, and many geologists have examined these particles microscopically, all coming to the conclusion that they are of volcanic origin. The University of Chicago scientists have even gone so far as to determine the dimensions of these particles of dust, and state that the production of "intrition" is so small that 4,000 to 25,000 of the particles are required to weigh one grain.—*American Inventor.*

Street Railways in New York State

Miles of track	1891	1901
operated	1,084	2,417
Capital stock	$90,321,983	$193,558,438
Assets	91,351,865	451,943,153
Liabilities	90,321,983	443,652,546
Gross earnings	20,153,973	43,068,405
Operating Expenses	14.914,204	24,501,456
Cars, box and open of all kinds	6,000	12,000
Horses	27,000	6,084
Passengers carried	410,720,306	1,162,439,614
Number of Employees	15,803	27,914

—*Street Railway Journal.*

Velocity of Ions from Hot Platinum Wires

Mr. C. D. Child describes at length his experiments on the velocity of ions from hot platinum wires and states that the fact that the discharge from a positive platinum wire is greater than from a negative one led him to suspect that the positive ions move with a greater rapidity than the negative. Mr. Child summarizes his conclusions as follows: The discharge from a hot wire first decreases and then slowly increases, until the positive discharge commences a little below the temperature of red heat, increasing, at first rapidly, as the temperature, then remaining nearly constant through quite a range of temperature, and finally experiencing a slight decrease. The negative discharge begins at about the same temperature as that at which the positive begins its decrease. It never becomes quite so large as the positive. Both discharges increase rapidly as the potential difference is increased between the wire and cylinder. Four methods were used for comparing the velocity of the positive and negative ions, all of them showing that the positive ions have the greater velocity. At the lowest temperature one method showed that the slowest of the positive ions possessed much greater velocity than the slowest of the negative, while at higher temperatures a slower class of ions is produced and a comparison of these with the slower negative is found to give no definite result. Mr. Child also discovered that at a certain temperature ionization is produced in the gas about the wire to greater than molecular distance. This temperature is practically the same as that at which the positive charge falls off and also as that at which the very slowly moving positive ions begin to appear. Experiments on a wire which had been inclosed in a glass tube indicated the presence in the tube of particles which tended strongly to diminish the ionic velocity. The "emanation" seems to load the ions, thus decreasing their velocity both when they are within an enclosed tube and when they are in an enclosed space. It will, therefore, be seen "that the particles driven off from a hot wire do not appear to aid in the discharge, but on the contrary to materially check it.—*London Electrical Review.*

Massachusetts Electrical Statistics

The advance made in electrical manufacturing and in the general use of electrical appliances and apparatus is well illustrated by figures just made public by the United States Census Bureau at Washington.

The figures are contained in a pamphlet prepared by Horace G. Wadlin, Chief of the Statistics of Labor Bureau. They compare the returns of 1895 and of 1900 as made from all of the manufacturing establishments in Massachusetts. These tables show the following figures for manufactories of electrical apparatus and appliances:

	1895.	1900.
Amount of capital invested		$8,947,143
Rock and material used	$3,027,798	5,943,951
Wages paid	1,740,222	3,114,037
Salaries paid	316,235	627,196
Value of products	5,625,882	10,490,361
Increase per cent		86.47

Average increase of production for 31,953 establishments, 21.90 per cent.

Current Engineering and Scientific Notes

Abstracts from the Foreign Papers

Theory of the Electrolytic Extraction of Copper

London Electrical Engineer

In connection with the Marchese process, the electrolytic extraction of copper sulphides by various solvents has been investigated, and in connection with the Höpfner process the electrolysis of cupric chloride solutions has been studied. An artificial cuprous sulphide containing some cuprich sulphide was electrolytically extracted with sulphuric acid of sp. gr. 1.225 (acid of maximum conductivity). On electrolysis, the ore being made the anode, a slime is deposited on it, which soon stops the current. This slime contains free sulphur, but it is shown from the analysis of the slime progressively deposited that the solution of the copper takes place in the two phases: (*a*) $Cu_2S + SO_4 = CuSO_4 + CuS$, and (*b*) $CuS + SO_4'' = CuSO_4 + S$. Using current densities up to 30 amperes per square decimeter the sulphur could not be oxidized. Rise of temperature favors the passage of the current. The same cuprous sulphide was electrolytically extracted with 4.5 N sodium hydroxide, the sulphide in this case being the cathode. The sulphur passes into solution, leaving metallic copper in the residual slime. Since the slime in this case has not a high resistance, the potential remains nearly constant throughout the electrolysis. The current yield is at first good, but falls off, and it has further been observed that the current yield decreases as the current density rises. The cathode slime can then be easily dissolved electrolytically in sulphuric acid, and as it contains little sulphur the previous disturbing factor is removed. The electrolysis of cupric chloride was carried out with a solution of this substance, using a platinum cathode and a carbon anode in a porous cell. When the solution is stirred, it is found that rapid stirring diminishes the yield for a given current, but the copper deposited is purer because the cuprous chloride formed by the dissolving of separated copper by the cupric chloride is washed away from the deposit. In a series of experiments, the solution circulated through the electrolytic cell and passed into another vessel containing a copper plate, and the rate at which the copper dissolved was measured. To obtain constant results, the liquid must always circulate at the same rate. Addition of hydrochloric acid diminishes the current yield, but leads to a pure copper, because the cuprous chloride formed is retained in solution. When the concentration of acid is very great, the current yield begins to increase slightly. Sodium chloride added to the solution also diminishes the current yield, but not to anything like the same extent as hydrochloric acid; the deposited copper is very pure. The current yield diminishes as the concentration of cupric chloride increases, and the copper deposited becomes more impure, for more cuprous chloride is formed, and it may even happen that cuprous chloride alone is deposited. It is not advisable, however, to diminish the concentration too much, for then the copper is deposited in a very spongy form. At a temperature of about 12 deg., the deposited copper is spongy; a coherent deposit is obtained at about 25 deg., but as the temperature rises above this, the current yield diminishes and the deposit is not so pure. Increase of current density slightly increases the current yield, because the solubility of the copper in the electrolyte is almost independent of this density. At very high current densities, however, the current yield falls on account of the separation of hydrogen at the cathode. A deposit containing up to 99.98 per cent. of copper can be obtained from a solution containing 0.1 gramme-molecule of cupric chloride, 0.1 gramme-molecule of hydrochloric acid, and 0.4 gramme-molecule of sodium chloride per litre.

Depositing Thin Films Electrolytically

Invention, London

An improvement in apparatus for depositing thin films electrolytically is claimed by Herr Endruweit, of Berlin. An endless metal band is used in conjunction with the usual electrolytic baths, and this band, first coated with potassium sulphide and washed, receives a nickel film on passage through the nickel solution. This film is backed with copper in a similar copper solution, a further backing with tough paper being applied before stripping. Rolls of paper with a brilliant nickel surface may be thus produced, and these may have a variety of applications. Colored and embossed, they make attractive wall papers and show cards.

The Valid Range of Faraday's Law

Journal of the Chemical Society

The accurate measurements which have been made with the copper and with the silver voltameter, have led Mr. Emil Bose to the conclusion that the slight deviations from Faraday's law are only apparent. In the paper in which this opinion is enunciated the author states that to test the accuracy of the law, a salt may not be used the cathion of which is able to exist in two forms, for then there enters a possible disturbing factor due to the reaction $M^{\cdot\cdot} + M = 2M^{\cdot}$. The variations discovered in the electrolysis of silver salts, which are equal to .001 of the gross weight of silver, are due to secondary reactions, one of which is attributed to oxygen absorbed by the platinum electrode. Faraday's law, so far as the weight of substance deposited by a given amount of electricity is concerned, may be regarded as an exact natural law. Otswald and Nernst have so worked that we may rightly conclude that the current which passes through electrolyte is entirely conducted by transport of material, there being no evidence of metallic conduction. The author believes Faraday's law comparable with Dalton's law of multiple proportions so far as exactitude is concerned, and thinks it is an extension of Dalton's theorems.

Synthetic Hard Rubber

Trade Journals Review, Manchester

This term applies to a new product which, when combined with sulphur and exposed to heat at about 300 deg. Fahr., can be vulcanized independently of india rubber or gutta-percha, or in combination with them. By this process almost any vegetable substance, or that of vegetable origin, can be rendered vulcanizable, and converted into a hard vulcanite, by heat, though the vulcanizing process differs somewhat from the ordinary form of treating rubber. Some of the substances which have been tested by this process are grass, common woods, oils, cotton, pine pitch, pine tar gums, paraffine (a large per cent), paper, etc. These materials are each first brought to a plastic state, when they can be tempered to any consistency desired and rolled into sheets, or moulded into any form. A very good result has been obtained by converting the twigs of the rubber tree—the entire wood—into hard rubber. The leaf of the rubber tree can also be converted into this new product. Of course all materials do not yield the same quality of hard rubber, but many kinds of vegetable substances give similar results. The cost of producing this article is far below that of ordinary hard rubber, and while its quality is not fully equal to that of good rubber for all uses, yet for many purposes it will fully fill the requirements. This new hard rubber has been produced by persistent study for years, and by numerous experiments and tests. The most favorable words yet spoken for its qualities are from rubber manufacturers, their chemists, and other rubber experts, who have seen the finished products, and until they have tested the material by heat, refuse to allow that it contained no ordinary rubber. This product will be placed upon the market in form of manufactured goods, and also in blanks for numerous purposes.

Electrolytic Persulphates

London Electrical Review

Details have recently been published regarding the laboratory experiments upon the electrolytic preparation of persulphates, caried out by Müller and Friedberger in the Electro-Chemical Laboratory of the Technical Hochschule at Dresden. Elbs had shown in an earlier publication, that persulphates could be produced without difficulty, by the electrolysis of acid solutions of sulphates, with the acid of a diaphragm. The authors of the present paper desired to find whether equally favorable results could not be obtained in neutral solutions in the absence of a diaphragm. The form of apparatus used for carrying out the series of experiments was based upon that first devised by Oettel, and permitted the course of the electrolysis to be watched by collection and measurement of the gases evolved at the anode and cathode of the experimental cell. Platinum was used as electrode material, and the contents of the cell were kept cool by a current of water. Potassium and ammonium sulphate solutions with and without the addition of sulphuric acid and potassium chromate, were used as electrolytes in the various experiments. The results showed that a current efficiency of 35 per cent could be obtained in the formation of potassium persulphate, using an acid electrolyte, but no diaphragm. The efficiency when working with the corresponding ammonium salt, rose to 80 per cent, when chromate was added to the electrolyte, and the free ammonia formed during the electrolysis at the cathode, was converted into the sulphate by continual additions of sulphuric acid. These efficiencies are equal to those obtained when diaphragms are employed—while the e. m. f. required to work the cell is reduced from 8 to 5.9 volts. The authors do not state that the electrolytic processes for manufacture of persulphates are in actual operation, but according to information in our possession, the Electrolytic Chlorate Works at Mansboe, Chedde, and St. Michel are already producing both perchlorates and persulphates on an industrial scale.

The Selenium Telautograph

Elektrotechnischer Zeitschrift

A new and improved instrument for the reproduction of images at a distance has recently been devised. The invention is based upon the sensitiveness of vacuum discharges at an exhaustion of 0.2 to 2 millimeters to slight changes in the resistance of the circuit, and the external protochemical activity of the rays proceeding from the discharge tube. The picture to be transmitted is divided up into small sections, each section being projected in turn upon a cell of selenium. At the receiver end of the machine a sensitive plate is made to move past an aperture, transmitting the X-rays at a rate corresponding to the motion of the original picture at the sending end. The variations in the current produce a variation in the size of the spark-gap, which in turn produces a similar variation in the actinic intensity of the vacuum tube. The greater the deflection of the galvanometer, owing to the elimination and consequent lowering of the resistance of the selenium cell, the closer does a brass needle approach the fixed needle representing the other electrode. An electrode of the vacuum tube is attached to a fixed needle, while the other is earthed and the movable needle connected with a pole of the secondary coil of a Tesla apparatus. The second pole of the Tesla coil is connected with a large capacity. A. Korn is the inventor.

Acetylene Army-Signals

Cosmos, Paris

Acetylene has recently been tried for army signalling in Germany, and the experiments are reported to have been very successful. The gas, when mixed with a fixed proportion of oxygen, is said to give three times as brilliant a light as the oxy-hydrogen, or calcium light, and is so powerful that signals made with it are visible in daylight at distances of more than eight kilometers, or five miles, while at night the range is practically trebled.

Thunder Storms and Hertzian Waves

Comptes Rendus, Paris

Mons. F. Larroque, in a communication to the Acadèmie Française, has shown that electric waves may be projected to infinite distances from lightning discharges. M. Larroque, in his experiments, received the waves upon a short vertical earthed wire and fitted its upper end with a horizontal metal plate. In this wire is a narrow spark-gap in which sparks may be observed by a microscope. The author noted that the removal of the horizontal plate rendered the system inert, but that the elimination of the vertical portion has no apparent influence upon the sensitiveness of the apparatus. From this fact he concludes that the electric oscillations are horizontal. In the case, however, of very distant storms, those, for instance, occurring about 300 kilometers away, he discovered the electrical vibrations to be vertical.

Alumina by the Volumetric Formula

American Manufacturer

The method consists in titrating acidimetrically the free acids, using methyl-orange indicator and then continuing the addition of standard sodium hydrate until phenolphthalein shows a faint, but decided pink. The standard sodium hydrate is made up with 11.65 grs. sodium hydrate per liter, which is standardized by the use of NaH C_2O_4+Aq, with phenolphthalein indicator. For indicators one gram methyl-orange is dissolved in one liter of water, and one gram phenolphthalein in 500 c. c. of alcohol. For each titration use two drops methyl-orange and four drops phenolphthalein, both added at the same time. For the first part (determination of free acid) add the standard sodium hydrate rather slowly, as the reaction needs a perceptible time to be completed. The end reaction is the occurrence of an orange (not yellow) color. Note the burette and then run in the standard sodium hydrate in a rather rapid succession of drops, stirring constantly until a faint, but permanent pink is noticed. The end point with phenolphthalein is sharpest when the solutions are kept at about 30 degrees C. Above that temperature results are incorrect. Below 20 degrees C. the reaction is tardy and the end point obscured. The ultramarine tests were found to give good results in testing for free acid in sulphate of alumina; 0.5 gram of ultramarine was shaken up with 500 c. c. of water and ten c. c. lots, equal to 0.01 g., added to flasks containing twenty c. c. of a ten per cent solution of the sample made up to 100 c.c. The flasks were kept hot on a radiator, and the contents frequently stirred by rotating the flasks, the time required to decolorize being noted. In the case of the presence of free acid, the time required to decolorize was much shortened, and the difference in effect between 0.1 and 0.5 per cent free acid was quite perceptible. The presence of basic alumina had a decided retarding effect. Different makes of ultramarine, as might be expected, were decolorized in different periods, but with the same ultramarine the times were uniform.

Silicon Determination by Sodium Peroxide

Moniteur Scientifique

So great difficulty has been found in the determination of the amount of silicon in rich ferro-silicons (i. e., of fifty per cent and higher) by means of peroxide of sodium that the process has not as yet been practically applied outside the laboratory. Violent reactions take place when it is attempted to decompose a rich ferro-silicon directly by the peroxide, when there is abundance of carbon and silicon, because of the high exothermic action which takes place. The reduction occurs suddenly, with bad results to the platinum crucible in a majority of instances; projections accompany the reduction, hence the injury to the crucible. If, however, a half gram of finely powdered ferro-silicon and ten grams of a mixture of potassium and sodium carbonates are fused together (Fresenius' formula) with one gram of powdered sodium peroxide, decomposition will take place without any disturbance, though the process must take place quickly to be thoroughly effective. To prevent particles being thrown out, the heat must be applied slowly. Cool on a plate of polished steel; treat with boiling water and then with dilute hydrochloric acid in a porcelain dish, wash the platinum crucible well, add ten c. c. of nitric acid and two grams of potassium chlorate and evaporate the solution to dryness on the water bath; heat in the hot-air oven to 110 degrees, take up with twenty c. c. of hydrochloric acid, add 200 c. c. of distilled water; boil; filter on the filter pump, wash with hot water; dry, and calcine in a platinum crucible. Perfectly white silica is thus obtained. This method is most rapid with the rich ferro-silicons which are not attacked by acids, and it gives excellent results. In the filetrate the manganese may be estimated volumetrically with zinc oxide and permanganate titration. The sulphur may also be estimated by means of chloride of barium.

Sulphuric Acid from Sulphurous Gas

American Inventor

The Lake Superior Power Company, at Sault Ste. Marie, Mich., has just recorded the successful manufacture of sulphuric acid from the sulphurous gas taken from reduced nickel ore. This operation has never before been successfully accomplished on a commercial scale, and is held to be an extremely valuable discovery, as it utilizes an enormous amount of material which has hitherto been an entirely useless by-product.

United States Iron Production in 1901

The production of iron ores in the United States during the year 1901, as given by John Birkinbine, of the United States Geological Survey, amounted to 28,887,479 long tons, as compared with 27,553,161 long tons in 1900, a gain of 1,334,318 long tons, or 5 per cent; the gain of 1901 over 1898 was 9,453,763 tons, or 49 per cent. The total value at the mines of the ore mined in 1901 was $49,256,245, or a mean value of $1.71 per ton, an apparent decrease of 71 cents, or 29 per cent, from the 1900 figures of $2.42 per ton. The value of the iron ores mined in 1900 was $66,590,504.

Telephone Service on the Overland Limited

Railroad travel in the twentieth century has in it so large an element of personal comfort that the average passenger, in spite of his feverish desire to "get there," demands what are practically all the comforts of his own home. Speed is imperative, but that speed must be accompanied with none of the disagreeable features of railroad travel in former years, and no patronage comes to the railroad which is niggardly in fitting out its trains for the entire ease and luxury of the passenger.

Three great railway systems centering in Chicago—the Chicago and Northwestern and the Union and Southern Pacific roads—have combined to put into service a daily train between Chicago, San Francisco and Portland which should be typical in every respect of the progress of the country, and the luxurious Overland Limited is the result of their efforts. One of the unique features of the train is the introduction of telephone service, connections being effected while the trains are in the depôts at Chicago and Oakland, at which latter point the local telephone company holds the wire open especially for the comfort and accommodation of the passengers prior to the departure of the train.

Electric lights are run throughout each car, being connected to a six pole, one hundred and twenty-five volt, twenty-five horse power, direct connected dynamo located in the baggage car and carrying on its circuit two hundred and sixty to three hundred and fifty sixteen candle power incandescent lamps. The Pintsch gas system is operated as an auxiliary. Underneath the baggage car is placed a storage battery, having a capacity of two hundred and fifty ampère hours, which is charged directly from the generator above. The lights are strung on a flexible, three-cable connector, and each sleeping and dining car contains seventy lights, and the buffet and smoking cars forty each. Another innovation of a most welcome type is the introduction of twelve-inch electric fans which effectually cool the observation, dining and buffet cars. The diningroom of the train has ten tables, with a seating capacity of thirty, on which electric candelabra are placed to supplement the general electric illumination.

At Chicago and Oakland the train is ready for occupancy at least forty-five minutes before its departure, and during this time the telephone is at the disposal of the passengers, and a uniformed central in the observation car gives them whatever numbers they ask for during this time, connection being had between the train and the main office of the telephone company by a special wire which cannot be used for other business.

The finish of the cars themselves leaves practically nothing to be desired, and in the private rooms in each car are the usual toilet arrangements supplemented by electric curling-iron heaters and illuminated by combination gas and electric fixtures pendent from the ceiling. In the compartment cars the observation end is strongly suggestive of a bay window in a private house. The library and writing desk are separated from the main room by a decorative arch supported by ornamental pillars, and the library is supplied with books, magazines, illustrated periodicals and current literature of all kinds. Four large plate-glass windows, each four feet in width, and four oval windows of art glass in metal frames are on the side of the observation room, which contains fourteen comfortable chairs of various designs.

The purpose of making the observation

room of these cars so commodious is to permit of its use by all passengers. This privilege is especially appreciated by women and children and adds greatly to the pleasure of the overland journey. The observation platform of the car is broad and roomy, and is inclosed with brass ornamental railings. The arrangement gives space for an observation window, five feet wide, overlooking the tiled platform, and from this window passengers are able to view the scenery on either side. The lighting arrangements for the observation room are brilliant and make it desirable for visiting and entertainment during the evenings.

Ornamental Cement Stone Work

The materials are mixed very wet, the fluid about the consistency of paint as applied with a brush—one part cement to three parts of stone crushed to a uniform grain. The mixture is then poured from a bucket or other vessel, depending upon the size of the stone to be cast. During the pouring process the fluid mixture is continually stirred with a stick or paddle. A sand mould similar to the moulds used in casting iron is used. The sand receives the impression of a wooden or iron pattern. The pouring process is all the labor required in forming this stone, no tamping being done. The stone remains in the mould from twenty-four to thirty-six hours, when it is removed, and brushed to get rid of the adhering sand, when it shows all of the delicate lines and tracings of the most intricate pattern. The structure of the mass of the stone is absolutely dense and homogeneous, and one peculiarity of this process is that the knife edges of carvings or petals of flowers come out as dense and hard as the body of the stone and plain surfaces. It is a well-known fact that tamped concrete is always brittle where fine, sharp edges form part of the work, in imitation of carved stone.

This stone can be tooled and worked when green with great ease, giving an exact imitation of the natural stone, and it can likewise be turned on a lathe. It is extensively used in this way for columns and other forms in buildings, resulting in a great saving in the cost over the price of natural stone.

Illuminating Gas and Trees

It has often been asserted that illuminating gas, escaping into the ground from street mains, was deadly to trees, and that it was largely due to this cause that shade trees in many cities prove short-lived.

This question was raised at a recent meeting of the Western Gas Association at New Orleans. One of the members in answering the question said:

"I cannot answer for all trees, but I can answer for what I have seen. I think in Columbus we have as healthy looking trees as can be seen anywhere in the gas-works yard. The effect of the gas is to help their growth. We cannot keep them from growing. The ground is charged with gas and there is where they seem to grow the best."

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"*To look at an incandescent lamp and realize that its luminous efficiency is at the most only three or four per cent of that theoretically possible, ought to take the conceit out of any engineer who feels complacently satisfied with what even the last decade has done.*"—*Louis Bell, Ph. D., in Ten Years' Progress in Electric Lighting.*

A suggestive article upon the possibilities of electric lighting stations making money by combining ice-making plants with their regular business appears on another page of this issue. Mr. F. H. White, the author, is connected with one of the principal ice-making machine manufacturers and is in a position to give figures which may be accepted without hesitation as being practically realized in commercial plants. According to these figures small plants can be installed at an expense of about $1,100 for each ton of ice to be made a day, and the cost of operation is set at $31.20 a day for a twenty-five-ton plant. This sum is made up of $19.20 for power, $5 for two engineers, $4 for two tankmen and $3 for oil, waste and repairs. Mr. White says in his conclusion that he has made his estimates purposely high, and that any engineer can see where money can be saved on several of the items. We believe Mr. White is right about this. He makes his estimates as to the cost of power upon the basis of one cent per horse power hour. This is a very liberal allowance for surplus power, and whatever saving could be figured out below this amount would represent just so much more profit. Mr. White also allows $5 a day for two engineers to operate the ice-plant. This would seem to be an unnecessary allowance since where the plant to be operated is as small as twenty-five tons a day capacity, it ought to be worked, it would seem, by the engineers who operate the electric plant. The saving of the pay for the two engineers, or even the leaving of one off the pay roll, would add materially to the percentage of profits. That there are many electric lighting and street railway central plants where the addition of an ice-making plant would prove profitable must be true. One of the best evidences that this is the case is to be found in the numerous reports of the building of such plants to be operated in conjunction with central electric stations in the south and west and southwest.

Gas=Engines as Gas Consumers

FROM A PAPER BY C. H. NUTTING

The gas-engine is slowly but surely becoming better understood, and in time is certain to outdo its rivals.

There are several gas-engine manufacturers who will guarantee their engines to run on 10,000 B. T. U. per brake horse power per hour. Now, if your gas-engine contains 650 B. T. U. per cubic foot of gas, it will take sixteen cubic feet of gas per brake horse power to run your engine.

The average gas consumer cannot be expected to give the subject of gas consumption the consideration necessary to determine the advantages of its use, and the gas company should do it and be able to demonstrate its advantages without loss of time or expense to the consumer, and should have employes who could and would assist the consumer in understanding its uses and advantages.

I have just sold one of our consumers a ten horse power gas-engine with a 7.5 kilowatt dynamo direct connected. This plant will be used for electric lighting in a hotel, for pumping water and to run a cold-storage plant.

Now, one word as to the selection of an engine. Don't get a cheap engine and make yourself think you are saving money, for you are not. A poor gas-engine is the poorest piece of machinery you can have around, and because there are a great many poor engines on the market, which do not do all the work as they should, and which cause backaches, heartaches and bad words, do not think that all gas-engines are alike.

Our gas company sets separate meters for gas-ranges and we find that our ranges average us 11,000 cubic feet of gas used per year. Now a one horse power gas-engine is worth three ranges to the gas company, a two horse power engine is worth seven ranges, a 3.5 horse power is worth ten ranges, a five horse power is worth 16.5 ranges and a twenty horse power is worth thirty-seven ranges. This is what I find from actual use, and is not guessed at.

Now, isn't it well worth while to make an earnest effort to get every gas-engine possible connected to our mains?

Street railway companies, electric lighting companies and gas companies which desire their reports to appear in the Financial Bureau of the ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Montnly reports are requested showing gross receipts and when possible operating expenses. Comranies are also requested to furnish the highest and lowest priees for which their stock has sold in the market for the previous month.

STREET RAILWAY STATEMENTS

Brooklyn Rapid Transit System

(All companies.)

Comparative statement of operations for months of May, 1902 and 1901.

	1902.	1901.		
*Miles operated (single track).....	489.3	488.9	Inc.	.40
Gross receipts..................	$1,156,344.84	$1,075,576.47	Inc.	$80,768.37
Expenses, including taxes	730,152.44	715,161.32	Inc.	14,991.12
Net receipts	$426,192.40	$360,415.15	Inc.	$65,777.25
For eleven months ending May 31.				
*Miles operated (single track).....	489.3	488.9	Inc.	.40
Gross receipts................	$11,624,417.09	$10,920,174.38	Inc.	704,242.71
Expenses, including taxes.......	8,220,062.33	7,237,894.12	Inc.	982,168.21
Net receipts..................	$3,404,354.76	$3,682,280.26	Dec.	$277,925.50

*Includes leased railroads of N. Y. & B. Bridge, 2.6 miles, and trackage rights over C. I. & B. R. R., 2.4 miles.

Metropolitan West Side Elevated Railway Co., Chicago

For five months ending May 31, 1902.

Earnings.	1902.	1901.	Changes.	
January......................	$98,029	$89,699	Inc.	$8,330
February	100,466	97,659	Inc.	2,807
March	105,512	98,339	Inc.	7,173
April........................	109,246	97,020	Inc.	12,226
May..........................	105,799	92,572	Inc.	13,227
June report:				
	1902.	1901.	Changes.	
Gross earnings...................	$152,614	129,269	Inc.	$23,345
January to June 30:				
Gross earnings...................	936,612	845,464	Inc.	91,148

Chicago Union Traction Company

Report for the year ending June 30:

	1902.	1901.	Changes.	
Gross earnings	$7,825,119	$7,289,139	Inc.	$535,980
Operating expenses	4,570,719	3,942,194	Inc.	628,525
Net earnings	$3,254,500	$3,346,945	Dec.	$92,545
Other income	117,349	869,670	Dec.	752,321
Total income	$3,371,749	$4.216,615	Dec.	$844,866
Fixed charges	3,619,277	4,058,040	Dec.	438,763
Deficit	$247,528	bal. $138,575	Inc.	$406,103
Preferred dividend	....	150,000	Dec.	150,000
Deficit	$247,528	sur. $8,575	Inc.	$256,103

Northwestern Elevated Railroad Co., Chicago

For five months ending May 31, 1902.

Passengers carried.	1902.	1901.	Changes.	
January	62,010	52,022	Inc.	9,988
February	64,760	55,256	Inc.	9,504
March	65,362	57,193	Inc.	8,169
April	65,430	58,623	Inc.	6,807
May	63,199	56,999	Inc.	6,200

South Side Elevated Railroad Co., Chicago

For five months ending May 31, 1902.

Passengers carried.	1902.	1901.	Changes.	
January	79,154	71,137	Inc.	8,017
February	79,386	74,525	Inc.	4,861
March	80,313	76,269	Inc.	4,044
April	81,009	77,782	Inc.	3,227
May	76,063	74,175	Inc.	1,858

Detroit United Railway Company

June Report.

	1902.	1901.	Changes.	
Gross earnings	$291,470	$260,109	Inc.	$31,361
Net earnings	$132,136	$120,696	Inc.	$11,440

For six months ending June 30.

	1902.	1901.	Changes.	
Gross earnings	$1,591,286	$1,372,947	Inc.	$218,339
Net earnings	684,243	596,601	Inc.	87,642

United Traction Co., Pittsburgh

For the quarter ending March 31, 1902.

	1902.	1901.	Changes.	
Gross earnings	$344,900	$315,959	Inc.	$28,941
Net earnings	87,135	90,566	Dec.	3,431

Montreal Street Railway Co.

April report.

	1902.	1901.	Changes.	
Gross earnings................	$154,389.73	$144,793.50	Inc.	$9,596.23
Net earnings.................	70,539.70	51,521.40	Inc.	19,018.30

St. Louis Transit

	1902.	1901	Changes.	
June report:				
Gross earnings	$557,114	$518,541	Inc.	$46,573
January 1 to June 30:				
Gross earnings	3,014,588	2,786,637	Inc.	227,951

International Railway Co., Buffalo, N. Y.

Report from February 21 to March 31.

Gross earnings..	$281,408
Operating expenses	161,526
Net earnings...	119,882
Income from other sources.............................	3,600
Fixed charges..	96,499
Net income...	26,983
Cash on hand...	166,742
Surplus..	970,719

Union Traction, Albany City

June report:				
Gross earnings	$131,992	$123,784	Inc.	$6,208
January 1 to June 30:				
Gross earnings....	724,290	624,416	Inc.	99,874

Hornellsville (N. Y.) Electric Railway

For the year ending June 30.

	1902.	1901.	Changes.	
Gross receipts	$13,102	$12,814	Inc.	$288
Net receipts..................	274	732	Dec.	458

Jamestown (N. Y.) Street Railway

Quarter ending June 30.

	1902.	1901.	Changes.	
Gross receipts	$18,824	$17,750	Inc.	$1,074
Net receipts..........	699	2,610	Dec.	1,911

Twin City Rapid Transit

	1902.	1901.	Changes.	
Second week of July:				
Gross earnings.................	$78 621	$63,311	Inc.	$15,310
January to date:				
Gross earnings.............. ...	1,812,353	1,578,316	Inc.	233,937

Duluth—Superior Traction

	1902.	1901.	Changes.	
June report:				
Gross earnings.................	$48,125	$38,857	Inc.	$9,268
January to June 30:				
Gross earnings.................	224,239	207,303	Inc.	36,936

Harrisburgh Traction

	1902.	1901.	Changes.	
June report:				
Gross earnings.................	$41,867	$37,192	Inc.	$4,675
Net earnings...................	18,582	16,655	Inc.	1,927
January to June 30:				
Gross earnings.................	213,321	174,078	Inc.	39,243
Net earnings...................	90,205	64,920	Inc.	25,285

Pottsville Union Traction

	1902.	1901.	Changes.	
June report:				
Gross earnings.................	$14,824	$17,401	Dec.	$2,577
January to June 30:				
Gross earnings.................	76,163	17,603	Inc.	560

Cleveland Electric

	1902.	1901.	Changes.	
June report:				
Gross earnings.................	$214,985	$199,696	Inc.	$95,289
Net earnings...................	95,094	91,298	Inc.	3,796
January to June 30:				
Gross earnings.................	1,176,014	1,053,134	Inc.	122,880

Cleveland, Elyria and Western

	1902.	1901.	Changes.	
June report:				
Gross earnings.................	$25,198	$22,236	Inc.	$2,962
Net earnings...................	12,172	12,501	Dec.	329
January to June 30:				
Gross earnings.................	128,392	107,026	Inc.	21,366
Net earnings...................	50,665	42,769	Inc.	7,896

Chicago and Milwaukee Electric.

	1902.	1901.	Changes.	
June report:				
Gross earnings.................	$17,745	$17,252	Inc.	$493
Net earnings...................	10,680	11,057	Dec.	377
January to June 30:				
Gross earnings.................	$78,934	65,460	Inc.	13,474
Net earnings...................	40,913	31,058	Inc.	9,855

Madison (Wis.) Traction

	1902.	1901.	Changes.	
June report:				
Gross earnings..................	$8,321	——	——	——
Net earnings....................	3,587	——	——	——
January to June 30:				
Gross earnings..................	36,462	——	——	——
Net earnings....................	8,945	——	——	——
September 1, 1901 to June 30:				
Gross earnings..................	59,750	——	——	——
September 1 to May 31:				
Net earnings....................	13,620	——	——	——

City Electric, Rome, Ga.

	1902.	1901.	Changes.	
June report:				
Gross earnings..................	$3,589	$4,268	Dec.	$679
Net earnings....................	525	511	Inc.	14
January to June 30:				
Gross earnings..................	20,777	20,264	Inc.	513
Net earnings....................	2,333	2,711	Dec.	378

Dartmouth and Westport St. Railway

	1902.	1901.	Changes.	
June report:				
Gross earnings..................	$11,805	$11,269	Inc.	$536
January to June 30:				
Gross earnings..................	52,980	49,494	Inc.	3,486

Elgin, Aurora and Southern Traction

	1902.	1901.	Changes.	
June report:				
Gross earnings..................	$33,874	$32,614	Inc.	$1,260
January to June 30:				
Gross earnings..................	186,456	167,648	Inc.	18,808

Union, New Bedford.

June report				
Gross earnings..................	$20,713	$25,343	Dec.	$4,630
January 1 to June 30:				
Gross earnings..................	146,870	118,501	Inc.	28,379

Washington, Alexandria and Mt. Vernon

June report:				
Gross earnings..................	$17,313	$15,475	Inc.	$1,856

GAS AND ELECTRIC COMPANIES

Kansas City (Mo.) Gas Company

For the year ending April 30.

	1902.	1901.	Changes.	
Net earnings	$304,428	$290,310	Inc.	$14,118
Interest on 5 per cent bonds	197,100	191,783	Inc.	5,317
Surplus	107,328	98,527	Inc.	8,801

Balance Sheet.

Assets.	1902.	1901.	Changes.	
Plant	$9,005,269	$8,927,386	Inc.	$77,883
Materials	80,284	84,398	Dec.	4,114
Cash	51,612	84,333	Dec.	32,721
Accounts received	65,509	65,796	Dec.	287
Insurance	2,248	1,542	Inc.	706
Sinking fund bonds	309,000	230,615	Inc.	78,385
Premium on sinking fund bonds	12,718	....	Inc.	12,718
Sinking fund trustee	8,507	....	Inc.	8,507
Total	$9,535,147	$9,394,073		$141,074
Liabilities.				
Stock	$5,000,000	$5,000,000		....
Bonds	3,942,000	3,942,000		....
Accounts payable	79,333	70,782	Inc.	8,551
Sinking fund	30,225	5,615	Inc.	24,610
Profit and loss	483,589	375,676	Inc.	107,913
Total	$9,535,147	$9,394,073		$141,074

Boston Gas Light Company

General balance sheet June 30.

Assets.	
Real estate, buildings and machinery	$7,217,949
Cash and debts receivable	568,325
Manufactures, merchandise, material and stock in process	260,295
Miscellaneous	24,414
Total	$8,070,983
Liabilities.	
Capital stock	$2,500,000
Debts	734,929
Balance, profit and loss	4,803,851
Guaranty fund	32,203
Total	$8,070,983

Bay State Gas Company, Boston

General balance sheet June 30.

Assets.

Real estate, machinery	$2,329,387
Cash and debts receivable	377,337
Manufactures, merchandise, material and stock in process	61,299
Miscellaneous	35,550
Total	$2,803,573

Liabilities.

Capital stock	$2,000,000
Debts	578,284
Balance, profit and loss	225,289
Total	$2,803,573

Consolidated Gas Co., Baltimore City

Year ending, June 30, 1902:

	1902.	1901.	Changes.	
Gross receipts	$1,757,863	$1,639,433	Inc.	$118,430
Net earnings	749,353	720,072	Inc.	29,381

Charleston (S. C.) Consolidated Ry. Gas and Electric Co.

Six months ending May 31:

	1902.	1901.	Changes.	
Gross receipts	$399,572	$245,745	Inc.	$153,827
Net income	191,247	86,320	Inc.	103,927

Buffalo Gas Co.

June report:

	1902.	1901.	Changes.	
Net earnings	$17,841	$14,386	Inc.	$3,455
Oct. 1, 1901 to June 30, 1902				
Net earnings	$270,545	$238,440	Inc.	$32,105

Consolidated Gas Co., New Jersey

May report:

	1902.	1901.	Changes.	
Net earnings	$7,890	$6,379	Inc.	$1,511
January 1 to May 31:				
Net earnings	18,420	16,113	Inc.	2,307

Gas and Electric Co. of Bergen County, N. J.

May report:

	1902.	1901.	Changes.	
Gross earnings	$19,790	$18,751	Inc.	$1,039
Net earnings	6,627	6,074	Inc.	553
June 1, 1901 to May 31, 1902:				
Gross earnings	268,793	235,683	Inc.	33,110
Net earnings	105,652	84,823	Inc.	20,829

Laclede Gas Light Co.

	1902.	1901.	Changes.	
May report:				
Net earnings....................	$84,320	$81,624	Inc.	$2,696
January 1 to May 31, 1902:				
Net earnings......	469,519	424,474	Inc.	45,045

Lowell Electric Light Co.

	1902.	1901	Changes.	
May report:				
Gross earnings..................	$15,625	$13,814	Inc.	$1,811
Net earnings	5,721	5,226	Inc.	495
July 1, 1901 to May 31, 1902:				
Gross earnings..................	176,542	165,620	Inc.	10,922
Net earnings....................	69,545	56,473	Inc.	13,172

Jackson Gas Light Co.

	1902.	1901.	Changes.	
May report:				
Net earnings....................	$3,005	$2,614	Inc.	$481
March 1 to May 31, 1902:				
Net earnings....................	9,767	7,067	Inc.	2,700

Telephone and Electric Companies

American Telephone Company

Output of Instruments for month ended June 20.

	1902.	1901.	Changes.	
Gross output	96,653	96,300	Inc.	353
Returned	41,741	34,221	Inc.	7,520
Net output..................	54,912	62,079	Dec.	7,167
From Dec. 21 to June 20:				
Gross output	589,109	469,923	Inc.	119,186
Returned	226,267	194,569	Inc.	31,698
Net output..................	362,842	275,354	Inc.	87,488
Total outstanding June 20........	2,888,852	2,228,170	Inc.	660,682

Mexican Telephone Co.

	1902.	1901.	Changes.	
May report:				
Gross earnings..................	$19,892	$17,359	Inc.	$2,533
Net earnings....................	9,124	8,104	Inc.	1,020
March 1 to May 31, 1902:				
Gross earnings..................	58,430	31,902	Inc.	1,528
Net earning	26,708	23,323	Inc.	3,385

Philadelphia Co.

Five months' report, 1902:

	1902.	1901.	Changes.	
Gross earnings	$5,773,615.85	——	——	——
Net earnings	2,802,789.85	——	——	——

Northwestern Electrical

June report:

	1902.	1901.	Changes.	
Gross earnings	$91,219	$80,385	Inc.	$10,824
January 1 to June 30:				
Gross earnings	575,414	503,313	Inc.	72,101

Belmont Forming a New Transit System

The Belmont-McDonald syndicate, which is building the underground railroad of New York, submitted to the Rapid Transit Railroad Commission on July 21 two remarkable bids for the construction of the proposed extension of the road from the New York City Hall to the Battery, under the East River and to Atlantic and Flatbush Avenues in Brooklyn.

The actual cost of building and equipping this extension has been estimated at $8,000,000 by Chief Engineer William Barclay Parsons. This was the sum bid by the Brooklyn Rapid Transit Company, the only competitor which appeared against the Belmont-McDonald syndicate.

The Belmont-McDonald bid was to construct and equip the new tunnel for $3,000,000 (including $1,000,000 for real estate and terminals) or if an underground extension of the present road from Union Square up Broadway to Forty-second street be authorized before July 3, 1903, to build that and the Brooklyn tunnel extension for a grand total of $4,100,000, and an integral portion of each bid is the character and extent of transfers to be given for a single fare. The Brooklyn Rapid Transit road offered free transfers to ninety-five per cent of the Brooklyn roads, but could not offer a ride into Manhattan above the post office. The Belmont-McDonald offer was of rides for a single fare from the Brooklyn terminal over the whole length of Manhattan and into the Bronx.

That the Belmont-McDonald bid was put at figures meant to blot out all consideration of other bids is obvious, and the significance of this is of the highest importance.

It is now certain that under the title of the Interborough Rapid Transit Company Mr. Belmont is organizing a passenger system which is destined to compete in size and ambition with the greatest in the country. It is designed to take into its territory as feeders the three largest districts within easy reach of Manhattan which are sparsely settled. These are the Bronx, the Astoria district of Queens, on the Sound, and the great South Brooklyn district down to Coney Island.

Mr. Belmont even intimated that free transfers would be given for rides as far out as Jamaica.

The formation of this vast new transit system was first indicated by the purchase by Mr. Belmont and his associates of the one hundred and ten miles of roads in and about Long Island City embraced in the system of the Queens County Railroad Company. The Interborough Rapid Transit Company is the $25,000,000 corporation which is to take over and operate the new underground rapid transit railroad which the Belmont-McDonald syndicate is building for the city. As the tunnel must of necessity have numerous feeders to make it a good paying investment, the road is in itself only a trunk line, and there has long been a feeling that by the time the road was completed and equipped it might fall into the hands of the Metropolitan Street Railway people to operate.

The Belmont-McDonald syndicate's latest purchase, and the rumor that it will furnish the money itself to build the proposed tunnel extension from the City Hall and the Battery to Brooklyn, rather than not get the lease of that line, is believed to set at rest all doubt that the contractors will operate the line themselves. It is now believed that their plans include the acquiring by purchase or building of a great system of feeders, which will reach out into a vast surburban territory of undeveloped country.

The purchase of the Queens county roads is a beginning. With these roads the Interborough company acquires the ownership of the franchise granted ten years ago for a tunnel from Forty-second street, Manhattan, to Long Island City.

This tunnel will connect with the Rapid Transit at Park avenue, opposite the Grand Central station. With this connection the great unbuilt territory to the north and east of Long Island City will be made as readily accessible to Manhattanites as it is to the Bronx.

The terminal extension asked for by Mr. Belmont to reach from Union Square to Forty-second street would be of high importance. It would run up Broadway through the shopping district and at Thirty-third street there would be a connection to the great station which the Pennsylvania road is to build. This connection would be by an underground arcade the whole width of the street.

The Bronx, it is believed, is to furnish another field for the Belmont-McDonald syndicate to develop in. In this great territory there already exist the lines of the Union Railway Company, now controlled by the Metropolitan Street Railway people. These lines, however, reach but a small part of the actual territory to be developed there. Years ago a crossline system was designed for th section. This or some other system, is now believed, will be developed, with close connection between it and the trunk lines of the rapid transit road, which is to run through the district. An eastern branch of the rapid transit road, to run north from the Forty-second street station, is already being designed by Chief Engineer Parsons, of the Rapid Transit Railroad Commission.

The acquisition of the right to build and operate the Brooklyn tunnel extension would open up another large and but partially developed territory for the operations of the syndicate. This is the territory in South Brooklyn lying between Prospect Park and Greenwood Cemetery, and Bath Beach and Coney Island.

This section of Brooklyn is mostly covered with broad farms. Here and there along the old lines to Bath Beach and Coney Island are new cottage settlements, like Borough Park, but there is room still left there for a vast city of separate homes.

The proposed tunnel would end at Atlantic and Flatbush avenues, Brooklyn. This is the key to South Brooklyn, and from there a new transit system might be built out toward the bay and sea to compete with the Brooklyn Rapid Transit Company, which now operates all but one of the few lines through that territory. The Forty-second street station of the Rapid Transit Railroad seems destined to become the most important one on the road.

It is from there that Chief Engineer Parsons has been instructed to design an east side extension to run to the Harlem river or above, and there will surely be a transfer connection at that point with the promised electrically-operated suburban system of the New York Central, Harlem and New Haven roads, from the Grand Central station across the street. Plans have been made for a physical connection between these roads at that point, and these may be adopted when the matter is definitely settled.

Franchise Bureau

The ELECTRICAL AGE intends to collect for reference purposes copies of every franchise issued by the various states to electric lighting, street railway and gas companies, and particularly those granted by special acts of legislation. All persons who can do so are requested to send copies of such franchises to the "Franchise Bureau, ELECTRICAL AGE." Copies not returnable.

Financial Notes

The New York Edison Company announces that on and after September 1 the retail prices for incandescent lighting service will be reduced from the present maximum of 20 cents to a maximum of 15 cents a kilowatt hour. The full schedule will be, for the first two hours of average daily use of the connected installation, 15 cents a kilowatt hour; for the third and fourth hours, 10 cents; for the fifth and sixth hours, 7½ cents, and for all over six hours, 5 cents a kilowatt hour.

To the great number of the users of electric light, but perhaps more especially the residential users, this change will represent a reduction of nearly 25 per cent and the result should be to greatly broaden the field of electric installation, as well as of electrical supply.

Kidder, Peabody & Co. and J. W. Seligman & Co. have issued a circular explanatory of the plan for reorganizing the New England Gas & Coke Company. To answer many inquires it may be stated that the owner of 25 shares and two bonds of the New England Gas & Coke Company would, upon payment of $250, receive in exchange for his stock $275 4 per cent preferred shares and $375 common of the Massachusetts Gas Companies; and for the bonds $1,040 in 4 per cent preferred stock and $1,100 in common stock. Interest on the preferred shares would be paid in cash at the rate of 4 per cent from December 1, 1901, to December 1, 1902, at the time of the exchange.

The Pennsylvania Gas, Fuel & Construction Company has obtained a franchise to furnish fuel and illuminating gas in Green Island, a suburb of Cohoes N. Y., charging 75 cents per 1,000 feet to private residents and 50 cents per 1,000 feet for village use. This company also has franchises in Cohoes, Watervliet and Colome, and is seeking new fields.

The Union Gas Corporation of Pittsburg, with a capital of six millions and an authorized two million bond issue, has been formed to take over the gas properties of Theodore N. Barnsdall, located in the Pennsylvania and West Virginia oil fields.

The United Gas Improvement Company of Philadelphia now virtually controls all the street railways of Rhode Island, and a great part of the trolley lines of Connecticut. The mileage aggregates 442 miles, of which 170 are operated by the Connecticut Railway & Lighting Company, and 272 miles by the Providence street railway. The Connecticut Company will have a Bridgeport, or southern division, including the lines in Waterbury, New Britain, etc. The Providence Street Railway operates in the cities of Providence and Pawtucket, R. I., Attleboro and North Attleboro, Mass., and several towns. Our Harrisburg, Pa., correspondent reports that the U. G. I. Co. is in control of all the gas producing properties in that city. It has secured options on the stock of the Harrisburg Gas, the People's Gas and the Gaseous Fuel Companies, whose plants and lines it has leased for 20 years. The matter will be finally settled in August, when the company will be enlarged. It was said that the United Gas Company had bought the People's Company at $39. The People's Gas had a capital of $200,000, with a par of $50 and $50,000 of bonds. The Commonwealth Trust Company and the First National Bank of this city and Drexel & Company of Philadelphia own most of the stock.

The new Lowe Coke & Gas Security Co. of New York has ten million 6 per cent non-cumulative preferred stock.

The Manufacturers' Light & Heat Co. of Pittsburg, Pa., has obtained $949,700 of the $1,500,000 capital stock of the Tri-State Gas Co., the entire capital stock (4,000 shares) of the Relief Gas Co., and $160,000 of the $200,000 capital stock of the Welzel Gas Co., whose funded debt is $114,000. In exchange the Manufacturers' gives about $1,500,000 stock, increasing its issue from $3,000,000 to $4,500,000, the total authorized issue being $5,000,000. But the total capital stock of the Manufacturers' with affiliated corporations is $7,180,000 authorized and $6,480,000 outstanding. The Pittsburg Stock Exchange has listed $3,000,000 (par value $50), also $598,000 6s of the authorized issue of $750,000, of which $50,000 must be redeemed every year from January 1, 1901, to January 1, 1915.

The People's Heat & Light Co., Ltd., of Halifax, N. S., recently sold under foreclosure, is now the property of the Halifax Street Railway, the bondholders, it is said, getting 35 cents on the dollar.

A new contract is under consideration between the Sprague Electric Co. and the General Electric Co. on account of a disagreement as to the value of the plants. If the security holders of the Sprague Co. shall by October 1, 1902, have deposited with the U. S. Mortgage & Trust Co. at least 66 2-3 per cent of the outstanding bonds and 66 2-3 per cent of the stock, the General Electric Co. will pay and deliver cash and 3½ per cent bonds in exchange, as stipulated in President Markle's circular letter of last month.

United States Coal & Oil Co. has been replaced on the Boston Stock Exchange.

Under the name of the Worcester and Connecticut system, the Sanderson-Porter Company, of New York, is organizing a sixty-mile system of street railways that will directly connect Worcester and Norwich, Conn. The following five to be combined into one big company: The Worcester & Webster, Webster & Dudley, Worcester & Connecticut Eastern, the People's Tramway and the Daniels.

Indiana has a new traction company to be known as Jasper, French Lick, West Baden & Northeastern. The capital stock will be increased from $100,000 to $500,000.

The St. Louis & Suburban Electric Railway will be controlled by a voting trust committee for three years.

The Philadelphia Rapid Transit Company's 999 years lease of the Union Traction Company went into effect last month. A statement was printed to the effect that the Company's net earnings for the year were estimated at $1,000,000.

The Camden Inter-State Railway Company of Huntington, West Va., has sold to a Pennsylvania syndicate its electric lines in that city, Central City, Ceredo and Kenova, W. Va.; Cattlettsburg and Ashland, Ky., and Ironton, O. The deal will also embrace electric light plants in Ironton, Ashland and Huntington. The consideration is about $2,000,000. It is rumored that the syndicate has in view the purchase of electric railways in other Ohio valley cities, the ultimate aim being to have a continuous line between Cincinnati and Pittsburg. John Graham was elected president of the new company.

The Paducah (Ky.) City Railway having obtained a new franchise running twenty years from August 1, 1902, has made a mortgage securing $1,000,000 5 per cent bonds dated July 1, 1902, and due July 1, 1932. Of the issue, $400,000 is reserved to take up underlying bonds and $600,000 goes at once for improvements and additions, including a three-mile extension.

The price of gas in Pittsburg has been reduced from $1.20 to $1.00 per 1,000 feet.

For the Oakland (Cal.) Transient Consolidated E. H. Rollins & Co. offered last month through their San Francisco branch $700,000 of the new first consolidated sinking fund 5 per cent 30-year $1,000 gold bonds, dated July 1, 1902, due without option July 1, 1932, with interest payable January-July. The mortgage is limited to $6,500,000. Earnings for the year ending May 31 were gross $830,282; net over operating expenses, $306,879; for June, 1902, $81,426, and net, $33,274, as compared with $54,382 gross in May, 1901, and $17,484 net.

The New Orleans & Carrollton Ry. Light & Power Co. passed to the New Orleans Railways on July 15, the final payment of 95 per cent for the $2,500,000 common stock.

The deal for the sale of the Charleston (S. C.) Water Works Company to the Mercantile Trust & Safe Deposit Company of Baltimore was closed at 70 for the $300,000 of 6 per cent bonds and 85 for the $200,000 first mortgage bonds. The result is the Charleston Light & Water Company, capitalized at $1,000,000, and it has under way a suitable plant. Bonds to the amount of $1,250,000 have been issued.

G. F. Penhale states that Park & Hamilton, of Youngstown, O., have secured franchises authorizing them to construct and operate electric street railways in the city of Havana. The concessions are estimated to be worth $25,000. Harry G. Hamilton negotiated the deal in Havana. Associated with Messrs. Park & Hamilton in the enterprise are G. F. Penhale & Co. and H. W. Whipple, of New York; Devitt Tromble & Co. and H. W. McDonald & Co., of Chicago, and W. J. Hayes & Sons, of Cleveland.

The Norfolk, Portsmouth & Newport News Company, owning the consolidated street railway system of tidewater Virginia has given a mortgage for $4,000,000 to the North American Trust Company of New York, and one for $2,000,000 to the Richmond Trust & Safe Deposit Company, trustee. Both are to cover forty year 5 per cent bonds.

General Electric stock dividend of 66 2-3 per cent amounting to $16,812,600 has been listed on the Stock Exchange, making the total $42,034,600.

The Montreal (Quebec) Street Railway was operated in April on a basis of 54.97 per cent of car earnings, as against 64.71 per cent for the corresponding month last year. As a consequence the surplus was increased $12,458.39.

The following securities were sold at public auction in New York during the past thirty days:

2 shares 6th Ave. R. R. Co.	181½
50 shares New Orleans Lighting Co.	50
$6,000 St. Paul Gas Light Co. 6 per cent	114⅞
$3,000 Equitable (Chicago) Gas Light & F. Co 1st 6s	103⅛
$2,000 People's Gas Light & Coke Co. 1st 6s	103⅛
$1,000 People's Gas Light & Coke Co. 1st con. 6%	122⅛
22 shares Empire and Bay States Tel. Co	80
$6,009 Haverstraw Light & Fuel Gas Co. 5% gold	20

Stock Market Reports

Traction Stocks and Bonds

	Bid.	Asked.
Am. Light & Traction	35½	36½
Am. Light & Traction pref	93	94½
American Railway (Phila)	46	47
Atlantic Ave. con. gen. 5s	112	113
Atlantic Ave. 1st gen. 5s	104	107
Atlantic Ave. im g. 5s	110	110¼
Atlantic Coast Electric	8	10
Atlantic Coast Elec. 1st 5s	85	90
Atlantic Coast Elec. gen. 5s	40	60
Binghamton R. R. Co. 5s	102	103
Bleecker St. & Fulton Ferry	32	35
Bl ecker St. & F'lton fy 1st 4s (Met. St Ry.)	99	100
Boston Elevated	164	165
Bridgeport Traction 1st 5s	106	107
Broadway & 7th Ave. 1st c. g. 5s	117	120
Broadway & 7th Ave. 2 5s	107½	109½
Broadway & 7th Ave. (Met. St. Ry.) 10 p c.	245	250
Broadway Surface 1st 5s	112½	113
Broadway Surface 2d 5s	101½	102½
Brooklyn Bath. & W. End 5s	102½	104
Brooklyn City 10 p. c	247½	248½
Brooklyn City & Newtown 1st 5s	115	117
Brooklyn City 1st. con. 5s	112½	114
Brooklyn (Cleve.) 1st 6s	103	104
Brooklyn (Cleve.) 1890 6s	103	104½
Brooklyn Crosstown 1st 5s	101	103½
Brooklyn Heights 1st 5s	105	108
Brooklyn Q. & S. con. gtd. 5s	102	103
Brooklyn, Queens Co. & Sub. 1st 5s	107	110
Brooklyn Rapid Transit	68	69
Brooklyn Rapid Transit 5s	107	110¼
Brooklyn Union El. 1st 4-5s	104	104½
Buffalo Crosstown 1st 5s	114	116
Buffalo & Niagara Falls Elec. 1st 5s	107	110
Buffalo & Niagara F. Elec 2d 5s	104	105
Buffalo St. Ry. 1st con. 5s	117	118
Buffalo St. Ry. deb. 6s	105½	106
Buffalo Traction 1st 5s	108½	109
Calvary Cem. & Greenpt. 1st 6s	106	108
Capital Traction scrip	106	107
Capital Traction Wash	113	113½
Central Crosstown Ry 10 p. c. gtd	250	275
Central Crosstown 7 p. c	265	280
Central Crosstown 1st 6s	122	125
Central Park N. & E. R. con. 7s	100½	102
Central Park N. & E. R. 9 p c. gtd	208	220
Chicago City Ry 9 p. c	214	215
Chicago Union Traction	15½	16
Chicago Union Traction pref 5 p. c	47	50
Christopher & 10th St. 1st 4s	99	100
Christopher & 10th St. Ry 8 p. c. gtd	185	195
Cincinnati St. Ry	144	145
Citizens Traction, Pittsburg 6 p. c	70	72
City Ry., Dayton, O 5 p. c	164	165
City Ry., Dayton, O , pref 6 p. c	181	182
City & Sub. Ry., Baltimore 1st 5s	105	106
Cleveland & Chagrin Falls	100	101
Cleveland & Chagrin Falls 1st 6s	96	102
Cleveland City Cable Ry. 1st 5s	100	103
Cleveland City Ry 5 p. c	106	115
Cleveland Electric con. 5s	107	108
Cleveland Electric Ry 4 p. c	83½	87
Cleveland & Elyria 1st 6s	102½	104½
Cleveland, Elyria & Oberlin 1st 6s	104	108
Cleveland, Elyria & West	84	85

	Bid.	Asked
Cleveland, Painsville & E. Ry. con. 5s	85	86
Cleveland, Painsville & E. Ry. deb. 6s	96	97
Cleveland, Painsville & E. Ry. 1st 5s	100	101
Columbus Crosstown 1st 5s	110	113
Columbus & 9th Ave. 1st gtd g 5s	122	123
Col. & 9th Ave., N. Y. 1st 5s	122	122½
Columbus St. Ry	57	64
Columbus St. Ry. 1st 5s	117½	118
Columbus St Ry. pref 5 p. c	105½	107
Coney Island & Brooklyn ctfs. 5s	100	102
Coney Island & Brooklyn 1st 5s	100	101
Coney Island & Brooklyn Ry	375	400
Consolidated Traction N. J	68	69
Consolidated Traction N. J. 1st 5s	110½	111
Conn. Ry. & Ltg. 1st & refg. 4½s	99	101
Denver Con. Tramway con. 5s	100	101
Denver Con. Tramway 1st purch 5s	95	100
Denver Met. St. Ry. 1st 6s	106	107
Denver Tramway con. g 6s	141	142
Denver Tramway 1st 6s	107	108
Detroit United Ry	79½	80
Detroit Citizens Ry. 1st con. 5s	103	104
Dry Dock E. Bway & B. 1st 5s	114	116
Dry Dock E Bway & B Scrip 5s	103	105
Dry Dock E. Bway & B St 6 p. c	125	135
Eighth Ave. St. Ry 15 p. c. gtd	397	410
Electric Vehicle	5	6
Electric Vehicle pref	13	15
Essex Pass. Ry. N. J. con. 6s	108	110
Forty-second St & Grand St. Fy 18 p. c.gtd.	407	420
Forty-second St. & Grand St Ferry 1st 6s	110	111
Forty-sec'd St., Man. & St. Nic. Ave. 1st 6s	111½	113
Forty-sec'd St., Man. & St. Nic. Ave. inc. 6s	99	101
"Forty-second St., Man. & St. Nic. Av. Ry	70	75
Frankfort & So. Ry. Phil. 18 p. c	407	420
Fulton St., 1st 4s	96	99
Germantown Ry	147	150
Grand St. & Newtown 1st 5s	105	106
Grand Rapids 1st gt. 5s	103	104
Greenpoint & Lorimer St. 1st 6s	106	109
Hartford St. Ry 6 p. c	55	56
Hestonville M. & F. Ry	47	50
Hestonville M. & F. pref 6 p. c	73	80
Illinois Elec. Vehicle & Trans	1	1¼
Indianapolis St. Ry	48	52
Indianapolis St. Ry gen'l 4s	85½	86
Interborough New York	200	205
Jamaica & Brooklyn 1st 5s	104	105
Jersey City, Hoboken & Paterson Ry	22	23
Kansas City El. 1st 6s	112	118
Kansas City El. 2d 4s	87	90
Kansas City Met St con. 5s	102	104
Kansas City Met. St. gen 5s	103	105
Kings Co. El. & P. stk	188	190
Kings Co. El. 1st g 4s	90	91
Lexington Av. & Par. Fy. 1st 5s	121	125
Louisville Central Pass Ry. 6s	102	103
Louisville Central Pass. Ry. 6s 1908	113	114
Louisville City Ry. con 5s	118	119
Louisville City Ry 2d 4½s	108	110
Louisville City Ry 6s	107	108
Louisville St. Ry 4 p. c	144	147
Louisville St. Ry pref	114	116
Manhattan El. Ry N. Y	135	136
Manhattan Transit N. Y	7½	7⅝
Market St., San Francisco	112	116
Metropolitan St., Kansas City	96	98

	Bid.	Asked.
Met. St Ry. N. Y. gnl col. tr. 5s	121¼	121½
Met. St Ry. new 4s	98⅝	98¾
Met. St. Ry. N Y. stock	150	151
Met. St. Ry. sub. 5s 1st instl. pd	123	123½
Met. W. S. El Chicago	39	40
Met. W. S. El., Chicago 1st 4s	102⅝	102⅞
Milwaukee Elec. Ry. & L. con 5s	111	113
Minneapolis St. Ry, con. 5s	107	110
Minneapolis St. Ry. 1st 7s	105	108
Minneapolis St. Ry. 2d 6s	114	115
Nassau Electric con. 4s	84	86
Nassau Electric 1st 5s	112	114
Nassau Electric pref	96	98
Newark, N. J. Pass. Ry. 1st con. 5s	117	119
New Orleans City & Lake 1st 5s	110	113
New Orleans City Ry	33	35
New Orleans City Ry. pref 5 p. c	110	112
New Orleans Ry. 1st 6s	105¼	106
New Orleans Traction 1st 6s	108	109
Ninth Ave. Ry. N. Y 8 p. c	190	210
Norfolk, Va. St. Ry. con. 5s	107	110
North America Co	125	127½
Northampton St. Ry	180	200
North Chicago Street	180	183
North Hudson Co., N. J. con. 5s	112	113
North Jersey Street	27	29
North Jersey St. Ry. 1st 4s	82¼	84
Northern Ohio Traction	39¾	40¼
North Ohio Traction 5 p. c	89	90
Norfolk Va. Ry & Lt	12	13
Oakland, Cal. Traction Co. 1st con. 6s	124	126
Orange & Passaic V. Ry. 1st 5s	80	85
Paterson, N. J. Ry 1st 6s	105	106
Paterson, N. J Ry con. 6s	115	116
Philadelphia City Ry 7½ p. c	205	210
Philadelphia Co	48	49
Philadelphia Co. pref	49	50
Philadelphia Electric	5	6
Philadelphia Electric 4s	65	66
Philadelphia Traction	99	100
Railroad Securities	94⅛	94½
Railways general	4	5
Railway Steel, Springfield	31	32
Railway Steel, Springfield pref	86	86¼
Reading, Pa. City Pass	180	200
Reading, Pa. Traction	32	33
Richmond, Va. Traction 5 p. c	32	34
Richmond Traction 1st 5s	85	100
Ridge Ave Phil. 12 p. c	300	315
Rochester St. Ry con. 5s	111	111½
Rochester St. Ry. 3d 5s	100	102
Rochester, N. Y. St. Ry	65	68
St. Louis Street Ry	000	000½
St. Louis & Suburban	75	88
St. Louis Transit	30	31
St. P. City Cable con. g 5s	115	116
Scranton, Pa. Ry	35	38
Scranton, Pa. Traction 1st 6s	117	120
Scranton, Pa Ry. col. tr. 5s	105	106
Sea Beach 1st 4s	85	86
Second Ave. Ry. N. Y. 9 p. c. gtd	215	221
Second Ave. N. Y. con. 5s	117½	119
Second Ave. N. Y. 1st 5s	105	107
Second Ave. N. Y. deb. 5s	105	106
Second & Third St., Phila. 10½ p. c	300	320
Seventh Ave. Ry. N. Y. 15 p. c	118	122
Sixth Ave. Ry. N. Y. 7 p. c. gtd	170	180
South Boulevard, N. Y. 1st 5s	110	113
South Ferry, N. Y. 1st 5s	107	110
Southern Ohio Traction	70	72
Springfield, Mass. St. 8 p. c	210	220

	Bid.	Asked.
Steinway L. I City 1st 6s	118½	119¼
Syracuse R. T. 1st 5s	101	102
Syracuse Rapid Transit	25	30
Syracuse R. T. pref	65	70
Third Ave. Ry. N. Y	131	132
Third Ave Ry. N. Y. 1st 5s	124½	125
Third Ave. Ry. gtd. 4s	99½	99⅝
Thirteenth & Fifteenth St. Phila. 11½ p. c	305	315
Thirty-fourth St. N. Y. crosstown 1st 5s	114	115
Toledo Traction con 5s	103	104
Twenty-eighth & 29th St. Ry. N. Y. 1st 5s	113	115
Twenty-third St. Ry. N. Y. 18 p. c	408	415
Twenty-third St. Ry. 1st 6s	110	111
Twenty-third St. Ry. deb. 5s	102	106
Twin City Traction	119¼	119½
Twin City pref	156	160
Union Passenger, Phila. 9½ p. c	240	245
Union Ry. N. Y. 1st 5s	118	120
Union Traction	44¾	44⅞
United Ry. & Elec. pref	109½	110
United Ry. & Elec. Balt. 1st 4s	94	95
United Ry. & Elec. Balt. inc 4s	72	72½
United Ry. St. Louis pref. 5 p c	82⅜	83½
United Ry. St. Louis gen 4s	87	87½
United Ry. Traction (Pitts.) genl. 5s	117	120
United Ry. Traction, Pitts	50	51
United Ry. Traction pref 5 p. c	15	16
United Traction & Electric pref	113¼	113½
Washington Traction	48	50
Washington Traction Co. 4s w. i	31½	32¼
West End, Boston 7 p c	96	97
West End, Boston, pref. 8 p. c	115	116
West Philadelphia Ry. 10 p c	252	255
Westchester Elec. Ry. N. Y. 1st 5s	109	110
Williamsburg & Flash. 1st 4½s	106	107
Yonkers Ry. 1st 5s	108½	109½

Gas and Electric Light

	Bid.	Asked.
Am. L. & Trac	36½	37½
Am. L. & Trac. pref 6 p. c	92	94
Baltimore Consolidated	69	70
Baltimore Consolidated 1st 5s	113	115
Bay State Gas	1¾	1⅞
Binghampton Gas Works 5s	92	95
Brooklyn Union Gas	232	241
Boston Union Gas 1st s. f. g cts. 5s	80¾	81
Brooklyn Union Gas 1st 5s	117¾	118
Buffalo City Gas 1st 5s	13¾	14½
Buffalo City Gas	11½	13½
Central Union Gas 5s	109½	110½
Chicago Consumers 1st 5s	109	110
Chicago Edison	130	180
Chicago E G. L. & F. 1st 6s	103	105
Chicago G. L. & C. 1st g g 5s	109	110
Columbus Gas Co. 1st 5s	107½	108½
Columbus Gas c 4 p c	96½	98½
Columbus Gas pfd 6 p. c	103	104
Consolidated deb. 5s	110	115
Consolidated Gas N. Y.	225	226
Con. G. L. of Chic. 1st g g 5s	108	109
Consolidated Gas N. J. 1st 5s	87½	90
Consolidated Gas N. J.	16	18½
Denver Con. Gas. 1st 6s	103½	105
Denver Gas 3 p. c	18	20
Denver Gas & Elec. 5s	68	69
Detroit Gas stock	80	90
Detroit Gas Co. con. 1st 5s	104	105
Detroit City Gas g. 5s	95	97½
Edison El. Ill. N. Y. 1st cv. g. 5s	107	108
Edison El. Ill. N. Y. 1st con. 5s	120	122
Equitable G. & F. Chic. 1st g g 6s	104	105

	Bid.	Asked.
Equitabl ɜ G. L. Memphis 5s	101½	103
Equit. G. L. N. Y. con. 1st 5s	118	119
Fort Wayne Gas 1st 6s	57	59
Gas & El. Bergen Co. N. J. 5s	66½	67½
Grand Rapids Gas L. Co. 1st g 5s	107¼	108
Grand Rapids 1st 5s u. l.	103	104½
Hudson Co. Gas 5s	102	103
Indiana Nat. & Ill. Gas 1st 6s	47	49
Indianapolis Gas 1st 6s	104	106
Indianapolis Gas V	76	85
Indianapolis Gas 1st 6s	82	86
Jackson (Mich.) Gas	73	75
Jackson (Mich.) Gas 1st 5s	100½	101½
Kings Co. Purchase Money 6s	123½	125
Kings Co. Ed. E. I 1st c. g. 4s	96½	99½
Laclede Gas (St. Louis)	88	89
Laclede Gas pref	109	110
Laclede G. L. Co. St. Louis 1st 5s	108½	109½
Lafayette Gas 1st 6s	58	64
Logan's & Wab. Vy. 1st 6s	54	58
Madison Gas & Elec 1st 6s	108	110
Mass. Lighting w. i. ex. rights	33	34
Mass. Lighting pref	83	87
Milwaukee Gas L. 1st 4s	95	96
Mutual New York	330	350
Mutual Fuel Gas Co. 1st g g 5s	105	105⅝
New Amsterdam G. L. con. 5s	112	113
Newark Con. con. gt. 5s	104	106
New England G. & C. Co	4	5
New England Gas & Cok 5s	62¼	63¼
New York & East River Gas 1st 5s	113½	114½
New York & East River Gas con. 5s	114	116
N. Y. G. E. H. & P. 1st 5s	112½	113½
N. Y G. E, H. & P. Purch Money 4s	97½	98
N. Y. & Queens El. & P. 5s	107½	108½
Northern Union Gas 1st 5s	108	109¼
Ohio & Indiana Gas 1st 6s	54	57
Orange & Ind. Nat Gas 1st 6s	50	54
Orange & Ind. N. I. C. G. Co	21	25
Orange & Passaic Vy. 5s	100	103
Paterson & Passaic Gas	27	35
Pat. & Passaic Gas & E. con. g. 5s	106½	107½
Peoples G. & C. Chicago 1st g. g, 6s	106½	107½
Peoples G. & C. 2d gtd. 6s	103½	105
Peoples G. & C. 1st con. 6s	121	122
Peoples G. & C. ex. refd. g. 5s	97	99
Providence Gas (.50)	104	105
St. Joseph Gas 1st 5s	94	96½
St. Paul G. L. gen. 5s	92	93½
St. Paul G. L. 1st 6s	114	116
St. Paul G. L exten. 6s	114	116
Southern L. & T. 1st 5s	89	91
Standard Gas	130	131
Standard Gas pref	150	155
Standard Gas 1st 5s	115½	118
Syracuse Gas 1st 5s	98	99½
Syracuse Ltg. Co	24½	28
Syracuse Ltg. Co. pref	86	90
Trenton G. & E. 1st g. 5s	10[illegible]	110
United Gas Improvement	109	110
Welsbach Co	36	37
Welsbach 5s	73	73½

Telegraph and Telephone

	Bid.	Asked.
Am. Dist. Tel	36	38
Am. Tel. & C	83	95
Am. Tel. & Telephone	164	165
Am. Tel. & Tel. col. tr. 4s	100	101
Commercial Cable 1st 4s	100½	100¾
Commercial Union 6 p. c. gtd	115	120
Commercial Union of Me. 6 p. c gtd	115	120
Erie Tel. & Telephone col. tr. 5s	107¾	108
Franklin Telegraph Co. 2½ p. c. gtd	45	55
Gold & Stock Telegraph Co. 6 p. c. gtd	120	125
Inter Ocean Telegraph 6 p. c. gtd	119	120
Met. Tel. & Telephone 1st 5s	114½	115
Mutual Union Tel. sink. fd. 6s	111	113
New England Telephone	141	142
N. Y. & N. J. Telephone 5s	113¼	114
Northwestern Telegraph 6 p. c. gtd	104	105
Pacific & Atlantic Telegraph 4 p. c. gtd	76	82
Southern & Atlantic Telegraph 5 p. c. gtd.	100	105
Western Telephone pref	102	103
Western Union	87	88
Western Union R. & R. E. 4½s	105½	106½

Miscellaneous

	Bid.	Asked.
Consolidated Refrigerating	5	5¼
Electric Boat	28	32
Electric Boat pref	40	47
Electric Co. of Am	6¼	6½
Electric Lead Reduction	2⅝	3
Electric Storage Battery	94	94½
Electric Storage Bat. pref	94½	95
General Electric	186	188
Massachusetts	42	43
Massachusetts Electric Cos. pref	97	98
Otis Elevator	35	37
Otis Elevator pref	102	104
Storage Power	1⅝	2
U. S. Reduction & Ref	38	39
U. S. Reduction & Ref. pref	2½	—
U. S. R. & R. 1st s. fd. 6s	86	87
Westinghouse	207	210
Westinghouse pref	213	216
Westinghouse Electric, Boston	1[illegible]4	105

Oil Stocks.

	Bid.	Asked.
Acme	—	.75
Alabama-Texas	02	.02½
Alamo	—	9.00
Alamo City	25.00	40.00
Anglo-American		.04
Bankers		.08½
Beatty, old	14	.25
Beaumont Oil	—	50.00
Beau Confed	06⅞	.08
Beau El Paso	—	.17
Beau Geyser	—	—
Beau Pet & Gas	—	.40
Beau Sara	4.50	6.00
Birmingham-Beaumont Oil		.03
Birmingham-Beaumont O. & T	.08	.09½
Blyson Oil and Gas		.40
Bunn's Bluff	21	.37
Cit Consolidated	10.00	17.50
Consolidated Oil & Pipe	—	5.00
Columbia	—	25.00
Creole American	—	.35
Drillers	.04½	.05⅜
Drummers	—	.50
Eastern Consolidated		.29
Enterprise	.08	.09
Equitable	.02¼	.04
Eureka	.35	.75
Federal Crude	.01	.03
Fort Worth	.50	1.00
Forwd Reduc, new	2.00	3.50
Fountain Oil & Fuel	—	1.05
Gladys of Beaumont	.07	.07½
Glover	—	.03

	Bid	Asked.
Greater New York Home		.95
Ground Floor	.78	.80
Guffey	78.00	80.00
Gulf Refining	—	50.00
Heywood	70.00	74.00
Higgins Oil and fuel	62 00	65.00
Home	.10	.12
Illinois	—	.13
International	.01½	.02
Isabella	—	3.00
Keith-Ward	—	40.00
Lone Acre	—	55.00
Lone Star (original pfd)	.65	.80
Lone Star Oil & Fuel	.14	.15
Louisiana Cons	.02	.02½
Lucky Dime		.06
Lumberman's	—	.35
Madeline	—	.02½
Madaline con	—	.25
Magnolia O & T	—	.25
Maid of Orleans	.01½	.02
Manhattan	28	.31
Mercer	—	.15
Merchants & Traders		.04
M & M	—	.02½
M. K. & T	.09	.10

	Bid.	Asked.
Mobile-Beaumont	—	.10
Mont & Neches River	.03	.04
National Consolidated (preferred)		.21
Nation' Oil & Pipe Line	.17	.18
Pales. Beau	.22	.27
Pennsylvania Texas	.10	.15
Potomac		.12
Queen City	—	.15
Queen of Waco	—	1.25
San Jacinto	.10	.15
Seaboard old	12½	.25
Silver Dime	.10	.15
Sour Lake Sprgs	—	150.00
Spangler	—	.09
Spindle Top	—	35.00
Standard Oil	695	697
Texas Illinois	.13	.14
Texas Western	—	2.00
Tri City	—	.14
U. S Oil	.16	.17
Vesuvius	.00¼	.02
Victor		.02½
Victor, old	.02½	.04
Yellow Pine	100.00	—
Young Ladies	—	.06
Zenith	30	.50

Texas Oil in Storage

The Oil Investors' Journal of Beaumont, Texas, gives the following information of interest:

IRON TANKAGE.

Companies.	No. of Tanks.	Barrels.	Oil stored bbls.
Guffey Co	*67	*3,070,500	2,883,000
Higgins Co	18	589,500	549,000
Lone, Star & Crescent	5	171,000	159,570
Heywood Company	2	7,500	75,000
Nat. Oil & Pine Line	†7	†207,500	151,500
Keith Ward	2	75,000	75,000
Texas Company	‡17	637,500	487,500
London Oil & Pipe Line	1	37,500	37,500
Texas Fuel Oil	7	357,500	137,500
Forward Reduction Co	1	55,000	......
Other	13	537,500	312,500
	140	5,813,500	4,868,000

EARTHEN TANKAGE.

Companies.	No. of Tanks.	Barrels.	Oil stored bbls.
Babbitt Syndicate................	1	500,000	100,000
Higgins Cempany................	1	280,000	building
G. A. Burt Reb..................	2	700,000	"
Brice Companies.................	3	800,000	"
Sern Companies.................	4	735,000	"
Lakewood......................	2	600,000	305,000
All others......................	7	610,000	33,000
Total.........................	20	4,235,000	438,000
Wooden Tankage................	..	192,500	145,000
Total all classes...............	..	10,231,000	5,451,000

* Including five buildings of 187,500 capacity. †Includes one building of 55,000 bbl. capacity. ‡ Includes two buildings of 75,000 bbl. capacity.

Wireless Telegraphy at Annapolis

Profesor N. M. Terry, who holds the chair of physics in the United States Naval Academy, at Annapolis, Md., has given the graduating classes for three years past practical instruction in wireless telegraphy, so as to enable the midshipmen to handle intelligently any system that the government may adopt for use in the navy. Practically all the work has been done at short range, the idea being rather to familiarize the men with the apparatus than to accomplish commercial results.

New instruments are now being imported for the Academy by the Bureau of Equipment, and the results of the tests to be made will be published in due course. Just at present the equipment does not warrant description, at it consists mainly of the familiar sending and receiving instruments.

Automobile Speeding

Mark Twain once, when traveling on a slow train, advised the conductor to take the cowcatcher off the front of the engine and fix it on the back of the train, as he was quite sure they would never overtake anything, but some cow might walk on board at the back and bite the passengers. When the legislators fixed the speed at twelve miles an hour they were convinced that at that speed we should never overtake anything, but to prevent our being run into by horse-drawn machines they ordered that we should show a red light at the back.—*The Car.*

Convention Papers

Excerpts from some of the papers presented at the recent annual conventions of the Independent Telephone Association, American Institute of Electrical Engineers, Ohio Electric Light Association, American Society of Mechanical Engineers and the American Association for the Advancement of Science.

A High Potential Direct Current Plant for Experimental Work

By G. S. Moler

Paper Presented before the American Institute of Electrical Engineers

In order to have a direct current potential of about twelve thousand volts available for experimental purposes, it was decided by Dr. E. L. Nichols, professor of physics, and Harris J. Ryan, professor of electrical engineering in Sibley College of Cornell University, that they would purchase jointly a large number of small high potential direct current dynamos, and, after thoroughly insulating them from each other, connect them like battery cells, in series, so as to obtain a potential equal to their added pressures. Such a set of dynamos was obtained and has been mounted in a suitable manner by the writer, making a high potential plant which has proved satisfactory in its working. In this plant twenty-four direct current separately excited dynamos of five hundred volts each have their armatures connected in series, so that a pressure between the terminals of the series is given, which is equal to the sum of the individual pressures of the dynamos, this sum being from twelve to fourteen thousand volts, depending upon the speed and the degree of excitation. The full load current for which they were constructed is .22 of an ampère.

For excitation purposes they are divided into three groups of eight each and have their fields connected in series; to these the terminals of a 170-volt exciter is connected.

Three similar exciters with controlling rheostats are used. The dynamos and exciters were constructed by the Crocker-Wheeler Company especially for this use, great care being taken in highly insulating them so that they would not break down under the enormous strains to which they might be subjected. It was assumed that the terminal pressure of four thousand volts in a group of eight would not be sufficient to cause a leap from one terminal brush to the frame, then to the field wire, and from that again to the frame of the eighth and to its brush, thus short circuiting the group through the fields and through the exciter. Further, to insulate their frames from each other, they were placed upon individual slabs of polished dark Tennessee marble, and the wires from the brushes and those from the fields were carried down through glass tubes placed in holes drilled through the marble. The dynamos and exciters are all driven from the same countershaft by means of leather belting. It was thought that the leather would afford ample insulation between the frames of the machines, so no additional precautions were taken to insulate them from the countershaft. A massive table or framework of white pine was constructed and was stained; then it was coated with hot linseed oil, which was allowed to dry for several days, after which it was thoroughly varnished with shellac.

The table was constructed so that the dynamos could be mounted in two rows upon it. In each row they are placed one to each foot in length of the table and in one row they are set a little ahead of those in the other row, so that their belts will not interfere upon the countershaft, which is placed between the legs of the table and near the floor. The exciters are placed upon raised platforms between the rows. The rheostats near the exciters have grooved wheels and are operated by means of cords extending to one side of the room. The top of the table is not solid, but consists of four longitudinal planks placed edgewise, supporting the ends of the two rows of small marble slabs. The slabs are about seven inches wide, thus leaving about five-inch spaces down through which the belts are carried. The countershaft is belted to an electric motor.

Over each machine is placed a galvanized wire-netting cage, and this is connected to the upper brush to keep it of the same potential as that brush; the adjacent cages, therefore, have a difference of potential of five hundred volts. These are to protect the dynamos from any induced charges which take place among them.

A glass case with doors hinged at the top encloses the whole of the upper part of the table. The wires from the terminal dynamos are carried through porcelain tubes up to the top of this case, one of them to the circuit-breaker and each to an oil-break switch. The circuit-breaker on the left hand end of the case has a long arm hinged at the top; this is actuated by means of a spring, so that when it is released from the catch at the bottom it flies upward, thus making an eighteen-inch gap in the circuit. The flash takes place between two pieces of carbon. The arm is latched again by revolving the wheel at the top of the circuit-breaker, which also opens the oil-break switch before it latches the arm of the circuit-breaker. The core of the solenoid of the circuit-breaker has been adjusted to jump up with .24 of an ampère. The oil-break switch consists of a plunger immersed in oil, but held up by means of a spring unless it is pushed down against the contact-plate in the bottom of the oil-reservoir by an arm extending outward from the wheel of the circuit-breaker. When opening the oil-break the plunger follows the arm to the limit of its path, when the arm leaves it, making an eighteen-inch gap in the circuit. In this way the wide gap is made without swinging through space an arm which is dripping with oil.

At the farther end of the case the second oil-break switch is located; it is also operated by means of a wheel, and these wheels are both turned by cords extending to the side of the room. A cord to open the circuit of the driving electric motor extends to the same place. These cords are all for the purpose of enabling the operator to make the proper adjustments without exposing himself to the high potential current.

The wires from the oil-break switches are carried to insulators which consist of long porcelain tubes suspended from the ceiling of the room; screwed into plugs in the lower ends of these tubes are screw eyes through which the wire is carried.

In the preliminary test of the apparatus each little dynamo was run alone and its brushes were connected to two 250-volt incandescent lamps, which were joined in series, and at the same time the exciter was connected to the eight field-circuits of that group to which the little dynamo belonged. In this way the brushes were adjusted before the cages were placed over the machines.

After these adjustments were made the individual groups were tried to note the effect of changing the rheostats of the exciters. A Kelvin electrostatic voltmeter, having a range of 20,000 volts, was used to denote the pressures obtained.

The circuit-breaker was found to work promptly under all conditions of overload, the severest test being suddenly to short circuit the terminals at the voltmeter. In this case a thick frame nine or ten inches long would be drawn out by the moving parts as the gap was being widened. A rough test of the jumping distance of the current at twelve thousand volts was made by bringing the blunt ends of two No. 14 B. & S. gauge copper wires near to each other, these wires being connected to the leads near the electrostatic voltmeter. When the space was reduced to about sixteen millimeters an arc was suddenly formed which lasted till the circuit was opened by the circuit-breaker. With 14,000 volts the space was about a millimeter longer.

The plant was run in the dark to observe the brush discharge that might take place around the small dynamos or from any part of the circuit and connections. A feeble glow could be detected at the ends of the leads, especially when they were almost near enough for the curent to leap across; a glow was also detected around some of the connections, but around the brushes and the dynamos themselves none could be seen for the reason that the sparking commutators gave considerable light.

In conclusion, each little dynamo appears to operate just the same as if it were entirely alone, so it would seem that another similar set might be connected in series to the present one with a considerable degree of confidence that the two would operate successfully together.

Mechanical Stokers for Locomotives

BY FRED. H. COLVIN

Excerpt from Paper presented before the American Society of Mechanical Engineers

The rapid growth in the size of locomotives and the consequent increased consumption of fuel per hour have brought many of our railroads face to face with the problem of securing men to fire them satisfactorily, for the fireman has not increased in size and capacity as has the locomotive. The question of economy in coal consumption is secondary to that of keeping the steam pressure at or near the popping point in order to secure the maximum work from the engine.

The conditions of locomotive practice are so different from those presented in the case of stokers for stationary boilers that they have seemed almost insurmountable, although much time and thought have been spent on them. These difficulties are not confined to the mechanical problem, for the selling of the locomotive stoker is an entirely different proposition from that in the stationary field. In the latter case it is an easy matter to show a marked reduction in labor cost, and this saving seems to appeal to buyers more than any other. In the case of the locomotive stoker there can be no reduction in labor cost, excepting in a few rare cases where two firemen are employed. This takes the cost of labor entirely out of the field, as it is not advisable to employ unskilled men on the locomotive equipped with a stoker, for in the event of the possible failure of the machine, the engine must be fired by hand until the end of the run. It is also necessary to train engineers, and the only practical way of doing this seems to be by having firemen work with engineers as at present.

The practical advantages of the locomotive stoker can, perhaps, be summed up as follows:

Increased work from the locomotive, due to maintaining a maximum working steam pressure under all conditions of service.

Doing away with the necessity of constantly opening the fire door and admitting large quantities of cold air into the fire box, which opening tends to retard combustion and also has an injurious effect on the flue sheet.

Even distribution of coal over the whole of the grate, obviating thin spots through which cold air may be admitted with results as injurious as when coming through the door, or even more so.

Marked decrease in black smoke, due to the constant and steady firing according to the demands of the boiler.

Economy of coal consumption, resulting from the steady firing above referred to.

As the only stoker for locomotive use of which I know is the one invented by Mr. John W. Kincaid, of Cincinnati, Ohio, formerly an engineer on the Chesapeake and Ohio Railroad, my paper will necessarily be confined to this machine and its work. Starting with the idea of producing a mechanical stoker which should take the place of hand firing, and realizing the difficulty of introducing or even experimenting with a stoker which would necessitate any radical change in the locomotive, Mr. Kincaid designed his stoker to be attached in place of the fire door. It will be noticed that it is a mechanical, but not an automatic stoker, as the experience of the practical engineer showed that it was not feasible to attempt automatic stoking. While it is possible that ingenious mechanism might be devised which would regulate the amount of coal fired by the steam pressure in the boiler, it would greatly complicate matters, and hardly be as effective as though under control of a skilled fireman. There are many cases, such as preparing for a hard pull up hill, where the fireman will anticipate the demand on the boiler and prepare for it, while an automatic device must follow the demand instead of anticipating it.

The Kincaid stoker is fastened to the fire door opening, and consists of a hopper, ram body, ram cylinder, steam chest, door frame, conveying cylinder, its valve chest, and the ram. The conveying screws are actuated by the piston in the cylinder, which travels up and down and operates the screws by ratchets. The amount of coal fed forward to the ram can be varied by regulating the amount of steam by a globe valve near the valve chest, and it can also be reduced one-half by throwing one of the screws out of gear.

A globe valve admits steam to the valve chest of the ram. The motion of this ram is controlled by an ingenious valve, which gives three different strokes in regular order. The first stroke takes a full charge of steam and throws the coal to the front end of the fire box; next comes a medium stroke, which takes care of the middle portion, and lastly, a stroke which hardly does more than push the coal over the deflector plate.

It is sometimes asked how this action

distributes the coal across the fire box, but the explanation is not difficult when we note that the exhaust from the ram cylinder passes along under the ram and goes over the deflector. It is an ingenious arrangement, and required considerable experimenting to secure the right shape for the plate. That the distribution is practically perfect is proved by the fact that one of these machines has successfully fired several of the largest engines on the Chesapeake and Ohio Railroad in which the fire box was 41 inches wide and 11 feet long.

Open and Enclosed Arc Lights

Excerpt from a Paper read by W. D'A. Ryan before Ohio Electric Light Association

Mr. Ryan clearly indicated the difference in actual luminosity between the open and enclosed arc lamps for street lighting, adding that the open arc light never attains its rated candle power. A number of reasons governs this, and, though freak readings of 1,700 or 1,800 candle power are sometimes obtained, the average efficiency at the usual angle is about 1,250 c. p. The paper continues:

In contrast to this we have in the enclosed arc lamp a long arc burning in air which is practically free from oxygen. Although most of the light comes from the crater, still a greater percentage is emitted directly by the arc itself, owing to its length. A large portion of the crater's area is visible over a wider vertical angle, and the crater is not so concave as in the open arc, hence less concentration and better distribution of light.

In open arc lamps two distinct variations in the light are constantly taking place. One is caused by the increased length of the arc from the picking up to the feeding points, thus making a great variation in the mean spherical candle power and watts at arc at different intervals of time. The other variation is caused by the wandering of the arc due to non-homogeneity of the carbons and drafts of wind. In strong winds the variations may become so rapid as to produce flickering of the light. These variations cannot be controlled satisfactorily.

In enclosed arc lamps there is very little change in the length of the arc at any time. The principal variation in the light is caused by the travel of the arc over the flat carbon ends. When the arc is in the center of the carbons we have equal lobes of light on opposite sides. When the arc travels to the edges of the carbons, the lobe of light on one side becomes enlarged, while the lobe on the opposite side is reduced.

Notwithstanding this, the mean spherical candle power of the lamp remains practically constant at all times. Furthermore, the variation in the light referred to can be greatly reduced by the use of an opal enclosing globe which becomes luminous all over and obliterates the shadows which would otherwise be cast by the side rods and the lower carbon. Even if we use a clear enclosing globe, the shadows are not so strong in contrast as those of the open arc.

Crushed Steel and Steel Emery. An Artificial Abrasive

By M. M. Kann

Excerpt from a Paper presented before the American Association for the Advancement of Science

Diamond crushed steel and steel emery are manufactured preferably from pieces of high-grade crucible steel, heated to a temperature of about 2,500 degrees F. (almost a white heat), and then quenched in a bath of cold water, or other suitable hardening solution, which gives the steel a granular structure. The pieces are placed under powerful hammers or crushing machines, and reduced to small particles, varying from fine powder to grains of many different sizes.

The steel particles are then tempered, preferably in the following way: They are placed in a cylinder or pan, and heated to a temperature of about 450 degrees F., until the particles change their appearance to a straw color; they are then cooled by being subjected to cold air in various ways. The material at this stage, or before the tempering process, is graded into many sizes, according to the number of mesh-openings in the sizing screen per square inch.

The sizes of Diamond crushed steel run from No. 6 to No. 60 inclusive. Diamond steel emery is similar to crushed steel, but is given an intensely hard temper, and its numbers range from 60 to 200 and above.

These two abrasives, so closely related to each other, are used for entirely different purposes in the various trades.

Crushed steel and steel emery rank very close to the diamond in hardness, they being 9.27, if the diamond is taken at 10.

Diamond crushed steel is tempered mostly to a tough hardness, while Diamond steel emery, having different work to perform, is made intensely hard. A grain of crushed steel, examined under a magnifying glass, exhibits a series of sharp points and cutting angles. In work, as fast as one point is worn down another is presented, while, should a grain break, it presents on the fractured face a multitude of new cutting points. When a grain breaks in work it simply becomes two grains, and is thus unlike all other abrasives, its life being phenomenal, and the grain or grains must be entirely worn away to an infinitesimal atom before it loses it cutting power.

Address of Judge Thomas

Delivered at the Annual Convention of the Independent Telephone Association

The Hon. James M. Thomas, president of the Independent Telephone Association, in the course of the annual address delivered by him before the recent convention of that body at Philadelphia, said in brief:

Broad-minded men are at work on the solution of the telephone problem, and everything necessary to give to the people telephone service at a fair price and adequate reward to capital and labor will soon be solved. The price through competition having in most instances been reduced to the minimum, something must be done to preserve the capital already invested and induce new capital to come into the enterprise.

People should never uphold ruinous competition in anything any more than they should uphold ruinous monopoly. We must always be fair and just to both sides of a controversy. The user of the telephone must not be allowed to enjoy its great privileges at the expense of the man who has invested his money. We only want such competition as will cause the capitalist to be fair and not a competition that will give advantage to the user.

Needed Improvements in Independent Telephony

BY L. W. STANTON

Excerpt from Paper read before the Independent Telephone Association

The independent telephone companies have popularized telephones and placed thousands of telephones in residences and places of business undreamed of before the advent of independent telephony. They have achieved wonders and astounded the telephone world with the progress they have made during the comparatively brief period of time they have been in the field. They have yet their crucial period to meet.

There are three giant problems,—tariff, traffic and equipment—which are deserving of as much sound consideration as any problem in the industrial field today.

Public sentiment has been a very prominent factor in the independent field, but it is becoming more and more apparent that the company giving the best service and the most courteous treatment will secure the business.

A discriminating public has favored the home companies on account of their origin and the conditions under which they were brought into existence. This protection has extended over a number of years, but the time will arrive when the independent companies, even though they be owned locally, must demonstrate their ability to furnish as good or better service than their competitor. The writer is acquainted with several independent exchanges in which the service is inferior to that of the Bell company, yet the public tolerates it, remembering the treatment formerly received before the inauguration of the independent companies. This will not always exist. The public is prone to forget.

The company furnishing the best service to the greatest number, at an equitable rate, will, unquestionably, do the greater business. For the independent companies to bring about such conditions requires a far-reaching revision in their present tariff system, a change in their engineering and equipment, and attention to details in traffic, the like of which they have never known before.

In our larger cities there are thousands of families and hundreds of small tradesmen that cannot afford to pay for flat rate individual service; neither can the telephone company, from a financial standpoint, afford to reduce its rate to meet these requirements. The inevitable result is party lines and measured service.

Address of Mrs. Anney McElroy Brett

Excerpt from Paper read before the Independent Telephone Association

When I took up the work in western Texas, the conditions were very much the same as they were in Michigan in the early days. The people had to be educated to know that another company could come into the field and compete with the Bell.

Two years ago, when I started the work in El Paso, the Bell company had 300 telephones in service, and they were charging $3 to $5 a month. When I commenced work, I thought if I reached 600 telephones I would be doing well. Today we have 1,550 three-year contracts.

Our franchise is rather peculiar. We have a sliding scale. We are permitted to charge $20 and $30 up to 1,000 telephones. In excess of 1,000 telephones, we are permitted to increase the price fifty cents per instrument. The contracts with the people also permit this.

It was necessary before obtaining those contracts to educate the people to the fact that in the telephone business—unlike most other kinds of business—the larger the plant grows the less money there is, unless one is permitted to increase the prices in proportion.

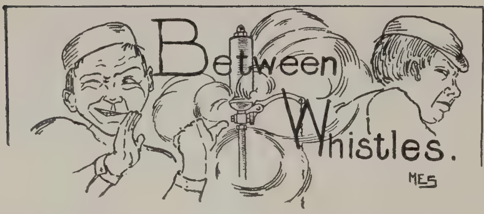
I believe that it would be possible for all companies to obtain these concessions, if the telephone companies would educate the people to know that this has to be done. They have to be educated to it.

The proposition is exactly the same as that of water, gas and electricity. Up to the present time we are not able to measure our service by meter. It may come to that—and I hope it will; but, in the absence of that, we have to do the best we can.

British Gas Statistics

Field's analysis of the accounts of the principal gas companies in Great Britain for 1901 has just been published. The thirty-four companies represented in 1901 produced 88,022,573,000 cubic feet of gas, while our recent census report gives 877 companies of the United States as producing but 67,093,553,471 cubic feet. The three London companies produced over thirty-seven billion cubic feet of 16-candle-power gas, had 3,363 miles of mains, 635,485 consumers, 76,445 public lamps, sold 10,356 cubic feet per mile of main, had 5.07 per cent unaccounted for, made 1,378 pounds of coke per long ton of coal carbonized, of which they sold seventy-five per cent for an average price of $2.62 per long ton; the income from residuals was $2.40 per ton of coal or 22.26 cents per 1,000 sold; the rates of dividend are three and one-half, four, five, seven and ten per cent, the average price of gas 71.4 cents. The following figures are of interest:

Per 1,000 cubic feet gas sold in 1901.	London; private.	Sub'rban; private.	Pro-vi'cl; municipal.	Scottish; municipal.	Pro-vi'cl; private.	Dublin; private.
Capital employed	$2.73	$2.69	$2.57	$1.72	$2.27	$3.95
Work'g expenses	0.34	0.33	0.26	0.27	0.27	0.31
Average price....	0.714	0.71	0.578	0.734	0.538	0.92
Cost of Coal.....	0.438	0.437	0.359	0.458	0.365	0.539
Gross profit.....	0.191	0.178	0.139	0.077	0.119	0.287
Net profit........	0.157	0.155	0.062	0.037	0.102	0.233
Capital charges..	0.200	0.190	0.076	0.083	0.147	0.296



Workmen who know the kinks of their trades, the tricks played by machines and tools, and ready methods for meeting shop emergencies, are invited to contribute to this department.

Apprentice: Will I make this key fit tight—top—bottom and both sides?

Mr. Lathe: That is what theoretically would be considered the proper way to fit a key, but it is hardly practical. In fact, few, if any keys, especially long ones, fit on the sides throughout their whole length. Take, for instance, a key twelve inches long. To cut a keyway of this length in a heavy shaft, and to have it within one one-thousandth of an inch of a perfect line with the center of the shaft, you will admit is perhaps closer than this sort of work is possible. To cut the corresponding keyway in the hub of the pulley to the same degree of accuracy, you will also admit is not done in practice. I need only remind you of what happened down in the assembling shop yesterday, when four different expert mechanics measured that fourteen-inch shaft and no two of them agreed as to its exact size, there being as much as three and one-half thousandths of an inch difference. In fact, fine measurements of this character are acquired by long training, and finally depend entirely on the delicacy of touch of the person making the measurement. This is true when we go to the other extreme. For instance, in watch-making, where limit-gauges are used, the refinements being worked down to one-twenty-thousandth of an inch, the sense of touch is entirely relied upon in determining which gauge the work shall pass through, and because of this fact, it has been an established rule in many shops that the final inspector should be the sole arbiter as to whether a piece of work was to gauge or not, which, as you know, has resulted in many heart-breakings, as well as loss of money, especially if the inspector is prejudiced.

Getting back to the way a key should be fitted, quite regardless of its dimensions, the best results obtain by the key fitting tight on both sides only, and held secure in the bottom of the keyway in the shaft by set screws through the hub of the pulley, or by countersunk screws through the key proper. In the latter case, however, great care should be taken to insure the thread part of the screws, to secure a snug fit, as otherwise the screws will back loose.

They key should not touch on top. In other words, the top of the key should just clear the top of the keyway in the hub. This will insure the most essential requisite in a properly keyed shaft and hub, since the most important feature is to have the bore of the hub a very snug fit on the shaft proper, not depending on the key to hold the pulley in place, but, on the other hand, depending entirely on the tight fit of the shaft in the hole, the key simply preventing the pulley from turning on the shaft. Never drive a taper key in a pulley, because it will at once throw your pulley or wheel out of line, no matter how carefully you do it. Give me a piece of chalk and I'll illustrate——

Apprentice: There goes that whistle again.

"Try Bilin' Water"

By E. R. Markham

From Machinery

An experience I had several years ago, with regard to the hardening of coil springs, has been brought to mind by a person who recently asked my advice on this subject. He was trying to harden some heavy coil springs that were used to sustain a heavy load under varying conditions. He had been hardening this same spring for years, using a bath of sperm oil with excellent results. But the company in whose employ he was decided that they were paying too much for their steel. They found a brand they could get two cents a pound cheaper, so bought several tons of it, and "sprung" it on him. Well, to make a long story short, he could not harden it in the sperm oil, and so came to see me. I told him to use a mixture of 50 parts sperm, 49 parts neat's foot oil, and 1 part resin. This is an old standby with some spring hardeners.

I was given some heavy springs to harden. I tried oil, but the springs came out of the bath as soft as they were before they went into the fire. I tried cold water and found that the springs broke, even when drawn very low. Finally an old, white-haired man, in whose experience and judgment I had unlimited confidence, came to my rescue. He whispered in my ear: "Try bilin' water." I went to the boiler room, got a tub of boiling hot water and took it to the fire where I had a spring ready to dip. I plunged it in the tub and worked it around well; then I took it out, put some tallow on it and flashed it over the fire for temper. From that hour my reputation was made, so far as that shop was concerned.

I advised my client to heat a tank of water to the boiling point and try it. He did so and reported that it was a huge success.

About Reamers

To make a tool that will cut a smooth, true hole is a job in which tool makers are not always successful, and many are the shapes that have been devised. The rose reamer having teeth only on the end, nearly cylindrical in shape and tapering toward the shank, is a good tool for holes that are broken into on the side, and holes in general where there is little to come out. But when it gets worn a little it is apt to bind, making trouble and perhaps spoiling or injuring both hole and reamer.

A fluted reamer is likely to chatter and to cut the hole many sided, giving it one more angle than the reamer has teeth. Thus a square reamer will sometimes make a five-sided hole; a reamer with five teeth a six-sided hole, and so on. The chattering can often be prevented by spacing the teeth unevenly. On taper reamers especially the following is a good plan; for half-way around the reamer shape each tooth a little wider or narrower than the preceding one; then begin a new series and make the second part of the reamer the same as the first. Then every tooth will be opposite to one just like it and no two consecutive teeth will be alike.

Square reamers are used for gun barrels, to finish the bore to size. A piece of wood is put on one side, to crowd it to the other side of the hole, and paper is put under that to get the hole exactly the right size. They are run quite fast, twice as fast as a drill of the same size would ordinarily be run.

Left-handed threads are sometimes found on taper reamers. They are to break the chip and keep the reamer from feeding too fast.

A good way to make a reamer for chucking is to make it like a rose reamer on the end, but have it fluted, making the fluting two or three times as wide as the teeth and do not back off the teeth. For hand use make it the same It is well to give it a slight taper towards the shank. This will remedy a tendency to cut a taper hole if the back center of the lathe is not in line.

Half-round reamers are very serviceable and are easier made than fluted ones.

Adam Filer.

Personal

Professor S. B. Christie, who since 1885 has held the chair of mining and metallurgy in the University of California, has had conferred upon him the degree of D. Sc. by Columbia University.

M. Emil Laurent has been elected a correspondent of the Paris Academy of Sciences. M. Laurent is professor of agriculture in the Belgian national school at Gembloux.

Mr. Charles Scott, Sr., of Philadelphia, and Mr. Charles Scott, Jr., of New York, it is announced, are the donors of the new physical laboratory for Wesleyan University, the estimated cost of which is said to be $75,000. Mr. Scott, senior, is a trustee of the university and his son is a graduate of the class of '86. The building is to be in memory of John Bell Scott, of the class of '81.

M. Amagat has been elected a member of the section of physics by the Paris Academy of Sciences, succeeding M. Cornu.

Lord Rayleigh has been elected a corresponding member of the Academy of Sciences of Vienna. Lords Kelvin, Lister and Rayleigh have been made charter members of the new Order of Merit instituted by King Edward for well-earned distinction. Sir William Huggins is also a member, and Lords Lister and Kelvin have also been made privy councillors. Knighthood has been conferred on Dr. Oliver Lodge, and Professor William Ramsay has been made a Knight Companion of the Order of the Bath.

Professor Brainard Kellogg, of the Brooklyn Polytechnic Institute, has been granted the degree of LL.D. by Middlebury college.

William Marconi has been given a prize of about $2,000 by the Accademia dei Lincei for his work in wireless telegraphy.

C. R. Emerson, a Boston engineer, has been appointed engineer of the proposed tunnel under the St. Lawrence between Montreal and Longueuil.

Alexander Graham Bell, inventor of the telephone and a delegate to the National Education Convention, recently announced that he has been awarded the medal given by the Society of Arts of London, which is known as the Prince Albert medal. Mr. Bell is the fourth American to receive it, his three predecessors having been Capt. James Eads, of jetty fame, Thomas A. Edison and Prof. David Edwin Hughes.

G. W. Edwards has been appointed general superintendent of the Brooklyn Rapid Transit Company, vice P. W. Folger, who recently resigned.

Henri Fournier, the French chauffeur, is reported to have sent word to a friend in this country that he would return to the United States next November, when, in all probability, he will attempt to create new speed records for gasoline-vehicles. At the present time he is testing new models for European builders before they are placed in the market.

Arthur D. Newton has been elected secretary of the Electric Vehicle Company. Mr. Newton was formerly president of the Eddy Electric Manufacturing Company.

W. R. Mason has resigned his position with the Sprague Electric Company and has become western manager for Coe, Smith & Company, selling agents for the Mechanical Boiler Company, of Chicago.

E. W. Goldsmidt, recently of the Chicago office of the Bullock Manufacturing Company, has assumed the management of the New York office, succeeding R. T. Lozier, who has gone to the home office to take charge of the selling organization.

Alfred Stromberg, president of the Stromberg-Carlson Telephone Manufacturing Company, is now in Sweden visiting his old home at Stockholm. Mrs. Stromberg is with him.

A. B. Ayres lately resigned from the Westinghouse Electric and Manufacturing Company's Chicago office to accept a position with Sargent & Lundy, engineers, New York.

J. Edward Addicks has sent in his resignation as president of the Bay State Gas Company, of Boston. His successor is J. Frank Allee, a Dover (Del.) jeweller.

A. E. Walden, at one time superintendent of the Blackstone (Mass.) Electric Light Company, is the new general manager of the Mobile Light & Railroad Company.

Dr. R. F. Ruttan has received the appointment as professor of chemistry in McGill University, Montreal, Que. He will succeed Dr. Girdwood, resigned.

Mr. H. Chester Crouch, of Oswego, N. Y., has been elected assistant professor of mechanical engineering at the University of Colorado. Mr. Crouch is a graduate of Cornell.

Professor Oscar Quick, assistant in the department of physics, University of Illinois, has resigned his position and will go into practical engineering work.

M. Lacroix, of the Museum of Natural History, M. Rollet de Lisle, the engineer, and M. Gerard, the geologist, have been sent by the Paris Academy of Sciences to the Lesser Antilles to investigate the effects of the recent volcanic disaster. They sailed on June 9, and will be absent several months.

Mr. George F. Gebhardt has been elected to the chair of mechanical engineering, Armour Institute of Technology, Chicago. Mr. Gebhardt was formerly an instructor in the same school.

Thomas L. Haskett on July 1st assumed his new duties as soliciting freight and passenger agent of the Grand Rapids, Grand Haven & Muskegon Railway Company, with headquarters at Grand Rapids, Mich.

George F. Porter has returned from Alaska, having accomplished the successful installation of the Kerite cable which was laid by his company for the government. Mr. Porter's own account of his cable work in the Skagway-Janeau waters was presented in the June issue of The Electrical Age.

J. W. Peterson, formerly with the Stanley Electric Company and the Northern Electrical Manufacturing Company, has been elected vice-president and general manager of the Electric Equipment Company of Chicago.

An Unlucky Car

Out in St. Joseph, Mo., the local street railroad company found recently that its car No. 13 was a steady drain on the receipts of the line. Investigation developed the fact that the negroes, through whose quarter No. 13 ran, and which is the most populous in the whole city, were so superstitious that this particular car always ran empty, though the other cars were full to overflowing. Protests against the car became so widespread that at last, fearing to continue the car any longer, the company withdrew No. 13 completely and operated it in a different section.

With Our Foreign Consuls

Railways

New Electric Road in Canada.—Commercial Agent J. E. Hamilton writes from Cornwall:

The project for an electric line from Cornwall to Toronto is being rapidly pushed by American and Canadian promoters, who have a capital of $8,000,000.

Opening for Railroad Material in Brazil. — Minister C. P. Bryan, of Petropolis, transmits a report regarding the equipment and material needed for the New Hamburg and Taquara Railroad, in the state of Rio Grande do Sul, Brazil. This road is 29.8 miles long, and traverses a fertile and thickly populated region hitherto without railroad facilities. The roadbed and right of way, including culverts but not the longer bridges, are practically ready for the rails. The material needed is as follows: For two bridges 21.8 yards long, overhead truss, 5.4 yards between supports; one bridge, undergirder 17.4 yards, 3.8 yards between supports; one bridge, undergirder 8.7 yards, 3.8 yards between supports; six undergirder bridges, one 6.5 yards, three 5.4 yards, and two 4.3 yards long; 1,960 tons of rails, 44 pounds per running meter (1.09 yards), and fish plates and screws for same; spikes for 29.8 miles; 20 complete turn-outs or switches; two turn-tables; 102 pairs of wheels and appurtenances, axle boxes, springs, etc.; 10 complete trucks, American "bogie" system; 31 locomotives of 25 tons, for a maximum grade of 0.98 inch per meter (1.09 yards) and curve with radius of 109 yards, gauge 1.09 yards, to pull 120 tons, with a velocity of 24.8 miles maximum (native coal); four complete apparatus for telegraphic transmission, Morse system; six telephone instruments; telegraph wire for 29.8 miles. Bids for the foregoing material are being received and considered by Dr. Augusto Carlos Legendre, 22 A Rua Rosario, Porto Alegre. No time has been fixed for closing the bids, but the company is under contract to have cars running the fall of 1902. It is desired that the bids be for material laid down in Porto Alegre, not including duties. Freighting to Rio Grande must be in vessels not drawing more than 13 feet. From Rio Grande to Porto Alegre, freight goes in barges drawing from 8 to 8½ feet, and contracts can be made at $1.82 per ton. Bids have been received from German and Belgian firms. Mr. Dawson adds:

There is more railroad building now going on and in contemplation in Rio Grande than in any other state of Brazil, and all the mileage in existence is under Belgian or English management and control. The native coal mentioned as the fuel to be used by the locomotives is a sort of lignite, and is of low calorific value.

Venezuelan Railway Project.—Consul E. H. Plumacher writes from Maracaibo in regard to a proposed railway from Maracaibo to Perija. A concession for this line was granted in 1895, but it has lapsed, and a new one has been granted. The consul says:

The district of Perija lies southwest of Maracaibo and is divided from Colombia by a spur of the Cordilleras. This mountain range is heavily timbered with valuable trees; the climate here is healthy and suited to the white race. The country is most productive; coffee, cacao, indigo, cotton, and corn grow readily. Its tobacco is famous. The land is well adapted for cattle raising, and diseases of live stock are unknown. Copper, iron, and coal are found, as well as gold and precious stones. There are deposits of asphalt and petroleum. Land producing the finest tobacco can be obtained for twenty cents an acre. Lack of communication is the main obstacle to the development of the country. The timber, which is shipped to Europe, can be brought to the coast only by means of freshets in the streams.

The line is to be a single track, with distance between the rails of 1.07 meters (42.13 inches) and a minimum radius of curves of 60 meters (196.8 feet). Work must be commenced within twelve months after the signing of the contract and the road completed and open for traffic within another twelve months. At the station of San Ignacio, the road may divide, one branch going to the north, passing through the town of Rosario, and the other to the south, through Machiques. The concessionnaire shall also establish a steamship line between Barranquita and Maracaibo. The grant is for ninety-nine years, counting from the date on which the road is open to service; at the expiration of that time, the railway with its rolling stock, warehouses, and offices, shall become national property. The Government also reserves the right to buy the road. Mails are to be carried free. Government troops and baggage, as also public employees on service, are to be transported for one-half of the tariff rate.

Electric Roads in Switzerland.—Consul H. H. Morgan writes from Aarau:

Refering to my report regarding the proposed construction of electric lines in Switzerland, I have to state that these lines will be built by the authorities of the townships through which they will pass. A committee will make the necessary contracts with the actual builders of the road and the furnishers of the material required in the construction. As soon as the advertisements for bids are made, I will report all possible details. The principal promoter of these enterprises is Mr. Konradin Zschokke, an eminent engineer of Aarau, and any communications regarding the matter addressed to him will, I am sure, receive a prompt acknowledgement. I would advise that the correspondence be in German.

General Information

Seoul Electric Company.—The State Department has received from Minister Allen, of Seoul, extracts from a report published in a Japanese newspaper, in which very favorable mention is made of the plant of the Seoul Electric Company. The plant in question is the largest single electrical plant in Asia. It was built for the Korean company by an American firm—Collbran & Bostwick—who hold the property under mortgage. The company operates an overhead-trolley road some twelve miles long, and, with the same power furnishes incandescent and arc lights for the city. The generating machinery consists of two 120-kilowatt rotary converters from the Westinghouse Electric and Manufacturing Company. The boilers are of the Babcock & Wilcox type. The special point of these machines is that they produce direct current at 550 volts for use of the cars and at the same time alternating current at 385 volts for the electric lighting. There are something over 1,400 incandescent lights besides the arc lights in use. Over 2,000 volts of alternating current are freely produced, which is most advantageous for a city like Seoul, where lights are scattered over long distances. The consulting engineer is a Japanese, a graduate of the Massachusetts Institute of Technology. The road is being well patronized by the natives.

Electric Plant in Amsterdam.—Consul F. D. Hill writes from Amsterdam:

The city council has voted a loan of 6,500,000 florins ($2,613,000) and a second of 2,900,000 florins ($1,165,800) for building a plant to furnish electricity for lighting and motive power and for changing the street railway to electric traction. The contract for the building of the plant has as yet not been made. The steam-engines, dynamos, and the installation will be furnished by German and Dutch manufacturers. Particulars of the cables will be published on July 1; bids to be delivered September 1, 1902.

American Gas Coal in Italy.—A recent demonstration of new gas lighting in Turin brought out several points of interest to American coal exporters and also to manufacturers of gas-burners and lamp supplies, says U. S. Consul Pietro Cuneo in his last report. One of the gas companies in this city decorated the leading avenue in the Valentino Park (in which the Exposition of Modern Decorative Arts is in progress) with Welsbach lamps. The exhibit aroused wide admiration. Gas is furnished to consumers here at a certain price, governed to an extent by the cost of standard coal—called the "New Pelton"—in England The price now charged is 5.75 lire (about $1.10) per 1,000 cubic feet, which is lower than that in almost any other city of Italy.

Until about two years ago, American coal was scarcely known in Italy. A cargo was then imported into Turin, and it proved so satisfactory that the local gas companies during the past year purchased some 25,000 tons. They claim that the American coal possesses more volatile matter than any other coal and that is makes better and more gas, and have issued an official statement to that effect.

The great distance is the only drawback to the use of our coal in this market. I am informed that the gas companies paid as much as one dollar per ton extra for the American coal that they have employed, and that if the difference were only thirty cents per ton, they would prefer it to all others.

Not only did this illumination develop the fact that American coal makes better gas than that produced in England, but it also showed that the globes, mantels, burners, etc., were mostly supplied by American manufacturers.

I may note in this connection that I have seen many articles of American origin in this city, such as sewing machines, cash registers, bicycles, sausage grinders, lawn mowers, typewriting machines, tools, and machinery, but I have not seen a single revolving office chair of American or any other make.

Incorporations and Franchises

Oregon.

Portland.—The Oregon Electric Power Company, formed a short time ago in Nebraska, with headquarters at Portland, has undertaken the construction of a large electric plant to be installed in Baker county. The company's authorized capital is $500,000, and it is expected that the plant will be completed for operation early in 1903. Eagle creek, the largest branch of the Powder river, has been chosen as the site on which to erect the power station. Water is fed out of the creek by a flume 15,000 feet in length, a fall of 385 feet being at the lower end. The capacity at the point where the power plant is to be built will be 4,000 horse power at low-water mark. The plant will be enlarged as the demand increases. It is anticipated that the line will be extended across the Sumpter, power and light being furnished for the mines of that district, as well as for railway and other purposes.

West Virginia.

Bellington.—West Virginia Lime and Cement Company; capital, $20,000. Harry E. Weaver, C. A. Bickett, C. E. Ferguson and others are the incorporators.

Fairmont.—Wyanoke Coal & Coke Company; capital, $100,000. This company will be devoted to coal mining and coke manufacturing.

Maryland.

Frederick. — The Frederick County Telephone and Telegraph Company has increased its capital from $25,000 to $100,000 and will extend its line into points in Frederick county and Loudoun county, Va., not yet reached.

Baltimore. — The Nepper Electrical Cutting Machine Company has recently been incorporated with a stock of $150,000; the company will manufacture and deal in electrical cutting machines.

The Baltimore Rolling Mill Co. has been incorporated by Harry Wehr, Charles G. Phillips and J. W. Bailey with a capital of $200,000.

The Refrigerating and Heating Company has been organized with a capital of $1,000,000; it intends to issue $2,000,000 in bonds. Incorporators not named.

Tennessee.

Nashville.—The Cope Bridge Company has been incorporated with a capital of $10,000 by Francis Cope, John O. Byrd and others.

The Cumberland Foundry and Manufacturing Company has been organized with a capital of $10,000. The company will equip a plant immediately.

South Dakota.

Pierre.—The Tri-County Mutual Telephone Company has been incorporated with a capital of $1,750. F. W. Dunn and H. A. Rademacher are the incorporators.

Yankton. — The Yankton Telephone Company, recently incorporated by Fred'k Schnauber, George W. Roberts and other, is capitalized at $10,000.

Kansas.

Wichita. — The Wichita Telephone Company has been organized with a capital of $200,000. Incorporators not named.

Ohio.

Warren.—The Peerless Electric Company, recently incorporated, will build a large electric manufacturing plant here; the company is capitalized at $500,000.

Columbus.—The N. L. Hayden Manufacturing Company has been incorporated with a capital of $500,000 by N. L. Hayden, H. C. Godman and others to manufacture steam, electrical and air appliances to be used in connection with boilers, engines and machinery of all kinds.

Cleveland.—The Automatic Heating and Lighting Company has been incorporated with a capital of $300,000.

Toledo. — International Motor Car Company; $2,000,000.

Long Island.

Glen Cove.—The Franklin Electric Illuminating Company has increased its capital from $35,000 to $60,000. The company's plant was recently enlarged, but increasing business makes further expenditures necessary. The company will furnish power for the Sea Cliff Street Railway.

Minnesota.

Lyle.—A telephone company has been incorporated with John Bergeson, of London, as president; capital, $20,000. Lines will be extended to London village, Deer Creek, Northwood and Toterville. Name not given.

Washington.

Spokane. — The Washington Water Power Company will soon increase its capital from $2,000,000 to $2,600,000. The money will be used to extend the plant.

Ballard.—The people have voted in favor of bonding the city to the amount of $25,000 for an electric lighting plant.

Massachusetts

Haverhill.—The Haverhill Illuminating Company has been incorporated with a capital of $150,000. It will build a plant at Haverhill.

Boston.—The New Hampshire Traction Company has been capitalized at $1,000,000. It has a bonded debt of $7,500,000 first lien sinking fund four and one-half per cent gold bonds dated July 1, 1902, and which fall due July 1, 1942, without privilege of earlier redemption.

The Engineering Company of America has been incorporated with a capital of $5,000,000 and will continue the business of the Cunningham Engineering Company of Boston.

Idaho.

Saint Anthony. — The International Telewriting Company of this city, which was lately incorporated by F. V. Gomers, C. E. Bowerman and others, with a capital of $600,000, will manufacture electrical machinery.

Belgium.

Brussels.—La Compagnie Internationale d'Eclairage et de Tramways à Tien Tsin is the name of a company which has just been formed in Brussels, with a capital of £250,000, to establish a system of tramways and a central electric lighting station at Tien Tsin, China.

Pennsylvania.

York.—The City Conduit Company has been incorporated to acquire, construct and dispose of conduit, telegraph, telephone and electric light lines; capital, $100,000.

Philadelphia.—The Diamond Automobile Company has been incorporated for $125,000, to manufacture vehicles of all kinds.

Easton.—The Easton Light and Fuel Company has been incorporated with Clarence P. King, of Philadelphia, as president, and will purchase existing gas and electric light plants; it will also expend about $50,000 for improvements.

Iowa.

Vinton.—The Vinton, Belle Plaine & Independence Interurban Railway Company, which was recently incorporated by M. Gaasch, George McElroy and others, will construct electric lines throughout Vinton.

Manchester.—The Manchester Electric Co. has been incorporated with a capital of $10,000 with M. F. Leroy as president; E. M. Carr, vice-president; C. J. Seeds, secretary, and B. W. Jewell, treasurer.

The Delaware County Telephone Company has increased its capital from $10,000 to $50,000.

Council Bluffs.—The Grinnell Electric & Heating Company has been incorporated with a capital of $75,000.

Lacona.—The Whitebreast Mutual Telephone Company, capitalized at $10,000, has been organized here. S. Exnereider is the president of the company.

Shenandoah.—The Independent Mutual Telephone Company will be the name of the new telephone corporation which will be incorporated shortly. The capital will be $50,000.

New York.

New York city.—The City Conduit Company has been incorporated with a capital of $100,000 to acquire conduits for telephone, telegraph and electric light lines.

The Electro-Magnetic Railway Company was recently incorporated in New Jersey with a capital of $100,000.

The Consolidated Fire Alarm Company has been incorporated with a capital of $2,500,000. The directors are Augustus D. Juilliard, Thomas R. Brown, Bernard M. Erwig and others.

The Railway Electric Refrigerating Company announces that it has filed a certificate changing its name to the Railway & Stationary Refrigerating Company.

Oswego.—The Oswego Electric Light Company has been incorporated with a capital of $50,000 and will manufacture and produce electricity for lighting, heating and power.

Kingston.—The Kingston Gas & Electric Company has been incorporated with a capital of $700,000, and will furnish light in Kingston and in the Ulster county towns. The directors are M. W. Stroud, R. L. Babcock and others.

Mount Morris.—The Mount Morris Water Power Company has recently been incorporated by W. A. Boland, M. J. Kennedy and J. M. Prophet with a capital of $50,000.

Texas,

Beaumont. — The Beaumont Iron Works has been incorporated with a capital of $100,000; C. B. Greeves, W. B. Greeves and others are the incorporators.

The Central Power & Equipment Company has recently been incorporated with a capital of $10,000. Incorporators not named. Manufacturing will soon be begun.

Colorado

Denver.—The Lacombe Electric Light Company was recently purchased by the Denver Gas and Electric Company. Purchase price withheld from publication.

The Grand River Electric Power Company has been incorporated by E. S. Douglass and E. P. Young with a capital of $100,000.

The Western Gas & Electric Supply Company has recently been incorporated by J. J. Henry, Chas. W. Jones and others with a capital of $25,000.

The Farmers' Union Telephone Company has been incorporated with a capital of $10,000. It will erect lines over the three counties of Saguache, Rio Grande and Costilla.

Colorado Electric Irrigation Company; $100,000; to reclaim the arid lands in the state. Main office and incorporators' names not stated.

Reasons for the Attitude of the St. Louis Exposition Toward Exhibitors

By Charles T. Malcomson

Superintendent, Power and Transmission Exhibits.

The most successful exposition is that one which gathers together the most representative exhibits of all kinds and displays them to the public in the most attractive manner. The methods to be used in attaining this object have developed as experience has been gained in exposition practice. From the facts that have been established as the direct result of experience there stands out clearly the idea that every facility should be furnished to the exhibitor at no, or at least a minimum expense. This facilitates his exhibiting and allows practically all expenditures to be utilized in making the exhibit complete and perfect. The compensation which a machinery exhibitor expects in return for the money expended on his exhibit is in the sale of the articles shown, sales from these as samples, in the exploitation of his name and wares, and in the awards which evidence competitive values.

Exposition work is essentially advertising, and the best methods of realizing results in this are found in exposition experience. Practice has shown that the "dead" exhibit has less value than the operative, particularly in machinery and those allied branches of industry in which machinery plays an important part. The lay public is always attracted by seeing the "wheels go round." The prospective buyer is better satisfied when he sees a machine actually doing the work for which it is designed. Demonstration often shows a visitor a short cut and chance for economy which had not before occurred to him, or indicates a want in his manufacturing methods. Realizing these chances to benefit, the exhibitor is anxious to make an operative display, but the cost heretofore has often been prohibitory, and so, free power, in so far as it is a necessity, is an element of exposition service which tends toward the realization of the highest possible ideal. This condition is not altogether new to the promoters of expositions, for it has been realized that the moneys accruing from the rental of exhibit space and operative facilities do not compensate for the losses due to incomplete exhibits, or the acceptance for purely pecuniary reasons of undesirable exhibits, or the loss of control over every space for the benefit of the exposition as a total; but to accomplish this ideal it is necessary to have sufficient funds to open the exposition and operate it for weeks or even months without depending upon revenues which may or may not materialize immediately after opening the gates. Stern necessity has compelled former expositions to avail themselves of every possible means of providing the "sinews of war," but fortunately the generous provision of Congress in appropriating $5,000,000 "to aid in carrying on such exposition" helped to eliminate this necessity in the present instance, and it now rests with the manufacturers to do their part toward making this great Universal Exposition a signal success. The eyes of the world are on us now. There is a great awakening to the fact that America has won the prize of commercial supremacy. Let us then fulfill expectations and make this exposition a fitting tribute by the greatest industrial age in the history of mankind.

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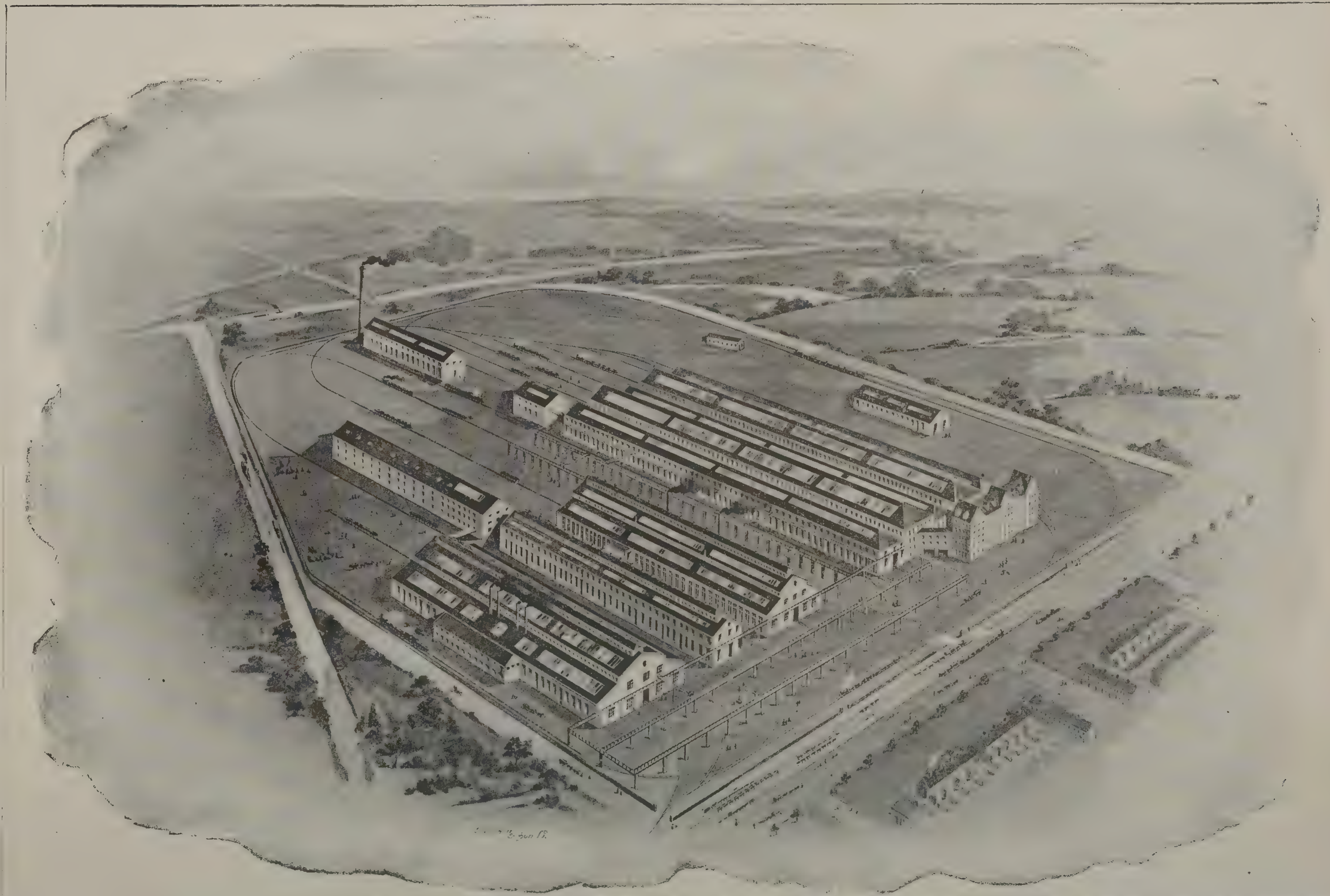
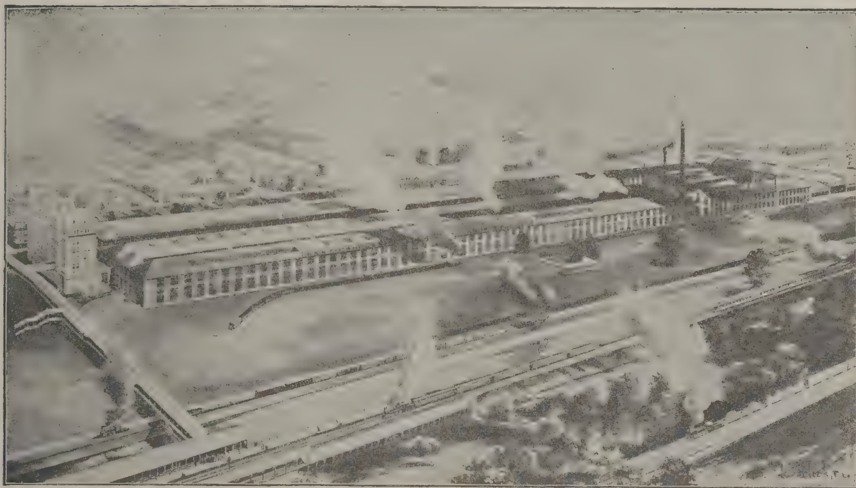


Works of the British Westinghouse Electric and Manufacturing Co. at Trafford Park, Manchester, England.

George Westinghouse and His Achievements

By Francis F. Coleman



Westinghouse Electric and Manufacturing Company's Works, East Pittsburgh, Pa.

George Westinghouse, big, strong and dominant, at the head of twenty-five corporations with an aggregate capital of $100,000,000, and employing more than 20,000 men, is nearly fifty-six years old and still filled with a vigor which promises that he may fill out his career with other series of successes such as those which have made his name known on both sides of the Atlantic as an inventor, organizer and financier. It was not in the schools that Mr. Westinghouse developed his abilities but in the practical work of the world. His aptitude for such a career was inherited from his father who was a manufacturer before him and a man of engineering skill.

The old works of "George Westinghouse & Company" still stand at Schenectady where young Westinghouse began first to display the liking for mechanics and tools which afterward made him a clever workman as well as a master inventor. Here in his father's factory he became familiar with tools and skilled in their use while still a schoolboy.

Here he was when the great Civil War broke out and deluged the country with blood. Although he was but fifteen years old at the beginning of the war he did not hesitate long. As soon as he could get himself accepted he enlisted and went to the front. He began his army service in the infantry and later was in the cavalry.

After something more than a year of service in the army he learned of the need of men in the Navy who were skilled in mechanics and he entered that branch of the service. In the Navy his abilities were recognized quickly and he became an engineer officer. In this capacity he continued to serve "Uncle Sam" until shortly after the close of the war, when he resigned. The Navy of that day was not an attractive place when peace came for an active and enterprising young man. This was especially true regarding those who belonged to the engineering corps. At that date the old idea was still rampant in the Navy that a naval officer should be a sailor and that the men who managed the machinery, although they bore the rank of officers were mere "mechanics." The engineering officers did not belong to the line either, but were staff officers and thus debarred from ever taking command. How different is the situation now when every one recognizes that to the engineering corps falls the responsibility for keeping in fighting shape every part of our complicated battle ships abroad, of which the old "sailor" officer would find himself a stranger to everything. The old members of the engineering corps are proud to look back to the time when George Westinghouse and many another man, since become eminent, were among the "dirty mechanics" who were looked down upon by the spick-and-span officers of the line in the years that followed the war and the development of the battle ship, whose complications of machinery have forced the recognition of the value of the "mechanic."

Mr. Westinghouse returned to his home at Schenectady after leaving the Navy and undertook a course in Union College. Mere study was, however, distasteful to him, while there was yearning within him the desire to handle tools and to "make things." He did not complete his college course but instead he engaged at once in active engineering work. His first successful invention was a special railroad frog with reversible points. This brought him into touch with the railroads and led without question to the invention and development of the air brake, whose success and fame have carried the name of Westinghouse into every land where a railroad has ever been built.

The need for a brake more efficient than that ground up by hand had become only too evident. The old hand brake had been good enough in the earlier days of railroading and, in fact, nothing could have been better, considering the crude conditions of the railroads and their entire equipments and the lightness of cars and engines. It was in itself a crude apparatus but it was handy and strong, any one could work it and it was sufficient in effect to control the old trains. But as heavier equipments came into use accidents began to multiply, until "the brakes failed" became a standing explanation of collisions and other accidents almost without end.

Others had seen the need of better braking apparatus and also of putting this under more direct control of the engineer of the train. Continuous chain brakes had been devised and the vacuum brake was being developed. Mr. Westinghouse saw with a clear mind that the only satisfactory solution must come from working the brakes by power and that this power must come from the engine and be controlled by the engineer. He saw also that for a safe and efficient system every car must have its own reservoir of power, so that its brakes could be controlled should it break away or be temporarily separated from the engine.

To use steam was his first thought, but this he saw was out of the question because it would be impossible to keep the steam from condensing in the cylinders under the cars, where the power must be stored.

It was while still studying this question that the work of boring the Mont Cenis tunnel was in progress and compressed air tools were introduced to do the work. When Mr. Westinghouse read of this the idea came to him with a flash. The ductile atmospheric air was exactly the medium he was seeking. Here, at last, was the vehicle of power with which he could connect the engine with each car and place the brakes at the will of the engine driver. Compressed air met all the other conditions that had bothered him.

People will remember that in those days the automatic coupler was practically unknown and the solid train with its vestibuled platforms and continuous walk from end to end was not yet dreamed of.

Cars were hitched together with links and pins and every separate lot of cars built was apt to be of a different platform height. As the cars in a moving train went banging back and forth, each one moving independently the length of its coupling links, any mechanical connection of the brakes, like a chain, would have been worse than useless. Air could be carried from car to car through flexible pipes.

This much for the conception of Mr. Westinghouse's greatest invention. The development was not so easy. It is true that the mere making of a braking machine that would act was not a difficult mechanical proposition, but there were many other conditions to meet.

The airbrake, as it has become, standard all over the world, did not spring complete, Minerva-like, from Mr. Westinghouse's brain. It had to be an evolution, and it could only evolve as the conditions under which it was to be used became more perfect. In many cases these conditions were so crude and bad that Mr. Westinghouse, as he looks back upon those days of struggle, cannot blame the great mass of the railroad managers, who honestly preferred the old hand brake to his improved one. There were failures to be met and details to be improved, besides the necessity of overcoming the inertia or poor feeling of the railroad managements. Air brakes cost money.

Mr. Westinghouse himself did not have money enough to start the long fight alone. He took as an associate a capitalist of sufficient means and then fought for the next step in advance. This was to find a railroad with a manager of courage and faith enough to give the new brake a chance. This man was found, and the air brake proved itself worthy of the efforts put into its introduction.

Railroad progress has been rapid along many lines since that date, and side by side with each improvement in cars and equipment has gone the Westinghouse air brake, itself the most important of them all.

The air brake as it was first applied was, however, not yet capable of replacing the old hand brake for general service. In its original form it was only suitable for starting trains like those used for passengers, and for years no attempt was made to adapt it to the needs of long freight trains. Its defect for such uses came from the fact that the setting of the brakes began at the engine and extended backward on the train car by car with an appreciable time between the action of each set of apparatus. On a short train this was of no consequence, but if it had been attempted to stop a half-mile-long freight train suddenly in this manner it would have led to disaster.

After the brakes were set on the forward cars and long before those in the rear would act the cars would have closed up on one another and by their impetus and weight crumpled the train up and thrown the middle cars off the track.

Mr. Westinghouse set to work to remedy this defect. His success was phenomenal. He did not so much improve the old air brake as create a new one. By means of a modified valve in that part of the apparatus under the cars he made every brake act in concert the moment the air pressure was reduced in the train pipe by any means.

With a long train equipped with the new brake Mr. Westinghouse went from one great railroad yard to another, demonstrating its success. The new brake met many conditions which were important. It would not matter with this if half the brakes in a train were out of

Works of the Société Anonyme Westinghouse, St. Petersburg, Russia.

order, the other half would work and, if a train broke in two, each part would be brought to a standstill automatically.

From that day the general use of the Westinghouse brake throughout the world was assured. Troubles there have been, other inventors have made improvements which have had to be absorbed and legal and commercial complications have arisen but Westinghouse has come out triumphantly. There are now in service about 1,500,000 Westinghouse air brakes.

The direction of Mr. Westinghouse's attention toward electricity was an incident of his railroad work. It was many years thereafter before he entered the lists as a leader among the giants of electricity, who were battling for the commercial control of this newly developed agency.

Mr. Westinghouse was making a pneumatic railway switching and signalling apparatus when the first idea came to him of using electricity. He found electricity so useful in conjunction with compressed air in the switching and signalling apparatus that he began to apply it in other directions.

He realized very soon the vast field the new-found agent was to have, particularly in the transmission and production of power and in lighting. He bought

Office Building and Works, Westinghouse Air Brake Co., Wilmerding, Pa.

electrical patents and formed about him a band of electricians of the highest skill.

From that time until today the work of Mr. Westinghouse has been more that of the developer and organizer of businesses than that of an inventor, although it is declared that there is still no important piece of new machinery to be produced in the shops of his many companies but that he takes a deep personal interest in it and aids with his inventive skill in developing it.

Mr. Westinghouse recognized the weird talent of that most wonderful of all the electrical wizards, Nikola Tesla, and gave him the opportunity to develop his theories and give them commercial shape. Out of this work came the fundamental patents of the distinctive Westinghouse electrical apparatus in the induction motors, and the use of alternating, high tension and polyphase currents.

Who is there in electrical circles who does not remember the battle royal of only a few years ago, when Westinghouse led the forces on one side and the General Electric Company was the center of the other faction?

One by one, for one reason and another, the various companies which had started out separately had been taken into one camp or the other, and it looked for a time as if the fight would end like that of the Kilkenny cats—with only the tails left. Lawyers got wealthy and millions were spent in the litigation started and carried on. Each side attacked the validity of the other's patents. It seemed at one time as if the result might be to make all the patents worthless and throw the whole business open to the world.

Main Aisle, Westinghouse Electric and Manufacturing Company's Works, East Pittsburgh, Pa.

It was while this battle was at its height and the World's Fair at Chicago was being got ready that Mr. Westinghouse won one of his most notable victories.

He took the contract for lighting the World's Fair for a million dollars less than had been bid by others. The bid was so audacious that his opponents thought they saw in it their opportunity to crush him.

Walter M. McFarland, in describing

this incident in the Engineering Magazine a year ago or so, said: "They, in the effort to crush him, endeavored to persuade the Exposition authorities that he could not secure adequate bonds to carry the scheme through and it is an actual fact that he furnished three separate bonds equal to the amount of the contract. After the contract was taken it would have seemed to an ordinary man as if everything was conspiring against him, for injunctions were obtained to prevent his using the Edison patents in the manufacture of the lamps, as well as the air pump for exhausting the bulbs, which was at that time supposed to be the best. Mr. Westinghouse himself invented another form of lamp, known as the "stopper pattern," and not only invented the lamp, but invented and built machines for the accurate grinding of the stoppers and the necks of the bulbs. He also developed a special form of air pump to secure the exhaustion. All the world knows how beautifully and successfully the World's Fair was lighted, and it is a fact that the million-dollar surplus which was distributed to the stockholders is just the amount that Mr. Westinghouse saved these stockholders by taking the contract for the lighting. This was the largest installation of alternating-current apparatus which had been made up to that time, and all who visited the Chicago Fair will remember the section of Machinery Hall which was occupied by the Westinghouse generators. His next great triumph with alternating-current generators was the Niagara installation, which was by far the greatest electrical installation which had been planned up to the time of its inception. Here again his courage never faltered and the results have shown that it was not misplaced."

Mr. Westinghouse won out and later in 1896 the war between the great electrical companies was ended by an agreement whereby each allows the other to use its patents upon the payment of an agreed upon royalty.

Before taking up Mr. Westinghouse's later work it is well to bear in mind the important part which he played in the development of the natural gas deposits of Pennsylvania.

His attention was turned to this subject by the finding of a "blower" by some men who were drilling a well for Mr. Westinghouse near Pittsburg. Natural gas had been struck in various places but beyond some local uses it was considered a waste product or worse.

Here was a gas richer by far than any artificially produced illuminating or heating gas. So rich that it could not be burned without intense smoking until special burners were made for it, and so cheap that it was consumed in great torch-like flames and no one thought of putting out street lights, day or night

Mr. Westinghouse saw the possibilities of the new fuel and created the Philadelphia Company of Pittsburg to secure the gas and pipe it to centers of consumption. Had not the supply rapidly diminished the cities of the East would now be using natural gas instead of the artificial product and Texas oil would find it an established fuel here as it has now long been in and about the gas districts. The industrial revolution created by the use of natural gas has been great and to this Mr. Westinghouse was an important contributor.

Glass making by gas proved so distinctly advantageous that in almost every part of the country this method has superceded the old one, even where it is necessary to make producer gas to heat the furnaces. Metal workers and other manufacturers found like benefits in the gaseous fuel.

From the development of natural gas to the development of the gas engine seems an easy and logical step.

While others were experimenting with gas engines of a few horse power in size Mr. Westinghouse laid plans for engines of this kind of hundreds of horse power. Gas works were built for sources of power supply and the Westinghouse gas engine is relied upon by Mr. Westinghouse himself to add as much to his reputation as the air brake did.

When the demand began to arise in modern power houses for great electrical producing units with engines directly coupled to the generators it was but a natural development for the Westinghouse concerns to begin to make steam engines. One of the two latest devices in which Mr. Westinghouse has become interested is the Parson's steam turbine. The success of this turbine in driving the little 100-foot steamer "Turbinia" at a rate of nearly thirty-eight miles an hour and its demonstration of a steam economy equal to that of the best steam engine was a strong feature to recommend it for electrical work, but in addition to this was the fact that it was a true rotary engine and one which could develop a given power with only a small fraction of the weight and cost of the reciprocating engine.

The other of the latest additions to the businesses of the Westinghouse Companies is the making of the Nernst electric lamp. The taking over of the American patents for this lamp and the energy with which the project has been pushed are characteristic of Mr. Westinghouse. The Nernst lamp, as it had been developed by its inventor, was but a laboratory device. It is true that its principles were well developed and that a suitable variety of refractory materials had been discovered and tested to provide proper bits of "glower" to replace the carbon filaments of the ordinary incandescent lamp. But beyond that little had been done to get the lamp into commercial shape.

Mr. Westinghouse set to work men of the highest skill upon the development of the lamp. Today the Nernst lamp is a commercial success, perfect in its details and but for its necessary high price would be pushing the vacuum incandescent lamp rapidly into second place. As it is Mr. Westinghouse and his associates can afford to wait patiently for that time to come as they count among their various properties the Sawyer-Man lamp works, where thousands of lamps are made daily to meet the present demand.

Of Mr. Westinghouse it can be truthfully said, as of perhaps few others who hold like positions, he is not a stock manipulator. Mr. Westinghouse's personality is striking. He is more than six feet tall and he is large in proportion. He dominates those about him but it is done without effort. He impresses one as a "big" man. He is full of energy and is an indefatigable worker. He attributes his success to hard work. He is always willing to listen to those who think they have some new and valuable ideas and to aid with money and brains any who convince him that they are on a useful trail. He will not permit of the commercial exploitation of any products of his factories, however, until the product has been tested to the last limits. Mr. Westinghouse has gathered about him a cluster of wonderfully able men. He holds them together not only by their mutual business interests but also by his personal magnetism. Every one is loyal to him. He is the head of the multiplicity of interests which gather about him. He is president of all but one of the companies which center in the air brake and manufacturing works and he is one of the very few men who could tell just what the relationships are by which these many interests are bound together.

Mr. Westinghouse makes his home at

Pittsburg, and there are also the central offices of his businesses.

He has a summer house at Lenox, Mass., and he spends much time each year in New York and abroad. For many years he kept a suite of apartments at the Windsor hotel on Fifth avenue. He also has a house in Washington.

Mr. Westinghouse was born at Central Bridge, Schoharie county, New York, on October 6, 1846. His parents were George and Emeline Vedder Westinghouse. On his father's side he is of German stock, his forefathers having emigrated from Germany and settled in Massachusetts and what is now Vermont before the Revolution. In 1856 the elder Westinghouse moved to Schenectady and established the Schenectady Agricultural Works. In June, 1863, George Westinghouse enlisted in the Twelfth New York Militia and served for thirty days when the service of the regiment ended. In November of that year he enlisted in the Sixteenth New York Cavalry and was made a corporal. He served there for a year. A month after his discharge he was appointed Third Assistant Engineer in the Navy and sent for duty aboard the Muscota. He was transferred from there to the Stars and Stripes and later, on June 28, was detached and sent to the Potomac flotilla. He was honorably discharged on August 1, 1865.

In 1865 he invented a device for replacing derailed railroad trains. In 1867 he entered into a contract with the Pittsburg Steel Works to manage the business of introducing his patent reversible steel railroad frogs. In 1868 he met Ralph Baggerley and got him to take an interest in the air brake.

The first patent for the air brake was issued on April 13, 1869. Two years later Mr. Westinghouse went to Europe to introduce the air brake there. This work occupied him for seven years. He was married on August 8, 1867, at Brooklyn to Marguerite Erskine Walker. They have one son, George, who is just entering manhood.

Mr. Westinghouse was decorated with the Order of Leopold by the King of Belgium in 1884; in 1889 he received from the King of Italy the decoration of the Royal Order of the Crown of Italy, and in 1880 Union College gave him the honorary degree of Doctor of Philosophy.

The Westinghouse Interests

By Wallace M. Probasco.

The Air Brake

Works of the Westinghouse Brake Company, Limited, Hanover, Germany.

A little over thirty years ago the device known as the Westinghouse air brake, which has made possible the speed, safety and economy of railway operation, was invented.

The first air brake was made in 1869. The first works of the air brake company were started in Pittsburg in 1870. They employed but twenty men. The immense growth of the business caused by the rapid adoption of the air brake by railways all over the world, is a familiar chapter in industrial history.

Compressed air is only less subtle in its outward manifestations than electricity, and the sight of a train stopped without application of any apparent force to the wheel was nothing less than magic to a railroader seeing it for the first time.

The first air brake was exceedingly simple, but Mr. Westinghouse, never being satisfied with anything short of the highest attainable perfection, brought out, in 1873, the automatic brake which completely superceded the first invention. This brake is one of the great marvels of the mechanical world, and its essential element, the triple valve, is a triumph of the skill and perseverence of the inventor.

It would be, for purely technical purposes, exceedingly interesting to describe the triple-valve in detail, for though apparently a plain casting that one could hold in his hand, it contains a combination of ducts, slides, spindles, all of which give evidence of wonderful ingenuity which no description could explain without elaborate drawings.

With the Westinghouse automatic air brake, operated by a little valve in the locomotive cab, all the brakes can be instantly set and the motion of a train of fifty or more cars, running at forty miles an hour, arrested within a distance of 150 yards (less than one-fourth the length of the train) thereby avoiding wrecks, saving lives and securing safety.

The automatic action is secured by keeping the pipe extended throughout the entire length of the train constantly filled with compressed air. It is by reducing the pressure of the air that the engineer controls the motion of the train. Under each car is placed a reservoir and a triple-valve. In case of accident the pressure in the pipe and reservoir is materially reduced, causing the triple-valve to act, allowing the air to rush from the reservoir to the brake cylinder which in turn applies the brakes.

Apart from the safety secured, the

air brake has proved an important factor in the economic handling of traffic. Thus, there is an incentive for even the poorest roads to adopt its use.

Owing to the rapid growth of the business of the Westinghouse Air Brake Company they were obliged to seek more spacious quarters.

They began work in Pittsburg, and afterward moved across the river to Allegheny, and thence a dozen miles or so east of Pittsburg to Wilmerding, on the main line of the Pennsylvania Railroad, where they have one of the finest factories in the world. The air brake works are two miles east of the works of the electric and machine companies.

In order to more readily supply the demands of other countries, the air brake company has established works in England, France, Germany, Canada and Russia.

The first air brake works had a capacity for turning out twenty brakes per day. Some idea of the magnitude of the present plant can be gathered from the fact that they are capable of turning out a complete brake every minute. As a brake is valued at from twenty-five to one hundred dollars or more (twenty-five dollars for freight car brakes) it is possible to gather some idea of the financial magnitude of the business.

At an hours' notice the company can fill an order for 1,000 sets of air brakes for freight cars.

The works have an annual capacity of brakes for 250,000 freight cars, 6,000 passenger cars and 10,000 locomotives.

The Switch and Signal Company

In 1881 Mr. Westinghouse organized the Union Switch & Signal Company. The first works were at the now historic Garrison Alley Plant, Pittsburg, Pa. In 1886 the company purchased its present site at Swissvale, Pennsylvania, within two or three miles of the electric, air brake and machine works, and it gives employment to over 1,200 men.

The company's work consists in the manufacture of mechanical, pneumatic, electric and automatic signals, crossing bells and frog-switches, and it has equipped a majority of the largest railways and terminals in the United States with its automatic systems.

Among the really remarkable achievements of its experts was the changing of the entire signal and switch system at the Broad Street station of the Pennsylvania Railroad at Philadelphia. The old signal tower was taken down and a new one installed, and the entire system of operation at the great terminal station was changed in one day without interfering for a moment with the regular traffic of the line.

It is interesting to note, as illustrating the efficiency of the electro-pneumatic interlocking machine for railway switch and signal work, that a mechanical interlocking machine at such a great terminal station as the Union in Boston would require 350 levers and 51 lever men to operate it. Calculating on, say, 20 levers to each man, the shifts would be eight hours each, so that the mechanical contrivance would require 17 levers to a shift.

The electro-pneumatic interlocking machine, on the other hand, requires only two men to a shift, making seven men in all, and instead of being operated by 350 levers, it is worked by a few.

The Electric Works

This is, taken as a whole, the most important electric company in the world. It is also the largest of the many interests with which the name of Westinghouse is associated. It was organized in 1886, and began operations in a small factory in the center of smoky Pittsburg.

Here Mr. Westinghouse gathered about him a corps of the ablest electrical scientists of the time. Shallenberger was one of these. He began his researches under the direction of Mr. Westinghouse. His first work was an examination into the alternating current system, which had just been started in Europe. The advantage of this system was at once recognized by the inventor of the air brake, who secured the American rights of manufacture. This work was new. Scarcely anything was known of the characteristics of the alternating current. The task of designing and constructing the apparatus for an alternating current plant, including generators, transformers, measuring instruments and switching devices, was immeasurably greater than it now is, when the principles and laws are well understood and the manufacturing facilities are all at hand.

The electric meter subsequently adopted by the British Board of Trade as the standard was also a result of Mr. Shallenberger's work at Pittsburg.

Electrically and mechanically the Westinghouse designs gave the direction to what is best in constructive practice everywhere.

Tesla soon followed at Pittsburg with that brilliant series of experiments which gave us the celebrated Tesla polyphase system of electric transmission of power, and the induction motor, involving the principle of the rotary magnetic field. The Tesla patents were acquired by Mr. Westinghouse.

Here also Stillwell perfected his regulator; Scott invented the two-phase, three-phase systems; Lamme, an electrical engineer second to none, was initiated into his work; and Wurts discovered the non-arcing properties of certain metals, that were embodied in the lightning arresters for which the Franklin Institute saw fit to award its medals.

Mr. Westinghouse was the pioneer in the manufacture of alternating current apparatus. The fact that he was installing power transmission apparatus at Telluride, Col., when some of the most noted scientists in the world and many envious manufacturers were condemning its use as impracticable and unsafe is greatly to the credit of the indomitable man who has given his name and guidance to this vast electrical enterprise.

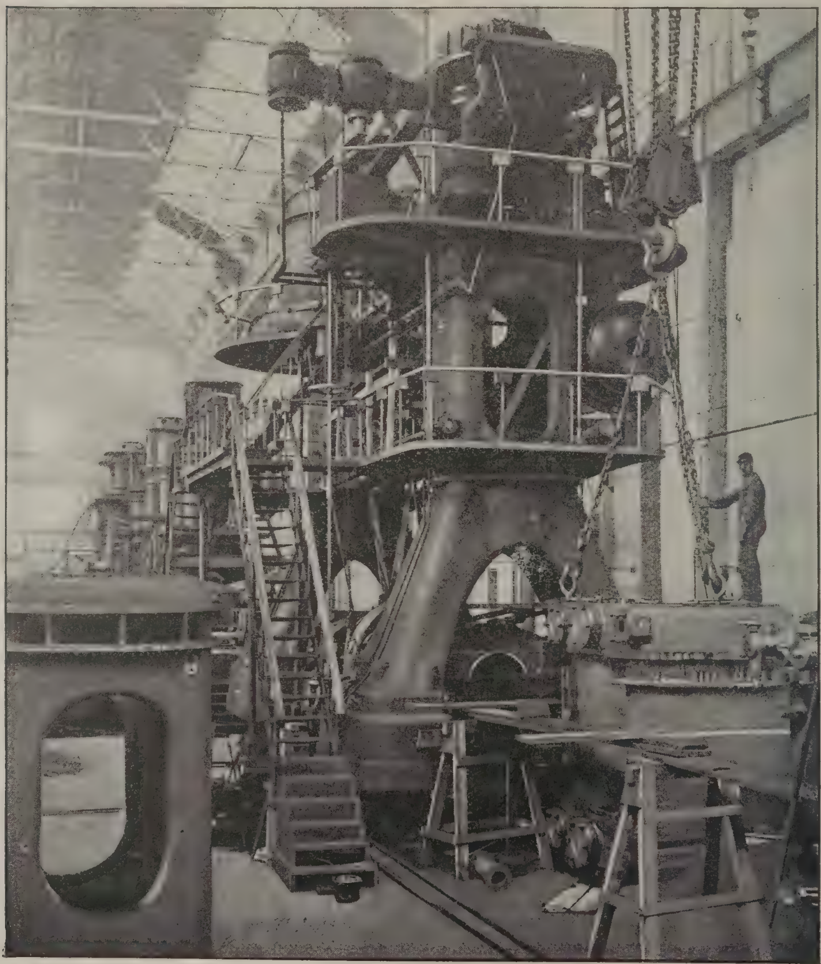
Westinghouse was one of the first to bring out the direct-connected type of generator, a machine having its armature mounted directly on the engine shaft. In fact, a Westinghouse engine drove the first direct-connected electric generator that appeared. The direct-connected generator, known as the "engine-type" reduces the number of bearings and takes up much less floor space than the coupling of the generator with a belt to the driving wheel.

Owing to the enormous increase in the demand for Westinghouse electric products the company was compelled in 1895 to combine the factories at Pittsburg, Allegheny and Newark into one mammoth plant. These new and commodious works are located at East Pittsburg, along the main line of the Pennsylvania Railroad, twelve miles from the city of Pittsburg.

The works are entirely electrically driven. All the shafting and machine tools and other work necessary to be performed in such an establishment are operated by induction motors, ranging in size from 1 to 50 horse-power. To the manufacturer and engineer this feature is most striking and is of especial interest.

There seems no end to the application of the products of these great manufacturing establishments. Interest is keener than ever in the generation and distribution of power. Great light and power stations are being erected in all parts of the world.

A notable example of all this is the Manhattan Railway of New York. In their great power house there are eight 6,650-horse-power Westinghouse generators, which are the largest ever built The height of these machines is forty-two feet, and the weight of each nearly a million pounds. Some idea of their size can be had when it is stated that a single one could supply current for 75,000 incandescent lamps, or power for nearly 600 trolley cars.



Interior of Westinghouse Machine Co.'s Works at East Pittsburg, Pa.

Westinghouse Machine Co.'s Works, East Pittsburg, Pa.

The machine company is another interest of the inventor of the air brake. It is engaged in the manufacture of steam engines, gas engines, steam turbines and mechanical stokers.

This company was incorporated in 1881, and, like the other Westinghouse interests, established its works in the city of Pittsburg, until the success of their compound engine, together with the acquirement in 1895 of the American rights for the Parsons' steam turbine, made an imperative demand for increased manufacturing capacity, resulting in the erection of the present works adjacent to the great Westinghouse electric factory.

Not more than a year ago Mr. Westinghouse gave instructions for the erection of a large addition to the machine company's works at East Pittsburg, to be devoted entirely to the assembling and testing of steam turbines. The building is now nearing completion and is of steel and brick, of fire-proof construction, sixty-three feet wide and 400 feet long. Provision has been made for the testing of ten steam turbines at one time, requiring a condenser capacity of 3,000 horse-power. The shop is equipped with every means for measuring exactly the steam consumption and the weight of the water evaporated. One ten and two twenty-ton travelling cranes driven by induction motors provide for the handling of the steam turbine parts. This company has over 50,000 kilowatts of steam turbines under construction at its works. The largest of these are of 5,500 kilowatt capacity, built for the Metropolitan Company of London. There are also in the works three 3,500 kilowatt turbines which will be used for lighting the subway of New York city.

The British Westinghouse Works

On Saturday, the third of August, 1901, the ceremony of laying the corner stone of the British Westinghouse Works at Trafford Park, Manchester, was performed by the Lord Mayor of London. The works are situated on a portion of the old Trafford Park estate, an admirable site covering about one hundred and thirty acres, having been acquired for the purpose. A better position could not have been chosen, as the works are adjacent to both the ship canal and the bridge water canal, and are also in direct connection with the main line railways. Hardly a year after the corner stone was laid these works produced their first machine.

The present manufacturing facilities of these works are of the amplest description, and they have already taken rank among Britain's greatest industries. The plant far exceeds in size any similar enterprise yet undertaken in Great Britain.

The Gas Engine

In 1896 Mr. Westinghouse announced that his company was prepared to offer to the public a gas engine whose action was extremely quiet and uniform, making it particularly adaptable to electric lighting service.

The principle on which the Westinghouse gas engine runs is a modification of the well known Beau de Rochas cycle. This consists of compressing the charge into the head of the cylinder before igniting it. These engines differ from the ordinary "hit and miss" type, in that the governor acts by controlling the quantity of explosive mixture which is taken into the cylinder. This results in an adjustment of the power of each explosion to the amount of work being done; hence the engine runs with the steadiness and regularity of a first class steam engine. The regulation is so perfect that the company has built hundreds of direct-connected outfits where the dynamo is mounted rigidly on the end of the engine shaft. Even under this most severe test the lights are perfectly steady.

Other Interests

In this necessarily incomplete article it is not possible to more than mention the following Westinghouse interests:

Westinghouse, Church, Kerr & Company. This organization is essentially one of engineer constructors. It has designed and installed some of the most important transportation, lighting and industrial equipments in this country.

The Sawyer-Man Company, of New York, constituting an immense lamp-making concern, having a capacity of 10,000 incandescent lamps per day.

The Nuttall Company, manufacturers of trolleys, gears and pinions. A plant located at Pittsburg, having a capacity of from fifty thousand to sixty thousand cars annually with the above equipment.

The Nernst Lamp Company at Pittsburg. A lamp developed in this country under the personal direction of Mr. Westinghouse and which has already been heralded as the most notable development made in electric lighting during the past few years.

Nor is there space to tell of the Westinghouse friction draft gear, fifty thousand of which have been applied to locomotives and cars during the past two years, filling a want on the part of railroad men, which for fifty years was not satisfied until Mr. Westinghouse gave the subject his attention.

The Telegraphone: A Magnetic Phonograph

By John A. Lieb.

The telegraphone, as its name indicates, is an instrument for recording speech at a distance. It not only records it, but automatically reproduces the same speech whenever desired, thus presenting that goal of so many inventors, the telephonic repeater. In many respects it resembles the ordinary phonograph; at first appearance, in fact, being very often mistaken for a modified form of that device.

While the phonograph and all other forms of talking machines will reproduce speech, their action is purely a mechanical one, there being no means provided whereby they may be worked in connection with a telephone and thereby afforded a wider field of usefulness.

The telegraphone, which is the invention of Waldemar Poulsen, a Danish engineer, however, receives speech in the form of an oscillatory electric current just as a telephone does, and is connected to the transmitter by a wire of any desired length. The sole difference between a telegraphone and a telephone circuit is that the latter terminates in a receiver instead of a recording telephone.

The first model of the telegraphone shown in operation was that at the last Paris Exposition, where it attracted an extraordinary amount of attention and was generally spoken of as the most interesting piece of apparatus there exhibited. This model is described as follows:

A spiral of steel wire is wound on a cylindrical drum, which is revolved by either an electric or spring motor or by hand. Situated above the drum is a small double-pole magnet, the two cores of which consist of iron wires placed at an angle. The ends of these poles embrace the wire on the cylinder, thereby completing the magnetic circuit.

The magnet, attached to a brass support, is mounted on a shaft, so that it is caused to move from right to left when the drum is revolved, being guided by a grooved finger resting on the steel spiral, each turn of the spiral, therefore, passing before the poles of the magnet.

The recording magnet is connected in circuit with a carbon transmitter and a couple of cells of battery. When the transmitter is spoken into, currents of various strength, proportional to the strength of the sound waves which strike the diaphragm, pass through the wires of the magnet, which transversely magnetizes the steel wire on the drum, permanently recording thereon "lines of force," which represent, as may be readily seen, the sound waves reaching the diaphragm of the transmitter.

When the spiral has been filled, the magnet is caused to return to its original starting point in the following manner:

The horizontal shaft parallel to the guide rod for the carriage is mounted also above the drum, upon which is a thread of steeper pitch with which another point on the traveling carriage is caused to engage automatically with the disengagement of the point on the recording wire when the end of the cylinder is reached, the carriage being returned to the beginning or the record at a high rate of speed.

The drum is now revolved again, and as the magnetized spiral passes before the poles of the magnet, it is transformed into a miniature form of dynamo, exuding currents of electricity of a strength and direction corresponding to the magnetization of the steel wire.

Before the drum had been revolved a

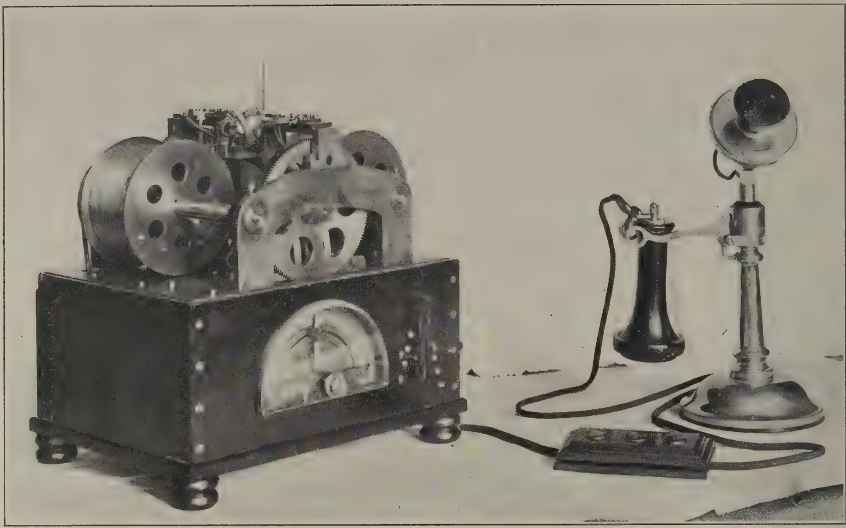


Fig. 1.—30-Minute Telegraphone Connected to Telephone Receiver and Transmitter.

second time, a telephone receiver had been switched into the circuit, replacing the transmitter previously employed. The currents sent out by the steel spiral while passing before the magnet, correspondingly affect the receiver, reproducing the words and sounds spoken into the transmitter.

This is done with absolute fidelity and with an entire absence of the false sounds noticed in the phonograph.

In order to obliterate the speech or lines of force on the steel wire and thus prepare the way for a new record, the recording magnet is placed at the end of the drum and connected with a couple of cells of battery. The constant magnetizing current supplied to the magnet entirely effaces the record on the steel wire while it is being passed before the poles of the magnet in a manner similar to that employed when the record was made.

In order to facilitate the taking of longer records, and also to allow of their transportation, should the instrument be used as a correspondence phonograph, a slightly different type of instrument is employed.

A coil of thin flat spring is wound from one reel to another across the poles of two small horseshoe magnets having flat poles, the poles touching the lower side of the steel ribbon only. The first magnet is traversed by a continuous current for obliterating the previous record, and the second magnetizes the strip corresponding to the message spoken into the transmitter, with which it is connected.

Since the above described machine was placed on exhibition, a different type has been brought to this country from Denmark and is now being shown by the American Telegraphone Company at 20 West Thirty-third street, New York City. Various styles of this machine are shown in the accompanying illustrations. The type of telegraphone which was above described is what is known as the drum machine, the later type being known as a spool machine.

The machine shown in Fig. 1—known as a 30-minute machine—consists essentially of a recording magnet system and a mechanism for winding the wire from one spool on to another as the record is made by the passage of the wire between the magnet poles. The spools are mounted upon a brass bed plate covering a box in which are located two motors, whose object is to drive the two spools and the reciprocating mechanism by which the spools are oscillated to preserve regularity of winding. In connection with the driving mechanism there is also an indicating mechanism, showing on a dial at the front of the box the amount of wire on which the record has been made and hence the amount of unused wire remaining. There are also fixed stops provided by which the motor can automatically be stopped at a predetermined point in either direction. A switchboard outside of the box is provided for starting, stopping and reversing the motors as required. The wire from the unused spool passes in this instrument between opposing horizontally disposed poles of three sets of magnets, two of which are active at a time. The object of the third set is simply that a record may be made in either direction if desired. The center pair of these three pairs of magnets is the recording magnet, which also acts as a polarizing magnet. The other pair are demagnetizing or obliterating magnets. The polarizing and recording processes occur simultaneously, that is to say, the wire passes first between the poles of a strongly energized magnet and is given a strong polarization of like sign throughout. It then passes through the middle pair of magnets which contains two windings, one a polarization winding energized in series with the obliterating magnets from a local battery, and the other the recording winding, which passes to the secondary of the transmitter induction coil when recording, or to the telephone receiver when reproducing.

The recording magnets are horizontally placed in the same straight line, their poles opposing and embracing opposite sides of the wire. The magnetic circuit is not complete, it having been found that better results are obtained with an open than with a closed magnetic circuit. Two sets of demagnetizing magnets are located on either side of the central recording magnet. One of these magnets only is used at a time and there are two sets in order that dictation may be given with the wire running in either direction.

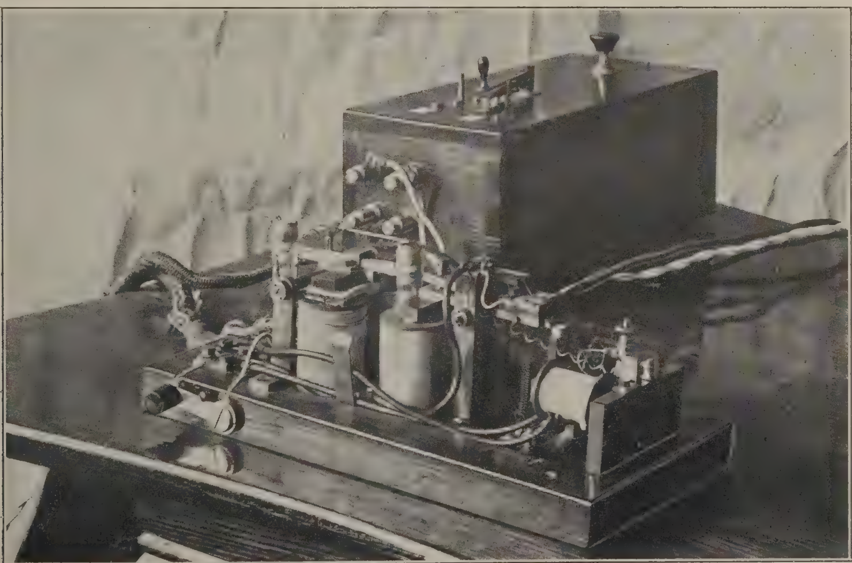


Fig. 2.—Relay used to Start the Operation of the Telegraphone.

With this machine is provided an automatic starting relay—Fig. 2.—for use in connection with machines used as telephone recorders. This consists of a set of magnets in series with the telephone line which are actuated by the magneto current to close the circuit and start the telegraphone. A winding in series with the telegraphone motor holds the circuit closed until a magneto current opens it, the ring off of the subscriber doing the talking being relied upon for this purpose.

The machine used for the distributing of news—Fig. 3—consists of an endless band running at a high speed. It passes first over a pair of obliterating permanent magnets, then over a polarizing magnet, the recording magnet and transmitting magnets in succession in the order named. Any number of transmitting magnets may be employed. A telephone receiver is connected with the recording magnet and the record may be successfully reproduced upon the transmitting magnet, the circuit from each transmitting magnet being connected to a separate telephone line over which the recorded message is transmitted. As fast as it passes from the last transmitting magnet the message is obliterated, the band polarized, and it is again impressed with the record.

Besides being used for the distribution of news this type of machine can be used in place of the stock ticker when used in connection with the recording instrument, as well as for train dispatching, a record of each transaction and message or order being obtained for future reference.

Recent advices received from Denmark state that a method has been discovered by means of which iron can be deposited electrolytically upon any other metal, the iron thus deposited possessing six times the permeability of the present speech carrier employed in the telegraphone, which heretofore has been some commercial material, such as steel tape or piano wire.

By permeability is meant the conductivity for magnetic lines of force; in other words, it is a measure of the ease with which magnetism passes through any substance.

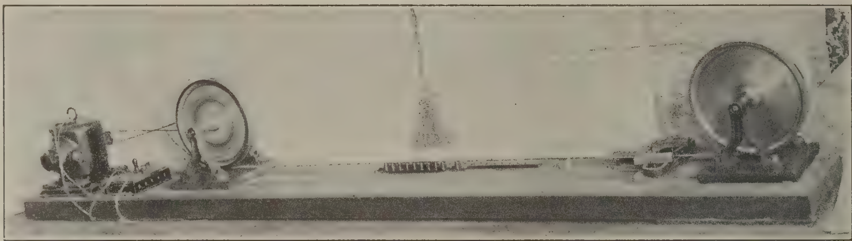


Fig. 3.—The Newspaper Distributing or Repeating Telegraphone by Means of which a Message can be sent to 50 or more Papers at One Time.

Up to the present the material used in the speech carrier was rendered receptive to peculiar effects corresponding to the variable hardness throughout its entire length, the result being a continuous hum heard in the telephone receiver, which detracted greatly from the intelligibility of the message being reproduced by the telegraphone.

The method of depositing iron by means of electrolysis overcomes this difficulty, as it renders the material used as a speech carrier entirely homogeneous, the hardness of the material being uniform throughout.

A plate about the size of a postal card

made according to this new method is large enough to receive upon its surface a message of three and a half minutes' duration. After the record has been made the plate may be enclosed within an envelope and mailed any distance. It can be demagnetized, that is, the message can be obliterated and once more used for the same purpose. The more or less rough handling which it would be apt to encounter in its journey would have no effect upon the record.

A series of disks are mounted on a common shaft. Closely approaching the first disk are the poles of an electro magnet which is connected to a telephone transmitter. A little further along is a second magnet which is connected to a similar magnet on the adjoining disk. Following the second magnet on the first disk is a third magnet connected with a similar magnet on the third disk. In a like manner magnets further on on the first disk are connected with corresponding magnets on the rest of the disks. Beginning with the second disk the balance of the disks have another magnet, these magnets being connected in series with a telephone receiver. A third magnet on each disk, used for demagnetizing, is connected in series with the others.

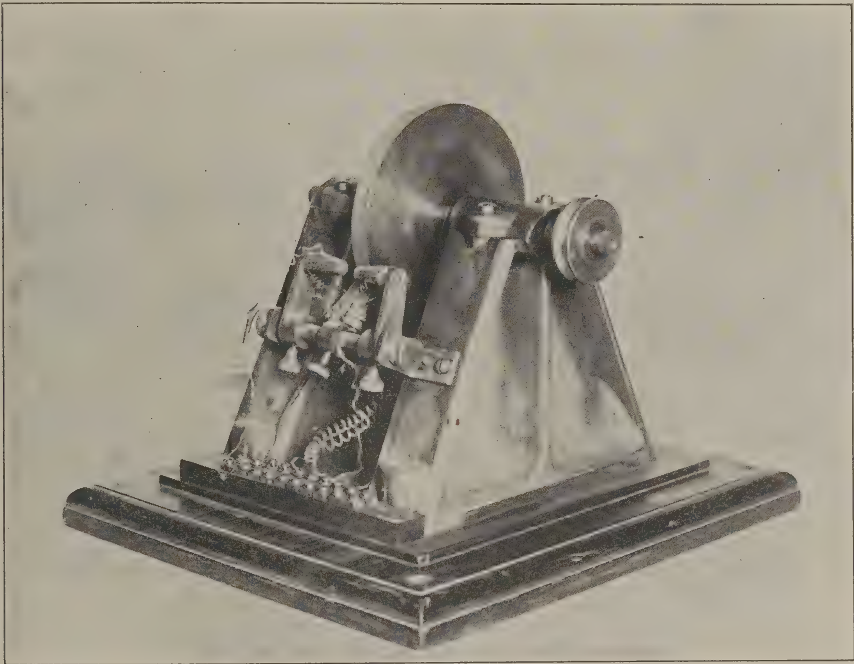


Fig. 4.—Modified Form of Newspaper Distributing Telegraphone.

Experiments which have been made for the purpose of applying the telegraphone as a telephonic repeater or relay while satisfactory, did not quite reach the expectations of the experimenters, the drawback being due to the humming heard in the receiver. This fault has now been overcome through the use of the electrolytic iron method.

The following method is employed in applying the principle of the telegraphone to a telephonic repeater:

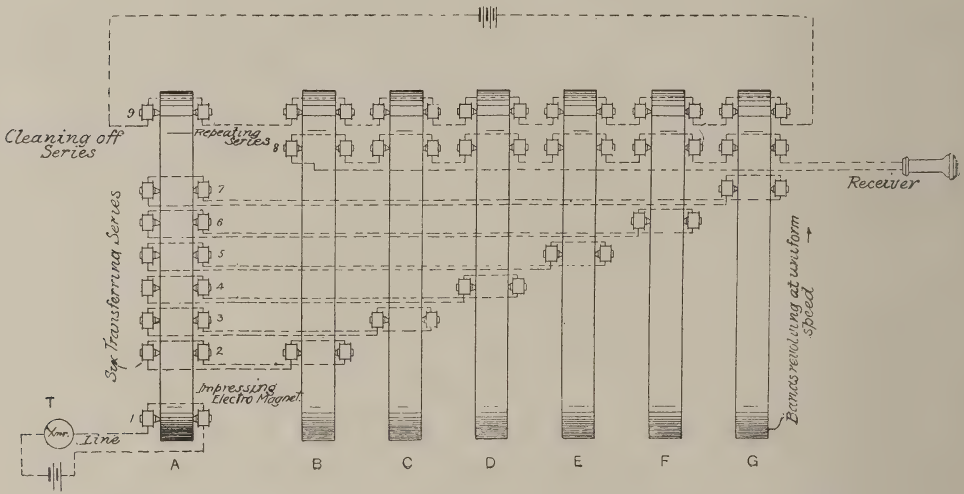
The disks having begun to rotate, which is brought about by means of a spring or electric motor, or by hand, the transmitter is now spoken into. The currents set up in the transmitter are conveyed to the first magnet on the first disk, transferring upon it lines of force. As the disk revolves and passes under the second magnet it generates currents which are transmitted to the corresponding magnet on the next disk, there to repeat the same magnetic effect. The same action takes place between the third magnet and the third disk, and so on until all of the disks are each impressed with the same lines of force. After having made half a revolution the second, third, fourth and other disks pass under and energize the series of magnets.

This series of magnets combines the lines of force stored up on each disk and sends them over the line into the receiver.

Finally, the last series of magnets obliterates the record and leaves the disks free to receive a new record. By using this method of relaying speech could be intelligibly transmitted from New York to San Francisco.

Several tests recently made over the long-distance wires of the American Telephone and Telegraph Company gave very satisfactory results. One circuit—which was the equivalent of a 207-mile metallic circuit (single distance)—was first tested with a telephone and proved to be a fair commercial circuit. A record was then made by means of the telegraphone, every word of which was intelligible, the volume of sound being very strong. Another test was made over a circuit of 280 miles, the record in this case being even more satisfactory. The record was exceedingly good and intelligible, in spite of the fact that a part of the record contained unusual words, making a somewhat severe test. The volume in this test was better, as was also the intelligibility.

In a test made in order to show the permanence of records made by means of the telegraphone a record was repeated 2,000 times without showing any appreciable deterioration.



Illustrating the Connections Employed in Applying the Telegraphone as a Telephone Repeater.

The field of the telegraphone is practically unlimited. It can be used for entertainment and instruction; in business offices for dictation; in telegraph and telephone stations; stockbrokers' offices; in fact, anywhere where an apparatus is required for recording and reproducing speech or messages.

It has received the unqualified endorsement of such noted scientists as Lord Kelvin, Nikola Tesla and Marconi and the engineering fraternities on both sides of the Atlantic.

Concrete Making

"Shall we make our concrete dry or wet; or is there somewhere a golden means by striving for which we may attain perfection?"

Under this caption H. W. Parkhurst, a member of the Western Society of Engineers, discussed a question which is of interest to every engineer and builder, and describes some interesting experiments by which he arrived at his conclusions.

The experiments consisted of the making of three blocks of cement—one nearly dry, one medium and one so wet it quaked—exposing them to the weather for ten months and then breaking them by drill and feather wedges.

The concretes used were mixtures of one part of Portland cement with two parts of sand, and two and a half parts each of gravel and crushed stone, all taken by measure and not by weight.

The volume of water used in the three mixtures was as follows: Dry, 5.1 per cent.; medium, 7.5 per cent.; wet, 9.5 per cent.

Mr. Parkhurst says: "Sand and cement were made into a mortar, and the crushed stone and gravel spread thereon, all turned over several times by shovels, and then shoveled into the boxes, made ready adjacent to platform, and the whole was tamped in layers six inches thick, as shoveled in. The surface of the wet mixture was the best, the medium next, and the dry was the poorest. There was not enough water in the dry block to permit a finish either to the side or top, and the surface could be easily abraded, and small pieces picked off by the fingers. The gravel and stone came away from the mass quite easily, and the block could not be handled to weigh it without crumbling edges and top surface. No amount of ramming the thin layers would bring water to the surface. In the wet block men could not stand on the concrete to ram it; the mass quaked easily, and the mortar stuck to the tamping iron. In the medium block there was enough water so that the top of each layer was flushed by the tamping, but there was no quaking, the mass being always hard. The top surface had enough free water on it to spatter when the tamping was finished."

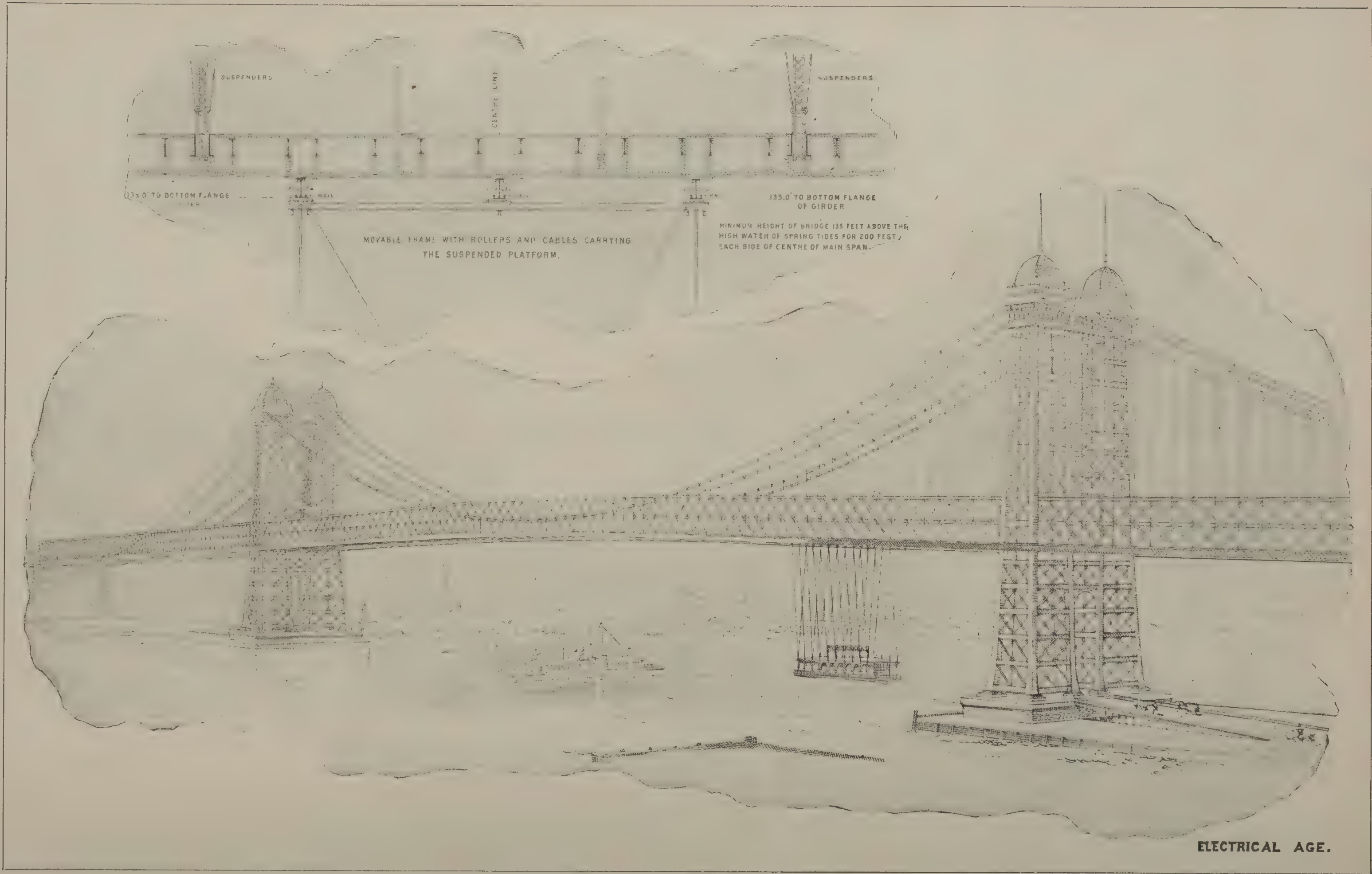
When the blocks were broken, it was found that the texture of both the medium and wet blocks were excellent, while that of the dry block was poor.

Mr. Parkhurst arrived at these conclusions:

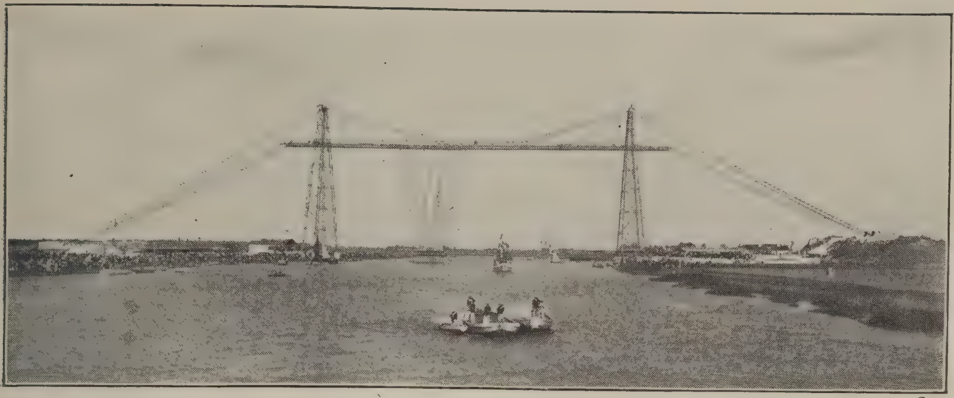
"1st. That a medium concrete, or one that has not enough surplus water to produce quaking, while having enough to permit easy and thorough ramming, is most desirable. The specification that the concrete shall not quake in the barrow, nor while handling, but that it may be wet enough to quake when heavily rammed, would seem about right for regulating the amount of water to be used.

"2nd. It is probably safer to have an excess than to permit a deficiency of water. Above all, however, it is of the utmost importance that the concrete shall be consolidated thoroughly by ramming."

An electrical punkah puller is one of the latest articles gotten out by British manufacturers. It is designed to take the place of the drowsy "punkah wallah" of India and to drive the rows of fans or punkahs with which the East Indians keep the sultry air of their houses and offices in motion.



Method of Applying a Transborder to the New East River Bridge.



Ferry Bridge Across the Seine at Rouen, France.

A Ferry Bridge to Relieve East River Traffic Congestion

The problem of successfully relieving the congested traffic over the Brooklyn Bridge has long been a bugbear to the municipal authorities. Sooner or later, when the new East River Bridge is completed, traffic will crowd it also, and the same problem will again have to be solved there. Suggestions of means to overcome this condition have been made from many sources, but it still remains an open problem. Besides the congested traffic question is the one of how to provide means to accommodate the shore-to-shore traffic, i. e., transit from one bank of the river to the other without the necessity for using the long approaches on either side leading to the bridge proper. The solving of this problem would mean to a considerable extent the solution of the main difficulty, as the amount of traffic which would be diverted by the shorter route would reduce greatly the transportation taken care of by the upper and longer course.

It has been proposed that elevators be built at the bridge towers, and stations established at these points on the bridges to take care of the shore-to-shore traffic, but to this serious objection has been raised. At present the course of a person on the bank of the river and wishing to cross is to go back about half a mile to the bridge entrance, and then after having crossed the bridge to go back again about half a mile to the bank he wishes to reach. This procedure involves the loss of at least a quarter of an hour, to say nothing of the amount of energy expended, this being a particularly serious matter to truck drivers and users of automobiles. The installation of elevators, it was found, would mean a serious interruption to traffic, as the stopping of the cars, operating under a headway of 55 seconds, at the towers to take on or let off passengers at the elevators would mean an almost complete tie-up of the car system within a very short time.

Elevators will probably be installed on the Blackwell's Island Bridge in accordance with a request made by the Charities Department to afford a way of reaching the island by means of the bridge. In this case the idea is more feasible, as the amount of traffic passing over this bridge will not very likely attain the proportions of that across the lower bridges, and suitable grades for stations will not be difficult to provide.

Louis A. Risse, former general topographical engineer of the City of New York, has made a suggestion to provide for shore-to-shore traffic, which seems at once possible and practicable. Mr. Risse, while at the Paris Exposition of 1900, in charge of the topographical map of Greater New York which he had laid out, became acquainted with the "transborder" or ferry bridge, the invention of Ferdinand Arnodin, one of the most eminent bridge engineers of Europe. This device consists essentially of a ferry-car suspended above the surface of the water to any desired height by means of steel cables from trucks running on tracks placed on the underside of a bridge-like structure, crossing a river or other body of water. An overhead electrical conductor furnishes the current to the motor which propels the truck, the operator managing it in a manner similar to that employed on trolley cars, by means of a controller.

Mr. Risse suggests the running of one or two of these ferry-cars—preferably two—on the under side of the platforms of several of the East River bridges. The only changes in the bridge structures which would be necessary, he says, would be an additional stiffening of the trusses and of the lateral system to withstand the undulations caused by the motion of the car. This could be done, he asserts, without much additional expense, except in the case of the Brooklyn Bridge. Upon this bridge a ferry-bridge system would mean a considerable outlay, because of the complete overhauling of the present suspended structure necessary to enable it to carry any greater loads than those now passing over it.

The center opening of the towers of the new East River Bridge, Mr. Risse says, would give sufficient access to the car; and the width of the bridge is sufficient to furnish accommodations for two cars.

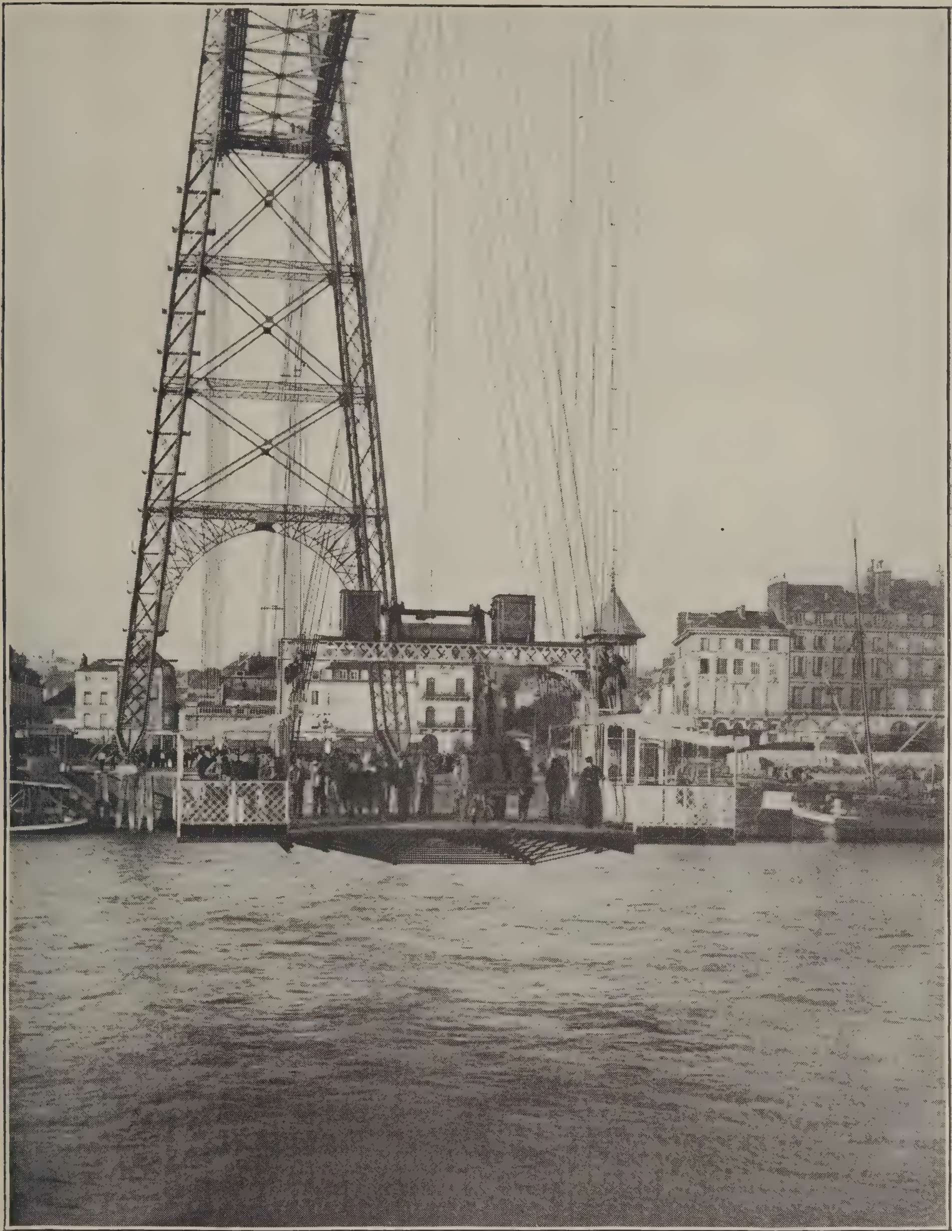
Mr. Risse further states that a car, 40 feet wide and 80 feet long, would carry about 10,000 passengers an hour in either direction.

In the busiest times of the day more than 35,000 persons an hour cross the bridge in one direction. A method which would take care of more than one-fourth of the traffic during the "rush hours" certainly seems worthy of investigation.

The Arnodin system, it is asserted, could also be used between New York and Jersey City by throwing a carrying structure across the Hudson at Hoboken and by like means easy communication could be established between Staten Island and Jersey City, crossing the Kill von Kull, without interfering with any maritime interests.

The requirements of the War Department of a clear height of 135 feet above high water under the center of a single span bridge are not difficult to meet in the construction of a supporting structure to carry the suspended carrier, as the average height employed in France is 150 feet.

In order to prove to the authorities of Rouen, France, the practicability of his device, M. Arnodin erected at his own expense a transborder crossing the Seine at Rouen. The span there measures 435 feet, and the height of the structure is 152 feet. The time occupied in moving the car from one bank of the river to the other is 50 seconds. At the end of the first year the transborder paid a profit to the inventor of about $30,000. The approximate cost of the installation was about $160,000. Other cities of France, Bordeaux, Bizerte, Martrou and Nantes, as well as Bilbao, Spain, have since then made similar installations, and their suc-



Passengers Crossing the Seine at Rouen, France, by Means of a Ferry Bridge.

cessful operation has created an unusual amount of interest among bridge engineers and the authorities of a number of towns in Europe with a view to their further introduction.

At Newcastle, England, there is a transborder in process of construction at present, as well as one in the immediate vicinity of London.

At Duluth, Minn., crossing the ship canal at that place, a ferry bridge—modelled after the one in operation at Rouen

—is being constructed by the Duluth Canal Bridge Company. According to the contract between the city and the bridge company, the latter will turn the bridge over to the city after its practicability has been successfully demonstrated during a period of three months.

The comparatively small investment which the installation of a ferrybridge system would call for, as well as the low operating expenses connected with it—these about equalling those required for the running of a ferryboat—ought to call for but a very low rate of fare.

Steel Roadways for Motor-Cars

The most important development of the day in connection with the automobile industry is the project to build steel roads for streets and highways, which has just been entered into by the Automobile Club of America in conjunction with Jacob A. Cantor, President of Manhattan Borough, New York City, and General Roy Stone, the noted road builder, who was for years connected with the Agricultural Bureau at Washington.

Able writers have pointed out before now that the real line of progress for the automobile was to be in the production of good roads, rather than in the making of self-propelling machines which could travel over bad roads.

The attempt to build self-propelled vehicles which could travel over any kind of a road, or climb mountains, has brought to the front many skillful mechanics and some exquisite mechanical devices, and in this way has been of value to the automobile art, but in itself it was predestined to failure. It presupposes that a mechanical device can be produced which will have the flexibility of an animal. This is impossible. A horse can upon occasion develop and exert six or eight horse power, and can keep this up for a considerable length of time. Hence a horse can pull a wagon through a long stretch of sand or mud or up a steep hill with apparent ease. To accomplish a like result with a given load by mechanical means would take six or eight horse power. But to get this amount of power, the machine would have to be made of six or eight horse power capacity. This would mean added weight, and this again added power, and so on. The more powerful the machine, the heavier it would have to be and the more need there would be for a good road for it to run over. The best of our streets and roads are built to meet the customary demand of their traffic. When subjected to weights or speeds greater than these they fail.

A railroad locomotive, with its hundreds of horse power, would mire in one of our best streets and be as helpless as is a powerful automobile on a bad country road. What is the moral of this?

Should we continue to build motor-cars to be forced over bad roads or build good roads where with a modification of power, simple and inexpensive machines could do service?

The attempt heretofore has been all in the direction of building cars of high power with ingenious devices and drive them over obstacles. Now comes the attempt to give them sensible roads.

General Roy Stone addressed the Automobile Club of America on this subject in March. He urged the building of steel highways. At the April meeting a committee on steel roads was appointed, of which Jefferson Seligman is chairman.

A. R. Shattuck, president of the club, Mr. Seligman and General Stone visited Borough President Cantor in the interest of the experiment. Mr. Cantor entered into the project with enthusiasm. He declared that he had the power to give consent to the building of steel roads in Manhattan and promised consent to the experiments on such streets as might be selected by Chief Engineer Olney and General Stone.

Charles M. Schwab, president of the United States Steel Corporation, has promised to supply at his own expense the rails for a mile of the new highway, and within a month it is expected work will be begun in laying it.

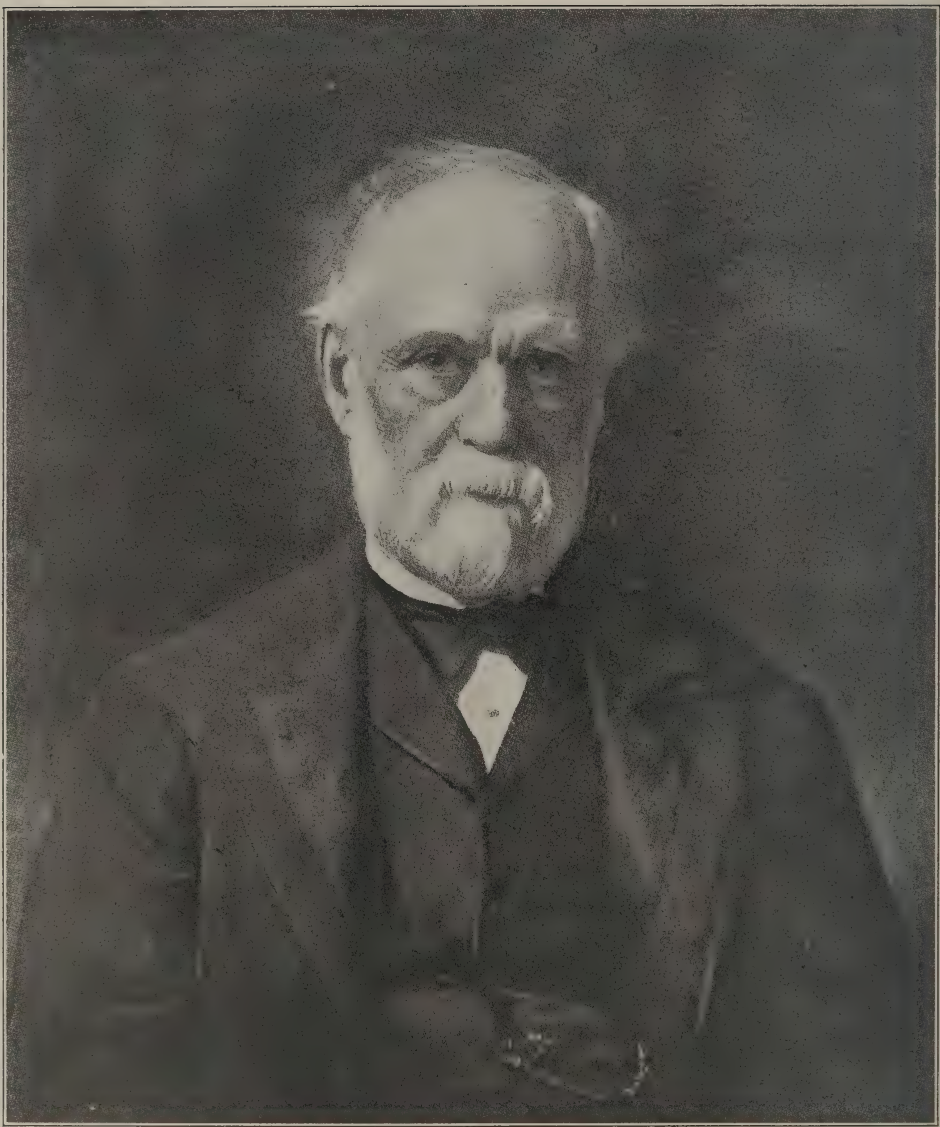
Three separate pieces of steel road will be laid for the experiment. One of these will be in a heavy trucking street down town—possibly Murray street. Another section will be laid on one of the avenues uptown—possibly Seventh avenue above Central Park—and the third upon an earth road, presumably near Kingsbridge.

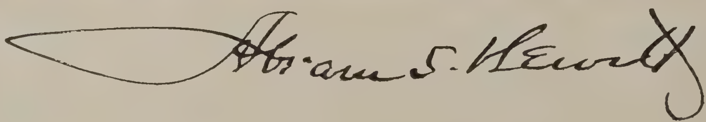
There can be no question raised as to the success of the steel roadways for automobile travel. If the design adopted proves equal to the demands of other traffic, and durable, there is little doubt that within a few years we shall see steel-tracked highways over many of our city streets and ranged out for miles and miles into the suburbs. The design upon which these roads are to be built is that of General Stone, as he has modified it from others.

The steel highway itself will consist of two rails, each twelve inches broad on the upper face, and set at the ordinary wagon track distance apart. The rails themselves are to be flat on top, except that at either edge they will have a ridge about a quarter of an inch in height to act as a slight wheel-guide. This upper part of the rail will be about a quarter of an inch in thickness. The section of the rail is like that of an ordinary channel bar, the turned down portions at either side being about two and one-half inches in depth. The bed upon which the rails are to be supported is to consist of coarse broken stone laid in a trench about fifteen inches deep and of about the same width. At the outer edge of the bottom of each trench will be a drain tile to insure good drainage. On top of the broken stone a layer of gravel or fine broken stone will be laid, and upon this the rail will bed itself, with its turned down edges holding the fine stuff in place.

The rails will be made continuous by joints consisting of flat plates riveted to each rail under the wide tread, and heavy fish plates bolted to the turned down portions of the rail on each side. To prevent spreading, there will be inserted in the roadbed at intervals, steel ties bent so as to clasp the rails and hold them in place.

These roads are not meant for use in cities alone. As a matter of fact, General Stone believes that they will prove themselves as valuable for country use as for the more thickly settled districts, and the cost would be no more than for a stone road where the stone has to be brought by rail from other sections. Stone roads in New Jersey cost about $5,000 a mile. General Stone says the steel for the new style of highway can be supplied for $4,000 a mile of road, and that the laying of it would bring the cost up to about the same as the total cost of the stone roads.





Abram Stevens Hewitt, educator, statesman and ironmaster, whose prophetic paper regarding the iron industry of the world, first made public nearly half a century ago, is now republished by THE ELECTRICAL AGE, celebrated the eightieth anniversary of his birthday at his summer home in Bar Harbor, Me., on July 31.

The greater part of Mr. Hewitt's long life has been devoted unselfishly to public and philanthropic purposes, and few men are able to count in their careers so many successes.

As the acknowledged father of the rapid transit railroad system for New York City, whose first links are now just nearing completion, Mr. Hewitt is entitled to the deep gratitude of his fellow citizens, but this is only one of the many excellent results of his efforts.

Those who know Mr. Hewitt do not hesitate to declare that in his own estimation the most successful feature of his career has been the organization and management of the Cooper Institute. This undertaking was difficult, but the results have been more than satisfactory. This admirable institution has given a career to many thousands of young men, for whom otherwise the struggle of life might have been too hard and discouraging.

As chairman of the Democratic National Committee in 1876, when the whole country was stirred to its depths over a disputed election for President, Mr. Hewitt's course is believed to have been a most important factor in saving the country from a second civil war, and in the struggle for honest money Mr. Hewitt stood in the foremost rank for twenty years, in Congress and out of it, as an advocate of a single standard of value.

The grasp of pertinent facts which made it possible for Mr. Hewitt to foresee the traffic needs of a great city and to predict the wonderful growth of the iron industry of the world, extended also to the vexed question of the tariff.

Of higher importance to the world today than all else, perhaps, are the views uniformly expressed by Mr. Hewitt in regard to the necessity for the association in great enterprises of capital on the one part and of labor in the form of unions on the other. Mr. Hewitt himself believes that his discussion of this important matter is already bearing fruit and that events will show that he has been right in diagnosing the trend of modern progress. This, he declares, will result in the diffusion of ownership, accompanied by concentration of management.

Mr. Hewitt was born in Haverstraw, N. Y., on July 31, 1822. His schooling was begun in the New York public schools and continued at Columbia for which he had won a scholarship at a special examination.

Supporting himself meantime by teaching, Mr. Hewitt was graduated in 1842 at the head of his class. He remained at Columbia as an assistant teacher, becoming acting professor of mathematics in 1843. In 1844 he visited Europe in company with Edward Cooper, who had been a classmate. In 1845 he was admitted to the bar and began to practice law, but gave it up because of impaired sight. It was soon after this that Mr. Hewitt became a partner of Peter Cooper in the iron business. In 1855 he was married to Peter Cooper's daughter.

In 1856 Mr. Hewitt erected the first experimental Bessemer converter in the United States in the works of Cooper & Hewitt. He was the first to build an open hearth converter in this country and through his exertions the basic process was introduced in the United States.

In April, 1859, Peter Cooper finished the building of the Cooper Institute and turned it over in fee to six trustees, of whom Mr. Hewitt was the head. Few men were so well qualified as Mr. Hewitt for planning the course of such an institution.

His own struggle for an education was first in his mind and the wide range of his activities in building up one of the great iron industries of the world gave him a clear insight of what was likely to be needed by those who were to be aided.

Mr. Hewitt's interest in public affairs led him, naturally, into politics. He was elected to Congress as a Democrat in 1874 and served there continually with the exception of one term until 1886. In 1886 he was elected Mayor of New York, in a contest in which Henry George and Theodore Roosevelt were his opponents. Mr. Hewitt was originally a member of Tammany Hall, but a man of his independence of thought and fearlessness of expression could not long remain a member of a faction. He left Tammany to join Irving Hall and in 1879 helped to organize the County Democracy. As Mayor, Mr. Hewitt instituted many reforms and new movements.

The value of his work in that office is only just beginning to be fully appreciated. Mr. Hewitt was elected President of the American Institute of Mining Engineers in 1876.

He was again elected to the presidency of this body in 1890. In this year the Bessemer gold medal was presented to him by the Iron and Steel Institute.

Columbia conferred upon him the degree of LL. D. in 1887.

Mr. Hewitt's papers upon iron and steel have attracted much attention. His report upon "Iron and Steel" made at the World's Fair in Paris in 1867 was reprinted at home and abroad.

As an employer of labor, Mr. Hewitt has been eminently successful. His course has been such as to avoid all causes for serious disputes, while he has never sacrificed the rights which he believed belonged to the employer. In times of commercial depression he has kept his works going, believing that this was the surest way to help restore prosperity and being at the same time unwilling to add to the distress of the community by throwing a large body of men into idleness.

A Magnetic Gusher

While bailing an oil well recently in the Texan fields a curious phenomenon was noticed by the owner. It seemed that in the course of pulling up the bailer out of the well, which was 1740 feet deep, one of the machinists chanced to touch the pipe with a cold chisel. He noticed that instead of falling to the ground it was forcibly attracted to the pipe and remained sticking to it. He accordingly called the attention of the owner to the matter. No explanation can be given except that the pipe, which was driven through a layer or stratum of iron pyrites, probably has a strong magnetic current induced in it by these same pyrites. It is well known that tools in the mines of the Mesaba range frequently become so magnetized as to attract very considerable weights of metal.

Motorless Electric Street Railways

Following closely upon the heels of the horseless carriage and the wireless telegraph comes the motorless electric street railway, the invention of a Chicago genius. This unique invention provides for the operation of street cars without the aid of electric motors as they are now made. Small electric magnets are embedded between the rails of the tracks and what corresponds to the armature is placed lengthwise on the bottom of the car. The current is supplied to the electric magnets buried in the earth which, by their attraction to the magnet in the car, combine to help the car along. The current is, of course, interrupted in the ground magnets by an automatic switch on the car. The inventor claims a great saving of electricity, stating that 75 amperes with the usual pressure will suffice for 40 cars, while the present trolley cars require 75 amperes for each one. Recently, a 10 foot model car, accomodating six people, was successfully manipulated on a track 150 feet long.

Iron, the Touchstone of Civilization

By the Hon. Abram S. Hewitt

(*Continued from August.*)

[A second installment is presented below of the remarkable paper read by Mr. Hewitt before the American Geographical and Statistical Society on February 21, 1856. The clear insight into the workings of the forces of civilization, as set forth in this paper, which led Mr. Hewitt to predict with accuracy the present wonderful growth of the iron industry of America and of the world furnishes as sound ground for predictions today as it did nearly half a century ago. Mr. Hewitt's paper will be completed in the October number of The Electrical Age. The complete paper in pamphlet form has been reprinted by The Electrical Age with a portrait and life sketch of Mr. Hewitt, and will be sent to any address in the United States or Canada, post paid, upon receipt of ten cents.—Ed.]

By the close of the war, England had entered upon the full tide of success in the manufacture of iron by the use of mineral coal. Capital, skill, and labor abounded, while here all was distress; the currency deranged by the unmanageable flood of continental money, and exchanges made by the rude process of barter. The advance of the nation from a condition of bankruptcy, with its resources all undeveloped, was painfully slow;—while in England, each year added to its resources, its skill, and its ability to withstand and crush competition. But the United States could be no competitor, using charcoal against mineral coal. It was not even known at the beginning of this century that we had any coal that could be rendered available for this purpose; and when our great resources in this respect began to be understood, there were no avenues to market from the coal fields. These avenues have since been constructed; but at what an enormous outlay of energy, capital, skill, and dogged resistance to obstacles of every kind, those who are familiar with the history of the Schuylkill Canal, the Reading Railroad, the Lehigh Canal, the Delaware and Raritan, the Chesapeake and Ohio, the Delaware and Hudson, the great state works of Pennsylvania and New York, will alone be able to comprehend. The outlay for this purpose, which had to be made before the iron business could be said to have a chance of existence in this country, probably exceeded one hundred millions of dollars; and it was not until 1840 that the first furnace was successfully started and worked with anthracite coal, which in England was regarded as entirely inapplicable until 1837, when Mr. Crane first demonstrated that it could be used.

The application of this fuel, which has given life to the American iron industry, and enabled it to bear up against the embarrassments which at times have threatened its existence, originated, as most great discoveries do, in a difficulty which was supposed to be insurmountable. The works of Mr. Crane were located at the lower edge of the Welsh bituminous coal fields, and at the verge of the anthracite deposits. Having exhausted his available deposits of bituminous coal, he had to choose between abandoning his operations and the use of anthracite. For a long time his efforts to use this fuel were abortive; when, sitting in his room late one night, it occurred to him that when a stream of cold air was blown upon a lump of red hot anthracite, a black spot appeared, and the combustion was extinguished. The same coal placed in a grate, with a blower on it, causing a draught of cold air, would burn with intense heat. It suddenly flashed upon him that this phenomenon was due to the heating of the air as it pressed through the ignited mass of coal. In his joy at this discovery, he summoned from his bed his assistant, David Thomas, Esq., the present manager of extensive anthracite furnaces in this country, and announcing his solution of the problem, proceeded at once to test it, by placing a coil of iron pipe in a mass of flaming bituminous coal, and forcing through the pipe, with a common bellows, a current of cold air, was delighted to find that as it issued highly heated from the other end of the pipe, it no longer destroyed the combustion of the anthracite, but on the contrary promoted it in a marvellous degree. From this day the economical use of anthracite for making iron was achieved; and yet, four years before, a resident of New York, remembered by many of you, Frederic W. Geissenheimer, had patented this identical process; but no use had been made of it, because the disastrous results of all attempts to establish the manufacture of iron on our soil on a large scale had discouraged the most sanguine. But after Crane's success, new efforts were made; and it is to be recorded to the honor of Nicholas Biddle, that he was among the first to contribute his money and his influence to the successful prosecution of this business. To another of our New York citizens, Edwin Post, Esq., who brought great intelligence, capital, and indomitable perseverance to the task, is due the honor of having first smelted successfully our rich magnetic ores with anthracite coal, at Stanhope, N. J., as he has since succeeded in reducing the franklinite, heretofore believed to be entirely refractory.

From the time of the application of anthracite coal, the historian will date the birth of the American iron business. Its great density and purity fit it peculiarly to our rich ores; so that while in England, with three years the start of us, the product of anthracite iron had reached only 140,000 tons in 1855, in this country it amounted to at least 360,000 tons; showing that, where an approach to an equality of the elementary conditions can be realized, there are lacking in this country neither energy nor skill to take advantage of the opportunity to achieve a successful result.

But the artificial impediments which stood in our way at the outset,—I mean the dearness of capital and labor invariably incident to a new country,—did not cease to exist with the opening of the necessary channels of communication, and the discovery of a new fuel for smelting. They did indeed enable us to place together the raw materials required to make a ton of iron at as low a cost, notwithstanding the higher price of labor, as they could be procured in Great Britain. But they could do nothing towards reducing the cost of smelting them afterwards; for this being done solely by the application of dearer capital and dearer labor, necessarily made the product more expensive. Many enterprising men, overlooking this consideration, and doubtless led astray by too clear a perception of our superior natural advantages, and relying upon the continuance of the duties imposed by Congress upon foreign iron, until the domestic production could compete successfully with it, by reason of the removal of the only obstacles to its success, dearer labor and capital—many such men, I say, staked their fortunes, and devoted their great energies to the establishment of the business here upon a scale not unworthy of their British prototypes. An examination of the diagram of American production will show succintly what these men or their successors, deriving title in most cases through the sheriff, have accomplished.

In 1810 the production of iron, entirely charcoal, was 54,000 tons.

In 1820, in consequence of the commercial ruin which swept over the country just before, the business was in a state of comparative ruin, and not over 20,000 tons were produced.

In 1828 the product was		130,000 tons.	
In 1829	"	142,000	"
In 1830	"	165,000	"
In 1831	"	191,000	"
In 1832	"	200,000	"
In 1840	"	315,000	"

In 1842 it fell to less than 230,000 tons, the result of the remission of duties under the compromise tariff.

In 1846 Secretary Walker estimated it to be 765,000 tons, the result of the combined action of the high tariff of 1842, and the high prices in England, caused by the new demand for railways.

In 1847 and 1848 it reached 800,000 tons.

In 1849 it fell to 650,000 tons.

In 1850, by the census returns, it was reduced to 564,755 tons; and it continued to fall off until the first of January, 1853, when the whole product did not exceed 500,000 tons, still leaving it, even at the lowest point, second only to Great Britain. The make then began to increase, so that in 1855 it had reached at least one million of tons.

These strange mutations of productions are susceptible of a clear explanation. I have stated that iron costs more to make in the United States than in Great Britain, only because capital and labor are dearer here than there. Bearing this in mind, it is evident that the difference of cost may be obliterated whenever the demand for iron is so great that the price rises sufficiently in England; or when the price is low, by the imposition of a heavy duty on the importation of English iron.

From 1842 to 1846, the latter cause will explain the increase of the domestic make; but it does not explain why, under the tariff of 1846, the make should increase for two years to 800,000 tons, then recede to 500,000 tons, then advance again to 1,000,000 tons, presenting a make equal to that of Great Britain only 19 years ago.

The fluctuations in the price of iron will alone explain this phenomenon; and as this is the only serious difficulty in the way of the permanent success of the American production from this day henceforth, I have prepared a diagram, which will give you some idea of the nature and extent of the fluctuations in the price of iron, a staple article, and more uniform in the actual cost of production than any article of manufacture. This diagram presents the price of common English bar iron in Liverpool, every three months, since the year 1806, when, as you will remember, owing to the general introduction of the improvements of Dudley, Cort, Watt, and Smeaton, the make began rapidly to increase, and the price to fall.

It is an established social principle, that the make of an article will increase even on a falling market, so long as it pays a profit.

An examination of the diagram, and of the diagram of production in Great Britain, will show clearly how great the profits must have been, or the economies introduced, to permit iron to fall in price, as it did, $45 per ton, in the 16 years, from 1806 to 1822. This great reduction in price will show why the American iron trade was utterly crushed in 1820, with no adequate duties to shut out the foreign product. But the low price in England, and the falling off in production in this country, soon created an additional demand, which raised the price in England,

and revived the manufacture in America. By the natural law that production will outstrip demand, when the profits are large, the price soon began to fall again in England, and ruin was only averted from the American product by the black tariff of 1828.

The great speculations and railway projects of 1836 again carried prices up; which, falling again under the influence of increased make, brought ruin again to our domestic production, no longer having any defence under the compromise tariff of Mr. Clay.

The tariff of 1842, imposing substantially a prohibitory duty, simultaneously with a largely increased demand in Great Britain caused by low prices stimulating consumption, and followed by the railway mania of 1844, again raised prices to a high point, and re-established our domestic manufacture. The commercial disasters which followed the railway speculation in England, and the famine of 1848, again reduced prices in England, and the American production was cut down one-half, because, under the *ad valorem* tariff of 1846, low prices are accompanied by low duties. But this time it is to be observed that the make did not get below 500,000 tons, showing that anthracite pig iron could hold its own, even with the low duties. If no duties had been imposed, I must declare my solemn conviction that every furnace in America must have been closed, because, for three years, every hour of which I remember, it was a struggle for life, and not for profit.

In 1852 the railway system in Europe and this country was again prosecuted with vigor. Prices of iron advanced in England; the manufacture here became prosperous, and it is a remarkable proof of the elastic nature of our people and our resources that the make of iron has doubled in four years, whereas in England it has never doubled in less than ten years. If you will examine carefully so much of the diagram as covers the last 30 years, during which time the cost of making iron has not varied much, you will observe that the extreme points of depression in price, which have always ruined our American ironmasters, do not continue more than one or two years. At such periods the selling price is below the cost of manufacture even in England. But herein lies the advantage of capital. The English ironmaster is either rich enough to hold his product for better prices, or can borrow money at low rates on it; while here the maker must sell at a loss, or stop his works—either of which is ruin. If the American maker could hold his product, he knows that remunerative prices cannot be long deferred.

The increase of capital in this country, and especially in the hands of the ironmasters, will overcome one of the artificial advantages which the English have heretofore possessed over us. At present capital is unusually dear in England, and the course of trade, and the better knowledge abroad of our resources, are doing much to equalize the value of capital, and to remove one of the most serious difficulties in the way of the progressive growth of our domestic manufactures.

But at the periods of low prices, the English maker does not require so much capital, because his labor is cheaper, and his iron therefore costs less.

Is there any reason to expect that this remaining artificial difficulty in our progress will be removed in like manner as that of capital is disappearing? The question of the cost of labor is a complex one, depending upon many elements, which the limits of this paper forbid me to investigate. It is apparent that the nature of the currency and the density of the population will have great weight in fixing the nominal or current rate of wages. Heretofore, and at the present time, the influence of both these elements have been and are against us. With a currency made up chiefly of paper, we have been competing with nations whose circulating medium has been composed chiefly of the precious metals. It seems to me that the recent extraordinary addition of gold to our domestic resources is doing much to relieve this difficulty; and if the addition be steadily continued, and especially if there is a corresponding effort made to restrict the circulation of paper money, or if such restriction be the result of natural laws, a very great difficulty will be removed from our industrial progress, so far as the question of foreign competition is concerned.

In regard to the other element, the density of population, it is apparent that every day is making its influence less and less disadvantageous to us. The annual rate of increase in the population, taking the average of the censuses since 1790, is $8^{17}/_{100}$ per cent. per annum in this country, while in Great Britain it is only $1^{48}/_{100}$ per cent., or only one-sixth of our ratio of increase. Again, in regard to density of population: In the Middle States, which must necessarily be the chief seat of the iron business, the population in 1790 did not exceed five to the square mile, whereas, in 1850 it had reached $57^{79}/_{100}$ to the square mile. The present density of population in Great Britain and Ireland is $225^{19}/_{100}$, a great difference, it is true, but one which the more rapid increase of our population is steadily reducing.

It is certain, however, that within the last ten years the disparity in the wages of labor in the two countries has been greatly reduced, not by any fall in the price here, but in the increase of the price in England. And it would seem reasonable to anticipate that, with the present rapid and cheap intercourse between the two continents, an equalization in the rewards of human industry would inevitably take place, and every step towards such an equality is in favor of our production of iron on terms of equality in every respect.

It is apparent, then, that the only reason why iron *now* costs more to make in this country, is the greater value of capital and labor, and that there are natural laws at work, slowly but surely sapping at the roots of these obstacles. But it may be alleged that it will require too long a time to equalize these conditions, and that it is better to abandon the business now, and wait till these desirable changes have actually been realized. To say nothing of the ruin which this course would entail upon those who are now engaged in the business, and who have nursed it to a condition where it no longer requires the aid of any duties beyond what the revenue of the General Government demands; to say nothing of the loss of skill and machinery, which twenty years of sacrifice would not replace; I think that another natural law is at work, which will soon place us beyond the aid of tariffs or the fear of competition; a law which, overcoming the extra cost of labor and capital, insures to us that iron will be produced here at an early day as cheaply as it can possibly be got from Great Britain, even if entire free trade be allowed. If such be the fact, to discriminate at this time against the iron trade, to deny to it the revenue duties which are imposed upon other articles of import, would be the height of folly; for the business would be ruined, and the country would save no money and vindicate no principle by such legislation.

Let us see what this law is. I have been at great pains to trace the increase of the consumption of iron by the world, and to form an accurate idea of its future demands. I have called your attention to the fact that, even now, the resources of Great Britain have been so taxed to meet the existing demand, as to increase *the cost* of iron, (I do not mean the price,) because the miners are driven to less favorable localities to procure adequate supplies of raw material. If the production of 3½ millions of tons per annum has made each ton cost more than it did when the production was only two millions, the addition of another million must have a corresponding effect. But the world will want and must have the other million, and two of them, and three of them, and, unless other countries aid in the supply, the price will rise far above our present cost of production. It seems to be the inevitable conclusion of the facts I have stated, that this day is not far distant. Even now we can make iron at the *average price* of English iron, and if we made none, that average price would be higher; so that there is no reason to believe that iron would be sold for less than it now is if it all came from England. But let it be noted that the American ironmaster now asks for no special legislation in his behalf; but he objects to any legislation, and very properly, which excepts him from whatever incidental advantage there may be in the fair imposition of duties for revenue. Heretofore, in times of great depression, long continued, he has felt the want of financial or legislative corks to float him over these "sloughs of despond;" and it is at such times, and such only, that you have heard him, a drowning man, conscious that he has many years of life in him, if he could only touch a buoy for a short period, calling on Congress for temporary relief, or entreating that the slight prop between him and ruin might not be knocked away. Now, however, he feels that the steadily increasing demand of the world for iron, and the fact that England cannot supply the whole of it without a decided increase in cost, insures to him that soon, aside from the question of capital and labor, these periods of extreme depression will either cease to occur, or, if recurring at all, will continue for such short intervals that he can sustain himself till the improvement takes place. But there is reason to believe that we are on the eve of another discovery, which will reduce the cost of making wrought iron in this country by intermitting the process of reducing the ore into pig iron, and then converting it into wrought iron. If we can succeed in making wrought iron direct from our rich ores, the whole cost of coal and labor in the blast furnace will be saved. Professor Wilson refers to this matter in his official report to the British Government on our iron-making resources, and again, in his able paper, read subsequently before the Society of Arts, expresses his decided opinion in favor of its practicability. My space forbids enlarging on this topic; but it offers another reason why the iron trade should not be singled out at this juncture as the victim of special legislation to its disadvantage.

I have been thus careful to show that at this day the possession of adequate skill, of extensive and properly constructed works, of a large body of intelligent workmen, of great natural resources in the way of raw materials and channels of communication, and of equally great ones in the canals and railways which the genius of our age and people have constructed, makes legislation for the purposes of protection no longer necessary, because I regard the days of protection, for the sake of protection, as passed away. I have been equally careful to show that the artificial elements of dearer labor and capital do not make us independent of a fair share of those duties which are necessarily imposed for the raising of national revenue, but that there are causes at work which promise soon to make us independent even of this aid, to which we have a fair claim in the balance of national interests; because, under this state of facts, intelligent and influential men, identified with our great railway interests, have combined together in the short-sighted policy of demanding a remission of the duties on railroad iron at a time when it has been demonstrated, and is admitted by all experienced engineers, that our American rails are more durable than the foreign rails, and consequently worth more by the whole amount of duty paid. They have made this movement at the very time when the facts and probabilities all favor the conviction that the steady approach to the equalization of the elementary conditions of cost in the two countries will soon place us on a par with our only competitors. I am anxious to have the exact nature of this proposition clearly understood, and to contradistinguish it from the old contest between the principles of free trade and protection. In 1846, the advocates of protection insisted that iron should be made an exception to the general principle that duties should be levied only for revenue, and that a special duty should be imposed upon foreign iron, in order to protect our domestic manufacture. The advocates of free trade denied that this could be done either upon sound principles or under the Constitution, and that the most that could be done was to place iron in the schedule which included other staple articles of consumption. An effort was then made to make railroad iron free; but it was firmly resisted by Mr. Walker, and the other consistent advocates of free trade, as being just as much subversive of the revenue principle, as to impose protective duties in favor of iron. The iron-masters conformed to the principle; and after a long struggle, in which many fortunes have been lost, have succeeded in placing the business on a firm footing. The effort now is to single out the iron business, and make it an exception to the general principle, and discriminate *against* it, so far at least as a leading branch of the industry is concerned. That this movement did not succeed last year was chiefly due to the firmness and intelligence of the present Secretary of the Treasury, who refused to lend his sanction to any measure of discrimination against the iron business; and to his adherence to sound principles is due the fact that the manufacture of railroad iron has grown, and continues to grow, in this country. As I am informed that the proposition to exempt railroad iron from duties will be again renewed this year, I desire not to repeat the conclusive arguments of Mr. Walker and others on this point, but merely to state the fact, that we can make railroad iron in this country with as much economy as any other kind of iron; that the quality is superior to that imported, and that the cost does not now exceed the *average price* at which foreign rails have been delivered in our ports. The only effect of a repeal of the duties, beyond a temporary advantage to a few local enterprises, would be the destruction of a business which has been established in our soil, under great sacrifices. but *in strict conformity* to the well-settled principles upon which our revenue is raised. Ten years ago no rails were made in the United States. In 1855, we made 135,300 tons, and imported only 127,516 tons.

		Tons of Rails.
In 1851, we imported		$188{,}625^{16}/_{20}$
In 1852,	"	$245{,}625^{10}/_{20}$
In 1853,	"	$298{,}995\ ^{4}/_{20}$
In 1854,	"	$282{,}663^{19}/_{20}$

[Vide Treasury Reports.]

We can point with pride to the fact that we have passed the half-way point; and if the business is not struck down by legislation expressly levelled at its destruction, in less than two years we shall be able to supply the entire wants of the country.

(*To be concluded in the October issue.*)

Floating Post Office and Wireless Telegraph Station

A novel plan for utilizing wireless telegraphy has been devised in Liverpool, and, according to the English shipping papers, it will soon be in practical operation. The scheme is to establish a Post Office and signal station, not in midocean, but 110 miles west of the Lizard, a place where, for British commerce at least, information from the shore is more valuable than it would be further out at sea. The purpose is to moor there a ship equipped with a powerful searchlight and the Marconi apparatus. The water at that point is seventy fathoms deep, and to overcome the tendency of a mooring chain as long as that to pull down the bows of the ship in heavy weather, the chain is to enter through a hawse pipe in the bottom of the hull at the keel of the foremast, so that the weight may be distributed evenly along the whole keel. With her light illuminating the clouds this vessel will be easily "picked up," even at night, from a distance of sixty miles, and situated right in the fairway of the Channel, it is expected that great advantage will be derived from the distribution of orders sent from shore by owners for vessels passing in or out. For instance, a ship from the south or west, on reaching this station, could be directed to proceed up either the English, Bristol, or St. George's Channel, without delay, thus avoiding pilotage and port dues, to say nothing of waste of time, and, in Winter, danger in making the land and entering and leaving port. As a reporting station to be approached in any state of the weather, for the purpose of transmitting important information, the value of the floating Post Office will be large, while as a saving station, lying as she will at the junction of the three great streams of British and Continental traffic, she should have many opportunities of rendering assistance, especially as her boat, designed primarily to pick up bottles or bags of letters dropped by passing vessels, will be so constructed as to withstand the roughest seas.—*N. Y. Times.*

A Telephone for Divers

A recent improvement introduced in the equipment of the ships of the United States Navy is the attachment of a telephone to every suit of diver's armor furnished to the navy. At least one such suit is carried by every ship in commission and one or more suits are supplied to all the navy yards and stations. Each helmet is supplied with a cap of stout canvas with a leather chain-strap, on one side of which is fastened a telephone receiver, so that it is held securely against the ear and cannot possibly change its position. Inside the helmet, placed so that the diver can speak directly into it by slightly turning his head, is the transmitter. The half-inch connecting wire cable, which is heavily insulated, enters the helmet near the top through a water-tight valve, which permits it to be immediately disconnected if it is at any time desirable to dispense with the use of the telephone.

The diver's assistant is equipped with a similar cap and receiver and around his chest is strapped a small nickel-plated shield, on which is mounted the transmitter with a funnel shaped mouthpiece pointing upward, so that he can speak directly into it by slightly lowering his head. Around his waist he carries the battery of five cells in a hard rubber case. It takes but a few moments to make the necessary adjustments and put the line in working order. Thus equipped the assistant has both his hands free to handle the air pump or hose or to comply with any directions that the diver below may telephone up to him.—*American Telephone Journal.*

The Bogota High Tension Transmission Line Between Power Plant and City. The Line is Sixteen Miles Long.

A South American Electric Plant

By Frank C. Perkins

The city of Santa Fe de Bogota, better known to Americans as Bogota, has 150,000 inhabitants, and before the recent installation for lighting by electricity, wooden conduits were used to supply the city with gas and there were frequent interruptions in the supply. As it was necessary to import petroleum as well as other illuminant supplies, such as candles, it was decided to take advantage of a waterfall about sixteen miles distant, for the production of energy, and the construction of the electrical installation was made by the Maschinenfabrik Örlikon of Örlikon, near Zurich, Switzerland; the hydraulic equipment was supplied by Escher, Wyss & Co.

This electric plant is claimed to be one of the highest situated in the world, being 8,300 feet above the sea-level, and is particularly interesting on account of the great difficulties that had to be surmounted in its construction, as well as its general arrangement.

Many obstacles had to be overcome on account of the defective state of the routes of communication, the primitive means of transport and the entire absence of railways, which made it very difficult to transfer the materials and machines, turbines, switch-boards and other apparatus to the power plant site.

It may be of interest to note a few particulars which will serve to illustrate the obstacles encountered in transporting the parts of machinery from Puerto Colombia (Savanilla). On leaving the port, the first part of the journey is made along a narrow road, which, after a distance of eighteen and a half miles, leads to the little town of Barranquilla, situated at the mouth of the river Magdalene, and from here, for a distance of 560 miles, the transport is effected by means of small steamboats which run between Barranquilla and the basin of the port of La Dorada.

A second road, twenty-four miles in length, terminates at Honda, 990 feet above the sea level, and the rest of the long journey to Bogota must be accomplished over very bad pathways. For this trip the machine parts must be carried on the backs of mules, and this fact had to be considered in the construction of the machines, since the maximum load a mule can support on such roads is only 330 pounds; and this must be evenly distributed on each side. It is also necessary to lay other restrictions in connection with the packing of the materials and apparatus, as the limiting of dimensions of the cases in order to be able to get them through all the narrow passes with ease and to permit of meeting other caravans coming from the opposite direction. The road passes over the Alto del Sargento, which is 4,160 feet above the sea-level, and then descends to Guada, 2,950 feet above sea-level. It is then necessary to reascend to Alto del Raizal, which is 4,870 feet above sea, and on up the mountains by Alto de Trigo, 6,170 feet above the sea, to Villeta.

High Tension Power Transmission Cables in Conduits at Bogota.

The path then traverses Alto de Roble, at an altitude of 9,075 feet, and finally arrives at the station of Facatativa, which is connected with Bogota by a railway, this last journey being only about three hours long.

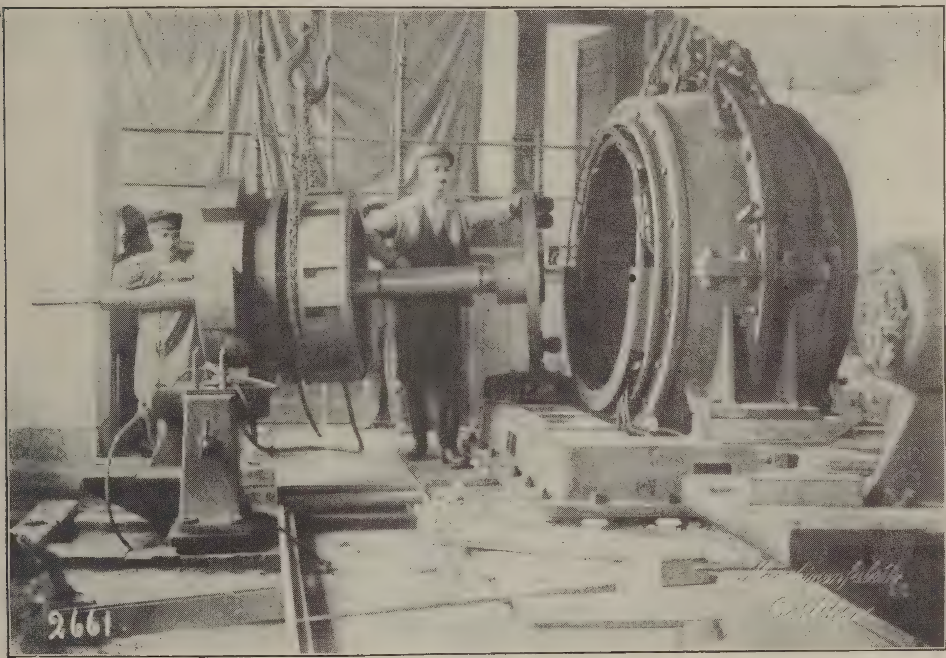
The hydraulic installation is of more than passing interest. The Rio Funza or Rio Bogota, an important river, traverses the middle of the table-land of Sabana, and its agitated waters flow into the Magdalene river. Along the Funza, from the point at which it leaves the table-land, are an almost uninterrupted series of cataracts for about 1,300 yards, the largest of which is known as the Fequendama. The stream, which is about fifty feet wide, is precipitated down a height of nearly five hundred feet, and forms a large waterfall. As there was no hope of utilizing the great amount of force which would be given by this fall, even when transmitting the power by electrical means, it was decided to use El Charquito cataract, which lies further up, is about 164 feet high and capable of supplying 6,000 horse power; a lake-like widening of the Rio Funza offered a very fine site for the new power house.

The water-inlet for this power house is about 436 yards up the river and consists of a short masonry canal, at the extremity of which, nearest the river, a round iron-bar grating has been built across it to prevent substances carried down by by the stream from getting into the canal and stopping it up. In addition to this basin-shaped canal there is another canal for the pebbles and earth with an emptying trap. Before passing into the main pipe, the water traverses a second and finer grating, then a trap, and finally a water-chamber, to which the pipe is connected. This water-inlet is designed for a total of 5,400 horse power, and to provide for future extension of the plant a double grating, trap and water-chamber have been constructed. The main pipe leading the water to the turbines is constructed of wrought iron tubes with flanged joints, nearly six feet in diameter and 436 yards long, and rests on blocks of concrete at short intervals. The lower end of the main pipe divides into several other pipes supplying the various turbines, and at the bottom of the main pipe there is an emptying trap fourteen inches in diameter with an outlet through which the main pipe can be emptied at will.

pied by the high-pressure pipes, and the turbine-room is furnished with an overhead traveling crane.

The turbines are coupled directly to the generators by flexible insulated couplings and have each a capacity of 450 horse power; the generators supply three-phase alternating current at a pressure of 6,700 volts.

The high tension power transmission line is led across very mountainous coun-



The Bogota Alternator, a 450 Horse Power Machine, Showing its Construction in Small Parts for Ease in Transportation.

The central power station, when entirely completed, will have an area of 1,116 square yards. Half of the station has already been constructed and is equipped with the necessary machinery; it is operating with great success. The main enclosure will be one hundred feet long and seventy-five feet wide, containing twelve hydro-electric sets. The switchboard measures about twenty-five by twenty feet. The underground portion is occu-

try to Bogota, a distance of fifteen and a half miles. Every third pole is provided with a lightning arrester. On the outskirts of the town there is a main transformer station, which reduces the line pressure to 1,600 volts, and cables are laid underground in conduits to the various sub-stations about the town, where the alternating current is again reduced in pressure to one hundred and sixty volts. The low tension lines at this voltage are supported on poles, as the brick work of the houses is not reliable enough to place the insulators in it.

There is a large number of motors now in operation in Bogota supplying power for driving all kinds of machinery, and there are more than 2,000 incandescent lamps in use, as well as a large number of arc lights.

Many installations in South America are now taking advantage of the numerous water powers in that country, and while many of the plants have been installed by European engineers, many of the American manufacturers are looking after South American trade and find there an extensive field for their apparatus.

In the Bogota power house the turbines have horizontal axes and utilize the whole head of the fall, the turbines being provided with draft tubes descending below the water-level. The head is 147.6 feet and the discharge volume is 1,000 litres; the power for each turbine is 450 horse power, with a speed of 600 revolutions per minute.

The turbines are automatically governed by means of two circular slide-valves, actuated by levers from an auxiliary motor. These valves open and shut all the distributors to the same degree, so that the water acts symmetrically all around the turbine, and uneven pressures on the bearings are obviated in this manner. To insure steady running the shaft is supported in several places. The auxiliary is direct-connected to the governor and the water is allowed to act either upwards or downwards on the piston of the auxiliary motor, according to the motions transmitted by the governor to the valve. Under this pressure it is raised or lowered and sets the systems of levers and slide-valves in motion, regulating the supply, while a special arrangement is provided to prevent oscillations or over-governing. The Örlikon alternators supply three-phase current at sixty cycles, the speed being 600 revolutions per minute, and the output 450 horse power at a terminal pressure of 6,700 volts. The armature has two laminated rings fixed to the inside of a cast-iron frame, and there are thirty-six slots in the inner portion of the rings, which carry eighteen coils, each having fifty-eight turns of round copper wire. These machines are of the inductor type and have a single field-coil which is wound with 530 turns of copper conductor. The exciters are four-pole machines keyed directly on the shafts of the alternators, and supply thirty-five amperes at seventy volts pressure.

As above mentioned, it was necessary in the construction of these machines to provide for readily taking them apart, and building small parts on account of the difficulties of transportation. The armature, and also the frame, is divided in both vertical and horizontal planes, which pass through the axis, and also in a plane perpendicular to the latter, so that these machines are made up of eight segments; the bedplate is divided into two parts, while the rotating portion is composed of more than one hundred parts. The poles are also so fixed that they can be taken out laterally, and if an armature coil requires repairing it can easily be changed without dismounting the whole machine.

The switchboard, which is three feet from the ground, is at present constructed for six units, and consists of the usual marble panels supported by an iron structure. Underneath the switchroom is a twenty-kilowatt transformer which lowers the pressure from 6,700 volts to 160 volts, to supply power from the various motors about the station as well as for lighting the power house.

The three high tension mains from the station to Bogota consist of pure copper conductors eight millimeters in diameter and are placed fifty centimeters apart, the total length being about fifty miles. The high tension line is supported on poles thirty-three feet high and one hundred and fifteen feet apart. At the main transformer station already referred to there are four step-down transformers of 350 kilowatts each, two of which are now installed and in operation. The polyphase current is reduced in pressure from 6,700 volts to 1,600 volts, and from the bus bars there are five sets of feeders, with the necessary switches and fuses, connecting with the various substations. These feeders are placed in underground conduits which consist of wooden casings, insulated with a mixture of sand and paraffine, with pitch poured round them, while the cables are first carefully insulated by a layer of gutta percha and supplied with a lead armoring surrounded by jute. On account of the difficulties of transportation, the cables had to be delivered in lengths of only 220 yards. Many joints were thus found necessary in this network of five miles of cable.

The Auto as a Scarecrow

It is claimed that a considerable decrease in the number of English sparrows in New York city has taken place within the last few years. This is said to be due to the introduction of the automobile which has made possible cleaner streets. The sparrows which feed largely upon the refuse in the streets have found their food supply in more limited quantities and have removed to other places. Thus does the automobile advance the cause of civilization and peacefulness.—*Automobile Review and Automobile News.*

A $3,000 Prize for Electrical Inventors

A monument in honor of Galileo is to be unveiled at Turin, Italy, during the latter part of this month and the occasion will be rendered further notable by the naming of the successful competitor for the "Galileo Ferraris Award" of $3,000, offered in 1898 by the Executive Committee of the General Italian Exhibition, the Chamber of Arts and Commerce, the Royal Academy of Science and the Royal Industrial Museum of Turin.

The prize is to go to the inventor of some practical application of electricity from which noteworthy progress may be expected to arise.

The competitors may present their inventions in the form of pamphlets, drawings, machines, apparatus or in almost any manner which will make their schemes clear to the jurors, but the jury preserves to itself full right to cause experiments to be made upon the lines suggested by the competitors in order to determine the real value of each invention.

The competition closes at the office of the Secretary of the Committee in the Chamber of Commerce building, Turin, at 6 p.m. on Sept. 15.

The Manhattan Railway Company has ordered four new electric passenger elevators for the new station at 110th street, near Eighth avenue, New York. Each elevator will have a lifting capacity of 3,300 lbs. and a speed of 300 feet per minute. The travel of each car will be 60 feet. These elevators will be built by the Otis Elevator Company.

Early Railroading Without Telegraphs

By W. P. Sneden

The New York and Erie Railroad was opened from the Hudson river to Goshen in Orange County, September 23, 1841. Its eastern terminus was at Piermont, in Rockland county, where connection was made with steamboats for New York city. The general offices and repair shops were at Piermont. Hezekiah C. Seymour, afterwards the first State Engineer and Surveyor of New York, was superintendent. S. S. Post, who subsequently became prominent as a designer and constructor of iron bridges, held the position of Master of Transportation, and John Brandt, Sr., of Lancaster, Pa., was then and for many years afterward superintendent of motive power. The writer, a mere lad at that time, after the usual common school education, supplemented by a course of mathematics in a nearby academy, secured a position as junior assistant in the superintendent's office, and became an eye witness of the scenes and incidents which are here related.

Looking back to those early days it seems wonderful how the few railroads were operated as successfully as they were. Everything was, in a measure, in an experimental stage, and the inventive genius of those in charge was in constant activity. The improvement of the track was of vital importance. The first T rails were laid on longitudinal timbers, being the trunks of straight chestnut and white-oak trees slabbed to a thickness of eight to nine inches, with two-inch plank dovetailed into them crosswise, at intervals of five feet, and supported by three-by-ten cross sub-sills underneath the stringers. It was difficult to keep the track in good line and surface with this crude arrangement, and when the plan of using six by eight surface cross-ties, with the rails spiked directly on them, was devised, the general cry was "Eureka."

The locomotive problem was intelligently handled by "old man Brandt," whose mechanical genius was a wonder in those days. He made improvement after improvement, and finally after many trials with all sorts of "cut-offs," introduced the "link-motion" for the valves, which has scarcely been improved upon since.

One of the incidents of those days is ever fresh in my mind, as one of the most important results of quick transportation that has ever occurred. It was the experiment of Thaddeus Sellick, of Chester, Orange county, in 1842, sending a forty quart can of milk to New York city, to test the question as to whether the milk would remain sweet and in good condition, or be churned into buttermilk by the shaking up of the long journey, which was the popular belief.

It went through all right, thanks to Mr. Sellick's forethought in cooling it in a spring to take out the animal heat before starting.

Every one now knows what a boon it has been to the crowded cities to get this indispensable article of food fresh from the farms of nearby counties, and the long "milk trains" now arriving in the early morning on all the roads, attest the immense quantity of this liquid food which is consumed in New York city.

After that first can got through all right, the business grew as if by magic, and it became of the greatest importance that the trains carrying the milk should not be delayed. But alas, there were no means then to tell where a train was if it did not arrive on time, except by going out and hunting for it, as the road had only a single track! This plan was frequently adopted. It became a standing order that if the train due at Piermont at seven p. m. had not arrived up to eight o'clock, the watchman at the roundhouse should ring the bell, and it was then the duty of *all* employes to hasten to the shop, an engine was to be fired up, cars gotten ready with wrecking tools and the usual appliances.

If by this time the train had not arrived, the hunting train would start out, creeping along and flagging every curve, until either the expected train was met or perhaps a hand car coming with news would be intercepted, when the relief would have a clear way to the scene of the accident which had brought the train to grief.

The transfer of the milk-cans being effected by the labor of every man and boy available, the relief train would hurry back to the waiting steamer at the Piermont pier.

It can be readily understood that operating a single track railroad was a very crude and uncertain thing, during the days and years when Prof. Morse was trying to perfect his telegraphic system, and waiting patiently on a reluctant Congress for aid to develop and demonstrate a science which has revolutionized the world.

Marconi's Cape Breton Station

The new Marconi wireless telegraph station which has been erected at Cape Breton, consists of four wooden towers, each measuring twenty-eight feet across at the base and from nine to eleven feet at the top, and attaining a height of two hundred and fifteen feet from the earth. These towers stand at the corners of a square, whose sides are two hundred and ten feet long. Four horizontal bridges connect the tops of the towers, and from each of these are suspended fifty copper cables. Outwardly these cables look at a short distance like single wires, but in reality there are three hundred and fifty wires, there being seven strands to each cable. This is very different from the solitary vertical wire of the original Marconi experiments. The fifty cables of each of the four groups converge a little as they go downward, and also incline slightly toward the center of the quadruplex edifice. The lower ends are arranged along the sides of a small square. In the coming attempt to transmit wireless messages across the Atlantic, Mr. Marconi, it is said, will retain the coherer as his receiving instrument. In the transmitting apparatus transformers will be substituted for the induction coil. The spark gap will be scarcely more than an inch long, but the spark itself will be greatly thickened by the shortness of the interval. It will be produced between globular terminals two inches in diameter. Alternating current at a voltage of 2,000, generated by a forty horse power dynamo, run by gasoline-engines, will be used, and this will be raised to 20,000 volts by the transformers. Condensers and other electrical appliances will increase this still further until a voltage of from 50,000 to 70,000 is secured.

A Novel Electric Hoist

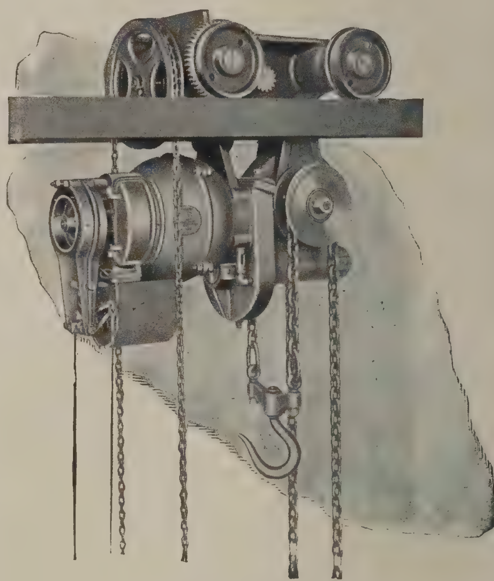
An electric hoist capable of handling heavier loads than can be handled by hand hoists, and not requiring the heavy and expensive supporting structure needed by the ordinary traveling crane has long been needed. This need has now been met, it is asserted, by a new hoist made by the Sprague Electric Company.

This hoist is shown in the accompanying illustration. It is designed to transfer light work rapidly around shipyards, factories, and such places, and when supplied with a trolley carriage, a geared hand cross-travel and a bridge-travel motor, to take the place of small traveling cranes. The advantages claimed for this hoist are that it has a very high efficiency and is much smaller and lighter than any other hoist of like capacity and, unless greatly overloaded, is almost indestructible.

All the different movements, hoisting, lowering, cross-travel and bridge-travel, are controlled by a simple pulling of the connected chains and cords, and these can be operated by the ordinary workman. No special operator or cage is necessary.

The apparatus consists of a chain and chain-wheel, connected by a hardened steel worm and bronze worm-wheel and steel spur-gears to a standard Lundell enclosed round-type motor. The thrust of the worm is taken up by hardened steel rollers. The motor is provided with a rotary reversing switch which works without the use of external resistance. All the parts are made interchangeable. The shaft of the hoisting-motor is extended on the commutator end and is provided with a mechanical brake and brake-wheel. This brake is operated by a cam and spring, so arranged that when the starting and reversing switch is in the "off" position, the cam is disengaged, and the brake is set. In starting up the motor in either direction, by pulling the cords attached to the switch-arm, the cam is thrown against the sides of the brake-levers, and lifts them off the wheel.

The bridge-travel controller is reversible, and in practice it is possible to move the crane or hoist as short a distance as about one inch in either direction. The motors are enclosed in water-proof casings for out-of-door use. The resistance-plates for the bridge-travel controller are glass grids, the resistance itself being entirely enclosed by the glass, which is cast around it. These grids are designed to have a large overload capacity. All the bearings are self-oiling, the worm-gear runs in oil, and there is a sight oil-gauge on the side of the gear-case. The trolley carriage is provided with roller bearings. No resistance box is used for the hoist-motor.



A Novel Electric Hoist.

The Ceraunograph—A Lightning Barometer

Despite the elaborate precautions taken by the Weather Bureau and notwithstanding the complicated pieces of apparatus employed, it yet finds the accurate forecasting of lightning storms to be beyond its reach. A telegraph service is not only too limited to be successfully employed for this purpose, but it is too expensive as well. While it may be used with some degree of success in regions not bordering upon a large sheet of water, such as the ocean or one of the great lakes, still the suddenness with which a line squall or tornado sweeps down upon the observer effectually puts to an end the dispatching of any warning.

The ceraunograph or lightning recorder, which is the product of the labors of the Rev. F. L. Odenbach, S. J., director of the Meteorological Observatory at St. Ignatius College, Cleveland, Ohio, is to lightning what the barometer is to the general weather conditions. By its use the observer is enabled to detect the presence of a distant storm. A table prepared by the inventor shows that storms were recorded by the instrument ten, and, in some cases, even twelve hours before their arrival. The keystone in the operation of this system of recording lightning is the coherer, such as is employed in wireless telegraphy. The inventor has, however, perfected a new type of coherer, which he calls the graphite coherer, the simplicity and thoroughness of whose operation ought to find for it a general acceptance in work where the tube coherer is found either too slow or too expensive.

The various parts of the instrument are a relay, telegraph sounder, coherer, choke coil, two batteries and a recording drum, similar to the chronograph.

The copper cap of the college tower, containing about 400 to 500 square feet of metal, is used as a collector and from this a copper wire is led down to the instrument placed in the laboratory.

The relay is placed in circuit with the choke coil and the coherer. In the secondary circuit of this relay are placed the sounder and recording magnet with its drum, the record being made by a pen attached to the magnet. The coherer is connected to the sounder, which at each click of its lever acts as a decoherer. Originally, the battery of the primary circuit consisted of four dry cells; that of the secondary of two cells. This latter would not have been strong enough to work both the decoherer and the recorder and in order to avoid a spark on the relay, which would have interfered with the coherer, a small pony-relay was put into the circuit with the decoherer. This controlled a third battery furnishing the current for the recording magnets. Besides this, a condenser is used on the large relay to avoid sparks of sufficient power to actuate the coherer. The wire running from the collector on the roof of the college is spliced to the main circuit between the choke coil and the coherer.

The electro-magnetic waves which are caused by lightning, which is a disruptive discharge of the same nature as the one produced by Marconi's oscillator, strike the copper collector, entering the primary circuit of the relay by means of the wire leading down from the collector. Their way being blocked in the direction to the battery by the choke coil they pass without any difficulty through the coherer. In so doing, the coherer, which up to the present moment had been a high resistance in the circuit, becomes a conductor for the primary current. The relay comes into action and closes the secondary circuit. The recording magnet moves the pen attached to it and makes the record. While all this is happening, the sounder in the secondary circuit has clicked and shaken the powder off of the coherer, and the coherer once more offers resistance until a second distant flash sends out more electric waves.

Lightning Recorder at Observatory of St. Ignatius College, Cleveland, O.

The graphite coherer, spoken of above, is described by the inventor as follows: To a plate of vulcanized rubber are bolted two binding screws; the nuts below the plate hold the two terminals of the broken primary circuit. The plate is about 1½ inches by 2 inches and is fastened upon the base of the decoherering sounder, so that it projects out from it along its longer axis. Above the plate the binding screws clamp two oxydized steel pins near their points; the glass heads project forward beyond the plate and parallel to each other. Owing to the rubber plate the primary circuit is open. If a third pin or a piece of metal were now placed across the two pins clamped by the binding screws this circuit would be instantly closed. A stick of graphite is laid across these pins and the coherer is finished. It forms so high a resistance at this point that the powerful current of six cells is unable to pass through to the relay. The sensibility of this coherer may be increased by adding a second, third and fourth stick of graphite. Each of these sticks have paper dics glued to their ends to keep them from touching each other or from sliding off the pins when the click of the decoherer causes them to vibrate.

There are some interesting peculiarities about this coherer. Among others, the resistance is not absolute. With the battery now in use, there is a very constant current of a few milliamperes passing through the coherer which cannot be increased by pressure on the graphite. There seems to be a doubt as to whether the current shown by the galvonometer is of voltaic origin or not. It has also been found that there is a great difference in graphite and that it seems to become more sensitive in time owing, perhaps, to a change in its molecular structure.

The successful results obtained through observations at St. Ignatius College attracted the attention of the Weather Bureau, which has ordered a ceraunograph for use at the observatory at Duluth, Minn., where a thorough test of its efficacy will be made.

It seems that this instrument could be put to excellent use along the Atlantic and Pacific seaboard, as well as along the great lakes, as, with very little trouble or expense, warnings received might be dispatched to fishing and pleasure boats, tugs and yachts—in fact to all vessels to which a strong and violent wind-squall might prove dangerous.

Experiments ought to enable investigators to throw some light on the origin and progress of electric storms, the nature of different forms of lightning, the formation of snow and, perhaps, include a record of auroras.

Texas Oil Once Marine Reptiles

From Paper by M. A. Granville.

To the marine saurians of the jurassic period, Texas is indebted for the great gushers which come from Spindle Top. Wyoming, Montana and Idaho owe their oil to the land or marsh reptiles of the same age. With California it is a little different, for her supply of petroleum is drawn from the tertiary deposits laid down at a time when the mammals ruled the earth, and birds with gay plumage were singing in the trees. But whether in West Virginia or Ohio, in Texas or in California, in Siberia or Japan, the origin of oil everywhere is just the same. If we procure it from the coal regions or distill it from the peat, the shale or even the rock of remote ages, which underlies our earth, these substances have nevertheless at one time been intimately connected with the organic creatures of the past, and impregated with the oleaginous material of which their bodies have been composed, in order to account for its presence in their constituent elements today.

The theory of the chemical origin of petroleum through the distillation of coal in the bowels of the earth in remote geologic ages has involved a series of very interesting experiments in the laboratories of several well-known chemical authorities. In these experiments some powerful deoxidizing agent, such as iron at a white heat, has been made to react with steam and carbonic acid, depriving both the hydrogen of the steam or water and the carbon of the carbonic acid of their original oxygen, and resulting in the formation of a greasy liquid almost identical with petroleum. It has been found also that coal itself, when subjected to distillation, is productive of a similiar result, so far as its reduction to an oily fluid is concerned, but the same may be said of the distillation of shale, of peat, of wood and even of the famous "burning rock" of the northwest, all of which in regions where coal is not known have been made to yield up their quota of petroleum in quantities more or less abundant. But that is not all.

Passing by the earlier stages of the palaeozoic age, however, which, through the invertebrates in the silurian and the fishes in the devonian eras, were probably responsible for the oil-bearing strata found today at great depths, we come to a more interesting period of the world's history—the carboniferous era. It is now more than twenty-five millions of years ago, according to the best geological opinions, since our earth, warmed by the rays of a fiery sun, was luxuriating in the most abundant vegetation which has ever blessed this planet, and which was so profuse at that period of the world's history that if compared with the densest of African jungles today, it might appear as some mighty monarch of the forest by the side of some delicate garden flower. To the death and decay of all this wonderful vegetation, continued through hundreds of thousands of years, we owe the coal deposits which underlie our soil.

No attempt seems to have been made to inquire into the genesis of this most useful substance until about the middle of the last century. In 1847 an English chemist named Young succeeded in obtaining oil through the distillation of coal, which in the process involved was subjected to a very slow heat, and satisfactory results from the commercial point of view of that time were procured in this manner. Subsequent to these efforts, shale oil, a product of bituminous shale, submitted to the same process of distillation was extensively manufactured in Scotland and Wales, and from these results and similar efforts elsewhere it was fully determined that petroleum was the product of the distillation of coal by the heat of the earth in past geological ages.

The distance at which we find oil beneath the surface of the earth is in no two regions alike. It has been struck in the devonian rocks, corresponding to the age of fishes; in the sub-carboniferous, in the carboniferous and in the permeian, corresponding to the age of acrogens and amphibians. In Colorado, Wyoming and Montana, and in Texas, Louisiana and Florida, it appears in the jurassic and cretaceous periods, corresponding to the age of reptiles, while in California we find it in the tertiary—the equivalent of the mammalian age.

If we look outside our own country we shall find that the great oil fields of Siberia are referrable to the jurassic or triassic geogolical periods, when vast hordes of monstrous reptiles swarmed upon the earth, and a comparison of the product of that country with our own recently discovered Texas oil shows it to be almost identical in specific gravity and constituents with that viscous fluid of Asia. In many of the oil regions of Siberia we find no traces of coal, and in our own country, where oil is produced abundantly, as in Texas, Florida, Louisiana, Colorado and portions of Montana and Wyoming, as well as in parts of West Virginia, Ohio and Pennsylvania, the coal measures abruptly break off or are totally wanting altogether.

What is the most ingenius single piece of mechanism ever made?

THE ELECTRICAL AGE desires descriptive answers to the foregoing question and will pay Five Dollars for each answer which it finds interesting enough to print.

For the answer which is finally considered the best Ten Dollars will be paid. Answers should contain from 600 to 1,800 words each and should be illustrated with drawings or photographs.

How the Telephone User and Operator are Protected Against Lightning

By G. Selwin Tait

One of the greatest handicaps experienced by the pioneer in telephone work was the popular belief that the telephone wires would supply a path by which lightning could enter the house, and even now the belief still exists among a great many people that they run great risks in having telephones installed in their homes. In the early days of telephony there was some ground for these beliefs but owing to the protective devices now in general use on telephone systems, and described in this article, the basis for this belief no longer exists.

To the best of my knowledge there has never occurred an instance in which lightning struck a subscriber's wire and thereby gained entrance to his house, one reason for this being found in the fact that a current of such a tremendous pressure as that of a lightning discharge would find a telephone wire far too small to serve as a conductor, the result being that the wire would instantly fuse or melt, thereby cutting off from all danger the house in which the telephone was situated. A small fraction of the discharge, however, might be deflected onto the telephone wire, thus allowing the discharge to enter the house. By the use of a good lightning arrester this is now rendered impossible.

It is very likely, however, that a reader may have noticed strange phenomena occurring in the telephone during a thunder storm, such as loud reports as though an explosion were taking place within the telephone box, crackling sounds, and even flashes of light when the receiver was removed from the hook. In some cases he may even have experienced a severe shock.

These manifestations were rarely caused by the lightning itself, however, but were due to the static induction caused by the same. In order to make this more clear one should imagine the earth to be the outside coating of a Leyden jar; the telephone wires being the inside coating. The two wires of a telephone line would form the same combination. Lightning striking the earth in the vicinity of a telephone would resemble the charging of a Leyden jar. After the charge had accumulated sufficient pressure it would endeavor to find a field through which to discharge itself, and local conditions would probably decide the manner in which this discharge would occur. If the telephone was equipped with a ground-plate, as further on described, the current would jump across the air gap to the ground connection, causing a pistol-like report. Where a carbon block arrester is used the wires are instantly and noiselessly rendered normal. Should the telephone, however, lack any form of lightning arrester whatever, the two sides or legs of the line would tend to evenly balance themselves as regards pressure, the current during this operation flowing back and forth through the telephone. Should a subscriber remove the receiver from the hook while this was going on the circuit would be disturbed, causing the induced current to momentarily arc across the switch contacts, causing the subscriber to receive a distinct shock should he touch any of the metal parts on the telephone.

There have been cases shown where static induction had accumulated to such an extent that it presented all the characteristics of a miniature discharge of lightning—jumping from the telephone to adjacent water-pipes, etc. In some cases fires have been attributed to this cause.

The question of reliable protection from lightning was among the first problems to receive the attention of telephone engineers and the variety of the devices designed and used for that purpose speaks highly for the intelligence and perseverance of those who have brought telephony to its present state of efficiency.

Before going any further, it might be well to mention the various kinds of currents which in practice have to be guarded against.

First, there is the direct discharge of lightning onto the line. This, although apparently the most formidable, was the simplest to dispose of and is now practically safeguarded against by two very simple means—by laying the wires in cables underground, as is done in our large cities, in which case they are not exposed to lightning discharges; and by running a single line of barbwire along the tops of the pole used in overhead construction; said wire being connected to the earth at regular intervals so as to insure a good ground connection. The barbs on this wire collect the lightning and thereby protect the telephone circuits.

Second: We have what is generally termed static induction; that is to say, the presence of atmospheric electricity in the neighborhood of the telephone line will often charge the same to such an extent as to render it unfit for service until the induced charge has been allowed to escape to the ground, and the line rendered normal. This latter is the current that the public is more or less familiar with in the form of shocks, loud reports, etc., and is what is generally supposed to be lightning itself.

A case of this kind that the writer recalls was in an exchange in a small Western town where most of the lines ran on poles for miles over the prairie. Here the effect of static induction was so pronounced that many of the lines could not be used until they had been grounded and thus discharged; and as grounding the lines before each conversation was not possible, the manager had the wiring of the subscriber's instrument changed, as per Fig. 2. Here it will be seen that when the receiver is hung up, the two sides of the line B C are short-circuited through the telephone hook, and also connected through contact A to the bell and thence to ground at G. This arrangement leaves the two sides of the line and the ground always connected except during conversation, and hence there was no chance for the line to accumulate unequal potentials. The ringer circuit is through both sides of the line and ground as can be seen in the sketch. This plan was found to be very successful and no further trouble was experienced from that source.

Third, we have what are known as "sneak currents," so termed on account of the fact that they sneak past the fuse and carbon block arrester. These are generally caused by crosses with, or leakage from, lighting or power systems, and may vary from a fraction of an ampere to the full current from the power house. It might not be amiss to mention here that crosses consist of a wire of our system (telephone) falling across wires of another system (electric light, etc.) the result being that the current leaks from one to the other. To these are attributed most of the burn-out troubles of modern telephony.

In describing the different forms of "arresters" or protectors now in general use, we will commence with those used to protect the subscriber and his telephone.

Among the first lightning arresters to come into general use was what is known as a "ground-plate," one form of which is shown in Fig. 1, which consists of three metal plates, A, B, C, usually mounted on the telephone itself. A is connected to the ground, while B and C are connected respectively to the two sides of the line. There is also a metal plug D which can be inserted between B and C at the circular opening E, so as to short-circuit the telephone by providing connections between B and C.

The theory of this arrester is that the high potential lightning discharge will leap across the air-gap from B C to the ground connection A, while the low voltage telephone currents will find the air-gap an impossible barrier.

In actual practice, however, this form of arrester was found to leave much to be desired. For instance, the subscriber would forget to remove the plug D from between the plates B C, with the result that the line would be short-circuited and useless, necessitating a trip for the "trouble-man" just to remove the plug. Also the crackling sound of the discharge across the ground plate led the public to believe that the house was in danger from lightning, or in some case caused the removal of an otherwise satisfactory telephone. In addition it was soon discovered that current was often found on the line too weak to jump the air-gap, and yet strong enough to "burn-out" the telephone.

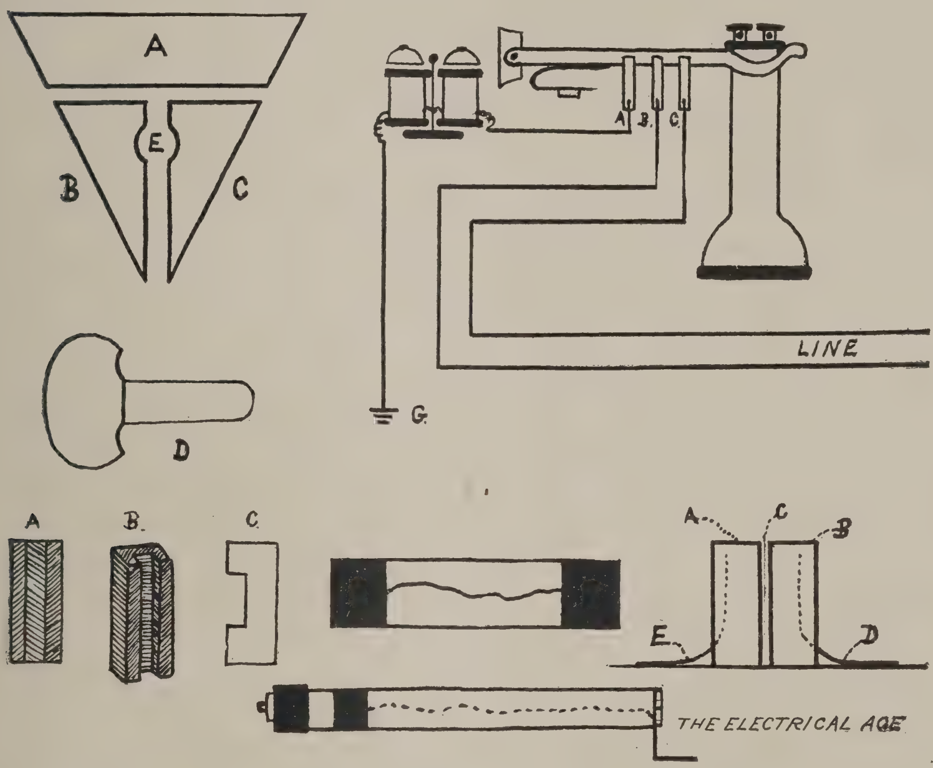


Fig. 1. Fig. 3. Fig. 2.
Fig. 5. Fig. 4. Fig. 6.

Illustrating Various Types of Apparatus Employed in Protecting Telephone Users and Operators Against Lightning.

As a substitute for the ground-plate,

which was mounted on the telephone itself, the next arrester used was a fuse or pair of fuses set in series with one or both sides of the line, the fuses being gauged to "blow" or melt, at a given amperage in excess of the usual current, such as would be occasioned by a cross or a discharge of lightning.

These fuses are divided into two classes, the plain fuse mounted on mica, and generally held between clips as in Fig. 3, and the enclosed non-arcing type shown in Fig. 4. These latter are found to be the most efficient form, as their length, four and one-half inches, obviates any risk of an arc forming, and being enclosed in a tube as shown, the fused metal is prevented from doing damage.

Both these fuses were found to answer the purpose of opening the line, and thereby protecting the instrument, but it was also found necessary to provide an easy path to the ground for the high voltage current which had been "arrested" by the fuse, as otherwise, it would cause damage to the building. With this end in view, a modification of the old "ground-plate" was designed, which possessed all the merits of the same without having any of its defects. This consisted of two carbon plates *a* and *b*, Fig. 5, and a strip of mica *c*, cut out in the centre. These are mounted as shown in Fig. 6, *d* and *e* being two brass springs forming terminals of the line and the ground respectively. It will now be seen that the carbon blocks *a* and *b* are held apart by the mica insulation *c*, but *c*, it will be remembered, is cut away in the centre so that there is an air space between *a* and *b* which is equal to the thickness of the mica, usually .008 of an inch. Now the ordinary telephone currents are not capable of jumping this air space, small though it is, but the slightest lightning or other high potential discharge would immediately bridge the air-gap, and continne through to carbon block *b*, to spring *d* and thence to the ground. This combination type of fuse and carbon block arrester was found to absolutely protect the public from any danger from lightning or other heavy current, and is the type of arrester generally in use by the large telephone companies. This type is usually placed where the line enters the building instead of on the telephone itself, as was the case with the old ground-plate type.

The next, and in some ways the most important improvement in protective devices, was that which was designed to take care of the sneak-currents.

These currents are frequently so weak that they will not blow the fuses on the arresters, or even ground themselves through the carbon-blocks, and yet by their continued flow they would, in the course of a short time, do great damage to the telephones and switchboards by heating and charring the insulation on the coils of magnet windings, etc.

The remedy for this class of trouble is generally conceded to have been invented by Mr. H. V. Hayes of the American Bell Telephone Co. The apparatus used consists of what is known as a heat-coil, composed of a coil of German silver or other high resistance wire wound around a fusible plug, which plug holds a spring in a state of tension. When current exceeding a predetermined amperage passes through the coil, it heats the same, and the heat thus generated melts the fusible plug and releases the spring, which either opens or grounds the line as arranged.

This device, which can be set to operate on a fraction of an ampere, has proven itself to be capable of doing all that is desired, and is to be found in one fo-m or another in all good exchanges.

To be concluded in October.

Fluid Clutches and their Applications

Second Article.—By Paul G. Tismer

It has often been stated by an enthusiastic press that some day everything would be done by electricity. Enthusiasm will undoubtedly go too far, but things will be accomplished electrically which ought to be done otherwise. It is well to bear in mind that the electric motor is merely a tertiary motor, receiving its power at third hand; a motor itself has no power, but derives its energy from a dynamo, and this dynamo, the secondary, is itself driven by the prime mover, the steam engine, for instance, a waterwheel or gas engine.

Since it means a number of separate losses to convert and transmit the original energy, say the fall of water, it must follow that there is a good reason for not employing the waterwheel direct for driving a machine. With a water power twenty miles away, naturally a belt cannot be placed on the waterwheel to drive a hoist in the town. Therefore an electric motor is employed, receiving its energy over wires from the electric plant.

There appear to be limitations to the electric motor; in other words, the electric motor is an engine with a string to it—the wires leading to the power station—and wires cannot always be strung. It costs money, for one thing; but there are other obstacles. The town authorities, perhaps, will not permit the erection of poles and putting the wires under ground would cost too much, or some property owner will not allow the erecting of poles on property which must be passed.

Looking about for some other agent to do the hoisting, the modern internal combustion or gas engine seems to be just what is wanted; an engine which will run when once started without any attention. Furthermore, it is a prime mover, deriving its energy from a tank alongside containing kerosene, gasolene, alcohol or from the gas mains.

Unlike a steam engine, the speed of a gas engine can be controlled only to a small extent, and it cannot be started under a load. It is true that devices to accomplish these ends have been produced, but no gas engine using them would be suitable to operate a hoist. The fluid clutch must be, therefore, employed. This allows the engine to run continuously and the movements of the hoisting drum are controlled by the simple shifting of a lever, which controls the friction of the oil used within the clutch.

Common friction clutches could not be employed for any such purpose. They would do only for starting or stopping. While a machine may be brought gradually up to speed with such a device, it cannot be set at half speed and maintained there. This, however, a fluid clutch will do. A fluid clutch may be set at any speed, and it will maintain the speed, varying only with the load, i. e., if the fluid clutch be set at half speed with a given load, it will run slower with an increase in load because, as was explained in a previous article, it is a matter of slippage only, and this means slippage under control. At full speed there is no lost motion. The cooling of the clutch can be done conveniently with water from the circulating tank used to cool the engine.

When using two fluid clutches on one shaft a very simple hoisting device can be provided requiring no gearing. The principle of this hoist is that of the differential chain-tackle. The arrangement would be this: The driving shaft carries two sheives of equal size mounted on fluid clutches. Above this and in line with it are two traveling sheives suspended by a cable running over a double sheive. An endless cable travels over the first four shieves. The traveling sheives will remain stationary in relation to one another as long as there is no difference in speed in the driving sheives—the speed of the driving shaft is immaterial. If one of the fluid clutches is allowed by the shifting of a lever to let its sheive slip, then one of the traveling sheives will go up and the other down. The more slippage, the faster the speed of the traveling sheive.

The hoisting cable may be fastened to either of the traveling sheives.

This device besides being light and convenient has another feature which is important: The leverage of the hoist alters with the speed. Light loads can be hoisted with great speed and almost any load can be lifted by hoisting at a very slow speed.

The gas engine can be started so readily that it is only run when needed, it is always ready, consumes nothing when standing still, requires no skilled labor and has an efficiency double that of the steam engine. The fluid clutch does the rest.

The fluid clutch is self contained and will run without attention for months, any leakage of the oil within being made up automatically from a chamber filled with oil, which is a part of the clutch. The fluid clutch, once an experiment, will become a necessity in a short time.

A Distilling Burner for Crude Oil

A new burner for crude oil which promises valuable results has been recently perfected by H. A. House, of Bridgeport, Conn. The burner is intended to be self-cleaning, self-adjusting and self-lighting after it is once started, and in addition to this it acts as a still when using oils with an asphalt base, such as those of Texas and California, burning all the lighter products and returning the asphalt as a by-product.

The vaporizer, which is located over the flame, is not in the form of a coil, but is made of a piece of iron, cast round, with tortuous grooves or channels, through which the oil to be vaporized passes. It is impossible to heat one part more than another because the flow of oil keeps it at a uniform heat. It is situated in the "blue" of the flame and out of the focus of the white flame.

The burners are provided with high and low pressure ports or orifices for the escaping vapor and are arranged from single to quadruple ports, depending upon the size of the burners, the volume and intensity of the fire being regulated by the amount of oil allowed to flow into the burner. The burners are capable of an adjustment and variation of from 50 per cent. above their rating to 80 per cent. below. They produce a round, disc-like flame, white and clear, without vibration.

The ports for the escaping vapor are so arranged and covered by weighted spindle valves, having angular veins, that the escaping vapor lifts them from their seat and causes them to revolve, the spindle dislodging all particles of carbon or other obstructions which might form around the orifice. As the fire is turned down or diminished the orifices are proportionately closed by the weight of the spindle valves, so that whatever vapor escapes or burns, is under a given pressure.

A large burner, with a number of

ports, is virtually a series of burners. When burning a small fire the upper port is opened at the lowest pressure, giving off from a one horse power to a twenty-five horse power fire. If more fire is required, the flow of oil is increased. This in turn increases the amount of vapor, which, being unable to escape through the small, low-pressure port, lifts the next weighted valve, which is of longer focus, and produces a larger flame, and so on. Each length of focus is arranged with reference to the size and length of flame, in order to keep the vaporizer in the blue, or cooler, part of the flame.

The distilling feature of this burner is an important function. As the crude oil enters at the top of the vaporizer it becomes heated, and as its course is continually downward, all the heavy and basic products move with the circulation of vapor. At the base of the burner a large chamber is provided for the non-volatile products, and they pass out through a pipe to the outside of the boiler to be recovered. Non-volatile products can be consumed if it is so desired.

There is a method provided for relighting the flame of the burner should it become extinguished. Water may become mixed with the oil and pass into the vaporizer, or the flow of oil may temporarily cease and extinguish the fire, and if not instantly relighted may prove disastrous at the first flow of vapor.

Through the top of the round vaporizer is a circular opening, over which sets a hollow cast iron bulb, filled with broken fire brick, with a connection through the generator by a perforated paper tube, through which a part of the burning vapor passes. This igniting chamber becomes a glow of incandescent fire brick, which will remain hot long after the fire becomes extinguished. In case the fire has been put out, the first escaping hydrocarbon vapor that afterward leaves the upper opening of the burner passes up to this chamber, becomes superheated and ignited by the incandescent fire brick, and exploding down the tube to the source of the escaping vapor, ignites the flow.

The burners require no compressed air or steam pressure, a stand-column or pressure against the oil being all that is required to feed it through the vaporizer. The fire can be regulated automatically by the steam pressure of the boiler, governing the flow of oil to the burner. The burners can be made in sizes of from one horse power to a thousand horse power.

Trolley and Track Scrapers

Ingenious devices for scraping dirt and obstructions of that character from street car tracks and for clearing ice from trolley wires have been made recently by Fred M. Root, of Kalamazoo, Mich. The track scraper consists of a wrecking arm carrying a set of tools for clearing the track. These tools are all supported by spring-steel arms. One tool always rests on top of the rail. When the motorman wishes to bring the others into play he has merely to draw a hand lever on the front platform to do so. The arrangement for cleaning ice and snow from trolley wires consists of three knurled rollers mounted on a framework which is pivoted on the axis of the trolley wheel. By pulling a cord the conductor can force these wheels up against the trolley wire. Two of them, which stand upright, clean the sides of the wire, while the third one cleans the lower portion of it, so that the trolley wheel, which follows the cleaning device, may get a good contact with the wire. The side wheels are mounted on springs so that they may separate to receive between them the ice-coated wire.

Polished Blades Forged Electrically

"The way to make excellent cutlery is, without a blacksmith, without a grinder, and without a polisher."

Such is the startling declaration of an inventor who is preparing to manufacture blades for razors and other fine cutlery by a process which is indeed revolutionary.

Under the only methods of manufacturing cutlery now in use anywhere in the world the blacksmith, the grinder and the polisher are each most important factors.

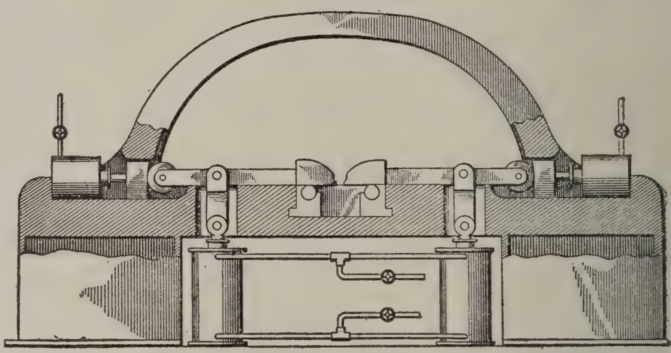
It is difficult enough to imagine how any one of these is to be eliminated from the process but that they are all three to go truly makes one marvel.

Apparently the only skilled workman left, under this process is the temperer. Electricity is to be the wonder worker, aided by vacuum pumps, refrigerating machines and clever power forgers. The new process is the invention of Joseph Misko, M. E., of Pittsburg, Pa.

"Cutlery is made today exactly as it was made a hundred years ago," Mr. Misko declares, "and it is the exception to get a blade which will hold an edge for any great length of time. This is not remarkable when one considers how easy it is for the blacksmith to burn the steel by over-heating, for the grinder to draw the temper by too rapid grinding and for the polisher to ruin whatever blade has escaped accident before it reaches him.

"Lathe tools are used every day which cut through a mile of iron or steel without being resharpened, yet out of such excellent steel the cutler finds it almost impossible to make a razor blade which will shave a man once over without repeated stropping."

In the Misko system the usual process of manufacture is reversed. The grinding and polishing are done before the forging is begun. A rod of steel ten feet long or of any other convenient length, is taken for this initial process. The rod is ground on all sides and polished. In this state it contains just enough material for the forming of the blades into which it is to be converted. It is now ready for the forging.

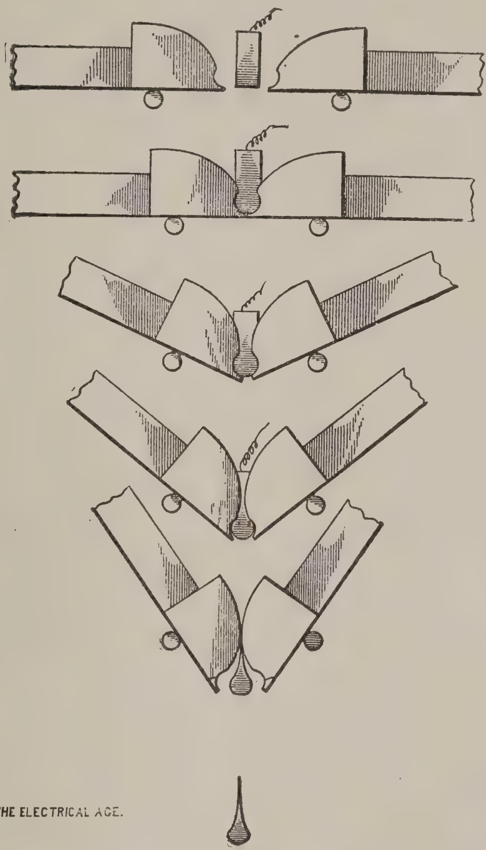


The Electric Forging Furnace.

The forging machine is a tunnel of steel a little longer than the steel rod. Lying along the middle of this tunnel and with their ends separated enough to receive the prepared rod and yet not touch it, is a double row of dies reaching almost to the full length of the rod.

Each pair of these dies is ready to form a blade, each die forming one side of it. The upper part of the tunnel is an arch of steel which trusses the dies together and serves also as a guide to them in their forging operation. At each end of the dies are hydraulic presses and there are more of these below the dies on either side.

The operator thrusts the rod of cold polished steel into the tunnel and between the die heads. He closes the door and touches a button. Powerful pumps quickly exhaust the air out of the machine. As the door closes and seals itself, electrical connections are made on either end of the polished steel rod. As the air disappears from the inside of the chamber the electric current is turned on. In a few seconds the rod is at a cherry-red forging heat. Another touch by the operator and the dies close together, forming with their ends the backs of the blades into which the rod is to be transformed. Another touch and the far ends of the dies begin to travel up the arched sides of the tunnel. As they move the inner ends close more and more with a revolving motion, squeezing down the steel between them until at the last it is forced into a very edge.



Showing How a Razor Blade is Formed.

The operator returns the dies to their places, cuts off the current and opens the machine. The steel rod has been transformed into a series of shining polished blades. There are nicks between the blades, marking where they are to be broken apart later. As there was no air in the forging chamber the blades have lost none of the brightness of the polished rod of steel.

The next operation is the hardening. Again the rod of blades is placed in a tunnel and the air is exhausted. This time instead of dies there are on either side of the rod heads of metal indented to fit the blades and inside each head runs a stream of refrigerating brine, cooled to below the zero of the thermometer. The current is again applied to heat the rod of blades and when they are glowing the refrigerated heads close together, chilling the thin steel, but doing it so evenly, that it is claimed that there is no tendency to produce warping or cracking.

Still the blades are bright and polished when they come from the hardening machine. To put the finishing touch to the blades, Mr. Misko has devised a refrigerated grinding and polishing wheel on which the cutlery would be kept from losing its temper though it were ground dry as is the custom. These wheels are of hollow iron with the abrasive substances cemented to their outer edges and the whole kept cool by a stream of freezing brine run through the inside of the wheel. A factory to make use of this process will soon be erected at Newcastle, Pa.

Wind-Shaken Ties Caused Wreck

By Joseph E. Ralph

"A Train Upset" was a newspaper announcement which startled me on the evening of a July holiday last summer. I was startled, not alone because I was expecting my wife and daughter home on that train, but also because an accident of such a kind ought to be well nigh an impossibility on a railroad whose business was strictly of the first class, carrying practically nothing but passengers and these of the high-priced-lives variety.

The train to which the accident had happened was a well-known express which has upon its route some of the most fashionable resorts both for summer and winter. A visit made to the scene of the wreck resulted in discoveries which startled me as much as did the story of the accident itself.

As my purpose is to call attention generally to a new danger in railroading and not to attack any particular railroad management, I shall not give any closer clue than is heretofore mentioned to the locality of the wreck or the name of the road, except to say that the wreck occurred within fifty miles of New York city.

The visit to the scene of the wreck was made on the day following the occurrence and it was made in the company of an old railroad man of skill and high standing. His suggestion was that "railroading is just as positive a science as chemistry" and that a little modest Sherlock Holmes treatment of the locality before the clues were effaced, would tell the tale of the wreck in unmistakable language.

About a mile and a half before reaching ——— station, while riding on fairly smooth track, we passed the scene of the accident. On alighting we found we were at about the middle of a long stretch of absolutely straight track laid on a fill, raised a few feet above low land, which was mainly salt meadow, with good drainage ditches on either side, and a road-bed of cinder as smooth and level as a bicycle path, with ties regularly spaced and fair looking (to me). I could see no excuse for any vagaries by passing trains and suggested that we sit down right there, and wait for a train home rather than walk a mile and a half in the broiling sun over such "fine" straight track, and charge up the accident to a visitation of Divine Providence.

So down we sat and friend Railroad started in with some reminiscences; how some years ago this part of the road was single-track but the summer and winter resort business increased to such an extent that something like eight years ago it was double-tracked. Now, that delightfully smooth cinder-path look was —to him—suggestive of suspicion. The track certainly bore no evidence that it been disturbed even to replace poor ties.

This discourse led to our walking along and closely inspecting the ties. They were split out southern ties, all of an age without any exception and although showing a clean smooth face proved to be *coming to pieces*.

"Wind shake," said friend Railroad

He then called my attention to the "wear" of the rail into ties at the outside of the rail base. This was quite deep on nearly every tie.

"Another proof," he said, "that those ties had been in service not only a long time but that they had never been quite equally rammed."

There was no other apparent reason for some ties not being worn.

"Why do the rails so seldom cut into the ties on their inside edge?" I asked.

"I am only a transportation man," he said; "but track has come to be the hobby of my recent acquaintances from the technical colleges. I am afraid that even they are slaves to custom."

Rails always showed the spreading tendency from the making of the running faces of the wheels cone shaped, to facilitate their tracking around curves. This also tends to make them gravitate to the center on straight track.

"So far as I know rails have always been made reversible and yet old track men tell me that the best results are obtained by wearing a rail out where it is first laid.

"That thrust is there and I can see no reason in the manufacture that would prevent the making of the rail base better to withstand it."

By this time we had jogged along about half a mile and friend Railroad said he was afraid I was not much of a Sherlock Holmes. Had I not noticed, he said, the piles of new ties along the road? I certainly had seen them, but until he suggested the connection, it had not struck me that some one had evidently concluded that it was full time to make heavy renewals of ties on this section.

His next suggestion—that this knowledge was of long standing—was another rub, for I did not see that point until he called my attention to the fact that the ties had been piled alongside the track so long that nearly half the piles had been on fire one—or more—times. As he said, they must have been there a long time or else the motive power department was no better than the maintenance of way department.

Just where the accident occurred we found a large gang of men at work finishing up the re-laying of about 1,000 feet of track with new ties and rails that seemed to have been slightly used. The old rails, badly tarnished, were there as well as the remnants of the old ties. About half the old ties still held their form but looked very bad. The innumerable cracks in them were only too evident when they were turned over and the "dead" condition of the timber was evident from the short breaks that many had. These showed no sign of splintering.

The other half of the ties was simply piles of kindlings. They had absolutely no solid heart, not even enough to hold a spike or to hold the rails to gauge.

For a few feet at either end of the repaired track the rails had been "spiked in" *a trifle* to bring them to guage but not enough to indicate that the track was "wide."

The accident occurred right in the center of the three miles we had traversed and every foot of this was as nearly alike as the eye could tell. We could see no reason why the coning of the wheels should not push any pair of rails apart or upset a rail at any point.

Instead of retracing our steps we kept on to the next station and looked the track over. We found that a good deal of work had been done on the last two miles. Long stretches had new ties or new ballast but all was left woefully unfinished. There were sections with new ties and ballast and others with new ties and with the ballast all out or with the ballast so generously applied that it was piled as high as the rails. There seemed to be no rule about the subgrade; in some places it was graded up neatly with a shoulder some distance beyond the end of the ballast line while in others it ran in a long slope from inside the line to the ditch. There were also many kinds of ballast. There were fine and coarse engine or furnace cinders, hard coal screenings, several kinds of furnace slag and broken stone. The ballast not only ran from nothing to rail-full and with ties covered beyond the rail, but, curiously, a long section had broken stone nicely placed between the ties and a solidly packed mass of fine cinders a distance beyond. As there were good ditches at this point the special reason for this peculiar treatment was a mystery.

There was a row of line stakes between the tracks all along but Mr. Railroad called my attention to the fact that while the "line" was good the "surface" was a good deal like the ballast; sometimes one track had been raised and surfaced six to eight inches and sometimes the other, and at the ends of these spots there was a short run off as if the job had been hurriedly left. Where the new surfacing had not been attempted there was quite a general tendency to "low joints."

He also called my attention to the curious fact that where the track was electrically connected to operate road-crossing signal gongs the rule seemed to be to connect one rail on the outside and the other on the inside. The reason for this we left as unsolved just as we did the double supply of wires from a draw-bridge over a river to the warning signals —half of which were more or less straggling alongside and up on the meadow.

As we neared our station we found a good many more new ties in or along the track. These seemed to be of northern growth—ordinary timber faced on two sides—but cut from such dead timber that the sap-wood had so nearly decayed that it had been trimmed off. Some had a very wide face but many were very narrow and altogether they were just about good for "rejecteds."

I probably have not enumerated more than half the little "pointers" my railroad friend called my attention to but I voted "for acquittal" for the trainmen for that wreck. But certainly some one is responsible and the company is running a terrible risk in using such track for heavy and fast expresses and for the heavy passenger traffic to the resorts along its line.

Electricity on the Pyrmont Bridge

The new Pyrmont bridge at Sydney, New South Wales, which was formally opened to traffic on June 28, is not only the largest structure of its kind in Australia, but it is strictly up to date in its appointments. The draw, which weighs 800 tons, is operated by electricity and is controlled by the touching of a button. It can be opened or closed in 44 seconds. The total length of the bridge is 1,758 feet. The swing span is 223 feet long. The slewing of the draw, lifting its ends, operating the gates, controlling the traffic and the lighting of the roadway are all electrically done and are controlled by a man stationed in a conning tower at the center of the bridge. Both the slewing and lift motors are carried on a platform inside the drum, the former working through a train of gears a vertical shaft, on the lower end of which is a cast steel pinion meshing with a cast steel rack secured to the top of a pivot pier, while the end lift is effected by means of cones on horizontal shafts worked by a 35 horse power motor gearing on to a longitudinal shaft running the whole length of the bridge span.

Protective Paints for Iron and Steel

By B. G. O'Connor.

To people interested in iron and steel (and in this age of machinery who is not?), the protection of the metal from corrosion is a serious problem. Iron and steel have a very bad quality in common, that of rapid disintegration if not protected from moisture and air. In other words, they rust and keep on rusting more and more. The chemical affinity of iron and steel for oxygen is a great misfortune, and many are the means devised to check this failing. The principal one is painting. The object of painting is to cover the metal with a thin layer of some substance impervious to air and moisture and not easily rubbed off by friction.

What have we learned from experience and from science in this regard? First, that oils are least disposed to combine chemically with water, and, second, that oils alone cannot be used as a protective coating for metals. In the first place, to prevent the coating from rubbing off at the slightest friction, the oils must dry with a hard outer layer. In this drying process in which the oil atoms absorb a certain amount of oxygen, a shrinkage takes place which leaves interstices, or pores through which air and moisture have access to the metal. A finely powdered substance is therefore mixed with the oil before it is applied over the metal surface to fill up these pores. This substance is generally known as the pigment, and the oil is called the vehicle. The two combined form paint.

Centuries of experiment and study have shown that no oil has yet been found to equal pure linseed oil as a vehicle for paint under ordinary conditions, and it may be set down as an axiom that nothing but pure linseed oil should be used as a vehicle for paint on iron and steel. There are legions of substitutes on the market with more or less pretentious claims, but none so far has proved its equality with linseed oil in the only absolutely convincing way, by practical use.

In the matter of the solid ingredients or pigments there is no such absolute unanimity. Under certain conditions, certain pigments act better than others, so that to make a judicious selection in this matter it will be necessary to establish a few general principles.

Two things are essential in a good pigment: First: It must mix intimately with the oil, so as to remain in suspension in it for some time, and consequently must be susceptible of grinding into a very fine powder. Second: It must not contain any elements producing chemical or electric action when brought in contact with iron and steel.

Theoretically, all pigments in paint are supposed to be entirely surrounded by the oil and insulated by it, but experience has proven the contrary in several instances. The principal pigments in use today and fulfilling more or less the above conditions are products of lead and zinc, iron oxides and carbons.

White lead, which is a carbonate of lead, and red lead, an oxide of lead, and zinc oxide are so well known as to need no further description. When pure they make excellent paints mixed with pure linseed oil, but unfortunately they are easily adulterated with cheap substances and these adulterations are sometimes hard to detect except by a searching chemical analysis or the practical test of time.

Iron oxides are also very largely used in paints, and are, generally speaking, good as pigments in proportion to the percentage of ferric oxide they contain.

Of late years engineers and others interested in the protection of iron and steel from rust have been turning their attention to carbons as a pigment for this purpose, and the results due to the use of these paints seem to warrant the assertion that they are so far the best adapted for the purpose. Pure carbon is absolutely inert; that is, it is not affected by acids or sulphurous gases which do affect lead products and iron oxides. It is also susceptible of great fineness, more so than any other substance used in paints, and its density is such that it does not settle in the oil, but remains in suspension for an almost indefinite time.

Carbon pigments may be roughly divided into two classes: natural carbons known under the general name of graphites; artificial carbons produced from the smoke of various substances.

The first class, or graphites, is now largely used as pigment and varies in efficiency according to the percentage of pure carbon contained, the form it takes and the nature of the foreign substances with which the pure carbon is contained The graphites have, however, one drawback; they do not as a rule adhere well after the first coat, owing to the silicious nature of the foreign substances they contain, which also affects their durability.

The second class, or smoke carbons, varies very much both as to the purity of the carbon and the molecular form it takes. The most common form, known as lampblack, is produced by the combustion of petroleum oil and is very largely used in making black paints. Within a few years, however, a new kind of carbon black, the product of natural gas smoke, has been made commercially available, and this carbon black seems both theoretically and practically to approach nearer to the ideal pigment than any other. It is almost pure carbon and its molecular form seems to give it an adhesiveness and a homogeneity when mixed with linseed oil that no other pigment possesses. Its density is but slightly greater than that of the oil itself and it remains unaltered indefinitely.

To sum up the present condition of the problem referred to at the beginning of this article, it is, that a number of paints protect iron and steel from rust for a few years, but none has yet been discovered which is a permanent protective. Pure pigments and pure linseed oil give the best results and should be absolutely insisted upon wherever paint is used on iron or steel. Of all the pigments generally in use today carbons have shown the best results, and it may be considered a rule that the purer the carbon is, the better will be the paint.

Safety Against Trolley Accidents

A clever arrangement for at once securing safety along trolley roads in case of fallen wires or other accidents, is the invention of Heaton & Smith, electrical engineers, of London, England. The device is contained within a cast-iron box which may be fastened to a trolley pole. Within is a grounding switch which, if left to itself, would ground the trolley wire. It is held open by a cord which is released by the breaking of a pane of glass. In case of an accident, all that is needed to make the section safe is to break this pane of glass. The grounding of the line gives notice at the power house and repairs can be sent at once to the proper section. So long as the line is grounded there is no danger to the workmen in making the repairs.

Digest

ENGINEERING LITERATURE OF THE MONTH

Experiments With Petroleum Briquettes

The French Navy is experimenting on petroleum briquettes, made on the Gonnet process, with a view to their adoption. They are said to be composed of ninety-seven per cent. of carbon and three per cent. of hydrogen. Volume for volume, they are half the weight of coal, and leave no more than from two to three per cent. of residue. There is no cinder, the briquettes preserve their form like coal when burning, there is no smell and no smoke, and they may be damped without deterioration. They burn without exploding or sending off sparks, and give a large and clear flame. The mean calorific force of these briquettes is 13,000 calories. Other briquettes are made, half coal and half petroleum. They are cheaper, but are less advantageous, owing to their density and less heat-producing power, which is 9,000 calories. The oil used comes from the United States, the French article containing too much fatty material for the purpose. When made from cheap petroleum and sold in large quantities, the price of the briquettes is about the same as that of coal.—*American Manufacturer and Iron World.*

An Electro-Magnetic Rectifier

Mr. G. H. Morse describes apparatus arranged at his suggestion by Mr. C. R. Cushman, in the electrical engineering department of the University of Nebraska. The object of the experiment was to see if an alternating current could be divided up into two uni-directional fluctuating currents by means of an electro-magnet. The experimenter used an arc between three carbons. Two of the carbons were placed side by side, and the third carbon opposite them. Across this space, where the arc played, a strong magnetic field was established by means of an electro-magnet. The connections were such that the current in one direction passed only through one of the carbons of the pair and in the opposite direction through the other carbon. That this was so was ascertained by means of ammeters and by altering the strength of the field, which was done by varying the position of the magnets. A point was reached at which the current in each of these alternative circuits was just half of the alternating current in the main, and had no reversal. It seems that the electro-magnet made the arc jump from side to side according as the direction of the alternate current varied. — *Electrical World and Engineer.*

Combining the Automobile and the Cinematograph

French ingenuity has made the automobile the servant of the cinematograph in the following manner: A voiturette has been fitted with a large box enclosing a small dynamo, switchboard, wires, etc. When it is desired to exhibit the cinematograph, the dynamo is fixed to the front of the car, then connected with the motor, and there is your electric battery. The performance over, motor and dynamo are detached, the dynamo replaced in the box, and the car is ready to run to the next place of exhibition. Considering the heavy transport the cinematograph usually necessitates, this seems a very useful application of the automobile.—*Automotor Journal.*

An Iridescent Coating for Copper

A method of forming brilliant and variegated surface colorings upon metals through the agency of electrolytic deposits consists of connecting the article to be coated as the anode in an alkaline solution of litharge and carefully regulating the current. This method depends upon the deposition of exceedingly thin lead films of lead peroxide. Such films give most brilliant interference effects, resembling the changing tints in a soap bubble and being, in fact, attributed to the same optical phenomenon. Articles so colored have found much favor since the early days of galvano-plastics.—*Electrical World and Engineer.*

Electric Canal Towage in Belgium

A novel system of electric haulage is that installed on a canal between Brussels and Charleroi, which has a length of fifty miles. The hauling is done by means of tractors which can draw five boats laden with seventy tons at a speed of a little over two and a half miles an hour. These tractors are supplied with current from an overhead line by means of a triple trolley and are driven by five horse power, six pole, three phase motors. A leather pinion with twelve or sixteen teeth is fixed to the axle of the motor and drives a shaft on which there is a clutch, with which it is possible to drive a chain connected with a driving axle or with a conicle winch on the other side. The tractors run along the bank of the canal and where this is too narrow to admit of passing they simply exchange boats and return on their own road. In passing through towns where the river banks are covered with warehouses or in going through crowded locks, electric tugs or launches are used. Although the tractors have been proven powerful enough to haul from four to five boats, the Belgium government, possibly through fear of disintegration of the bank by the effort of the tractor or the "wash" of the boats, does not allow this. The boats are therefore hauled singly, which is a more expensive method, particularly as regards the item of labor. The commercial speed of hauling is four kilometers per hour while the speed with horses is between one and nine-tenths and two kilometers per hour.—*Electrical World and Engineer.*

Copper

The total production of copper in 1901 was 512,131 tons, as compared with 486,039 tons in 1900. America produced 262,206 tons, a decrease of about 6,000 tons. Next in order come Spain and Portugal, with an output of 53,621 tons, and Australasia third, with 30,785 tons, as compared with 23,000 in 1900. The gold production of the United States for 1901 was $80,218,800. The value of the copper produced in the same year was $102,917,000.

Platinum in Porto Rico

The interesting and probably important discovery has been made that platinum exists in Porto Rico. It is found mixed with placer gold got on the island from the negro peons who were panning it. Ignorant miners are so likely not to know platinum and to sort it out and throw it away when it appears in the pan with gold that it is probable the quantities that may be found in Porto Rico may be larger than would appear from this small trace. At any rate, what there is can probably be got out very easily as a by-product in gold placers which yield from 15 to 35 cents to the pan. That which was found came from Corozai, in the northwestern part of the island, about forty miles southwest of San Juan, whence it is reached by good wagon road.—*San Francisco Mining and Engineering Review.*

Reduction by Aluminum

The exothermic or endothermic reaction of aluminum is made use of in an electro-chemical method for reducing oxids, a patent for which has been granted to Dr. Frederick C. Weber, of Chicago. He attributes the occasional explosive violence of the "thermite" reactions largely to the presence of water, free or combined, in the reducible oxid, and avoids the difficulty by a preparatory treatment through the agency of electrically applied heat; for initiating the reaction, it suffices to fuse a portion of the aluminum, and this is accomplished by its inclusion in a second circuit. The objects attained are thus a regulation of the reaction and the avoidance of a contamination of the product by the base of an easily reducible oxid such as is ordinarily used, with aluminum or magnesium, for producing the initial high local temperature. The arrangement of the charge is as follows: In the bottom of a metal crucible, lined with graphite or lime and an additional lining of mineral wool, mixed, if desired, with lime or magnesia, is a spiral of fine aluminum wire connected in a circuit; this wire is surrounded by its atomic equivalent of an oxid in a state of very fine division. A sheet of tissue paper separates this oxid from the main charge comprising granulated aluminum in admixture with the oxid, such as boron trioxid, to be reduced. In this main charge also, atomic proportions of oxid and aluminum are observed, the weight of the main aluminum helix and of a supplemental crucible lining of aluminum being considered in estimating the proportions. This large helix of aluminum is included in another circuit, and in operation sufficient current is passed to thoroughly dry and otherwise prepare the charge, whereupon by shifting the current through a smaller helix, the wire is fused and its reaction with the surrounding oxid initiates the general reduction; as the reaction spreads rather slowly through the coarse mixture, it is possible to add additional quantities as required. It is stated also that by heating the mixture by means of the main helix to a temperature just short of the fusing point of aluminum, reactions may be obtained with oxids, which require for their reduction a higher temperature than is furnished by the oxidation of aluminum. —*Electrical World and Engineer.*

How the Secret of Making Cast Steel Was Stolen

The history of cast steel presents a curious instance of a secret stealthily obtained under the cloak of an appeal to philanthropy. In 1760 there lived at Attercliff, England, a watchmaker named Huntsman. He became dissatisfied with the watch springs in use, and set himself to the task of making them homogeneous. He succeeded; his steel became famous, and about 1770 a large manufactory of this peculiar steel was established at Attercliff. The process was wrapped in mystery, faithful men were hired, high wages paid, and stringent oaths administered. One midwinter night, as the tall chimneys of the Attercliff Steel Works belched forth their smoke, a traveler knocked at the gate. It was bitterly cold, and the stranger awakened no suspicion. Moved by motives of humanity, the foreman let him in. Feigning to be worn out with cold, the fellow sank upon the floor and soon appeared to be asleep. That, however, was far from his intention. He saw workmen cut bars of steel into bits, place them in crucibles, and thrust the crucibles into the furnace. The fire was urged to extreme heat until the steel was melted, and then drawn out and poured in liquid forms into molds. Mr. Huntsman's factory had nothing more to disclose; the secret of making cast steel had been stolen.—*San Francisco Mining and Engineering Review.*

Current Engineering and Scientific Notes

ABSTRACTS FROM THE FOREIGN PAPERS

What Light Costs

Prof. Vivian B. Lewes, the celebrated expert, made public the following estimate as to the cost of lighting by various methods, in a lecture recently delivered before the Petroleum Institute of London, England:

COST OF 1,000 CANDLES PER HOUR.

	Cents
Electricity 7 cents per unit:	
Incandescent	28
Arc	7.5
Coal-gas:	
Flat flame	36
Argand	24
Incandescent	4.5
Incandescent high-pressure	3.5
Oil:	
Lamp (oil at 16 cents)	14.5
Oil-gas (oil at 8 cents)	12.0
Incandescent lamp (oil at 16 cents)	4.5
Incandescent air-gas (spirit at 20 cts.)	4.0
Kitson lamp (oil at 16 cents)	2 0

Carbon a Non-Conductor Under High Pressure

London Invention

While melting carbon and maintaining it in the liquid condition, Dr. A. Ludwig discovered the curious fact that under a pressure of 1,500 atmospheres—the pressure employed in the electric furnace to achieve the above result—the electric arc failed, the current refusing to pass even when the voltage was much increased. It is supposed that as the carbon passed into the liquid and transparent state, it assumed a rare allotropic form, becoming a non-conductor. The experiment was too brief for a study of this condition, but was made to include a sudden cooling of the molten carbon by a flooding with water of the interior of the pressure vessel. Though minute diamonds were recognized in the gray powder thus obtained, the result was not wholly satisfactory.

Vibratory Anesthesia

Some years ago a man went to sleep on a railroad track and was decapitated by a train. The doctors who examined his body after the accident stated that they believed him to have been resting on the track, and that the vibration of the rails produced a condition of sleep and semi-coma or genuine anæsthesia, so that he was absolutely unaware of the train's approach.

Other vibratory means of producing insensibility have been tried from time to time and all of them seemed to have a certain amount of merit, but a new electrical apparatus, which was primarily intended for dental work, seems to have been the most successful.

In recent experiments conducted in Paris by M. Regnier, who is head of the electro-therapeutic laboratory of the Charity Hospital, high frequency electric currents were employed with entire success. The method followed by the experimenter was as follows:

A device invented by M. Gaiffe was placed in connection with an electrode and the part to be anæsthetized, the electrode being modelled from a clay cast and rendered a perfect conductor by an interior covering of thin sheet tin and a metallic powder. To absorb the heat produced by the current, the tin sheet was covered with a layer of damp asbestos paste.

M. Gaiffe's invention is composed of

a coil having a thirty centimeter spark, a Contremoulin interrupter and an Oudin resonator connected with a petroleum condenser. On the conductor is placed a galvanometer, which connects the resonator and the electrode, and indicates the intensity of the current passing into the patient's body. Insensibility is produced within a few moments after the machine is started.

A Solder for Aluminum

London Electrical Review

In the making of a valuable solder for aluminum, four points must be considered: It must be composed of some metal or alloy which fuses at a low temperature, so that it shall flow smoothly from a copper, nickel or aluminum soldering bit. It must not oxidize appreciably nor segregate when heated to its melting point on the bit. It must, as a whole, be as electro-positive as possible, so that it may not be capable of forming with the aluminum object to which it is applied, a galvanic couple of sensible voltage. The fourth requirement concerns the aluminum surface itself; it must be cleaned from its film of oxide either by mechanical or chemical agency during the act of soldering; that is to say, while the metal is protected (if possible) by the molten solder from the surrounding atmosphere.

Dr. Richards' solder for aluminum has been in existence for eight years. It was patented in Great Britain under the name of W. A. Briggs, on November 9, 1892 (No. 20,208). The active ingredient for removing the oxide is phosphorus, and, according to the specification, the solder is prepared by mixing 32 parts of tin with 1 of phosphor-tin containing 5 per cent phosphorus, then adding 1 part of aluminum, previously melted with 8 parts of zinc. It was also stated in the English patent that the melting point of the solder might be lowered by increasing the percentage of tin, while its mechanical strength could be improved by raising the proportion of aluminum and zinc. Further experience with the material has shown, however, that the normal composition, as given by the formula of the specification, tends to liquidate when melted a second or third time; and so the solder is now composed of aluminum, 1 part; phosphor-tin, 1 part; zinc, 11 parts, and tin, 29 parts. It is used much in the usual way with a copper or nickel bit; but the aluminum requires to be first "tinned" (i. e., coated with the solder as is done in soldering copper or sheet-iron), before the two pieces which have to be united are brought together. No flux is employed either on the bit or on the sheets, as the contained phosphorus effects the cleaning necessary. This solder has been adopted largely in America, and yields results probably as good as can be expected with aluminum; it has also been recommended by the authorities of the Neuhausen Aluminum Works. It is known to be permanent for over three years, to be as strong as, or stronger, than the aluminum itself, to be reasonably cheap, to have a color matching well with the rest of the object, but to darken after the lapse of time.

Cervera System of Wireless Telegraphy

La Nature, Paris

For about a year the scientific press of Spain has contained details of the system of wireless telegraphy invented by Commandant Julio Cervera Baviera, of the Spanish navy. Numerous experiments conducted with this apparatus on Spanish territory have also been reported, chief of them being the trials held under the auspices of the War Department, between Ceuta (an island between Gibraltar and Africa, and near the African coast) and the Spanish town of Tarifa, which are distant about thirty-four kilometres. Some of the articles recently published claim the speed of twenty-four words per minute for Sr. Cervera's system. If verified, this claim will show it to be more than twice as rapid as the Marconi system. It has also been announced that a company has been formed in France to exploit the Cervera wireless telegraph system in connection with the Hughes apparatus, thus having a combination whose speed should eclipse all previous records of any sort for transmitting and recording such messages.

The Cervera transmitter is similar to that described by the chief of Italian engineers, Della Riccia, in the *Rivista di Artiglieria e Genio*, September, 1897, A manipulator and a battery of accumulators or piles (galvanic or electric batteries), or a dynamo of continued current, are put in circuit with the primary of the induction coil furnished with an interrupter and a condenser. The source of energy and the interrupter can be replaced by an alternating current machine. The secondary boundaries of the induction coil come out at the terminals of an oscillator connected across the condensators, respectively to the ground and to the antennae. The condensators augment the capacity of the system and consequently the energy of discharge given by C V2, where C is the capacity and V the difference of potential. The close connection within the ground in the Cervera negative transmitter is not even necessary; it can be replaced by other agencies. For the rest, its suppression diminishes but does not arrest the transmission.

The Cervera apparatus is characterized by two species of transmitters equally interesting. The first is a manipulator like a piano keyboard. In touching with the finger the button or touch of ebony which carries the letter or sign to be transmitted, it produces the points which represent the letter or sign of the Morse alphabet. It is a keyboard similar to that of a writing machine. Lastly, Señor Cervera has employed a manipulator in which he suppresses absolutely the rupture sparks. Señor Cervera obtained this by putting one part to the earth directly and the other across a condenser, where the interruption of the current takes place. The Cervera receiver approaches very much the last form of the Marconi receiver, except that it is, to our mind, more complicated. The antenna is connected with the earth across the primary of a little transformer, of which the boundaries of the secondary are divided in the middle by a condenser, ending at the electrodes of a coherer. The battery, which is in the circuit of the coherer, works a first relay, closing the circuit of a second relay which has four roles; first, to work a Morse; second, to work a "knocker" for disconnecting the sensitive tube (which is easy of regulation and is made of filings and electrodes of magnetic metal); third, to interrupt the current of the battery of the coherer (this is confined to the armature of the knocker); fourth, to interrupt the circuit of an electro-magnet, which governs by magnetic cohesion (consequently by the pressure of the filings) the sensitiveness of the radio-conductor. It is to be noticed that each one of the three parts, the Morse, knocker, and the electro-magnet, has an electric source; this, with the battery, coherer and relay, makes five electric sources in the Cervera receiver. This being so, it is difficult to admit, as the daily journals have just announced, that with the Cervera system they have been able to communicate at a speed of twenty-four words a minute, whereas with the Marconi system an average speed of only ten words (of five letters) can be attained.

With Our Foreign Consuls

An Electrically Driven Fire Pump.—Consul Haynes, at Rouen, France, sends the following interesting notice of a fire pump which was recently tested in that city: An experiment was lately made at the Hotel de Ville with a new fire pump invented by Mr. Robert Lefèbre, captain of the Rouen fire company. This pump is so small that only a very light two-wheeled cart with one horse is necessary to transport it. The dynamo is so constructed as to be run by a current from the street car or electric light wires, and is brought into contact with them by means of a hooked pole or rod. The pump furnishes a pressure capable of throwing a jet of water, with a force equal to that of a steam pump, to a height of over 100 feet. It also has the advantage of being placed quickly in action wherever there is an electric current. For this operation, it took only three minutes in the experiment, whereas to get a steam pump up to the same pressure takes fourteen minutes.

The Telephone Service of Germany.—According to Consul-General Guenther, stationed at Frankfort, Germany, the telephone service of Germany is carried on by the Post-Office Department. According to an official report, the cost of the entire plant, up to April 1, 1902, amounted to about $42,000,000. Up to April 1, 1901, the cost had been $36,600,000. At the beginning of the present year, 2,024 places had public telephone stations, with 322,281 miles of line. These stations averaged 2,205,966 conversations per day, or about 804,000,000 per year. The following cities have the greatest number of public telephone stations:

	Number.
Berlin	51,561
Hamburg	20,823
Frankfort	9,271
Dresden	8,914
Leipzig	8,725
Cologne	7,484

The total number of employees in this service is 8,189, of which Berlin has 1,712.

Electricity for Cultivation of Plants.—A Frankfort journal of recent date describes experiments made by Mr. J. Fuchs, a wine producer of Elba, in the use of electricity in grape culture, writes Richard Guenther, Consul-General at Frankfort, Germany.

He planted, some years ago, four fields with native grapevines, in the midst of a district infested with phylloxera, and treated two of these fields with "air electricity." The difference in the development of the grapes of the fields was apparent; those treated with electricity yielded better results, both in quantity and quality, and were not infected with phylloxera, while the other fields were.

Mr. Fuchs has demonstrated that electricity increases the fertility of the soil. It is not sufficient to simply conduct air electricity to the earth, but there should be a direct metallic connection of the electric conduit with the main stem of the plant. On a field of about 2½ acres, five masts are erected, the tops of which are supplied with an arrangement for accumulating atmospheric electricity. These accumulators are connected with each other by wires. Wires are laid in the soil about $1\frac{1}{2}$ feet deep, forming an evenly distributed metallic net. Every accumulator is connected with this metallic net by a wire running along the mast. Short wires connect with the plants, the free ends being stuck into the stem or into the main root thereof.

Alcohol for Fire Engines in Hanover, Germany.—Consul-General Richard Guenther writes from Frankfort:

The use of alcohol for technical purposes is being extended. The chief of the fire department at Hanover has constructed an alcohol firing apparatus, in connection with an automobile fire engine, which is said to be satisfactory. The fire department of this city had been using the first automobile fire engine in Germany, which does away with the disadvantages of smoke and noise during the trip, and it proposes to procure another alcohol automobile engine.

New Mexican Railway. — Consul-General P. C. Hanna, of Monterey, reports that the Coahuila and Pacific Railroad Company (an American property) has completed its line from Saltillo to Torreon, thus giving Saltillo—the capital of the State of Coahuila—a second connection by rail with the United States.

An Opening for American Automobiles and Bicycles in Algeria.—Daniel Kidder, U. S. Consul at Algiers, writes that there is no reason why automobiles and bicycles manufactured in the United States should not be sold in Algeria, as the inhabitants of that country are favorably disposed to American manufactures of all kinds, especially machinery. Freights between the United States are very low, and the newly established Levant line gives bi-monthly service between New York and Mediterranean ports.

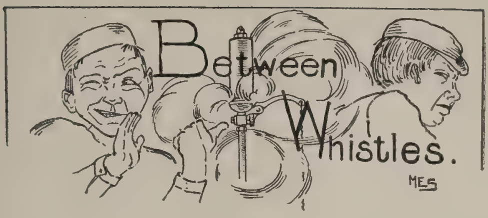
Of the 100,000 population of Algiers, one-half is of European birth and descent. This portion of the population owns about 900 automobiles and about 300 motocycles, these being exclusively of French manufacture.

Algeria is a country specially adapted to the use of automobiles, both on account of its excellent roads and the steep grades which prevail. As far into the country as roads are built, they are constructed with great care and kept continually in repair. Many of them are military roads adapted for the rapid movement of soldiers, including, of course, artillery and munitions, the railroads being wholly inadequate for such purposes. Other roads are almost as good, owing to the necessity of bringing heavy loads of wine from the vineyards of the interior to the seaboard.

Demand for Drills in South Africa.—Consular Agent W. D. Gordon writes from Johannesburg that he has been requested to secure data in regard to drilling outfits suitable for drilling alluvial wash a depth of 25 to 30 feet and a core 6 inches or more in diameter, if desired. If American merchants will forward information to Mr. Gordon he will see that it is placed in the proper hands without delay.

German Iron for America.—Consul-General Richard Guenther reports from Frankfort:

According to a recent report of the Chamber of Commerce at Dortmund, the extraordinary increase of demand in the United States has made it possible for German works to dispose of their surplus there. This possibility still exists, and these orders have prevented further reduction of output in Germany, although it is not to be presumed that this market will be anything but temporary, as American establishments will eventually be able not only to supply the home demand, but to throw quantities of iron and steel goods into the older industrial countries.



Workmen who know the kinks of their trades, the tricks played by machines and tools, and ready methods for meeting shop emergencies, are invited to contribute to this department.

To the Editor of The Electrical Age:

Sir:—Several years ago there came into my hands a specimen of Chinese printing type, made of brass, which puzzled all who saw it as to how it was made, and the recollection of it still puzzles me. The type was about a quarter of an inch square and about one inch high with a perfect letter face. Men well versed in type-making and all others who saw it said there seemed to be no doubt that it was cast in a steel or iron mould, but none could imagine how this had been successfully done. It was a perfect casting, bearing all the marks of the mould the same as ordinary type does and without any signs of any after finishing. Any filing or grinding on the cast surface would have been recognized at once by many of those who examined the type. This had come from the mould a perfect and finished article. But how was it made? Have the Chinese some secret in casting brass still unknown to the people of the West? If finished brass articles could be produced from steel moulds as white metal articles are now produced, it would be one of the notable achievements of the century.

I have made many experiments in casting brass into steel moulds, but have failed to obtain good results. I now write to ask if any of your readers can give me any information on this subject.

The Chinese type had a peculiar appearance along the sides. The sides felt smooth to the touch, but to the eye had a roughened look as if the type were made up of small globules of metal poured one after another, and each flattened down upon the other.

I prized this remarkable specimen of Chinese skill very highly, but through loaning it to one of my friends it went astray and I have not been able to recover it. I still have hopes that it will come to light and be returned to me.

Yours respectfully,

A. Smith.

New York, Aug. 15.

A Fire Escape of Steel

A new fire escape which might prove useful for factories, shops and hotels has been patented by a Springfield man. It consists of rings of steel wire joined together by smaller rings of steel and the whole arranged so that it makes a steel ladder when it is dropped from a window or roof.

An Explosive Arc Extinguisher

Gerald William Partridge, of London, England, has patented in this country a novel mechanism for extinguishing the dangerous electric arcs, formed by the breaking of high tension currents. The arc is to be extinguished by a blast, either from the release of some fluid kept under pressure, such as carbon dioxide, or by an explosion, like gunpowder. What Mr. Partridge actually uses for extinguishing the arcs is the well-known "sparklet," made for charging drinking water with carbonic acid gas. Vessels containing the substances for the blast would be placed where the arcs were likely to be found, and the release or explosion of these would be effected by any production of undue heat.

Personal

Mr. William C. Banks, of the Gordon Battery Company, city, has returned from an extensive tour of the west.

Mr. C. W. Hunt, of the C. W. Hunt Company, accompanied by his family, is spending a prolonged period in Scotland.

Mr. M. A. Oberlander, purchasing agent of the Western Electric Company, New York city, has gone to the Thousand Islands for several weeks' vacation.

Gen. A. W. Greely, chief of the United States Signal Service, recently sailed for Alaska, to superintend the building of the government telegraph from Valder to Eagle City.

Mr. Horace Porter, assistant superintendent of the Cincinnati Traction Company, has resigned his position to accept that of superintendent of the street railway at Paducah, Ky.

Col. R. G. Monroe, a prominent leader in political reform movements in New York, has been appointed to succeed Mr. J. H. Dougherty as commissioner of water supply, gas and electricity.

Mr. Sigmund Bergman, of Berlin, Germany, formerly connected with the General Incandescent Arc Light Company, of this city, will soon visit the United States to confer with Mr. Thomas A. Edison.

Frederick C. Stevens, formerly president of the Washington Traction and Electric Company, has been nominated for state senator by the Republicans of the forty-sixth senatorial district in New York.

Mr. George B. Francis, of Providence, R. I., has resigned his position with the United Traction Company, of that city, and will now be associated with Westinghouse, Church, Kerr & Company, New York.

Mr. F. J. Spaford, at one time superintendent of telegraph for the Burlington, Cedar Rapids and Northern, has been elected assistant superintendent of telegraph for the Chicago, Rock Island and Pacific Railroad Company.

Mr. O. H. Ensign, chief engineer of the Edison Electric Company, Los Angeles, Cal., is in the east purchasing equipment for the new 6,000-horse power steam plant which the company purposes installing in Los Angeles.

Mr. C. S. Colton, formerly associated with the Cleveland office of the Westinghouse Electric and Manufacturing Company, was recently made assistant to Mr. F. S. Drake, manager of the Union Electricitaets Gesellschaft, of Berlin.

Mr. F. W. Weiss, well known in the electrical and street railway field, has established himself in offices at 128 Broadway, where he will continue in the practice of corporation, commercial and legal accounting in all its branches.

Mr. Charles Steinmetz, past president of the American Institute of Electrical Engineers and electrical engineer of the General Electric Company, has had conferred upon him the degree of A. M. by Harvard University.

Mr. W. B. Graham, assistant superintendent of the St. Paul City Railway Company, has resigned that position to accept one under General Superintendent Dow Smith, of the Brooklyn Rapid Transit Company.

Mr. W. A. Bailey has resigned his office as treasurer of the Worcester & Webster Street Railway Company, of Worcester, Mass., and in the future will devote his entire attention to the Worcester & Southbridge Street Railway Company. Mr. M. J. N. Potter will succeed Mr. Bailey.

Colonel S. G. Booker, St. Louis, Mo., for a number of years identified with the manufacture of electric batteries, has opened an office at 405 Fullerton Building, St. Louis, as manufacturers' agent. He will represent a number of electrical houses.

Mr. E. P. Vining, at one time general manager of the Market Street Railway, San Francisco, Cal., has become prominently associated with the Midland Pacific Railroad, which will build a road from Bakersville, Cal., to the Pacific coast.

Mr. J. C. Bennet, auditor of the Westinghouse Electric & Manufacturing Company, recently sailed for Europe on business connected with the British Westinghouse Electric & Manufacturing Company. As a "send-off" Mr. Bennet was tendered a dinner by his office force.

Mr. W. R. Mason, who recently resigned his position with the Sprague Electric Company, has been appointed western manager for Coe, Smith & Co., of Boston, selling agents for the Mechanical Boiler Cleaner Company, with offices at 413 Western Union Building, Chicago.

Mr. H. V. Miller, superintendent of telegraph of the Chicago and Alton Railway Company for the past fifteen years, has resigned his position with that company and will engage in active business. The railroad signaling system which is just coming into prominence is Mr. Miller's invention.

James F. Jackson, chairman of the Massachusetts Board of Railroad Commissioners, has returned from Europe, where he inspected the London subways and the electrical equipment of continental railroads. His reports on the result of his observations will be handed to the next Legislature.

Mr. Louis A. Ferguson, on July 9th, was chosen second vice-president of the Chicago Edison and Commonwealth Electric companies by the directors of these corporations. The office of general superintendent, formerly held by Mr. Ferguson, has been abolished, although the new vice-president will continue to discharge the duties of that position. Mr. Ferguson is president of the National Electric Light Association and also of the Association of Edison Illuminating Companies.

John Fritz, the veteran ironmaster, whose work as the executive head of the Bethlehem Iron Works made that one of the greatest establishments of its kind in the world, was eighty years old on August 21. A dinner is to be given in his honor at the Waldorf-Astoria Hotel, in New York, on October 31. At the same time it is the intention of Mr. Fritz's friends to establish in his honor a fund, for the yearly awarding of a medal to be known as "The John Fritz Medal," for notable achievements in the fields of science and mechanics. Subscriptions to this fund are now being received by John Thomson, 253 Broadway, New York city.

Mr. Robert T. Todd, vice-president of the Cincinnati Traction Company, was lately made general manager of the United Gas Improvement Company, which owns many miles of electric railway lines. Mr. Todd has been in the service of the Whitney-Widener-Elkins syndicate for the past ten years, having left Johns Hopkins University to accept that position. Although only thirty-two years old, his employers are willing to place him in one of the most responsible positions they have. It is rumored that his salary will be about the same as that of the president of the Cincinnati Traction Company.

Big Prizes for Flying Machines

The Louisiana Purchase Exposition has set apart $150,000 to be awarded as prizes for flying machines, air ships, balloons, kites and other navigators of the air in competitions to be held at the World's Fair at St. Louis, Mo., between June 1 and Sept. 30, 1904. The sum is divided into a grand prize of $100,000 for a free-for-all speed contest and many minor prizes.

Competitors for the $100,000 prize must have made a flight of a mile or more and return in a machine similar to the one to be used in the race at some time at least 10 days before the first competitive trial. Each vehicle shall carry at least one person.

The course will be L shaped and marked by three captive balloons. It will be not less than ten miles long nor more than fifteen miles. Every competitor may go over the course as many times as he likes, but to be considered for the grand prize he must make at least three separate and complete trips around the course at a rate of not less than twenty miles an hour, including the time consumed in starting and landing.

The successful competitor must give three exhibition flights after Sept. 30.

Prizes of $3,500, $3,000, $2,000 and $1,500 will go to other competitors, providing these have made three full rounds of the course at a speed of ten miles an hour.

The most interesting of the prize offers from the scientific view is that of $3,000 for a successful attempt to drive an airship motor by energy transmitted through space, either in the form of electric radiation or in some other form of electrical energy. This must be accomplished at a distance of at least 1,000 feet, and the power transmitted must amount to at least one-tenth of a horse power.

The other prizes offered are as follows:

$2,500—Flying machines not carrying operators; to carry ten pounds load; one mile and return.

$2,000—Gliding machines carrying operators; must make twenty glides of 400 feet each, vertical angle most acute with horizon wins.

$1,000—Gliding machines with operator showing best automatic stability in wind; forty glides of 400 feet each.

$2,500—Airship motors other than one in grand prize winner, having least weight and greatest efficiency; 1 to 100 horse power.

$1,000—Airship motors, second prize.

$5,000—For the greatest altitude attained from exposition grounds; any device carrying one person or more.

$5,000—For the longest time in the air starting from exposition grounds; any device carrying one person or more.

$5,000—For landing nearest to Washington Monument, Washington, D. C.; start from exposition grounds; any device carrying one person or more.

$5,000—For longest distance in one flight, any direction, from exposition grounds; any device carrying one person or more.

KITES.

To fly 500 feet high or more with 800 feet of line. Prizes, $500, $300 and $200. One mile high—any length of line—prizes, $800, $500, $200.

Entrance fee for flying machine and balloon contests, $250, to be returned upon arrival at exposition grounds. Kite contests free. No hot-air balloons allowed.

Incorporations and Franchises

Alabama

Talladega.—The Talladega Company, George W. Chambers, president, has purchased the city gas plant and will utilize same in connection with its water-power developments, now in progress, and proposed electric light plant.

Tuscumbia.—Mr. J. Worthington, of Sheffield, Ala., has secured the franchise for the electric light plant and the construction of waterworks.

Colorado

Denver.—The Denver Electric Wiring Company has been incorporated by A. W. Hille, S. B. Hardy and J. W. Waddington with a capital of $10,000.

Delaware

Wilmington.—The Improved Hydrocarbon Light Company has been incorporated with a capital of $500,000; Howard Watkin, Watson B. Rulon and Harry Emmons, incorporators.

Fernandina.—The Amelia Beach Company, capital $100,000, has purchased the Simmons ice plant, and will enlarge it to thirty tons capacity.

Sanford. — The Sanford Telephone Company has elected C. R. Walker, president; W. H. Mitchell, vice-president; and W. B. Mitchell, secretary. Capital, $2,500.

Georgia

Dalton.—The Standard Electric Company has been awarded a contract by the city for the construction of its electric light plant recently reported.

Hartwell.—The city has decided to construct waterworks and erect electric light plant.

Macon.—It is reported that the Railway & Light Company, J. W. Middendorf, president, is negotiating foi the power plants at Macon. The home office of the company is at Baltimore, Md.

Illinois

Bloomington.—The Home Telephone Company has increased its capital from $30,000 to $100,000.

Chicago.—The Chicago, Milwaukee Avenue and Inland Lakes Traction Company has been incorporated with a capital of $50,000. It will operate street railways, light, heat and power plants. S. A. Walther, J. A. Walther and others are the incorporators.

Gillespie. — The Gillespie Telephone Company has been incorporated by J. C. Steere, J. M. Rodiner and H. R. Williams with a capital of $5,000.

Indiana

Colfax.—The People's Co-operative Telephone Company has been incorporated with a capital of $600. The incorporators are J. A. Morrison, E. L. Darby and others.

Franklin. — The Franklin-Southwest Traction Company has been organized with a capital of $10,000. Directors: William G. Irwin, Carl E. Willan and others.

Muncie.—The Muncie, Hartford City & Ft. Wayne Traction Company has increased its capital from $100,000 to $1,000,000.

Petersburg.—The Southern Indiana Traction Company has been incorporated with a capital of $100,000, to construct and operate an electric line between Vincennes and Jasper.

Iowa

Fort Dodge.—The Fort Dodge Light and Power Company, including the Fort Dodge street railway, has been purchased by a legal firm of this city. A transfer of $67,000 in stock and a total issue of $125,000 is involved in the transaction. A gas and electric light plant are included. Important improvements are contemplated by the new management.

Mitchellville.—The Mitchellville Telephone Company has been organized with a capital of $10,000. The incorporators are: S. B. Uhl, B. R. Patterson, S. J. Oldfield and D. K. Pearson.

Kentucky

Burnside. — The Burnside Electric Light & Power Company is contemplating the construction of a ten to twenty ton ice plant.

Hopkinsville.—The Home Telephone Company will be organized by M. C. Forbes, R. E. Cooper and others with a capital of $30,000, to construct a telephone system.

Nicholasville.—The Jasamine County Home Telephone Company has been organized with a capital of $50,000, to construct and operate telephone and telegraph lines in various parts of Kentucky.

Paris.—The Bourbon County Home Telephone Company has been incorporated with a capital of $75,000, to construct and operate telephone and telegraph lines in Paris and Bourbon County.

Maryland

Baltimore.—The Hughes Telephone Manufacturing Company has been incorporated with a capital of $100,000, to manufacture telephone supplies, etc.

Elkton.—The Elkton Gas Light Company will shortly erect its proposed new holder, with 25,000 cubic feet capacity, and make other improvements.

Minnesota

Minneapolis.—The Warren Light & Manufacturing Company has been incorporated by Benjamin Warren, Jr., L. H. Murray and K. B. Christian; capital, $10,000.

Mississippi

The Quitman Ice, Light and Power Company has been incorporated; $10,000. Incorporators: S. W. Pettibone, B. H. Donald and others.

Missouri

Buckner.—The Jackson County Telephone Company has been organized with a capital of $5,000. Incorporators: U. D. Ravenscroft, Ed. C. Roth, J. G. Burnley and others.

Mexico.—The Mexico Telephone system has been purchased by R. V. Montague and other Kansas City men, and $10,000 will be expended to extend and improve the lines in this section of Missouri.

St. Louis.—The Diamond Electric Machinery Company has been incorporated by Charles Lindenberger, Harry Lindenberger, Houston Jones and others, with a capital of $12,000.

Tarkio.—A farmers' mutual telephone company has been organized here.

Nebraska

Fremont.—The Fremont Independent Telephone Company is soon to equip its new plant and will connect with the Farmers' Telephone Company, extending lines into country districts surrounding Fremont not covered by other companies.

New Jersey

Atlantic City.—The Atlantic City & Suburban Traction Company has been organized with a capital of $500,000. Incorporators: Edward R. Spensler, C. Taylor Leland and Albert M. Jordan.

Jersey City.—The Quincy Electric Drill Company has been organized with a capital of $50,000. Incorporators: George F. Bradstreet, Richard H. Farries and Herbert L. Keyes.

Newark.—The American Gas & Electric Company has been incorporated with a capital of $1,000,000. Incorporators: Edward T. Magoffin, Herbert E. Murphy and Alfred G. Brown.

Paterson.—The Electric Metal Separating Company has been incorporated; $150,000; to refine scrap metals.

Trenton.—The Atlantic City & Suburban Traction Company has been incorporated ; $500,000; to build a line from Atlantic City to Pleasantville.

Trenton.—Lima Street Railway Company has been incorporated with a capital of $5,000,000. Object: Transportation. Incorporators: Charles E. Neville, Henry W. Carter and Charles Bott.

New Mexico

Santa Fe.—The Capital Light & Power Company has been incorporated with a capital of $700,000 by Daniel W. Miller, George Miller, John P. Conner and others.

New York

Albany.—The G. B. W. Electric Company has been organized with a capital of $15,000. Joseph Veit, C. F. Lewis and L. C. Scrymser, incorporators.

Albany.—The Hudson River Electric Company has increased its capital from $30,000 to $3,000,000. The directors are: Charles H. Peddrick, Jr., Robert T. De Long and others.

Albany.—St. Lawrence Power Company has filed a certificate of re-organization; capital, $700,000, one-half being preferred stock.

Albany.—The West Seneca Light, Heat and Power Company has been incorporated with a capital of $200,000; incorporators, Elwood B. Smith, Charles A. Hahl and Harry N. Kraft.

Albany.—The National District Telegraph Company has been incorporated with a capital of $150,000; the general route in this state to include Poughkeepsie, Binghamton, Elmira, Buffalo and other towns and villages. Belvidere Brooks, George H. Fearons, Edward M. Mulford and others, incorporators.

Albion.—The Rural District Telephone Company has been organized by William E. Peck, Frank Grantier and Frederick C. Lincoln; capital $25,000.

Newburg.—The Intervale Traction Company has been incorporated with a capital of $300,000, to construct an electric railroad from Newburg to Goshen, a distance of twenty-eight miles.

New York City.—The De Veau Telephone Manufacturing Company has been organized; $50,000. Directors: A. S. De Veau, William Hoffman and Charles Auth.

New York City.—The New York Engineering Construction Company has been incorporated with a capital of $100,000, to construct steam and electric railways, etc. Incorporated by Henry V. Brandenburg, Warren Dixon and E. Tibbits; office, 1 Exchange place, Jersey City.

North Carolina

Lenoir.—The Lenoir Electric Company has been incorporated with a capital of $50,000; to furnish power and light and to operate telegraph and telephone lines.

Ohio

Canton.—The Canton-New Philadelphia Railroad Company has been incorporated with a capital of $600,000. Incorporators: Edward C. Louis, J. E. Reeves and others.

Columbus.—The Cincinnati & Northeastern Traction Company has been incorporated with a capital of $15,000 by Dennis Dwyer, Albert Emanuel, Charles D. McCrea, Charles L. McCrea and B. M. Hopkins.

Kenton. — The Kenton Construction Company has been organized with a capital of $10,000, to construct telephone plants.

Oregon

Salem. — The Consolidated Power Company has been incorporated with a capital of $100,000. Frank S. Baillie, H. S. Bowen and John L. Rand, incorporators.

Pennsylvania

Pittsburg. — The Consolidated Improvement Company has been organized with a capital of $1,000,000, to acquire telephone, telegraph and railway lines.

Tennessee

Jackson.—A telephone company has been organized to operate a system here, by Joseph D. Lloyd, Robert T. Pettebone, F. C. Johnson and others; $125,000.

Texas

The Gilmer Electric Light Company has been organized with a capital of $4,000. Incorporators: J. F. Croley, T. C. Mitchell and C. H. Buckner.

West Virginia

Monnington.—The Augusta Telephone Company has been incorporated with a capital of $100,000, $600 having been subscribed and $60 paid in, to operate a telephone line. Directors: F. R. Stewart, J. N. Devare, R. W. Bryant and others.

Wisconsin

Sussex.—Lisbon Telephone Company has been incorporated with a capital of $720. Telephone lines will be constructed and operated in and about Lisbon. Incorporators: James R. Watson, Alexander Will and others.

Franchise Bureau

The ELECTRICAL AGE intends to collect for reference purposes copies of every franchise issued by the various states to electric lighting, street railway and gas companies, and particularly those granted by special acts of legislation. All persons who can do so are requested to send copies of such franchises to the "Franchise Bureau, ELECTRICAL AGE." Copies not returnable.

Advertisements under this head, 75 cents per line.

Kentucky

Parties controlling charter and right-of-way 36 miles in western Kentucky would like to correspond with financiers who would be interested. Apply to Franchise Bureau, ELECTRICAL AGE.

Maryland

Parties controlling franchise for laying pipe lines in any part of the state of Maryland would like to communicate with parties whom this franchise would interest. For further particulars address the Franchise Bureau of THE ELECTRICAL AGE, where copy of same is on file.

Mexico

Parties having option of control on several street railways in important city in Mexico would like to correspond with bankers' interests in Mexican enterprises. Address Franchise Bureau, ELECTRICAL AGE.

Pennsylvania

Wanted, to purchase the control, or all the interest in a trolley line franchise that has rights of condemnation, for inter-urban work in the northwestern part of the state of Pennsylvania. Would prefer to purchase small operating road with such franchise. Address Franchise Bureau, ELECTRICAL AGE.

Tennessee

Valuable charter and majority of right of way secured, with valuable water-power property. Owners desire financial aid. Address Franchise Bureau, ELECTRICAL AGE.

Virginia

Parties controlling Potomac Western Railroad charter, granted by the legislature of Virginia, giving broad railroad rights, both electrical and steam, seek financial assistance. Copy of charter can be seen at the office of the ELECTRICAL AGE, Franchise Bureau.

The Electrical Age

Incorporated April, 1902

CHARLES A. LIEB - - - - PRESIDENT
A. G. GREENBERG, SECRETARY AND TREASURER

F. F. COLEMAN - - - - - - Editor

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TO ADVERTISERS

Changes for advertisements and new advertisements **must** be in this office by the **20th** of the month to be included in the issue of the month following. The advertising pages carry printed matter measuring five and a half by eight inches. Cuts intended for use on these pages should be made to accord with these measurements.

Correspondence and semi-technical articles, with suitable photographs for reproduction, or cuts, are invited. Accepted matter will be promptly paid for. We cannot be responsible for any unsolicited manuscripts, but when stamps are enclosed all unavailable matter will be returned. Postage must always be fully prepaid. Cuts to be available for illustrating articles must conform to the column or page measurements. The columns are 2½ inches wide. Cuts for single column use should not exceed that width. Cuts to go across the page should not be more than five inches wide, and full page cuts may not exceed 4½ x 8 inches.

As was clearly foreshadowed by THE ELECTRICAL AGE last month, the bid of the Belmont-McDonald Syndicate, to build the tunnel extension of the underground railroad to Brooklyn for $3,000,000, including real estate and terminals, was accepted by the Rapid Transit Railroad Commission. Their alternate bid to build the Brooklyn extension and a tunnel road up Broadway from Union Square to Forty-second street for $4,100,000 was not considered because the Board had not yet authorized or adopted the Broadway line, but measures were taken at once to have this authorized, and, in addition, it was resolved to build another tunnel under the East River to run in a direct line from the City Hall in Manhattan to the old City Hall in Brooklyn. It is clearly understood that the Brooklyn Rapid Transit Company will probably secure the contract and lease for this tunnel and that its facilities will serve to relieve the Brooklyn bridge of a part of its burdensome traffic.

Persons who are not entirely familiar with the conditions under which bids are made for the construction of rapid transit roads under the rapid transit law, find it difficult to understand how the Belmont-McDonald Syndicate can afford to build the Brooklyn extension for $3,000,000 when the engineer's estimate of cost and the Brooklyn Rapid Transit Company's bid were $8,000,000. On the face of it, it appears as if the successful bidders must be destined to lose heavily on the work, and the city to make an equivalent gain. This, however, is not necessarily true. Each contract for constructing a rapid transit road carries with it an obligation to lease and operate the road for a long term of years. The lessee must pay to the city an annual sum equal to the interest which the city pays on the bonds issued to meet the cost of the work, and in addition to this one per cent per annum to serve as a sinking fund. Under these conditions the contractor is really the borrower and it has been calculated that before the expiration of the leases for the rapid transit roads he will have paid the whole sum back to the city, with a profit.

The only advantage to the contractor of getting the city's money to pay with is what may be found in the ability of the city to borrow more cheaply than a contractor might. If a contractor could borrow the necessary money at the city rate it would be more profitable for him to furnish the whole sum than to take up a cent from the city.

Before the contract for the main line

of the Rapid Transit Railroad was let there was a strong feeling of mistrust as to the money-making possibilities of the scheme. This feeling had been skillfully worked up by certain interests. The contract was no sooner let than light began to break in upon the public mind, and it became an accepted understanding that it was going to be an exceedingly profitable contract. Upon the basis of this main contract the Belmont-McDonald Syndicate will probably have no difficulty in borrowing all the money it needs at about as low rates as the city pays. Under these circumstances it would not be surprising if Mr. Belmont and his associates were to offer to carry out any additions needed to complete the rapid transit system entirely at their own expense, although the railroads themselves would all be the property of the city of New York from the beginning.

Oil

The most important recent event in the history of industrial America is the discovery of the great petroleum deposits of Texas, California and Louisiana. That this is but the beginning of the development of a wide oil belt extending clear across the continent from Florida to the Pacific is evidenced by the most recent discoveries of oil of like character along the eastern coast of Mexico.

These discoveries have already brought fortunes to many enterprising persons, but the wealth which has been secured from these sources up to the present time is but an inconsiderable mite compared with that which these fields are yet to yield.

Yet those who would seek wealth from investments there need a word of warning. Teeming as these new oil fields are with the material for wealth, it will avail one little to purchase mere shares of stocks which may represent nothing more valuable than pretty pieces of printing. But those who take pains to see that they are buying shares in actual productive properties and live enterprises should reap ample rewards. These new oil fields are at present in a remarkable position. Filled as they are with "gushers" ready to spout out thousands and thousands of barrels of oil a day—with a country full of mills, factories and power houses yearning for the oil for fuel—yet a large percentage of the wells are sealed up, or their product by the millions of barrels is lying unused, filling costly and enormous tanks. Why is this?

The product of these new oil fields is new to this country. Heretofore the United States has been the great producer of petroleum with a paraffine base whose chief ingredients were illuminating oils. Had the new find been of this character there is little doubt that it would have been quickly cared for as have been the products of the recently opened oil fields of Java, Borneo and adjoining East Indian islands. These discoveries brought into existence the Shell Transport and Trading Company, the Rothschild rival abroad of the Standard Oil Company.

The Texan and California fields yield an oil like that from the Baku fields of Russia.

The Russian wells yielded in 1891 92,000,000 barrels of oil. From this only 14,000,000 barrels of illuminating oil was produced, the great bulk of the product being used for fuel. Unless Yankee ingenuity can find new and more profitable uses the bulk of the product of our new oil fields must find a market as fuel or be used for making illuminating gas.

A failure to realize this during the excitement of development and the desire to realize speculative profits has left the oil fields in their present tied-up condition.

Today, when the whole country is crying out for fuel and Texan tanks are overflowing, it is impossible to get the oil to market. It is a fact well known in this and many other cities of the East and Middle States that the largest traction and lighting companies and other great consumers of coal stand ready to substitute oil as soon as any responsible persons are able to assure them a supply and enter into contracts for certain and regular delivery. This would mean the provision of tanks at the centers of consumption and cheap and ample means for transportation.

It is the temporary impossibility of providing these which now restricts the market and the price of oil. Foreign bottoms are prohibited by law from doing a coastwise trade in this country and our own shipyards are too busy with higher priced work to give much attention to building tank vessels. Railroad transportation is too costly for Eastern markets.

Notwithstanding this hampering condition of things much progress has been made and the last month has seen the price of oil in Texas rise from a mere nominal figure to above twenty cents a barrel.

Encouraged by the high price of coal many active and many more tentative contracts for the use of oil have been entered into and orders have been placed with various shipyards for the building of new tank steamers or the conversion of old vessels to this use. Hundreds of concerns have begun using oil both on land and water.

The reports from all of these are favorable. Professor Denton, of Stevens, found some time ago that 4¼ barrels of crude oil were equal to a ton of coal for steam making. Actual commercial use has given even better comparative results, some showing that three barrels of oil did the work formerly done by a ton of coal. The oil burns without producing smoke or cinders and there is a large saving in the cost of stokers. At present prices oil is cheaper than coal, even in localities like New York, where coal is usually very cheap. Since it costs forty to forty-five cents a barrel to take Texan oil to New York it is probable that the selling price there would settle naturally to somewhere from seventy-five cents to $1 a barrel. At these prices it could compete with coal with advantage. But in the localities of dear coal, oil will have all the advantage. From the oil fields new lines of movement are springing up day by day, taking the oil to new users. Railroads around the Texan and California fields are firing their engines with oil and saw mills, cane mills and other local factories use oil for fuel and it is used for smelting metals.

In California the problem of using the oil is working itself out more rapidly than in the East because of the high price there of other fuels.

More than 200 power users in San Francisco use oil, the Southern Pacific road has nearly 400 oil burning locomotives and other railroads are following suit, while several Pacific steamers are burning oil. Dr. C. T. Deane, secretary of the California Petroleum Miners' Exchange, writes as follows to THE ELECTRICAL AGE:

"I believe that in less than five years California will be producing 50 per cent of all oil in the United States. This year, 1902, the product will be about 12,000,000 barrels. There is no limit to the supply, as we have in one county alone over 10,000 acres of actually proven land, besides vast fields in several other localities. I shall be astonished if in five years we are not producing 50,000,000 barrels per annum."

Gushers may cease to gush and pumping have to be resorted to, but there need be no fear that the new fields will give out. On the contrary it may be accepted as a fact that their output will increase largely and rapidly. The real news of this new industry will be in the extension of means to transport and use the oil.

Electricity for the Sick Room

The sick room offers an excellent field for the use of electrical appliances to the advantage both of the patient and nurse.

Few who have had charge of a sick room but know how arduous are its labors and how difficult it is to meet many of its various demands.

Every nurse knows how by the use of illuminating gas her labors are lightened. Electricity is an even more pliable agent. More important still, it does away with matches. It is not always desirable to keep even a dim light in the sick room and yet the nurse may be called upon at a moment's notice to perform some delicate service for which plenty of light is needed or to prepare food, poultices or other preparations for which heat is needed.

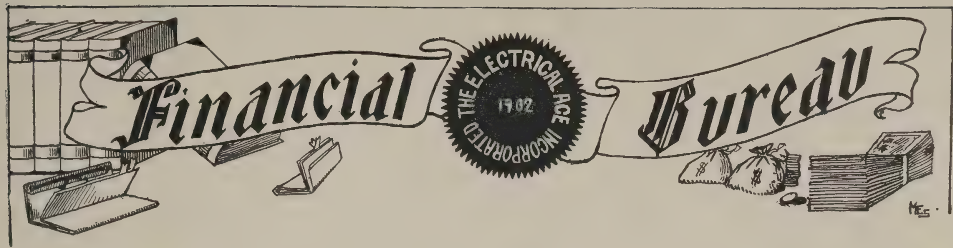
The snap of a match is at all times startling. To a sick person it might be dangerous in its effect. Even where the nervous shock of its report was not to be feared the explosion might be enough to waken a sleeping patient and to do at least that much harm.

The electric lamp does away with this trouble entirely. It does more. The electric lamp can, at will, be strung at the end of flexible wires and hung at the head of a bed, beside the bed or placed in any place where patient or nurse might need it. Lamps are made which, at the will of the user, give their full complement of 16-candle power or light up with only a single candle-power. The electric lamp has the advantage over all others of being safe. It will not set fire to the house, the bedding, the curtains or the night dress of the patient.

An electric chafing dish will do the sick room cooking and will leave the air without the "burnt" smell which gas makes.

Perhaps the most ingenious and useful of the electrical appliances for the sick room is the electrical substitute for the hot water bag. This is a soft and flexible pad made largely of asbestos. It has hidden in the body of it, amid the asbestos fibre, coils of wire which heat up when the electric current is sent through them.

Such a pad, applied with only a cloth between it and the body, takes the place of the hot iron, the hot brick or the hot water bag commonly used and it is ready for application at a moment's notice. With a wet cloth between it and the flesh it takes the place of the fomenting cloth and the poultice. It merely needs a turn of a button to make it ready and its temperature thereafter is always even. It does not get cool and have to be renewed nor does it get too hot and burn the patient. It is one of the beauties of the electrical current that it can be thus delicately regulated to render it suitable for each kind of service.



Street railway companies, electric lighting companies and gas companies which desire their reports to appear in the Financial Bureau of THE ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Monthly reports are requested showing gross receipts and when possible operating expenses. Companies are also requested to furnish the highest and lowest prices for which their stock has sold in the market for the previous month.

Street Railway and Other Statements

Companies. Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901
Albany & Hudson Ry. & P....				
April 1 to June 30...............	39.987	35,534	‡17,364	‡8 991
January 1 to June 30............	66,905	......	‡30,250	......
Int., rents., etc., Apr 1 to June 30	40,080	......	......	......
January 1 to June 30....... ...	78.728	......	......	......
Bal. of net earn. Apr. 1 to June 30	......	......	def. 22,716	......
January 1 to June 30............	......	......	def. 48,478	......
‡ Includes other income.				
Am. Light & Traction...........June	......	......	57,702	......
July 1 to June 30............. ..	......	......	628,732	605,229
American Railways Co,.......July.	119,870	89,658	......	......
January 1 to July 30..........	628,128	493,010	......	......
Auburn City Ry. Apr. 1 to June 30	21,612	......	1,864	......
Brooklyn Rapid Transit Co.... June.	1,165,287	1,181,023	433,135	448,282
12 months ending June 30.......	12,789,704	12,101,197	3,837,490	4,130,563
Buffalo Gas Co...................July	......	......	17,855	14,176
October 1 to July 31.............	......	......	288,400	252,616
Burlington Vt. Traction.........July	8,144	6,947	......	......
Charltn. Cons Ry. Gas & El. June	48,061	43,013	18,538	17,013
December 1 to June 30....	447,637	288,758	209,785	103 333
Interest, rentals, etc., June......	12,575	13,168	......	......
December 1 to June 30..........	127,997	22,774	.....	......
Balance of net earnings, June....	.....	......	5,963	3.845
December 1 to June 30..........	......	......	81,788	80,595
Chic. & Milwaukee Electric.. July	23.591	23,459	16,005	15,770
January 1 to July 31............	102,530	88,919	56,923	46,828
Cin., Dayton & Tol. Tr.........July	50.317	41,572	26,870	21.402
Interest, rentals, etc., July......	15.820	9,917	......	......
Balance of net earnings, July....	......	......	11,050	11,585
Cin., Newport & Cov. Ry. ....June.	77,545	72,201	34,875	30,054
January 1 to latest date..........	422,149	384,637	174,272	148,785
City Electric, Rome, Ga. ....July	3,659	3,873	429	260
January 1 to July 31.............	24,436	24,137	2,763	2,971

Companies. Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
Citizens Ry. & L. Muscatine, Ia. July	7.655	6,963	3,389	1 881
January 1 to July 31	45.290	40,505	14,803	......
Interest, rentals, etc., June	15,614	15,746	......	......
January 1 to June 30	93,024	94,104	......	......
Balance of net earnings June	......	......	19,261	14,307
January 1 to June 30	......	......	81,248	54,681
Cleveland Electric ..July	231,629	210,329	......	......
January 1 to July 31	1,407,643	1,263,463	......	......
Cleve. Elyria & West July	28,542	24,228	14,667	12,418
January 1 to July 31	156,934	131,254	65,332	55,187
Cleveland, Painsville & E. July	22,649	19,142	12,214	11,393
January 1 to June 30	102,206	84,592	47,072	40,615
Cohoes City Ry. Apr. 1 to June 30	6,531	5,975	725	def. 1,132
January 1 to June 30	12,305	11,723	1,669	5
Detroit & Pt Huron Shore Line June	36,329	......	16,067	......
July 1 to June 30	301,119	......	170,190	......
2d week August	10,737	9,893	......	......
Jan. to 2d week August	245,692	194,931	......	......
Duluth Superior Traction July	52,362	45,983	27,647	23,856
January 1 to July 31	297,679	254,321	140,638	112.604
Detroit United July	325,899	302,988	143,051	153,175
January 1 to July 31	1,917,185	1,674,935	827 294	749.776
3d week August	73,630	61,945	......	......
Jan. 1 to 3d week in August	2,135,769	1,864,419	......	......
Elgin, Aurora & Southern July	40,472	36.454	19,275	20,236
January 1 to July 31	226,928	204,102	90,205	84.959
June 1 to July 31	74,346	69,068	33,001	35,191
Interest, rentals, etc., July	8 333	8,333	......	......
January 1 to July 31	58 333	58.333	.....	......
Balance of net earnings, July	......	......	10,941	11,902
January 1 to July 31	......	.... .	31.873	26,627
June 1 to July 31	......	......	16,334	18 524
Elmira Water, Light & Ry,				
April 1 to June 30	40.538	......	‡8,810	......
January 1 to June 30	77,346	......	‡15,803	......
Int., ren., etc. Apr 1 to to June 30	8.537	......	.. ..	......
January 1 to June 30	19,561	......	......	......
Bal. of net earn. Apr 1 to June 30	......	......	273	......
January 1 to June 30	.....	......	def. 3,758	......
‡ Includes other income.				
Gen., W. Sen Falls & Cayuga L. April 1 to June 30	15,590	14,256	5,235	4,670
Interest, rentals, etc	5,207	7,463	......	......
Balance of net earnings	28	def. 2,793	. ....	......
Harrisburg Traction July	46,751	41,169	25,878	24,260
January 1 to July 31	260,072	215,247	116,083	89,180
Hudson Valley Ry				
April 1 to Jnne 30	83,795	......	‡29,765	......
January 1 to June 30	145,073	......	‡59 862	. ...
Int., ren., etc,, Apr. 1 to June 30	36 959	......	......	......
January 1 to June 30	66,245	. ....	......	......
Bal. of net earn. Apr 1 to June 30	......	......	def. 7,194	.....
January 1 to June 30	......	......	def. 6,383	.....
‡ Includes other income.				

Companies.	Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
International Ry Co.	*June	266,065	393,684	118 451	201,419
Gross and net receipts June, 1900		......	213,823	......	107,644
Quarter ending June 30		772,384	922,639	335,469	436,740
Gross and net receipts June 1900.		......	615.306	......	281,379
* Comparison is made with two years because 1901 was the Pan American year.					
Kingston Consolidated					
April 1 to June 30		28,142	......	13,122	......
January 1 to June 30		50,130	......	‡19,807	......
Int., rents., etc. Apr 1. to June 30		9,856	.....	......	......
January 1 to June 30		19,699	......	......	......
Bal. of net earn. Apr. 1 to June 30		......	......	3.266	......
January 1 to June 30		......	......	108	......
‡ Includes other income.					
Lake Shore Electric Ry	June	42,936	33,201	20,074	13,835
January 1 to June 30		199,432	147,824	......	.....
Lehigh Traction	June	6,420	11,401	......	......
January 1 to June 30		53,482	59,679	......	......
Los Angeles Ry	June	115,948	87,522	55,415	32,665
Jan. 1 to June 30		685,352	517,638	306,220	202,647
Madison (Wis.) Traction	June	8,321	......	3,587	......
January 1 to June 30		36,462	......	8,945	......
Massachusetts Electric Cos.	June.	569,314	577,362	......	......
January 1 to June 30		2,635,504	2,499,601	......	......
Met. West Side El. Chicago	July	151,790	122,927	......	......
January 1 to July 31		1,088.402	968,391	....	......
Mexican Telephone	June	20,117	17,449	10,866	8,168
March 1 to June 30		78.547	69,351	37,574	31,491
Montreal St. Ry	July	198,656	178,180	104,689	87,716
October 1 to July 31		1,643,836	1,533,206	702,976	601,272
Nashville Railway	June	72,941	66,012	......	......
Jan. 1 to June 30		400,615	356,596	......	......
New London Street Railway	July.	10,952	11,666	5,572	6,897
January 1 to July 31		39.092	37,153	12,582	11,407
New York & Queens County					
April 1 to June 30		160,261	142,806	79,087	77,878
January 1 to June 30		258 892	232,470	93.715	102,785
Int., rents., etc , Apr. 1 to June 30		45,268	43,389	......	......
January 1 to June 30		90,387	87,793	......	......
Bal. of net earn., Apr. 1 to June 30		......	......	33,819	34,489
January 1 to June 30		......	......	4,988	16,305
Northern Ohio Traction	July	81,130	66,898	40,542	33.414
January 1 to July 31		400,067	335,856	174,117	137,924
Northwestern El., Chicago	July	86,971	95,266	......	......
January 1 to July 31		662,385	578.579	......	......
Oakland Trans. Cons.	June	82,920	69,341	37,151	23,698
January 1 to June 30		449,486	......	171,353	......
Orange Co. Traction	June	10,624	10 935	5,348	5,290
January 1 to June 30		42,312	41,783	39,966	43,714

Companies.	Date.	Gross Earnings. 1902.	1901.	Net Earnings. 1902.	1902.
***Philadelphia Co.**...............	July	1,111,388	961,277	407,081	383,477
January 1 to July 31.......... ..		7,961,804	7,024,409	3 599,540	3 346,527
* Includes Pittsburg Ry. Co.					
Pottsville Union Traction......	July	17,034	19,122	......	......
January 1 to July 31		93,197	94,725	......	......
Po'keepsie City & Wap. Falls ..					
April 1 to June 30		23,248	22,542	9,715	9,408
July 1 to June 30................		90,312	86,600	37,703	34,777
Railways Co., Gen.............	July	33,127	28,994	......	......
January 1 to July 31		159,610	130,645	......	......
Sacramento El. Gas & Ry ...	June	36,702	34,473	......	......
January 1 to June 30		219,474	198,815	......	......
St. Louis Transit...............	July	575,173	505,723	......	......
January 1 to July 31....		3,589,761	3,292,360	......	......
Sioux City Traction	June	21,846	19,598	......	......
January 1 to June 30............		113,335	95,910	......	......
South Side El., Chic	July	109,639	98,833	......	......
January 1 to July 31....		822,007	767,790	......	......
Staten Island Electric..........					
April 1 to June 30		56,227	56,647	21,013	21,336
Int., rents, etc., Apr 1 to June 30		25,000	25,000	......	......
Bal. of net earn. Apr. 1 to June 30		......	......	def. 3,987	def. 3,664
Staten Island Midland..........					
April 1 to June 30...............		36,234	34,818	9,730	13,580
Int., rents., etc., Apr. 1 June 30		12,500	12,500	......	......
Bal. of net earn. Apr 1 to June 30		......	......	def. 2,770	1,080
Syracuse Rapid Transit........					
April 1 to June 30		173,324	159,795	75,934	72,932
July 1 to June 30................		687,193	615,160	307,702	278,936
Int., rents, etc., Apr. 1 to June 30		57,076	56,313	......	......
July 1 to June 30................		228,247	223,917	......	......
Bal. of net earn. Apr. 1 to June 30		......	......	18,358	16,619
July 1 to June 30		......	......	80,771	56,550
Toledo Bowling Green & S Tr..	July	22,571	16,926	12,343	7,494
Toledo Rys. & Light......	July	131,492	121,012	69,177	67,399
January 1 to July 31.............		802,776	719,940	388,079	362,925
January 1 to June 30		671,284	298,928	318,903	295,527
Toronto Railway................	w. Aug. 9	38,608	38,866	......	......
Troy & New England					
April 1 to June 30...............		5,745	6,021	2,585	1,618
January 1 to June 30		8,739	8,917	2,098	1,733
Int. rents., etc., Apr. 1 to June 30		2,200	2,000	......	......
January 1 to June 30		3,632	3,332	......	......
Bal. of net earn Apr. 1 to June 30		......	......	385	def. 328
January 1 to June 30............		......	......	def. 1,534	def. 1,599
Twin City Rapid Transit.....	July	337,452	290,648	195,083	155,299
Jan. 1 to July 31.......		2,003,892	1,748,181	1,081,153	924,504
2d week August.................		68,067	63,692	......	......
Jan. 1 to 2d week August........		2,145,073	1,875,003	......	......
Interest, rentals, etc., July.......		76,233	75,320	......	......
Jan. 1 to July 31		532,767	510,048	......	......
Balance of net earnings July.....		......	......	118,850	79,979
January 1 to July 31.............		......	......	548,386	414 456

Stated Reports of Companies

Chicago Union Traction

Annual report.

The income account for the fiscal year ending June 30, 1902, shows:

Earnings	1902	1901
Passenger receipts	$7,801,075	$7,269,816
Chartered cars	4,264	4,222
Mail	19,779	15,101
Gross earnings from operations	$7,825,118	$7,289,139
Expenses.		
Maintenance way and structure	$274,575	$198,929
Maintenance of equipment	499,047	351,938
Transportation	2,793,999	2,735,362
General	1,003,096	655,965
Total operating expenses	$4,570,717	$3,942,194
Net earnings from operations	3,254,400	3,346,945
Other income.		
Advertising	$33,525	$33,535
Rent of land and buildings	49,703	33,564
Rent of tracks and terminals	10,000	10,000
Interest on deposits and loans	9,786	12,417
Miscellaneous	14,335	14,073
Total income from other sources	$117,349	$103,579
Deductions.		
Taxes received	$614,416	$320,296
Interest on loans accrued	117,784	70,196
Rentals accrued	2,884,679	2,898,988
Premiums on bonds purchased	2,397	2,468
Total deductions from income	$3,619,276	$3,291,948
Dividend on preferred stock		1¼% 150,000
Balance for year	def. $247,527	sur. $8,575

President Roach says: "Prospective profits have been taxed into a deficit. This will sufficiently appear by reference to the enormous amounts paid out for taxes—$683,732. Of that sum $112,493 was for personal property, $60,429 for real estate, $311,567 capital stock, $64,893 car licenses and paid city per ordinances, and $134,350 paid on account of reassessment for 1900 as directed by the United States Court. This drain is equal to about 8½ per cent of total gross receipts for the year and to about 21 per cent of the net receipts before deducting either the interest on bonded indebtedness or rentals paid underlying companies. I have some reason to hope that for the current year the company may have its property, including capital stock, assessed upon the basis of its earning capacity. The item of $134,000 additional tax for 1900 of course will not occur again, and upon the basis of earning capacity the item of $311,567, capital stock tax for 1901, would be reduced by at least $100,000 and should be reduced by $125,000. Large sums were expended in permanent improvements in right of way, rolling stock and power plants. Several miles of new track have been laid, thousands of rail-joints have been castwelded, and upon streets where city improvements have been made we have resurfaced our tracks, substituted granite, asphalt or brick pavement in place of cedar block or cobblestone. The improvements, when completed, will lessen the cost of operation and improve the service to the public, but at present they eat heavily into the receipts with no immediate financial return. Our rolling stock has been maintained at a high standard and increased by a large number of new cars. In view of our heavy expenses for improvements, the early settlement of the river bridge problem and the general prosperity of the community, the management confidently expect (barring unforeseen contingencies) that the ensuing fiscal year will show results more satisfactory to the stockholders. The sale of unused real estate has brought in $74,000. Betterments, reconstruction and additions made to property aggregated $273,646."

Montreal Light, Heat and Power Company

First Annual Report.

	1902.	1901.
Gross earnings	$1,760,285	$1,600,706
Expenses	939,068	890,329
Net revenue	$821,217	$800,377
Interest on bonds and loans	91,495	176,670
Dividends paid, 4 per cent	587,969	490,404
Surplus	$141,753	$133,303

Balance sheet.

Assets.		Liabilities.	
Stocks, bonds and interest in other companies	$18,162,188	Capital stock	$16,977,800
New construction	324,094	Bonds	2,500,000
Accounts receivable	209,052	Chambly plant	298,576
Stores	155,810	Accounts payable	259,690
Coke, tar, etc	39,442	Customers' deposits	17,604
Gas stoves	34,218	Accrued interest	65,798
Cash	1,490,393	Dividends unclaimed	7,168
		Dividend, May 15	146,807
		Surplus	141,753
	$20,415,197		$20,415,197

President H. S. Holt says: "Under agreements the four controlled companies are operated by the Montreal Light, Heat & Power Co., and being under one management the cost of operation has been largely reduced, but the company will only receive the full benefit of the combined operation during the coming year. Of the $7,500,000 of first mortgage bonds authorized Jan. 15, 1902, $2,500,000 have been sold to take up $2,000,000 of outstanding bonds of the

Montreal and St. Lawrence Light & Power Co., and to provide for present requirements; $1,405,000 are held in escrow to redeem the outstanding bonds of the Montreal Gas Co. and the Royal Electric Co., leaving $3,595,000 of bonds in the treasury for further requirements of the company. The work of completing the full development of the power at Chambly has proceeded satisfactorily, and the directors anticipate that all the power necessary for the operation of the company's electric system will be received by Sept. 1, when the three steam stations will be held as reserve. The development of the water power at St. Therese Rapids, three miles above the Chambly power house, has also been commenced, and it is expected that it will be completed some time next winter. This development will add largely to the water power of the company, as well as doing away with any possible interference by frazil. The new central electric transforming station on Queen street is nearing completion and will be the most modern and complete station on the continent. The increase in the gas output for the year has been 54,291,000 cubic feet. The use of gas for fuel purposes continues to increase most satisfactorily. There were installed during the year 2,010 gas stoves, 3,148 meters, 1,090 new services, and 619 miles of new mains have been laid. The increase in the electric department has also been highly satisfactory. During the year, 13,918 incandescent lamps, 35 arc lamps and 79 meters (equivalent to 756 horse power) have been added to the company's circuits. The contract for the city lighting expiring in 1904, the city called for tenders for the lighting of the streets for five years from that date, the company receiving the contract."

The company recently made a statement to the New York Stock Exchange, from which are gleaned these additional facts: The company controls all the gas business in Montreal and suburbs, does all the municipal lighting, furnishes 133,295 incandescent lamps, 1,536 arc lamps, 6,315 electrical horse power to the city and public, and 5,000 electric horse power to the Montreal Street Railway Company, under a contract running until 1923. The charters of the company and its subsidiary companies are perpetual and convey rights in Montreal and its suburbs. The Montreal and St. Lawrence Light & Power Co. has developed a large hydraulic plant for the production of electricity at Chambly, on the Richelieu River, the outlet of Lake Champlain. Current from this station was first used in Montreal in August, 1899. The present development is about 20,000 nominal horse power, and a further development of 6,000 horse power is under construction.

	Year Incop.	Capital Stock Issued	Capital Stock Owned	Dividend Per annum	Bonds Outstanding	
Montreal Gas	1847	$2,999,040	$2,949,080	* 10%	† $880,074	4–5%
Royal Electric	1884	2,250,000	2,250,000	** 8	‡ 487,158	1st mort. 4½
Mont. & St. L. L. & P.	1888	2,750,000	2,750,000	......	‖	
Imperial Electric Lt.	1896	150,000	150,000	7	......	
Total		$8,149,040	$8,099,080		§ $1,367,227	

* regularly. † Since 1894. Includes $243,414 4½s due Dec., 1902; $150,000 5s due June, 1908; $486,660 4s due July, 1921; ** regularly since 1884; ‡ due Oct., 1914, but $34,473 are retired annually at 105 and interest; ‖ $2,000,000 5s due July 1, 1950, but all owned by Montreal Light, Heat and Power Co.; § of the bonds of the Montreal Light, Heat and Power Co. $1,405,000 are reserved to take up these bonds.

Consolidated Gas Company of Baltimore

Abstract of circular report by Hambleton & Co.

	10 months to Apl. 30, 1902	1901 to June 30	1900 to June 30
Gross income from gas	$1,505,888	$1,634,693	$1,682,841
Total deductions	15,195	7,859	2,381
Net income	$1,490,693	$1,626,834	$1,680,459
Operating expenses	863,158	917,196	893,741
Earnings from operation	$627,534	$709,638	$786,718
Total income from other sources	8,057	32,558	110,463
Earnings from all sources	$635,591	$742,197	$897,182
Deduct bond interest	314,766	377,720	386,886
Earnings after payment of bond interest	$320,825	$364,477	$510,297
Earnings for div. and extensions	320,825	312,727	510,295
Dividends paid (*six months)	161,554	592,366	430,810
Surplus or deficit	$159,279	def. $279,639	$79,485

Estimating two months' earnings and deducting six months' dividend for 1902 would leave an apparent surplus of $29,-000.

The full statement covers four years and ten months of 1902. Hambleton & Co. represent a committee of stockholders opposed to the management of the company and favoring an opposition ticket. The present management excepted to the statement, claiming that while it was an exact excerpt from the books, the figures are misleading. In extenuation they put out a circular from which these figures are taken:

Revenue from gas after deducting worthless bills and gas used by the company	$1,744,912	$1,618,488	$1,671,287
Receipts from other sources	12,750	20,944	34,628
Operating expenses	1,008,409	919,361	901,513
Interest on bonds and debt	377,720	377,720	386,886
Premium from bond substitution	......	......	92,780
Premium from sale of city stock	8,095	21,375	......
Regular dividends declared	323,109	323,109	430,810
Added to surplus each year	56,619	40,618	79,485

Hambleton & Co. say:

It will be noted that the results of the operation of the company for the years ending June 30, 1898, 1899, 1900, 1901 are practically the same in both statements, with one important exception—the present management claims a surplus for 1901 of $40,618, while the experts show for that year a deficit of $279,-639.50. The method by which this deficiency is converted into a surplus is by not charging the company for that year with the extra dividend of $269,257.50, or with the $51,000 Siemens-Lungren gas stock charged off. Taking their own figures, however, the board of directors paid out in 1891 $592,366.50 in dividends, and earned during the same period $363,-727.

The declaration of an extra dividend in

July, 1900, of 2.5 per cent, when the legislature had just previously reduced the price of gas from $1.25 to $1.10, was one of the most amazing and inexplicable events on record. The company had accumulated a surplus of about $350,000, and the greater part of it was invested in city stock and held to meet any future requirements of the company, when the directors, with a certain large reduction in revenue from the decrease in the price of gas staring them in the face, met together and resolved to sell the company's city stock and divide $269,257.50 among the stockholders.

We like to receive dividends as much as any one, but we never could appreciate any reason for the declaration of this dividend. A surplus of $350,000 is none too large for a company to carry which is capitalized at $18,000,000.

The parties who have been instrumental in bringing about a contest for a change of management of the Consolidated Gas Company, ourselves among the number, are very large holders of the stock of the company. They did not increase their holdings with any idea of making a market for the stock and selling at a profit, but were instigated by the belief that the property is in a somewhat crude condition and susceptible of great improvement under an active, modern management through up-to-date methods.

Baltimore appears to us a most excellent field for the business of manufacturing and supplying gas. Not more than one-half of the houses of Baltimore use gas at all. Therefore, we have a population of nearly 300,000 non-consumers to work upon and to convert into consumers. Popular prices for illuminating and fuel and power gas and the application of modern methods should in a few years add 50 per cent to the output and largely increase the earnings of the company. A gas expert recently reported:

In point of size Baltimore is the sixth largest city in the United States. That the city has had a steady growth in both wealth and population. The general conditions presented for the sale of gas are favorable, and the sales per capita should compare favorably with other cities in its "class. The following table shows the per capita sales in Baltimore, Milwaukee, Washington and Boston:

City	Population	Year	Sales per capital; cu. ft. est'd	Net price per 1,000
Baltimore	530,000	1902	3,030	$1.10
Milwaukee	305,000	1902	4,140	1.00
Washington	250,000	1898	3,920	1.10
Boston, including Brookline	580,827	1900	6,000	1.00

It will be noticed that the per capita sales of gas at Baltimore is only 3,030 cubic feet per annum, against 4,140 cubic feet at Milwaukee, a city of only about one-half the population of Baltimore, while Washington, D. C., with not half the population, sells 4,140 cubic feet per annum. The houses are here, the people are here; they simply do not, for some reason, burn gas. That they can be persuaded to become consumers we have not the slightest doubt. It is with the expectation that Baltimore will not remain such a comparatively small consumer of gas that we hold the stock of the Consolidated company. The management of the Consolidated Gas Company is to be commended for the progress made during the past two years. There has been unquestionably an improvement since the contest for control two years ago; but there is room, much room, for further progress, and this will be accomplished under the new management and direction of the best gas experts in the country.

Financial Notes

BROOKLYN RAPID TRANSIT'S report for June and for the year indicates that the stockholders will be compelled to wait longer for dividends. In round figures there was a decrease of $15,000 in gross and net earnings for the month, and a decrease in net for the year of $293,000. Rainy weather undoubtedly affected traffic this summer more than usual and accounts for the showing in June as there was a small decrease in operating expenses, thus showing that the management is making progress in the right direction. Operating expenses, including taxes for the year, were $981,579 greater than in 1901, which goes to show how important this reform is in the conduct of the property. Ordinarily traction companies are operated on a fifty per cent basis, but Brooklyn Rapid Transit is by the latest showing costing about twenty per cent more. The next most gratifying exhibit in the annual report is an increase of $688,507 in gross receipts. It shows a healthy growth of traffic due to an increased population. The city has expanded wonderfully and is growing every year. Every new home established means so much more business for the traction company and real estate men are confident the development boom will get a fresh impetus with the completion of the new bridge and the extension of the Greater New York subway system. The Pennsylvania Railroad has great plans for improving Long Island, all of which will not be a drawback to the electric lines controlled by B. R. T. The current year ought to see a decided advancement in the affairs of the great traction system especially in the physical betterment of the property. Stockholders authorized March 20 a general consolidated and collateral trust mortgage for $150,000,000, of which $61,065,000 will be used to retire all existing bonds, the balance to go for improvements, additions and new acquisitions as needed. In May, Flower & Co. took $5,000,000 of these bonds. Financially the company's prospects never were better. An insider in Brooklyn Rapid Transit says of the situation in that stock: "We do not claim that the present earnings on Brooklyn Rapid Transit make the stock attractive to the public at the present price. The public buys a stock either for speculation or for the current return. There will be no return in the way of dividends on Brooklyn Rapid Transit for some time. We are willing to hold the stock because we believe in the future of the property. There must be great growth in the Borough of Brooklyn, and growth from this point on is growth of earnings on Rapid Transit stock. The company can take care of its charges on the present volume of business, and every year this business will increase. There will be a great influx of population in the northeastern part of the city when the Williamsburg bridge is finished. The tunnels will build up business between East New York and Jamaica. Growth in South Brooklyn is steady and will continue. All we have to do is to wait, and the time will come when Brooklyn Rapid Transit will be a staple dividend stock. Earnings this year have been somewhat disappointing on account of the cool weather and the smaller travel to the seaside. On the other hand, the short travel is increasing. More people take the cars for short distances. We are putting earnings into the property and intend to keep on. We may be disappointed in our expectations, but the people who are risking their money on the proposition have a good record in reading the future."

METROPOLITAN STREET RAILWAY, New York, has had listed on the New York Stock Exchange $12,-

780,000 four per cent refunding 100-year coupon mortgage bonds, of which $11,000,000 were offered by Kuhn, Loeb & Co. last May. These eleven millions were issued to the Interurban Street Railway Company in part consideration for a payment of $23,000,000, the remaining $1,780,000 having been sold for refunding $1,200,000 consolidated mortgage 7 per cent. bonds of the Central Park, North & East River Railroad, which mature Dec. 1, 1902; $50,000 first mortgage 6 per cent extended bonds of the Twenty-third Street Railway and $50,000 first mortgage 6 per cent extended bonds of the Forty-second Street & Grand Street Ferry Railroad, which bonds were called for redemption at par July 1 last; and two bonds, aggregating $350,000, secured by mortgage upon a portion of the Company's real estate. In applying to the Stock Exchange to make the listing the Metropolitan Company made this statement: Gross earnings for the year ending March 31, $15,409,817; net, $8,023,934; other income, $456,824; fixed charges, $4,815,421; dividends, (7 per cent.), $3,640,000; balance, surplus, $25,337.

INTERBOROUGH RAPID TRANSIT COMPANY'S stockholders voted August 26 in favor of the proposition to increase the capital stock from twenty-five to thirty-five million dollars.

OTIS ELEVATOR COMPANY stockholders will vote September 8 on a proposition to increase the preferred stock to $2,000,000. Of this amount $1,000,000 will be offered to shareholder on a basis of 10 per cent of his holdings at par, the balance to remain in the treasury.

STATEN ISLAND TRACTION will probably be consolidated under developments by the committee reorganizing the New York & Staten Island Electric Railway, the Richmond Power Company and other allied corporations. This will bring the Midland Railway into the combination. At foreclosure sale last month William L. Bull, of Edward L. Sweet & Co., Chairman of the Reorganization Committee, bid in the power plant for $10,000 and the electric railway for $250,000, and the successor company, Richmond Light & Railroad, was incorporated with $190,000 capital.

OMAHA STREET RAILWAY shareholders by a large majority, have agreed to accept an offer by J. & W. Seligman & Co., to buy not less than ninety per cent of the outstanding capital stock ($5,000,000) at $90 per $100 share. This is part of the plan to consolidate the company with the Omaha & Council Bluffs Bridge and Railway and the Omaha, Council Bluffs & Suburban Railway Companies.

EDISON ELECTRIC COMPANY, of Los Angeles, recently contracted with N. W. Harris & Co., E. H. Rollins & Sons and Perry, Coffin & Burr to take all or any part of $10,000,000 bonds as needed, $3,000,000 for immediate delivery, the proceeds to be used for building a new steam plant, enlarging the water power plant, etc.

WESTERN ELECTRIC CO. is to increase its stock from three million to thirteen million and stockholders will be allowed to subscribe at par. This company is controlled by the American Telegraph & Telephone Company.

NORTH JERSEY STREET RAILWAY COMPANY'S plant in Jersey City has been assessed at $1,338,000, an increase of $850,000.

AMERICAN LIGHT & TRACTION now has outstanding $8,554,400 of the $25,000,000 six per cent cumulative preferred stock and $4,378,600 of the $15,000,000 common stock, the same having been issued in exchange for $1,917,600 cash and the purchase of controlling interest in the Western Gas Company of Milwaukee, Grand Rapids (Mich) Gas Light Company, Madison (Wis.) Gas & Electric Company, St.

Joseph (Mo.) Gas Company, St. Paul (Minn.) Gas Light Company, Binghamton (N. Y.) Gas Works, Southern Light & Traction Company, of San Antonio, Tex., and St. Croix Power Company. For the fiscal year ending June 30 last the company earned net $828,732, out of which was paid in the way of a full year's dividend on its preferred stock the sum of $457,015, leaving a surplus for the year of $371,717, which is equivalent to about 8½ per cent on the outstanding common stock. Early last month the company made an offer to buy not less than $750,000 of the $1,000,000 capital stock of the Consolidated Gas Co. of New Jersey, paying therefor at the option of the holder per $100 share either $17 cash per share, or $18 face value of preferred of the American Light & Traction Co., or $40 face value of common stock of the A. L. & T. Co. The Consolidated Company supplies gas in Long Branch, Asbury Park and Red Bank, and also owns the electric light plant at Long Branch, which furnishes illumination and power to Elberon, Branchport, Monmouth Beach, Seabright and Eatontown. The company has outstanding $971,000 first consolidated 40-year 5 per cent gold bonds due in 1936, Knickerbocker Trust trustee. There are also $15,000 Long Branch lighting bonds, to retire which $15,000 cash is with the trustee.

PRIVATE TELEPHONE SYSTEMS for the New York Stock Exchange and other exchanges have been discussed of late, but the consensus of opinion is against the experiment. It is argued by the advocates of the invention that greater privacy and a more satisfactory service from the viewpoint of celerity and economy would result. Brokers who have used the private switchboard of the general company with an experienced operator say that it answers their purpose in every emergency and it is better to leave well enough alone. However, there is much to be said for and against a private system and the agitation will probably be continued by the promoters in the hope of winning converts.

NEW ALBANY STREET RAILWAY has been sold to the United Gas & Electric Co., of New Albany and Jeffersonville, Ind., for a sum reported to be $250,000. This makes the eighth plant in the consolidation, the others being the New Albany Gas Light & Coke Co., New Albany Light, Heat & Power Co., New Albany Water Co., Indiana Water Co., Jeffersonville Electric Light, Heating, Gas & Coke Co. and the Jeffersonville Light & Water Co.

UNION ELECTRIC LIGHT & POWER CO., of St. Louis, was last month authorized by the shareholders to execute a $10,000,000 mortgage, $4,000,000 of the bonds to be issued without unnecessary delay through the Mississippi Trust Co.

PHILADELPHIA RAPID TRANSIT COMPANY has bought a site at West Philadelphia and proposes to build and operate a car building and repairing plant.

NORTHEASTERN RAILWAY of England will convert thirty-seven miles of line for electric traction and will buy largely of the American dealers.

Attention is called to the issue of $1,000,000, at 4 per cent. 5-20 years, first mortgage trust gold bonds of the United States Mortgage & Trust Company, advertised in another column. These bonds are specifically secured by a deposit with the Guaranty Trust Company of New York of $1,000,000 of first mortgage on improved real estate in the principal cities of the United States valued at $2,648,969, having a gross income of $265,273, and a net income of $178,372, as against the 4 per cent. charge on the above bonds of $40,000.

In addition to this security these bonds are the direct obligation of the Company.

The care with which the Company's mortgage investments have been made is evidenced by the record of the past seven years, during which over $13,000,000 have been invested, and no real estate is now owned by the company.

Mortgage bonds of this character, issued by a conservative and responsible institution, have been a popular high priced investment in Europe for many years; and the intrinsic security of the deposited mortgages, added to the obligation of the United States Mortgage & Trust Company, renders the above bonds secure beyond question.

OLD DOMINION STREET RAILWAY of Portsmouth, Va., has been bought by Pennsylvania Railroad interests.

CONTINENTAL TRACTIONS are being bought by the Whitney-Widener syndicate. There has been something doing at Hartford and New Haven.

LEHIGH VALLEY TRACTION COMPANY has increased the quarterly dividend from 1 per cent to 1¾ per cent on the preferred stock.

MASSACHUSETTS GAS COMPANYS is the proposed successor of the New England Gas & Coke Company, but there has been delay in issuing the new securities owing to the attitude of certain interests in the Bay State Gas Company. Kidder, Peabody & Co. have bought at $200 a share almost the entire outstanding minority stock (about $110,000) in the Jamaica Plains Gas Light Company. It is reported that about all the Boston United Gas first and second series bonds have been deposited under the call and that the first series will be paid off in cash at par and the seconds will receive ten shares of Massachusetts Gas preferred. It is believed that the Addicks and Content interests will oppose foreclosure of the Bay State Gas properties and the former will make a reorganization committee to protect the Bay State Gas Company of Delaware. Content & Co. say they represent 1,000,000 shares. There is widespread interest in the outcome.

UNITED GAS IMPROVEMENT COMPANY sold in the city of Philadelphia during the quarter ending June 30 and the previous six months as reported to the Comptroller:

Cubic feet, 3 mos., 1902.........	1,224,122,860
Cubic feet, 3 mos., 1901.........	965,293,690
Cubic feet, 6 mos., 1902.........	2,627,994,910
Cubic feet, 6 mos., 1901.........	2,237,588,490
Six mos. gross revenue, 1902....	$2,627,995
Six mos. gross revenue, 1901....	$2,237,588
Of which the city receives, 1902.	$262,799
Of which the city received, 1901.	$223,758

CALIFORNIA GAS & ELECTRIC CORPORATION has secured the Oakland Gas Light & Heat Company, more than 51 per cent of the outstanding stock having beeen deposited with the First National Bank of San Fransisco in response to the offer for an option at $70 per share.

UNITED RAILWAYS INVESTMENT COMPANY'S (San Francisco,) transfer books for participation receipts were closed from August 9 until August 25 for the purpose of enabling Brown Bros. & Co., managers of the San Francisco Street Railway syndicate, to make distribution under the agreement of February 17. From the proceeds of sales of United Railroads of San Francisco four per cent sinking fund gold bonds a cash payment of fifteen per cent was made to holders of full paid receipts and five per cent cash and ten per cent "in account" to holders of "ninety per cent paid" receipts, making these last full paid. Officers of the company now are: President, Henry J. Bowdoin; vice-president, W. G. Vermilye; secretary and treasurer, W. J. Duane; other directors, P. Calhoun, Eugene Delano and T. Mullally. The Mercantile Trust is transfer agent and the U. S. Mort. & Trust Co. register.

Stock Market Reports

Traction Stocks and Bonds

	Bid.	Asked.
Akron, O Bed & Clev g 5s	103	104
Allen & Kutz Tr 5s g	98½	100
Albany Ry con M 5s g	115⅜	118
Albany Ry gen g 5s	116½	119½
Am. Light & Traction	37	38¼
Am. Light & Traction pref	93	94½
American Railway (Phila)	49¾	50½
Atlantic Ave. con. gen. 5s	110	115
Atlantic Ave. 1st gen. 5s	103	106
Atlantic Ave. im g. 5s	110	110¼
Atlantic Coast Electric	8	10
Atlantic Coast Elec. 1st 5s	85	90
Atlantic Coast Elec. gen. 5s	40	60
Augusta, Ga, Rys & E Co 1st 5s	100	105
Balt City Pass 1st 5s g	107	109
Balt City & El Mills 5s g gtd	000	000
Balt Tr & Co 1st M 5s	117	118
Balt Tr & Co con v 5s	101	102
Beaver Val Tr 1st con g 5s	105	107
Bing. Lester & U g 5s	105	109
Binghamton R. R. Co. g 5s	102	103
Binghamton R R g 5s	106	107
Birmingham Ry L & P 1st con g 5s	104	105
Birmingham Ry & El 1st g 5s	108	112
Bleecker St. & Fulton Ferry	34	38
Bleecker St. & Fulton fy 1st 4s (Met. St Ry.)	100	102
Boston Elevated	159	160½
Braintree & Weymouth g 5s	108	109
Bridgeport Traction 1st 5s	106	107
Bridgewater W & R g 5s	108	109
Broadway & 7th Ave. 1st c. g. 5s	101	102
Broadway & 7th Ave. registered	107½	109½
Broadway & 7th Ave. (Met. St. Ry.) 10 p c.	248	252
Broadway Surface 1st 5s	112½	115
Broadway Surface 2d 5s	101½	102½
Brockton B & T Ry 1st g 5s	106	108½
Brooklyn Bath. & W. End 5s	102½	104
Brooklyn City 10 p. c.	246½	247½
Brooklyn City & Newtown 1st 5s	115	117
Brooklyn City 1st. con. 5s	112½	114
Brooklyn (Cleve.) 1st 6s	103	104
Brooklyn (Cleve.) 1890 6s	103	104½
Brooklyn Crosstown 1st 5s	101	103½
Brooklyn Heights 1st 5s	105	108
Brooklyn Q. & S. 1st g 5s	107	109½
B'klyn, Queens Co. & Sub. 1st con gu g 5s	100	102
Brooklyn Rapid Transit	67⅛	67¼
Brooklyn Rapid Transit 5s g	108	110
Brooklyn Union El. 1st 4-5s	102½	103
Brooklyn Union Stamped guaranteed	104¼	104½
Buffalo Bellevue & Lan 5s	102	103½
Buffalo Crosstown 1st 5s	114½	116
Buffalo & Lockport 1st g 5s	107	108½
Buffalo & N F. E. L. & P. Co 5 p. c.	100	—
Buffalo & Niagara Falls Elec. 1st 5s	100	110
Buffalo & Niagara F. Elec 2d 5s	104	106
Buffalo St. Ry. 1st con. 5s	117	118
Buffalo St. Ry. deb. 6s	105½	106
Buffalo Traction 1st 5s	108½	109
Burlington Ry & Light 1st g 5s	101	101½
Calvary Cem. & Greenpt. 1st 6s	106	108
Caimbridge 1st M 5s	101	102
Camden & Trenton Ry g 5s	101	103
Canton Man Ry 1st g 5s	102	103
Capital Traction scrip	106	107
Capital Traction Wash	113⅜	113½

	Bid.	Asked.
Central Crosstown Ry 10 p. c. gtd	250	275
Central Crosstown 7 p. c.	265	280
Central Crosstown 1st 6s	120	125
Central Park N. & E. R. con. 7s	100½	101½
Central Park N. & E. R. 9 p c. gtd	208	220
Central Ry con M g 5s	118	120
Central Ry ex & imp 5s	117½	118
Charleston Con Ry Gas & El Co con g 5s	93½	95
Charleston City Ry 1st g 5s	105	106
Charles River 1st M 5s	102½	103
Chicago City Ry 9 p. c.	210	229
Chicago & Mil E Ry 1st g 5s	102½	103
Chicago Union Traction	16	16¼
Chicago Union Traction pref 5 p. c.	47	50
Christopher & 10th St. 1st 4s	99	100
Christopher & 10th St. Ry 8 p. c. gtd	180	190
Cicero & Prov St 1st 6s	105	106
Cin New & Cov 5s g	111½	112
Cin & Ham 6s g	109½	111
Cincinnati St. Ry	144	145
Cin St Ry con 5s	106	107
City Island & Bklyn 1st 5s	101	102
City Island & Bklyn 5s ctf ind	101	103
Citizens Traction, Pittsburg 6 p. c.	70	72
City Ry., Dayton, O 5 p. c	164	165
City Ry., Dayton, O , pref 6 p. c.	181	182
City & Sub Ry Baltimore 1st g M 5s	105	106
City & Sub Lk Ro El 1st g 5s	118	120
Cleveland & Chagrin Falls	100	101
Cleveland & Chagrin Falls Elec 1st g 6s	96	102
Cleveland City Cable Ry. 1st 5s	100	103
Cleveland City Ry 5 p. c.	106	115
Cleveland & Elyria g 6s	102½	104½
Cl Ber Ely & Ober 5s g	100	100½
Cl Ely & West con 1st g 5s	101	102
Cleveland Electric con. 5s	107	108
Cleveland Electric Ry 4 p. c.	83½	87
Cleveland, Elyria & Oberlin 1st 6s	104	108
Cleveland, Elyria & West	84	85
Cleveland, Painsville & E. Ry. 5s.	100	101
Cleveland, Painsville & E. deb. 6s	95	97
Cleveland, Painsville & E. Ry. con 5s	85	90
Columbus Crosstown 1st 5s	110	113
Columbus & 9th Ave. 1st gtd g 5s	122	123
Col. & 9th Ave., N. Y. 1st 5s	122	122½
Columbus (O) Con St Ry 1st g 5s	104	105
Columbus Crosstown St Ry 1st g 5s	110	113
Col, London & Springfield Ry 1st g 5s 1920	99	102½
Col, Grove City & S WRy 1st g 5s 1921 op 1906.	99	101
Columbus St. Ry	54	56
Columbus St Ry. pref 5 p. c.	105½	107
Columbus St. Ry. con 5s g	117½	118
Coney Island & Brooklyn ctfs. 5s	100	102
Coney Island & Brooklyn 1st 5s	101	104
Coney Island & Brooklyn Ry	375	400
Consolidated Traction N. J.	69½	70
Consolidated Traction N. J. 1st 5s	110	111
Conn. Ry. & Ltg. 1st & refg. 4½s	99	101
Crosstown Street Ry 1st g 5s	115	116
Dayton Leb & Cin Ry 1st g 5s 1921	100	101½
Dayton, Spring & Urbana 1st g 5 1928	105	106½
Dayton (O) Traction 1st g 5s 1916	102	104
Denver City Tramway 1st g 6s 1908	107½	108
Denver City T con g 6s 1910	107½	108
Denver City T Met g 6s 1911	108	109
Denver City Con T con g 5s 1933	100	101
Denver City T 1st g 5s 1919	103½	104
Des Moines St Ry 1st sfg g 6s 1919 op 1911	110	110¼

	Bid.	Asked.
Detroit United Ry	79½	80
Detroit United Ry cons 4½s 1932	97½	98½
Detroit Sub Ry 1st 5s 1902	100	101
Detroit Citizens Ry. 1st con. 5s 1905	100⅝	101
Detroit Electric Ry con g 5s 1916	102¼	103
Detroit Railway 1st 5s g 1904	109	110
Detroit Ft W & Belle Isle 1st g 5s 1927	104	105
Detroit & Northwst g 4½s 1921 op 1911	98½	100
Detroit & Pontiac g 5s 1922	106½	107½
Detroit & Pont con g 4½s 1926 op 1911	95	96
Detroit & Port Huron S L 1st g 5s 1950	100	102
Detroit, Ypsi, Ann A & Jack 1st g 5s 1926	101	102
Det, Ypsi, Ann A & J g 6s 1917	112	113
Det, Ypsi, Ann A & J con g 6s 1924	106	108
Duluth Sup Tr 1st & col tr g 5s 1930	102	103
Dry Dock E. Bway & B. 1st 5s	114	117
Dry Dock E Bway & B Scrip 5s	103	105
Dry Dock E. Bway & B St 6 p. c.	120	130
East Cleveland 1st 5s	102½	103
East Middlesex 5s	109	110
Elyria & Oberlin g 6s	101½	102
Eighth Ave. St. Ry 15 p. c. gtd	397	410
Essex Pass. Ry. N. J. con. 6s	108	110
Forty-second St & Grand St. Fy 18 p. c. gtd	407	420
Forty-second St. & Grand St Ferry 1st 6s	110	111
Forty-sec'd St., Man. & St. Nic. Ave. 1st 6s	111½	114
Forty-sec'd St., Man. & St. Nic. Ave. inc. 6s	99	101
Forty-second St., Man. & St. Nic. Av. Ry	70	80
Frankfort & So. Ry. Phil. 18 p. c.	407	420
Fulton St., 1st 4s	96	99
Germantown Ry 5¼ p. c.	147	150
Grand St. & Newtown 1st 5s	105	106
Grand Rapids 1st gt. 5s	103	104
Greenpoint & Lorimer St. 1st 6s	106	109
Hartford St. Ry 6 p. c.	55	56
Hestonville M. & F. Ry 4 p. c.	47	50
Hestonville M. & F. pref 6 p. c.	73	80
Highland Park (Detroit, Mich) 1st 5s 1908	102½	103
Indianapolis St. Ry	78	88
Indianapolis St. Ry gen'l 4s	87	88
Interborough New York	200	205
Internat'l Traction (Buffalo) sub. 4½ p. c.	117	118½
International Traction Co pref 4 p. c.	60	65
International Traction Co 4s	90	91
Jamaica & Brooklyn 1st 5s	104	105
Jersey City, Hoboken & Paterson Ry.	23	25
Kansas City El. 1st 6s	112	118
Kansas City El. 2d 4s	87	90
Kansas City Met St. con. 5s	102	104
Kansas City Met. St. gen 5s	103	105
Kings Co. El. & P. stk	188	190
Kings Co. El. 1st g 4s	89	91
Lakel. St Eevated (Chicago.	10½	11
Lake St El deb 5s g gtd	103	103½
Lake St El inc deb 5s	50	54
Lima Elec. Ry & Ltg. Co.	20	21
Lima Elec. Ry & Ltg. Co. 5s	85	100
Lorain & Cleveland g 5s	103	104½
Lehigh Valley T 1st g 4s	86	87
Lex & Bost 1st g 4½s	103	104
Lexington Av. & Pav Fy. 1st 5s	121	125
Lexington Av & Pav Fy registered	120	122
Lockport & Olcott 1st g 5s	102½	104
Louisville Central Pass. Ry 6s 1962	102	103
Louisville Central Pass. Ry. 6s 1908	113	114
Louisville Ry Co 1st con g 5s	118	120
Louisville City Ry 2d 4½s	108	110
Louisville City Ry 6s	107	108
Louisville St. Ry 4 p. c.	104	106
Louisville St. Ry pref	114	116
Lynn & Bost 1st g 5s	113	114

	Bid.	Asked.
Manhattan El. Ry. N. Y.	134⅝	134¾
Manhattan Transit N. Y	7½	7⅝
Market St. Cable San Francisco	112	116
Market St Cable 1st 6s	124	125
Massachusetts Electric Co.	40	40⅝
Massachusetts Electric Co pref	144⅛	145½
Metropolitan St., Kansas City	96	98
Metropolitan Brs plain 5s	101	102
Met Ry Co 1st guar g 6s	111	111
Met. St Ry. N. Y. gen col. tr. g 5s	121¼	121½
Met. St Ry. new 4s	98⅝	98¾
Met. St. Ry. N Y. stock	147½	147⅝
Met. St. Ry. sub. 5s 1st instl. pd.	123	123½
Metropolitan Securities Co. (N. Y.)	126½	126¾
Met. W. S. El Chicago	38½	40
Met W S El pref	89½	90
Met. W. S. El., Chicago 1st g 4s	102⅝	102⅞
Met W S El registered	111	111
Met W S El ext g 4s	97	98
Middlesex plain 5s	102¼	103
Milwaukee Elec. Ry. & L. con. 5s	111	113
Minneapolis St. Ry, con. 5s	109	112
Minneapolis St. Ry. 1st 7s	105	108
Minneapolis St. Ry. 2d 6s	114	115
Mount Aub Cable 1st 5s	105	106
Mt Ad & Eden Pk 1st 6s	107¾	108½
Nassau Electric con g 4s	87½	89½
Nassau Electric 1st 5s	112	114
Nassau Electric pref	97	99
Newark, N. J. Pass. Ry. 1st con. 5s	117	119
New Orleans City & Lake 1st 5s	110	113
New Orleans City Ry	33	35
New Orleans City Ry. pref 5 p. c.	110	112
New Orleans Ry. 1st 6s	105¼	106
New Orleans Traction 1st 6s	108	109
Ninth Ave. Ry. N. Y 8 p. c.	195	205
Norfolk, Va. St. Ry. con. 5s	107	110
North America Co	121¼	122
N Balt Div (Belt Tr) 1st g 5s	120	122
Northampton St. Ry	180	200
North Chicago Street	....	190
North Chi City con 4½s	103½	105½
North Chi St Ry 1st 5s	103	107
North Chi St Ry 1st 5s 1909	104	105
North Hudson Co., N. J. con. 5s	113	114
North Jersey Street	34	35½
North Jersey St. Ry. 1st 4s	82¼	83
Northern Ohio Traction	39¾	40¼
North Ohio Traction 5 p. c.	89	90
Northern Ohio con g 5s	100½	101
Norfolk Va. Ry & Lt	12	13
Oakland, Cal. Traction Co. 1st con. 6s	124	126
Old Colony St Ry Boston	111	111
Orange & Passaic V. Ry. 1st 5s	80	85
Paterson, N. J. Ry 1st 6s	105	106
Paterson, N. J Ry con. 6s	115	116
Philadelphia City Ry 7½ p. c.	205	210
Philadelphia Co	49⅝	49¾
Philadelphia Co. pref	49	50
Philadelphia Electric	5	6
Philadelphia Electric 4s	65	66
Phil & Lehigh V T 1st g 4s	74	78
Philadelphia Traction	99¾	100
Quakertown Traction 1st g gtd 5s	98	100½
Railroad Securities	93⅞	94½
Railways General	5½	6
Railway Steel, Springfield	31	32
Railway Steel, Springfield pref	86	86¼
Rapid Ry (Det & P H S L) 1st g 5s 1915	101	104
Reading, Pa. City Pass	180	200
Reading, Pa. Traction	32	33

	Bid.	Asked.
Richmond, Va. Traction 5 p. c	32	34
Richmond Traction 1st 5s	85	100
Ridge Ave. Phil. 12 p. c	300	315
Rochester St. Ry. con. 5s	111	112½
Rochester St. Ry. 2d 5s	100	103
Rochester, N. Y. St. Ry	65	67
San Francisco Rys	21½	22½
San Francisco Rys. pref	61½	62½
San Francisco Rys. 4s	90	91
San Francisco Rys. ex rights	48½	49
St. Louis Street Ry	31½	32½
St. Louis Street Ry. pref	84	84¾
St Souis Street Ry. 4s	87	87¼
St. Louis & Suburban	75	88
St. Louis Transit	31⅞	32¼
St. P. City Cable con. g 5s	110	111
St Paul City gtd g 5s	111	111
Seattle Elec 1st g 5s	111	111
Scranton, Pa. Ry	35	38
Scranton, Pa. Traction 1st 6s	117	120
Scranton, Pa Ry. col. tr. 5s	105	106
Sea Beach 1st 4s	85	86
Second Ave. Ry. N. Y. 8 p. c. gtd	215	225
Second Ave. N. Y. con. 5s	117	120
Second Ave. N. Y. 1st 5s	105	107
Second Ave. N. Y. deb. 5s	105	106
Second & Third St., Phila. 10½ p. c	300	320
Seventh Ave. Ry. N. Y. 15 p. c	118	122
Sixth Ave. Ry. N. Y. 6 p. c. gtd	175	185
South Boston plain 5s	103½	104
South Boulevard, N. Y. 1st 5s	110	113
South Ferry, N. Y. 1st 5s	107	110
South Side St Ry (Clev) 6s	101	102
Southern Ohio Traction	70	72
So Cov & Cin 1st 6s	130	135
So Cov & Cin 2d con 6s	130	135
So Ohio Tr 1st con g 5s	100	101½
So Shore & Boston g 5s	109	110
Southern L. & T. 1st 5s	90	91½
Springfield, Mass. St. 8 p. c	210	220
Springfield & West (Dayton O) g 5s 1921	100	103
Steinway L. I. City 1st 6s	118½	119
Syracuse R. T. 1st 5s	101	102
Syracuse Rapid Transit	27	30
Syracuse R. T. pref	70	74
Third Ave. Ry. N. Y	131	133
Third Ave Ry. N. Y. 1st g 5s	124½	125
Third Ave. Ry. 1st con gtd. 4s	98⅝	98⅞
Thirteenth & Fifteenth St. Phila. 11½ p. c	305	315
Thirty-fourth St. N. Y. crosstown 1st 5s	114	115
Toledo Traction con. 5s	103	104
Toledo Ry. & Traction	33½	34
Troy Ry 5s g	115	117½
Twenty-eighth & 29th St. Ry. N. Y. 1st 5s	113	115
Twenty-third St. Ry. N. Y. 18 p. c	408	415
Twenty-third St. Ry. 1st 6s	110	111
Twenty-third St. Ry. deb. 5s	102	106
Twin City Traction	127⅜	128
Twin City pref	156	160
Union El Chic 1st g 5s	123½	126
Union L (Loop) 5s g	113½	114
Union Passenger, Phila. 9½ p. c	240	245
Union Ry. N. Y. 1st 5s	118	120
Union Traction	47⅞	48
Union Tr Ind 1st g 5s	100	101
Utica E L & P 1st s f g 5s	110	111
United Ry. & Elec. Balt	15	16
United Ry. & Elec. pref	109½	110
United Ry. & Elec. Balt. 1st con g 4s	94	95
United Ry. & Elec. Balt. g inc 4s	72	72½
United Ry. St. Louis pref. 5 p. c	84	85½
United Ry. St. Louis gen 4s	87⅛	87⅞
United Ry. Traction (Pitts.) genl. 5s	117	120
United Ry. Traction, Pitts	50	51
United Ry. Traction pref. 5 p. c	15	16
United Traction & Electric pref	113¼	114½
United Tr Albany deb g 4½s	103¼	104
Washington Ry & Elec Co	14	15
Washington Ry & Elec Co pref	48	50
Washington Ry & Elec g 4s 1949	85	86½
West End, Boston 7 p. c	95	96
West End, Boston, pref. 8 p. c	115	116
West End St Ry g 5s	105¾	106
West End St Ry g 4½s	106	107
West End St Ry g deb 4s	101	102
West End St Ry g 4s	102½	103½
West End St Ry 4s	104½	105
West Philadelphia Ry. 10 p. c	252	255
W Turnpike & R R 1st g 6s	122½	125
W Turnpike & R R 2d gtd 6s	122	124½
Westchester Elec. Ry. N. Y. 1st 5s	109	110
Williamsburg & Flash. ex 4½s	103	107½
West Chi St Ry 1st 5s	108	109
West Chi St Ry con g 5s	100	100½
West Chi St Ry deb. 6s	100	101
W. C. Street Tun 1st 5s gtd	103	104½
West Div Ry 1st 4½s	108	109½
Yonkers Ry. 1st 5s	108½	109½

Gas and Electric Light

	Bid.	Asked.
Atlanta Gas Light 1st 5s 1947	104	105
Baltimore Consolidated	69	70
Baltimore Consolidated 1st 5s	113	115
Baltimore Consolidated Gas 6s 1910	112	112⅜
Bay State Gas	1¾	1⅞
Binghampton Gas Works 5s	92	95
Boston Gas 5s	98	99
Boston Gas 2d mtg	80	81
Boston Union Gas 1st s. f. g cts. 5s	80¾	81
Brooklyn Union Gas	238	240
Brooklyn Union Gas 1st con g 5s	117½	118¼
Buffalo City Gas 1st 5s	81	82½
Buffalo City Gas	7	7½
Buffalo City Gas pref	27	—
Buffalo City Gas 5s	83	84½
Buffalo Gen. Elec. Co	99	—
Central Union Gas 5s	110	111
Chicago Consumers 1st 5s	109	110
Chicago Edison	173	176½
Chicago E G. L. & F. 1st 6s	103	105
Chicago G. L. & C. 1st g g 5s	109	110
Columbus Gas Co. 1st g 5s	107½	108½
Columbus Gas c 4 p c	96⅛	100
Columbus Gas pfd 6 p. c	106½	107
Consolidated deb. 5s	110	115
Consolidated Gas N. Y.	223¾	224
Con. G. L. of Chic. 1st g g 5s	108	108½
Consolidated Gas N. J. 1st 5s	90½	91½
Consolidated Gas N. J.	16¾	18½
Denver Con. Gas. 1st 6s	103½	105
Denver Gas 3 p. c	23	25
Denver Gas & Elec. 5s	68	71
Detroit Gas stock	80	90
Detroit Gas Co. con. 1st g 5s	104	105
Detroit City Gas g. 5s	94⅞	97½
Edison El. Ill. N. Y. 1st cv. g. 5s	107	108½
Edison El. Ill. N. Y. 1st con. 5s	120	122
Equitable G. & F. Chic. 1st g g 6s	104	105
Equitable G. L. Memphis 5s	101½	103
Equit. G. L. N. Y. con. g 1st 5s	118	118¼
Fort Wayne Gas 1st 6s	57	59

	Bid.	Asked.
Gas & El. Bergen Co. N. J. 1st g 5s	66½	67½
Grand Rapids Gas L. Co. 1st g 5s	107¼	108
Grand Rapids 1st 5s 1915	103	104½
Hudson Co. Gas 5s	102	103
Indiana Nat. & Ill. Gas 1st 6s	47	49
Indianapolis Gas 1st 6s	104	106
Indianapolis Gas V	76	85
Indianapolis Gas 1st 6s	82	86
International Tr col tr 4s	90	91
Jackson (Mich.) Gas	73	75
Jackson (Mich.) Gas 1st 5s	101½	103
Kansas City, Mo Gas 1st g 5s	100½	111½
Kings Co. Purchase Money 6s	123½	125
Kings Co. Ed. E. I. 1st c. g. 4s	96½	99½
Kings Co E L & P 1st 5s	111	111
Laclede Gas (St. Louis)	85	90
Laclede Gas pref	100	100½
Laclede G. L. Co. St. Louis 1st 5s	103	103½
Lafayette Gas 1st 6s	58	64
Logan's & Wab. Vy. 1st 6s	54	58
Madison Gas & Elec 1st 6s	108	110
Mass. Lighting w. i. ex. rights	40¾	41½
Mass. Lighting pref	88	89
Milwaukee Gas L. 1st 4s	95	96
Mutual New York	330	350
Mutual Fuel Gas Co. 1st g g 5s	105	105⅝
Naumkeag Ry 1st 5s	103	104
Naumkeag Ry con 5s	104	105
Newport & Day 1st 6s	115	120½
New Amsterdam G. L. con. 5s	112	113
New Amsterdam Gas	112	113
New Bedford M & B 1st g 5s	109	110
Newark Con. con. gt. 5s	104	106
New England G. & C. Co	5½	6
New England Gas & Cok 5s	67¾	68⅛
New York & East River Gas 1st 5s	113½	114½
New York & East River Gas con. 5s	114	116
N. Y. G. E. H. & P. 1st col tr g 5s	112½	113½
N Y G E H & P registered	111	111
N. Y. G. E. H. & P. Purch Money 4s	95¾	96½
N. Y. & Queens El. & P. 1st con g 5s	106	109
Niagara Falls & Suspension Bdg 1st g 6s	101	102
Northwest Elevated 1st g g 4s	96	97
Northern Union Gas 1st 5s	108	109¼
Ogden St (Chi) 6s	114	115
Ohio & Indiana Gas 1st 6s	54	57
Orange & Ind. Nat. Gas 1st 6s	50	54
Orange & Ind. N. I. C. G. Co	21	25
Orange & Passaic Vy. 5s	100	103
Paterson & Passaic Gas	27	35
Pat. & Passaic Gas & E. con. 1st g. 5s	106½	107½
People's Gas L & C Chic	104¼	105
Peoples G. L. & C. Chicago 1st g. g. 6s	106½	107½
Peoples G. L. & C. 2d gtd. g 6s	104	104½
Peoples G. L. & C. 1st con. g 6s	121	122
Peoples G. L. & C. ex. refd. g. 5s	97	99
Providence Gas (.50)	104	105
St. Joseph Gas 1st 5s	94	96½
St. Paul G. L. gen. 5s	92	93½
St. Paul G. L. 1st 6s	114	116
St. Paul G. L exten. 6s	114	116
Standard Gas	130	131
Standard Gas pref	150	155
Standard Gas 1st 5s	115½	118
Syracuse Gas 1st 5s	99	100
Syracuse Ltg. Co	28	29
Syracuse Ltg. Co. pref	86	90¼
Trenton G. & E. 1st g. 5s	112	112½
United Gas Improvement	112	112½
Welsbach Co	36	37
Welsbach 5s	73	73½

Telegraph and Telephone

	Bid.	Asked.
Am Bell Telephone deb 4s	99½	100
Am. Dist. Tel	39	40
Am. Tel. & C	83	95
Am. Tel. & Telephone	172½	173
Am Tel & Telephone rights	..	...
Am. Tel. & Tel. col. tr. 4s 1929	99¼	99½
Bell Telephone of Canada deb g 5s	111	112
Bell Telephone (Buffalo.) 6 p. c	105½	107
Commercial Cable	155	160
Commercial Cable 1st 4s	100½	100¾
Commercial Union 6 p. c. gtd	115	120
Commercial Union of Me. 6 p. c gtd	115	120
Chicago Telephone	165	169
Consolidated Telephone Co. (Buffalo.)	—	25
Erie Tel. & Telephone col. tr. 5s	107¾	108
Franklin Telegraph Co. 2½ p. c. gtd	45	55
Gold & Stock Telegraph Co. 6 p. c. gtd	120	125
Inter Ocean Telegraph 6 p. c. gtd	119	120
Met. Tel. & Telephone 1st 5s	114½	115
Met Tel & Telephone registered	—	—
Mutual Union Tel. sink. fd. 6s	111	113
New England Telephone	141	142
N. Y. & N. J. Telephone 5s	112	120
Northwestern Telegraph 6 p. c. gtd	120	121
Northwestern Tel 7s 1904	103	104
Pacific & Atlantic Telegraph 4 p. c. gtd	76	82
Southern & Atlantic Telegraph 5 p. c. gtd	100	105
Western Telephone pref	100	101
Western Union	95½	96⅝
Western Union col tr con 5s	110	112
Western Union R. & R. E. 4½s	105½	106½

Miscellaneous

	Bid.	Asked.
Buffalo General Electric Co	108	109
Cataract Power & Conduit Co 5s	104½	105
Consolidated Refrigerating	5½	7¼
Con. Storage Battery	19	19½
Electric Boat	23	27
Electric Boat pref	30	42
Electric Co. of Am	8	9
Electric Lead Reduction	2¼	2½
Electric Lead Reduction pref	2	3
Electric Storage Battery	88	89
Electric Storage Bat. pref	86½	87½
Electric Vehicle	5	6
Electric Vehicle pref	14	15
General Electric	186	187½
Illinois Elec. Vehicle & Trans	1	1½
Manhattan Transit	8½	8¾
Niagara Falls Power Co	—	90
Niagara Falls Power Co. 5s	107	108
Niagara Falls Power Co. deb. 6s	107	108½
Niagara Falls Power Co. con. col. 6s	106½	107½
Otis Elevator	43½	44
Otis Elevator pref	101½	102
Storage Power	1⅛	1⅜
U. S. Reduction & Ref	30	34
U. S. Reduction & Ref. pref	57	60
U. S. R. & R. 1st s. fd. 6s	86	87
U S R & R 1st s f g 6s	111	111
Westinghouse Elec & Mfg assent	222	225
Westinghouse 1st pref	225	230
Westinghouse Electric, Boston	104	105
Westinghouse Elec. (Pitts.) 1st	110½	114¼
Westinghouse Elec. (Pitts.) 2d	108	109⅜

Oil Stocks.

	Bid.	Asked.
Acme	—	.75
Alabama-Texas	02	.02½
Alamo	—	10.00
Alamo City	25.00	30.00
Anaconda, of Okl	20	25
Anglo-American		.03
Atlantic & Pacific	120	150
Bankers		.08½
Beatty new	1⅛	1½
Beatty, old	14	.25
Beaumont Oil	—	50.00
Beau Confederated	—	.10
Beau El Paso	—	.17
Beau Geyser	—	—
Beau Pet & Gas	—	.40
Beau Sara	—	.07
Beckey Sharp	1½	.3
Big Four	—	.10
Birmingham-Beaumont Oil		.03
Birmingham-Beaumont O. & T.	.08	.09½
Blyson Oil and Gas		.40
Bunn's Bluff	21	.30
Buffalo	4½	.6
Cit Consolidated	10.00	15.00
Consolidated Oil & Pipe	—	5.00
Columbia	—	9.00
Creole American	—	.35
Detroit-Bmt	—	1.00
Dividend	⅞	.1
Drillers	.04	.06
Drummers	—	.50
Eastern Consolidated		.29
Eastern Oil Co 6 p. c.	—	98
Enterprise	.08	.09
Equitable	—	.06
Eureka	.35	.75
Export	—	.25
Federal Crude	.2½	.10
Fort Worth	.04	.06
Forwd Reduc.	—	1.00
Fountain Oil & Fuel	—	1.05
Gladys of Beaumont	.07	.07½
Glover-Anderson	2½	.03
Gold Eagle	—	.10
Grace	—	.64
Greater New York Home		.95
Ground Floor	.70	.80
Guffey	78.00	80.00
Gulf Refining	—	50.00
Heywood	70.00	74.00
Higgins Oil and Fuel	61 00	65.00
Home	—	.35
Illinois	—	.13
Independence	1½	.02
International	.01½	.02½
Isabella	—	3.00
Keith-Ward	20.00	30.00
Lone Acre	—	55.00
Lone Star (original pfd)	.65	.80
Lone Star Oil & Fuel	.14	.15
Louisiana Cons	.02	.2½
Lucky Dime		.04
Lumberman's	—	.35
Madeline	—	.02½
Madaline con	—	.25
Magnolia O & T	—	.25
Maid of Orleans	.01½	.02
Manhattan	28	.31
Mercantile	—	.90
Mercer	—	.15
Merchants & Traders		.04
M & M	—	.02½
M. K. & T	.09	.10
Mobile-Beaumont	—	.10
Mont & Neches River	.03	.04
National Consolidated (preferred)		.21
Nation' Oil & Pipe Line	—	14.20
New York & Ala	—	.15
Pales. Beau	.27	.35
Pennsylvania Texas	.10	.15
Potomac		.12
Producers	—	75.00
Queen City	—	.15
Queen of Waco	—	100.00
San Jacinto	.09	.12
Seaboard. old	12½	.25
Silver Dime	—	.10
Sour Lake Oil	7.50	12.00
Sour Lake Sprgs	120.00	175.00
Spangler	—	.10
Spindle Top	—	40.00
Spindle Top Power	75	1.00
Standard Oil	670	675
Sutcliffe	—	100.00
Texas Illinois	.13	.14
Texas Oil Transit	108.25	108.50
Texas Oil & Pipe Line	—	.35
Texas Western	—	1.50
Tri City	—	.14
U. S. Oil	.17	.17⅜
Vesuvius	.00¼	.02
Victor		.02½
Victor, old	.02½	.04
Yellow Pine	100.00	—
Young Ladies	—	.06
Zenith	30	.50

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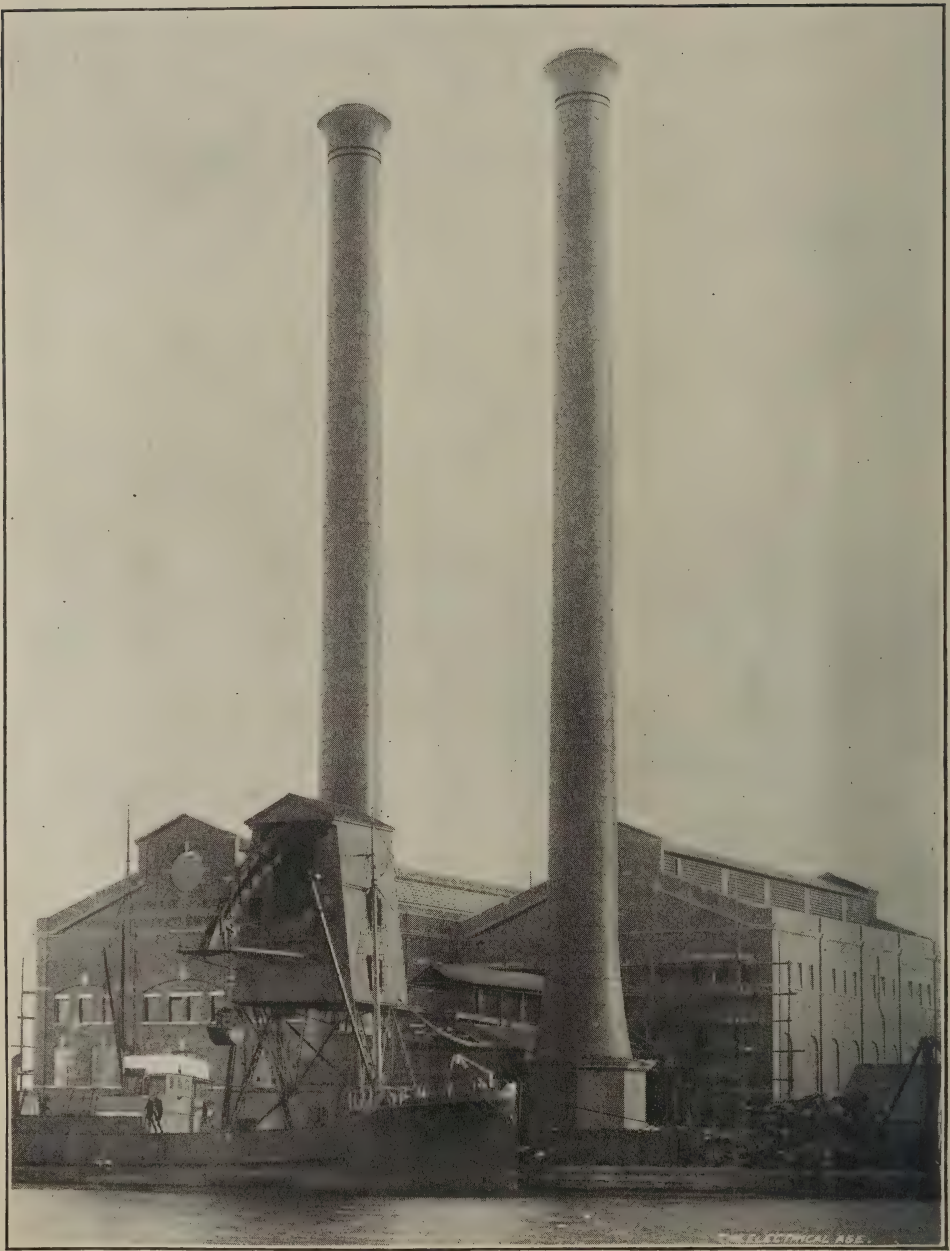


American Coal Handling Machinery in use at the Power Plant of the Dublin United Tramways, Dublin, Ireland.

An American Cantilever Crane for Handling Beams at Rothe Erde, Germany.

American Machinery Abroad

By James N. Hatch, C. E.

That the United States has become pre-eminent among the nations of the world as a land of labor saving machinery is a fact beyond denial. That the American workman is without a rival as an operative of machinery is shown by every opportunity afforded for comparison. The Yankee will not "do with his might what his hands find to do" if he can possibly discover some mechanical way of doing the same thing without the use of his hands. He is always wondering and scheming how he can save labor. In making the discovery, he not only finds a way to save himself the drudgery of menial servitude, but discovers at the same time a way to give to the world the same amount of work, performed more cheaply and better than it could possibly have been done by hand.

Such a revolution has labor saving machinery worked in the great commercial life of the United States that political economists have changed their views so far now as to take as a premise that almost paradoxical statement, that, "as wages increase, manufactured commodities must decrease in price, and vice-versa."

The truth of this statement experience has proved for us, in the face of all the old theories which started out with exactly the opposite proposition. And this statement could not possibly have become true without the use of machinery, and, in fact, does not hold true today in those oriental countries where everything is still done by hand. But the fact that the United States can produce almost every sort and kind of mechanical contrivance that can be produced anywhere about as cheaply, if not absolutely cheaper, than it can be produced in such a country as Germany, where wages are less than one-half of what they are in America, is a condition which really requires some paradoxically sounding theory to explain.

That this growing American supremacy is not a mere delusion of an over-enthusiastic people, may be shown by evidences that are too plain to be mistaken. The British and German press are neither of them sanguine enough to overlook this—to them alarming—leadership that the United States is acquiring in the manufacture of machinery of all kinds, and in the manufacture of machine-made articles. And the fact that foreign manufacturers are studying American methods, shows that they are coming to recognize America's position in the world of commerce. But no more conclusive evidence need be required of the foreign recognition of American supremacy in the design and manufacture of labor-saving machinery, than the evidence gained from a glance at the American machinery now in use in foreign countries.

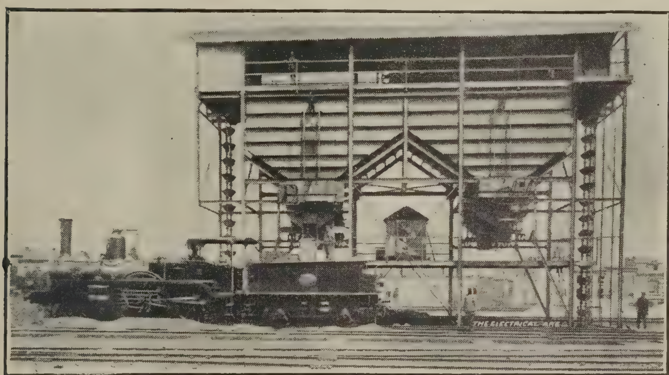
For purposes of illustration we will confine our examination to that class of machinery which is used for auxiliary transportation purposes; machinery for loading or unloading vessels or trains, for carrying heavy pieces of machinery, or moving structural material about the works of manufacturing establishments, or for the rapid and economical distribution of ore, coal and other materials about the mills and furnaces of steelmaking plants. American machinery in large quantities also forms parts of the mills and furnaces themselves in many foreign steelmaking plants, but in this article only such machinery will be considered as is used for handling materials while in transit.

An interesting example of a machine that is being adopted in many places in Europe, may be found on the water-front at Dublin, Ireland, as shown in the illustration. This plant was designed and erected by the C. W. Hunt Co. of New York City, for the unloading and storing of the coal used at the power house of the Dublin United Tramways. The coal is delivered at the wharf in vessels; from the holds of the vessels it is taken directly to the firemen behind the boilers without being handled with shovels at all.

When a vessel is ready to unload, the operator, who is in the tower, lowers his bucket into the hold of the vessel. A grab-bucket is used for this purpose until most of the coal has been removed. The grab-bucket, open, is lowered upon the pile of coal, the operator starts his hoisting engine, and as the rope begins to tighten, it first closes the bucket, automatically filling it with a ton or more of coal and locking it, and then it lifts the bucket from the vessel and carries it up along the projecting boom, until it hangs directly over a hopper in the doorway of the power house. The bucket is now unlatched, the load falls into the hopper, and the bucket automatically unlocks itself ready for the next trip into the hold of the vessel. Beneath, and behind the hopper, is an automatic car in waiting. This car is operated by one man. He fills the car from the hopper, and then starts it down an inclined track towards the storage bin. The car goes unattended down to the storage bin, automatically dumps its load and returns to the hopper. No outside power whatever is required to operate this railway, as the loaded car in descending raises a counter-weight at the far end of a cable attached to it, and this furnishes the power to haul the empty car back to the bin.

The coal is taken from this first storage bin by means of an endless chain bucket conveyor to an elevated storage room situated over the boilers. From this bin it is delivered by chutes directly to the firemen as required. This type of machine is designed not so much for rapid handling of coal, as for its handling and storing at a small cost with a minimum amount of resultant noise and dirt. But even with this plant, with only two men to operate it, an ordinary vessel of 3,000 to 4,000 tons burden can easily be unloaded within a week.

Many other interesting American machines for handling coal and ore may be found along the harbors and at the shops in various places in Great Britain. An example, which is conspicuous enough to claim some attention, will be found in the great shipbuilding cranes constructed by the Brown Hoisting Machinery Co., of Cleveland O., for Vickers' Sons & Maxim, at the latter's shipyards at Barrow-in-Furniss, England. There are two of these cranes, of the balanced cantilever type, used for the carrying of structural materials from the yards to where they are required on the ships in process of construction. Each cantilever runs on a track on the top of a high trestle, so that it is a hundred feet in the clear from the ground to the end of the cantilever projection. The whole crane can be moved rapidly back and forth along this trestle for several hundred feet. Vessels under construction are on each side of the trestle. The load can also be traversed from one end of the cantilever to the other and suspended at any desired distance from the ground. A load of 9,000 pounds can be lifted at the end of the cantilever, and a load of 28,000 pounds may be carried at any point not more than half way out from the pier. As a load moves out on either arm of the cantilever, a counterweight moves out upon the opposite arm to keep the crane balanced and to make it impossible to tip it off the trestle. The load can be traversed along the arms of the cantilever at almost any desired speed. A load can be hoisted from the ground at a speed of 200 to 300 feet per minute. And the whole machine, with the load hanging from it, can be moved along the trestle at a rate of 650 to 750 feet per minute, equal to about seven or eight miles per hour. In the yards of the same company are two somewhat similar cranes, more particular mention of which will be made later. In another plant of Vickers' Sons & Maxim, at Sheffield, England, may be seen a powerful traveling crane, built by the Wellman-Seaver-Morgan Engineering Co., Cleveland. This crane is used for handling ladles of molten steel, and will pick up anything which weighs not more than one hundred tons. For instance, it will pick up a locomotive and carry it about with the greatest ease.



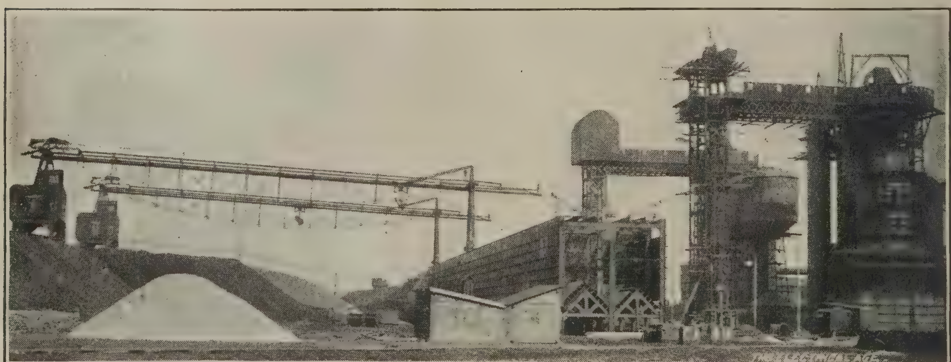
Locomotive Coaling Station at Antwerp, Belgium, Using American Machinery.

At Newcastle-on-Tyne there is another shipbuilding crane, in the yards of

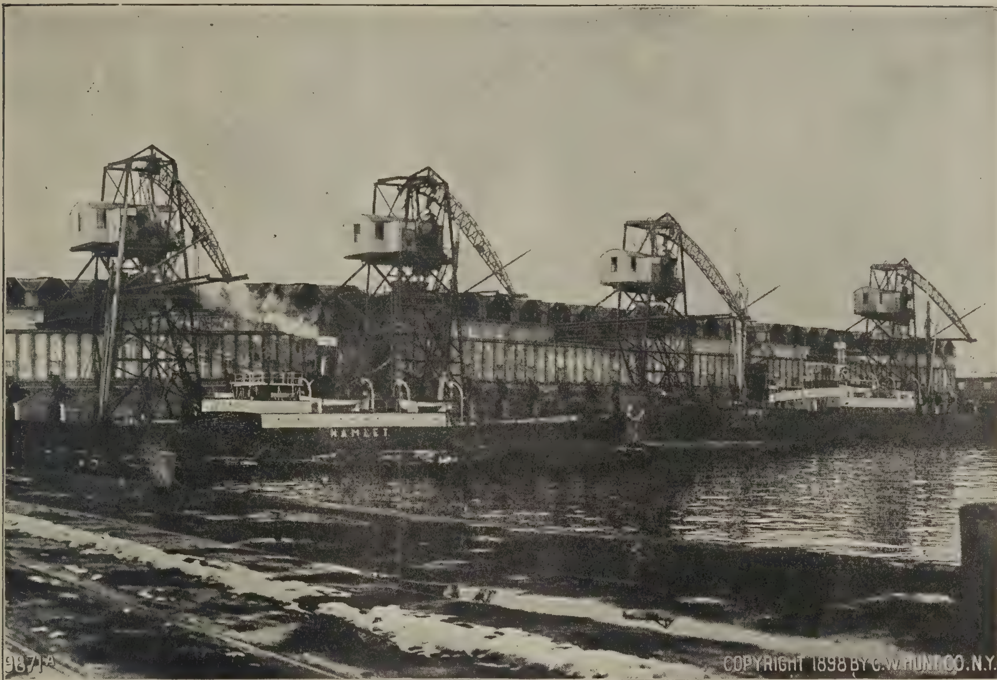
Robert Stevenson & Co., Limited, which is in most respects very similar to the ones described above. The distinctive feature of this crane is that the cantilever does not stand at right angles to the track on which it runs, but stands at an angle of about sixty degrees.

Let us now put on our seven-league boots and step across into Sweden, that country noted for its excellent quality of iron and steel. Here we will find many American coal and ore handling machines. Several different types of machines can be found at each of the more prominent ports of Sweden, used to rapidly unload the coal which that country of long winters stands so much in need of. At Gefle are several fast plants or direct unloaders, which take the coal from vessels and load it into cars or dump it into elevated bins. When these machines were first erected and ready for a trial, the people for miles around took a holiday and flocked down to the dock in great numbers to see the strange machines at work. In a recent account of his travels in Sweden, William E. Curtis mentions these machines as among the objects of special interest which were brought to his notice.

Pausing at Denmark, on the way to Continental Europe, it will be seen that this little country is not without some interesting examples of modern American machinery. The Danish Coal Company has a very large coal storage plant, similar in principle to the one at Dublin, which we have already described. The storage yard for this company stretches for a long distance along the wharf, and is provided with thirty-seven tracks. Two-ton automatic cars run on these tracks. On the wharf in front of this storage yard there are five towers, which may be moved at will up and down the wharf, so as to work above any vessel or deliver the cargoes to any part of the yard. Trains may also be run along the wharf under the towers, and the coal loaded into these direct from the vessels; taken from the trains to the stock piles; or, again, from the stock piles to the trains; or, in fact, loaded or unloaded in any combination that is desired. With this plant, when conditions are favorable, each elevator tower can take out from ninety to a hundred tons of coal an hour from the hold of a vessel. The automatic vessels are capable of carrying to the stock piles 500 tons per hour. In a typical case a cargo of 2,036 tons was discharged through four hatches in ten hours, and in another case 1,600 tons was moved in seven and a half hours, working with four ele-



American Bridge Tramway for Handling Ore at Marioupol, Russia.



American Elevators at Work at the Wharves of the Danish Coal Company.

vators. The plant is designed for the handling and storing of 300,000 tons of coal per annum.

Denmark has numbers of other interesting machines of American make. We will next cross into Germany, where American hoisting and conveying machines are numbered by dozens. At the great works of Fred. Krupp, where the wonderful rapid fire guns are made, among other American machines are three bridge tramways, for coal handling. Similar to these are those of a coal handling plant at Alexandria, Egypt.

At Rothe Erde, Germany, there is a cantilever crane that is remarkable in several ways, not the least of which is its great size. This crane is used for carrying beams around the stock yards, loading or unloading iron from cars or distributing the material where required for use. It is operated by electricity and is very rapid in all its movements. It can be moved the whole length of the yards on the tracks on which it is carried, which run at right angles to the direction of the cantilever arms. The four legs which support the cantilever are so widely spread that a beam sixty feet long may be carried from one end of the cantilever directly through between the legs to the other end of the structure. The beams are carried by two chain slings, which keep them always at right angles to the direction of their travel along the cantilever arms. If it were desired to pick up a dozen beams in one corner of the yard and load them into a car at the diagonally opposite corner, all that need be done would be to hoist the load from the ground high enough to clear everything in the yard, carry the load to the other end of the crane and then traverse the whole machine the length of the yard. This would require the employment of but four or five men, and would take perhaps five minutes for the round trip. Cars of twenty tons, which are as large as are ordinarily found in Germany, are thus loaded or unloaded in a very short time. The two yard cranes at Vickers' Sons & Maxim, already spoken of, are almost duplicates of this crane, except that neither of them will permit beams quite so long to be carried. There is a similar crane at Teplitz, Austria, that will carry beams seventy feet long. Other cranes of this sort are used in several of the large steel works in Europe.

At Peine, Germany, may be seen a crane which ought to be familiar to American engineers, as it was one of the cranes used in the construction of the Chicago Drainage Canal. After the canal was completed the Brown Hoisting Machinery Company, who had eleven of their cranes at work on the great ditch, took them away and sold them to various customers, and one is now serving in quite a different capacity in Peine.

At Kraft's Iron Works, Stettin, Germany, is a plant of four of Hunt's elevators and automatic railways, used for the handling of the ore, coal, and limestone employed in the making of steel. These machines operate along a warf 1980 feet long, and are capable of discharging and storing 2,000 to 3,000 ton of material per day of ten hours. There is also a similar plant at Ludwigshafen, owned by the Rheinisches-Westfaelisches Kohlen-Syndicat. This tower has two booms, one for unloading from the vessels and the other for unloading from the stock yard. A bridge, which forms part of the structure, has a span of 328 feet. The entire plant, bridge and all, may be moved rapidly up and down the water front for 1000 feet.

At Rhombach, Germany, as well as in several places in France, and also elsewhere in Europe, are found conspicuous examples of the American furnace hoist. This is a very steep inclined railway used for elevating and properly distributing the fuel, ore, and limestone used in blast furnaces. These hoists work very rapidly, are almost automatic, and have proved a very important factor of economy in modern steel making. In a large number of places in Germany is found American machinery for charging steel furnaces, handling booms and ingots in the steel works, and performing various other important functions around the works.

At Saarbruecken, Germany, and at Antwerp, Belgium, are some notable and interesting machines, for the rapid coaling of locomotives. The coal, which is brought in on trains, is dumped into a storage reservoir beneath the level of the tracks, and underneath the building. This storage reservoir has a capacity of about 2000 tons. From there the coal is elevated to the bins above, which have a capacity of 50 tons each, by means of an endless chain bucket conveyor. The cost of elevating the coal and placing it in the hoppers ready for dumping into the tender, is about one cent per ton. When it is desired to coal a locomotive, the tender is placed beneath the opening of the hopper, and a small gate is opened, which allows the coal to pour down into the tender. The largest locomotive can be coaled in five or six minutes. Where desired, it is arranged so that the coal can be automatically weighed as it is discharged. A record may thus be kept of the amount of coal used by each locomotive. The whole structure is made of steel, thus reducing to a minimum the danger from fire. In the Antwerp machine, two locomotives can coal at the same time. The plant at Saarbruecken is provided for the coaling of four locomotives at one time.

A large cantilever gantry crane, at Micheville, France, is notable on account of its great speed, and the length of the beams that may be carried through between the supporting piers. It bears some resemblance to the great crane at Rothe Erde, Germany, but was built by a different company, and is really quite different in details.

Austria comes next to Germany, if indeed she is not in the lead, in the use of American machinery of the kind we are considering. The Alpinen-Montangesellschaft, having works in several different places, has quite a variety of different kinds of American machines, used for various purposes in connection with their great steel works. Two machines used by this company that are well worth noticing, are the overhead travelling cranes at their works at Loeben, Austria. These cranes are used for handling large plates, and are particularly interesting owing to the peculiar arrangement for lifting the plates. This lifting device consists of a number of Wellman-Seaver-Morgan's immense electro-magnets attached to a lifting bar. The crane is moved along until it stands over the pile of plates, the lifting bar and its magnets are lowered until the magnets rest upon the top plate. During this part of the process there has been no current through the magnets, so that they are not magnetic at all, and can be moved about to any desired position on the plate. When all is ready, current is switched in which makes each magnet active. In this way very large plates are lifted and carried. The plates can be dropped instantly by shutting off the current. This device is a great labor saver, as the plates are very awkward to handle with slings of grappling hooks of any kind. This is especially true of plates 80 to 100 inches wide and from 40 to 50 feet long. Leaving out of consideration the inconvenience of the old method, it is obvious that the magnetic lifting cranes can be operated

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Hunt Elevator and Automatic Railway erected for the Rheinisch-Westfaelisches Kohlen-Syndicat, at Ludwigshafen, Germany.

Balanced Cantilever Cranes in the Shipyards of Vickers' Sons & Maxim, Barrow-in-Furniss, England. Built in the United States.

entirely by electricity and are especially rapid in all of their movements.

The Alpinen-Montangesellschaft, at their works at Vienna, have an American aerial tramway, or cable-way, for conveying materials. This method is often found a very good one, where the material, after being loaded into buckets, is to be taken quite a distance or where there are obstructions in the way, such as railroad tracks or buildings. By this method the materials may be carried over the tops of the shop buildings and landed anywhere in the yards.

Even in the old historic town of Trieste may now be seen an embodiment of some of the most modern Yankee ideas in the shape of rapid handling machinery.

The traveller will need his seven-league boots again for the remainder of the journey, for the other machines to be examined, while very interesting in their character, both as regards use and location, are much scattered. In Russia there may be found various kinds of machines similar to those mentioned, and products of all the makers that have been spoken of and of others. At Marioupol there is a large storage and re-handling plant.

Two of Barnhart's steam shovels, owned by the Moscow-Jaroslav-Archangelsk Railway, were used on that line between Valagda and Archangelsk. Chief Engineer Karejsha writes concerning these shovels, that each easily replaces the hand labor of 100 to 150 men, their efficiency depending upon the hardness of the soil; and that 250 trucks of sand or dirt could be loaded per day. The average time of loading each truck was from one and one-half to four minutes. The trucks mentioned were small cars holding about six tons each. Each bucket excavates about two and a half tons at a load. Several other somewhat similar machines might be found in other parts of Russia and elsewhere in Europe.

In Egypt, the land of the Obelisks and Pyramids, we will find a new wonder that the Rameses never so much as dreamed of. This is in the form of an American rapid coal handling plant on the docks of the Egyptian State Railways, at Alexandria, Egypt. This plant consists of six bridge tramways, in two sets of three tramways each. Each set is operated from one engine house, the power being transmitted by wire ropes. It is contemplated adding six more tramways at some time in the future. These tramways differ from the standard bridge tramway in having long cantilever projections of over ninety feet at either end of the bridge span, making an entire travel for the bucket of 360 feet. These machines are so arranged that they can be moved to any desired position on the wharf to accommodate themselves to the positions of the vessels to be unloaded. They can be placed so that one will work over each hatch of the vessel, or it is possible to so arrange them that two can work through the same hatch. These six machines are able to unload from a ship and carry the cargo to a deck two or three hundred feet from the wharf, or load into cars under the bridge, at least 2,000 tons of coal in a day of ten hours, at a cost of about 1½ cents per ton.

To keep this entire plant in operation is the work of but eight men. These include six operators, two firemen and one general utility man. One ton grab buckets are used for taking the coal from the holds of the vessels, until sixty or seventy per cent has been removed. After that a kind of self-righting tub is used. These tubs are filled by men in the hold with shovels, and are on rollers so that they may be moved about in the vessel as required. The buckets, after being hoisted from the ship, are car-

American Gantry Crane in the Yards of the Alpinen-Montangesellschaft, Donawitz. Austria.

ried along the bridge, suspended from a small car or trolley, which is drawn back and forth by means of a wire rope. There are three engines operating nine wire ropes, three for each tramway. The tramway may be as much as a hundred feet from the engine. Dumping irons can be clamped at any desired place along the tramway and trip the bucket and cause it to automatically drop its load. The tubs as soon as they are empty return to an upright position and are held so by a latch. The grab buckets in dumping lock themselves open.

Even Asia has been invaded by the machinery of the Western Devils. Examples may be found scattered along the coast from Hindustan to Siberia. The old method of unloading coal from ships in India was to have it carried in baskets on the heads of natives. The American method is therefore a wonderful improvement. At Kobé, Japan, Mitsui & Co., are erecting an immense shop building, that was made by the Carnegie Steel Co. It was already to be put together when received in Japan. The machinery in this shop and in the yards of this company was much of it purchased in America, and even that which was made in Japan is modeled as nearly may be on American practice.

In Mexico, Central America, South America, Cuba, and in the Dominion of Canada, much United States machinery is in use. Among our insular possessions there are in process of construction some mammoth coal handling machines, to be used in connection with new coaling stations; and in Cuba there is a great ore loading pier similar to those used on the Great Lakes.

Radium and its Wonderful Qualities

Paul Bary, in "La Nature"

It is to M. H. Becquerel that we are indebted for the discovery of the emission of rays by uranium and its composites.

Later Mme. Curie of France, and M. Schmidt of Germany found that thorium possessed the same properties. The rays emitted by these bodies are at once similar to both the X rays and the cathodic rays.

The uranical rays resemble the X rays in that they can traverse certain opaque bodies; that they impress photographic plates; that they excite fluorescence and, finally, discharge electrified bodies. They resemble, besides, the cathodic rays by their property of transporting an electrical charge, and, consequently, also of being deviated from their route by the presence of a magnetic or electrostatic field.

Uranium and thorium emit but very small quantities of rays, and the study of the properties of these rays could only be made in connection with some other bodies recently discovered, under the following conditions:

Mme. Curie, in measuring the activity of bodies containing uranium or thorium, observed that the rapidity with which the rays produced by these bodies discharged electrified bodies was proportionate to the quantity of uranium or of thorium which they contained. Thus certain ores of uranium, and, in particular, the pitchblende of Joachimstal, possess even a greater activity than uranium. M. and Mme. Curie were then led to suspect the existence in these ores of one or several new bodies to be found there, probably in very small proportions, but, without doubt, invested with an enormous activity compared with that of uranium. The ores were submitted to a chemical treatment, having for its end the separation, little by little, of their constituent parts, and after each separation the activity of the different parts was measured in order to make sure in which fraction resided the radio-active element which it was proposed to isolate.

The work was long and delicate. The chemical properties of bodies sought were ignored, and the tests depended upon were those of the electrometer. The search was crowned with success through the consecutive discoveries, first, of polonium, made by M. and Mme. Curie in 1898; second, of radium, by M. Curie, Mme. Curie and M. Bemont in the same year; third, of actinium, by M. Debierne in 1899.

Of these three bodies, one alone, radium, can, up to the present time, be considered with certainty as a new element, distinct from all the simple bodies known, possessing similar properties to those of barium, but not identical, having an atomic weight very different from that of that metal and giving to the spectral analysis a series of rays absolutely characteristic.

At the first news of the existence of radium in pitchblende, the chemists had some doubt as to the reality of the new metal, of which the presence, in an ore so well known, had passed so long a time unperceived. The explanation of this fact is easily found in the figures which give the small quantity of radium contained in the ore and in the susceptibility to its action of the most sensitive tests employed in chemistry.

The treatment of a ton of pitchblende

only gives, in fact, two decigrammes of radium. The electrometer serving to measure the activity of pitchblende would have permitted the disclosure of quantities a thousand times less. On the other hand, the spectral analysis, justly considered the most sensitive for ordinary bodies, requires, in order to exhibit the characteristic ray of radium, a product containing at least one ten-thousandth part of radium. It is seen that the electrometer is, in this case, five thousand times more sensitive than the test of the other methods of qualitative analysis.

Mme. Curie has just obtained, after a very long treatment, about one decigramme of pure chloride of radium, free of the barium with which it is always found, so that the test with the spectroscope, made by M. Demarcy, shows no single characteristic ray not belonging to the radium.

This pure product has been employed for the determination of the atomic weight of radium and has furnished the number 225, considerably higher than that of barium (157).

In the table of elements of Mendelef, the radium is placed with strontium and barium in the group of alkaline earth metals to which, from a chemical point of view, it is analagous and in the series with thorium and uranium which possess as it does, the property of being radio-active.

These three radio-active elements have the highest atomic weights of all the simple bodies.

These last results obtained by Mme. Curie can leave no doubt then, as to the existence of radium as a new element. The interest that this body presents, lies above all in the spontaneous and constant emission of rays which it produces, without our being able to determine the source from which the energy is borrowed.

Whatever may be the hypotheses made to explain this phenomenon, not one has so far been found which would be justified by the results of experiments, and the conclusion is therefor arrived at, that there is an apparent contradiction, perhaps a real one, between this inexhaustible emission of energy, and the principle of Carnot, universally admitted in physics.

The radiation of radium is absolutely of the same nature as that of uranium, but of a considerably greater power, perhaps about a million times greater. It has therefor been possible to study the properties of the rays of these bodies as exhibited by radium in a much more certain manner than was possible with uranium and thorium. A leather purse with metallic clasp, containing a sou and a little key, was placed in the dark on a photographic plate. A radiant substance placed at a certain distance emitted rays which could not reach the photographic plate except by passing through the porte-monnaie. The radiograph thus obtained indicates then that the rays are very little absorbed by the leather, and on the contrary, almost completely by the metallic objects. This shows nicely the resemblance of results obtained by the rays of radium with those that would have been given under the same conditions by the Roentgen rays.

All the experiments which have been made with the cathodic and with the X rays, experiments well-known today, can also very easily be reproduced with the Becquerel rays.

The rays emanating from the radium produce reactions on other bodies, modifying their chemical condition.

They transform oxygen into ozone, color glass and porcelain a deep violet or brown, they act on the organic tissues as do the ultra-violet rays and the X rays, but with a much greater power, in producing deep burnings. This action of the Becquerel rays on organized tissues has been applied with success by Dr. Oudin for the treatment of lupus.

The fact that the rays emitted by the radium render fluorescent and phosphorescent bodies very luminous, such as platino-cyanide of barium, double sulphate of uranyle and of potassium, sulphide of zinc, etc., has given rise to the thought that the day may arrive for the production thus, without an expenditure of energy, of an artificial light sufficiently powerful to be utilized.

The question considered under this form, from an industrial point of view, is far from being resolved. The figures that we have given above as to the quantity of radium which a ton of pitchblende (the richest ore) contains, and the cost of the treatment of this amount of ore, which is about 10,000 francs, suffice to show, outside of any other consideration, that the solution of the problem of continuous and gratuitous lightning is still, unfortunately, far off.

One can, nevertheless, show some brilliant experiments based at once on the fluorescense or the phosphorescence and another property of the radium, which induces in bodies, which are in its presence, an activity which renders them temporarily like itself. If in a closed space there is placed an active product of radium with some other bodies and they are left together a certain time, it will be found that the bodies thus exposed have taken on an activity analagous to that of the radium and this will prove the greater as the space within which they are inclosed is smaller.

Two glass bulbs are connected by a horizontal tube. In one bulb is placed a solution of chloride of radium, in the other a solution of the sulphide of phosphorescent zinc. The two bulbs are sealed and the air is excluded. After keeping the two bulbs in darkness for a certain length of time, it will be observed that the sulphide of zinc has become strongly luminous as well as all the glass of the apparatus. If the two bulbs are then separated it will be seen that the activity induced in the sulphide of zinc only remains a certain time. Keeping it closed the bulb remains luminous, though less and less as time elapses, but still to an appreciable extent for more than a month, but leaving it open, on the contrary, it will lose its activity in a day.

All bodies have thus, to an equal degree, the property of acquiring the induced activity, but only those become luminous which are fluorescent or phosphorescent. Finally this radio-activity induces, seemingly, at least, in certain cases, the transformation of the chemical properties of those bodies which acquire it.

In a very curious experiment by M. Debierne, a solution of a salt of barium was exposed to this influence and working with this, as one would with a mixture of barium and of radium to separate the two he obtained a very active product, having all the properties of radium, less the spectrum. But this transformation of the barium is but temporary and loses, little by little, its activity, the pseudo-radium finally retaking all the characteristics of the barium.

The Compressor Blowing Off Air.

Compressing Air With Falling Water

By John A. Inslee

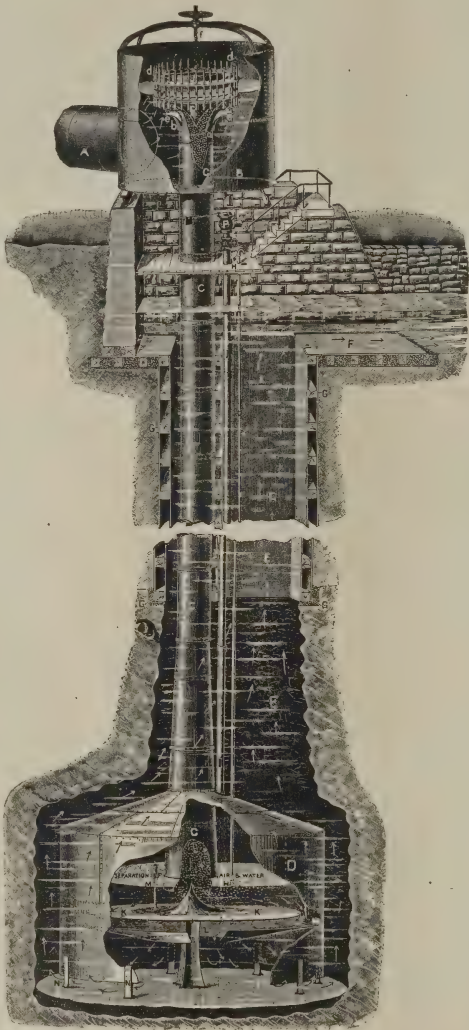
An unusual amount of interest among scientific and business men attaches to the hydraulic air compressing plant, which is nearing completion at Norwich, Conn., not only because this is the first plant of its kind to be installed in the United States, but also because compressed air has become such an important motive power. Indeed, even ten years ago, it is estimated that more power of this kind was distributed than by electricity, if we exclude that which was used for lighting.

Compressed air has been used in engineering operations for many years, but it is comparatively recent that its full capabilities have been recognized. The earliest application of compressed air is supposed to have belonged to the sixteenth century, when diving bells were used; since then it has been used in many important undertakings, in tunnelling, transporting goods, building railways, operating motors; and in Paris and Vienna a system of compressed air was installed for regulating a great number of clocks, the air being conveyed in pipes from a central station.

Thus we find that once more is exemplified the fact that there is ''nothing new under the sun,'' but that does not prevent the assurance that an invention may be improved seventy times seven, and still leave something to be required, until a state as near perfection as possible is attained. For instance, if the sage old priests of Isis, who centuries upon centures ago, when the world was young, maintained a sort of speaking tube apparatus which proved to be the greatest great-grandfather to our modern telephone, could see and hear the modern instrument, how great would be their simple amazement. And, as for Benjamin Franklin, who introduced us to the uses of electricity through the medium of a key and a certain convenient thunder storm, what an important sponsor he would feel, to that system of ''chained lightning.''

The compressed air plant at Norwich (or, more correctly, Taftville) will yield about 1500 horse power. It is situated on the Quinnebaug River, about three miles above Norwich, to which city air is to be conveyed through a line of 16 inch pipe, for the purpose of operating stationary engines.

The compressor is very simple in its construction, all that is required being the provision of a vertical shaft, a large vertical iron pipe and two receiving tanks, one at the top and the other at the bottom. The water is conveyed through a supply pipe to the upper tank which is known as a receiving tank, where it rises to the same level as the original source of supply. Projecting upwardly through the bottom of the receiving tank is the down flow pipe, 14 feet in diameter, built of ⅜-inch steel plates, which extends down through a vertical shaft or well. Any pressure desired may be obtained by varying the depth of the shaft. This shaft, in which the steel tube is placed, is 24 feet in diameter for a distance of 160 feet, then it is enlarged to 52 feet in diameter, the total depth being 208 feet below the river bed. At the bottom of the shaft is a tank known as the air chamber and separator in which the water and air are separated in a simple manner, *i. e.*, the water after leaving the separating tank, flows to the surface through a return shaft, leaving the air in the tank at the bottom of the shaft; the weight of the column of ascending water holding the air in the tank under compression.



THE ELECTRICAL AGE

Cross-sectional View of the Compressor.

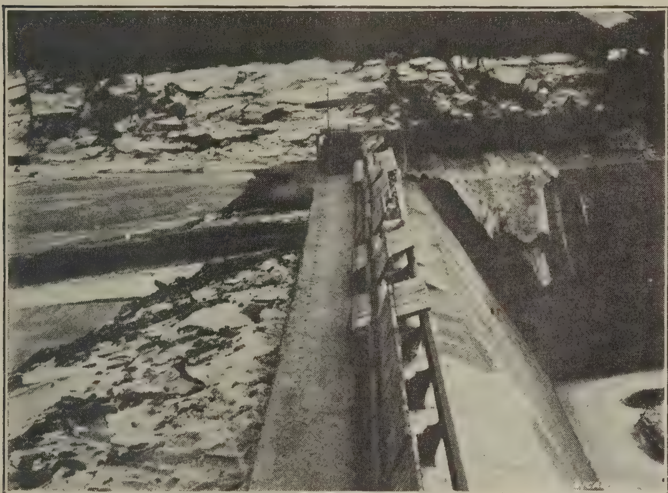
Located vertically above the top of the down flow pipe is a head piece in which the air is entrained by the velocity of the water. As the water enters the compressing pipe, it produces a partial vacuum with the result that the atmospheric pressure drives the air into the water in innumerable small bubbles, which are carried by the water down the compressing, or down flow, pipe. The head piece consists of a bell mouth casting, opening upwards, a cylindrical casting shaped like a cone, and a circle of small vertical air supply pipes, at the lower ends of which are small inlet pipes, extending at right angles from it towards the center of the down flow pipe. This head-piece is operated by means of a hand wheel and a screw.

A remarkable feature about the air compressed by this hydralic system is that it is dry, while air mechanically compressed contains considerable moisture, and in Paris, where mechanically compressed air is extensively distributed, drainage boxes are necessarily called into service. With compressed air, the loss of available power due to transmission to a distance is small, though there is necessarily a small pressure loss in the pipes, but the effect of this on the efficiency is not great.

If the compressed air is to be used economically it must be reheated at the locality where it is used before entering the motor. By re-heating the air before use it may be expanded to almost atmospheric pressure in the motor, and the efficiency is much higher. Experience shows that it is extremely advantageous to re-heat the air; a larger fraction of heat is converted into work, and the heat, according to experiment, is used five or six times as efficiently as heat supplied to a steam engine. The usual method of doing this is by heating the air through coil pipes, which are in a furnace.

An instance is shown of the small loss of pressure by the fact that in some tests made several weeks ago at Norwich, when the gauge at the compressor registered 91 pounds, the pressure in the pipe two miles distant was only one pound less.

If the air were drawn from the air tank and reservoir faster than it was being carried down by the water, the quantity of air in the tank would diminish and the water would rise in the tank, and as the quantity of air continued to diminish the water would follow it up. Apparently the water would not rise above the tail race, but it was proven by a recent trial at Norwich that the water would follow the air through the pipe line over the top of a hill, although the elevation was 31 feet higher than the forebay that supplied the water to the compressor. This would, of course, be a serious matter, as it would permit the water to enter the engines of the customers if the air was being used too freely.



Automatic Flash-boards on the Crest of the Dam.

To prevent such an occurrence, a valve has been placed on the pipe line near the compressor. This valve works automatically, and if the pressure falls below a given point the valve closes until the air again accumulates and increases the pressure, thus causing the valve to open. It should be borne in mind that the pressure is regulated by the distance from the level of the water in the forebay and the air and water line in the air chamber. When the water rises in the air tank, the pressure diminishes at the rate of about one pound for every 27 inches of water. When the air is not drawn off as rapidly as supplied to the tank, the air and water line become lower or farther from the the tail race. To prevent the air line from getting below the bottom of the down flow tube, and thus permitting the air to return up the tube, a 10-inch escape or "blow-off" pipe has been connected with the air tank, about 6 inches above the bottom of tube. This 10-inch pipe runs up to the surface, thus permitting the surplus air to escape.

Another innovation in connection with this compressor, is a storage reservoir 100 feet long, 18 feet high and 20 feet wide, excavated in the granite at or near the bottom of the shaft, *i. e.*, about 200 feet below the surface. This reservoir is connected with the air tank by a 24-inch pipe and a large quantity of air is thus stored for use as required.

The pipe line, which is four miles in length, is laid with 16-inch cast iron cylindrical pipe, put together with an iron ring, two gaskets of composition of rubber and two flanged collars. The ring and the collar press the gaskets down on the pipe as the bolts are tightened, thus preventing leakage. This is commonly known as the Paris joint. This plan of joining is an admirable one, as it allows the pipes to contract and expand with the weather, and is a safeguard against sudden breakage. The pipe is buried 3½-feet below the surface to protect it from the frost.

There were unusually difficult problems to be overcome in building the compressor at this especial point, for the river being very narrow here, where it breaks through a natural rocky formation, there was great liability and danger from freshets, and on the other hand, to further complicate matters, as the New York, New Haven & Hartford Railroad occupies the northern bank, much care had to be taken in the construction of a proper dam which would protect the railroad.

The dam in construction resembles the form of a letter "Z," and is built about 690 feet below the narrowest part of the gorge. As a further safeguard to the roadbed of the railroad, a protection wall has been carried to a height of 11 feet above the crest of the dam, which effectually guards it against any freshet. This especial dam is made of "cyclopean concrete," consisting of bank gravel, sand and cement. The degree of plasticity desired was that known as "moist concrete," the object being to insure an absence of voids without much ramming around the large rocks. Into this mixture, large and small rocks were introduced and packed around other rocks, until a firm foundation was established. It was found on excavating, that the bed rock was of excellent quality, firm and dense as a rule. A great deal of inferior rock had to be excavated to a depth of nearly 15 feet before masonry could be started and in these portions of unsatisfactory bed rock frequent springs were met with, which were closed and forced in other directions. Some 12,000 cubic yards of concrete were placed.

The Three Head-gates

There are three head gates, which present no particularly unusual features, except that they are raised and lowered by operating levers, but the gates can be worked by hand if necessary.

The head wall does not connect with the hill side, but a crib dam closes the space between the bank and the head wall, its purpose being to permit of the construction of other shafts for the utilization of freshet water, if deemed advisable.

An interesting and novel feature of the installation, is the automatic flash boards on the crest of the dam. These consist of shutters of oak about 6 feet long by 3½ feet wide, which revolve from an upright to a nearly horizontal position when weighted down with the water as it rises over the dam. The mechanism regulating these flash boards is a toothed cam attached to the boards over a steel rack, which is bolted to a cast iron pedestal securely fastened to the crest of the dam by anchor bolts. As explained above, when the water assumes a maximum head these boards turn to a horizontal position, allowing the flow to escape underneath, and then resume their original place when the water falls.

Constructing the Mouth of the Compressor.

Another interesting feature is the introduction of pipes into the end and intermediate piers to supply air and overcome the vacuum which would otherwise exist on the face of the dam.

The possibilities of this system for refrigerating purposes are very great. At a test made at the plant in Magog, Quebec, air was admitted to an engine at a temperature of 66.5° F. and exhausted at 41° below zero, an almost inconceivable change. This cold exhaust air could be carried a reasonable distance and distributed through pipes.

One important reason for the use of compressed air, where the natural conditions are favorable, is its cheapness. The water costs nothing, the cost of maintenance of the hydraulic compressor and the cost of superintendence are very small; the expenses annually amount almost entirely to interest charges on the capital expended in works, and the result is a regular controllable power.

Whether in any given case it is the most advantageous, the least wasteful of power, or the cheapest in working cost, depends on various circumstances. Points in its favor are the minimum cost of distributing mains and minimum loss of energy, simplicity and efficiency of motors, freedom from danger to life or property when accidents occur (air leakage is less dangerous than electrical leakage), and, particularly, the facility of adaptation to requirements.

A plant once perfected and set in motion requires no large force of workmen; there is practically no attendance. The plant at Magog has been in continuous operation day and night, ever since it was started, over two years ago, and has cost nothing whatever for repairs or attendance. That would seem in itself sufficient proof that the great expectations advanced for this system are not disappointing, and the capitalists who have taken hold of the European rights of this power, have pledged themselves to install at least as much as 100,000 horse power within ten years.

First Aid in Ammonia Asphyxiation

Care must be taken not to inhale any of the ammonia gas, as it is very irritating, and may have serious if not fatal results.

If a person has inhaled an injurious amount of ammonia, a good stiff drink of vinegar will help to counteract the action of the ammonia, revive the unconscious, and in many cases save life. If the victim is unconscious, it may be necessary to pry his jaws open to get the vinegar down. A good way to neutralize the gas in a confined room is to burn sulphur, which may be best done by throwing it upon a shovelful of hot coals. The fumes of the sulphur, when brought into contact with the ammonia gas, turn to a dense white vapor, which has none of the characteristic odors of ammonia or sulphur, and makes the atmosphere passably comfortable.

I have often, when an ammonia pipe has sprung a leak in confined rooms, neutralized the ammonia fumes by this method, so that I was enabled to enter the room to make the necessary repairs much sooner than would otherwise have been possible.

Burning sulphur is also very useful in detecting and locating leaks in ammonia pipes. A handy way is to take long splinters of white pine and dip them into melted sulphur, which will leave a coating of sulphur on the sticks. While about it, make up a supply of a couple of dozen of these matches and lay them away for emergencies.

To locate a leak, ignite one of the matches and pass the flaming end around the suspected joint, and the white vapor resulting from the mixture of the two gases is an infallible indicator. There is also a sulphur fumigating candle sold by druggists which may be used for the same purpose, and is very convenient.—*Alonzo G. Collins, in Power.*

A Revolutionary Bug

The telegraph "bug" recently caused rather an amusing incident in Germany. A prominent "captain of industry" was asked by telegraph whether he approved of a certain resolution which had been passed by one of his companies. Through a mistake by the sending operator, "resolution" became "revolution," and the Sherlock Holmes instinct of the receiving operator at once caused him to scent a plot against the Kaiser's government. The secret police were notified and the arrest of the addressee of the telegram speedily followed.

Maternizing Cow's Milk for Infants

[The preparation of cow's milk so that it may properly replace that of the mother's for human infants has long been a subject of research and experiment, with but unsatisfactory results in general. We are indebted to *La Nature* for the description by Dr. A. Krause, printed below, of a new process which is declared by eminent physicians of France and Germany to be absolutely effective.

The process is a triumph of simplicity, is purely mechanical, and is capable of being carried on at a very small cost and upon a scale large enough to easily supply every demand upon it.

Only those who have given special thought to this subject realize fully its importance. For various and many reasons there are millions of infants born into the world every year who must depend for sustenance upon other sources than the mother's breast. The enormous figures of infant mortality are largely due to this fact.

In hospitals where foundlings are cared for this mortality reached something like 80 per cent a few years ago. This great death rate has been reduced some by modern methods and the use of sterilized milk, but it is still pitifully large. Thousands of attempts have been made to invent foods for infants which would take the place of the mother's milk, but —by the very nature of things—this is well nigh impossible. Nature has made the baby to depend upon its mother for sustenance, and any substitution of food it resents. The results are apt to be fatal to the baby. Milk of various other sorts, prepared by nature for other mammal infants, has proved itself to be the best substitute for that of the mother, but each of its kinds has some serious defects. Cow's milk, which mankind has found to be so generally useful, comes the nearest, perhaps, to that which the baby should have, but it contains too much of the cheesy matter and not enough sugar. The sugar is easy to supply, but the excess of casein is hard to get rid of. Science has now come to the rescue, and aided by mechanics seems to have provided the long needed substitute.—Ed.]

Dr. Gustave Gaertner, professor in the Faculty of Medicine in Vienna, has solved the problem of preparing cow's milk for babies in a manner as simple as it is ingenious, by a purely mechanical process and without the employment of either condensed cream, pressure, or the use of chemical products of any kind. As the analysis below demonstrates, the composition of the Gaertner milk is nearly identical with that of the mother.

	Casein.	Fatty matter.	Lactic sugar.
Mother's milk...	1.80 %	3 %	About 6 %
Gaertner milk...	1.78 %	3 to 3.2%	About 6 %

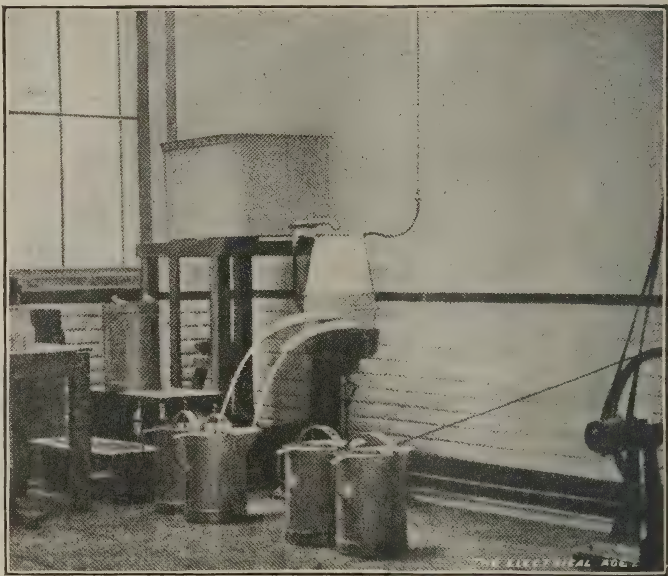
This process has been approved without reserve by a large number of savants, notably by Professors Escherich and Biedert, in Germany (both authors of processes for the maternization of milk, that they have abandoned in favor of the Gaertner process); Widerhofer, Vienna; Boissard, Bolognesi, Bardet, Saint-Cene and Kaminski at Paris. Dr. Duclaux has noticed it in the "Annals of the Pasteur Institute," and it has been presented to the Society of Therapeutics by M. Weber, member of the Academy of Medicine. Dr. Tison has communicated the very favorable results of his experiments to the Medical Society of Practitioners and, finally, M. Six chose the Gaertner process as the subject of his thesis, presented on March 29, to the Faculty of Medicine of Paris.

Its advantages are as follows: It supplants the wet-nurse; its composition is identical to the milk of woman; it contains all the elements necessary to the physiological alimentation of the newborn; it should be consumed just as delivered, without mixing or blending; introduced in the stomach it curdles or coagulates in light flakes as essentially digestible as the milk of the mother; finally, its sterilization is perfect.

The illustration shows the apparatus for the production of the maternized milk. The method of its preparation is as follows:

One hundred litres of fresh milk from the cow are first mixed provisionally with one hundred litres of sterilized water. There are then obtained two hundred litres of a liquid which does not contain more than half the quantity of casein per litre of the milk of the cow; that is to say, the mixture contains the same quantity as the milk of the woman. This mixture is put into the large reservoir, shown in the picture, and from there it flows out through a cock. It is led during its passage over a cone, heated internally by steam, by means of a steam pipe, to the temperature of 35 C. From there the milk goes to the drum of a centrifugal separator of the same kind as is used for separating cream from milk.

The centrifugal force projects the heaviest particles—that is to say, the aqueous solution of casein—towards the periphery, while, meantime, the lighter particles, being the emulsion of fatty particles, are grouped around the axis of rotation. Considering then that one hundred litres of water and one hundred litres of milk, containing 3.6 per cent of casein and 3 per cent of butter, formed the mixture, it will be easily understood that if there be caused to run out through an orifice situated at the periphery one hundred litres of aqueous solution containing the half (being 1.8 per cent of casein) that the one hundred litres of milk remaining in the centrifugal, or collected separately by a tube from the interior of the drum, will contain the butter in total (3 per cent) and the half only of the casein (1.8 per cent). This is what is done: tubes gather separately the solution of casein and the maternized milk, as these are separated by putting the turbine in motion.



The Separator at Work. Maternized Milk and the Mixture of Water and Casein Flowing from Respective Spouts.

The speed of the separator is from 3,000 to 4,000 revolutions per minute. Since the milk employed does not always contain exactly the proportion of fatty matter indicated above, a "vis-à-crême" placed in the partition of the centrifugal, permits the regulation of the respective flows of the small or little-milk (solution of casein), and of the fat-milk (maternized milk) according to the daily indications furnished by an analysis of the fresh milk employed.

The sterilizing apparatus in which the milk is next treated insures the complete destruction of microbes and of spores. A certain quantity of lactic sugar is added to the maternized milk before the sterilization. The only appreciable difference which exists between the composition of the maternized milk and the milk of the mother consists in the maternized milk containing more of salts and, above all, of phosphates; but, as Dr. Bardet said in the second lesson, "of waters and of milk considered as alimentary food, this one constitutes naturally a superiority."

The Public as a Telephone Operator

The public are responsible for two-thirds of the operating in the obtaining of a telephone connection, says Joseph B. Baker. In the operation of making a connection the calling subscriber, the called subscriber—which two constitute the public—and the telephone operator are the three elements, and upon the clearness with which the public gives its instructions to "Central," who plays but a mechanical part in the transaction, depends its entire success.

If these instructions are not correctly and succinctly given, errors and delays arise; if the called subscriber does not respond promptly to the operator's ring, all she can do is to continue ringing—she cannot get him to the telephone by force or by hypnotic suggestion. If the caller leaves his telephone before the connection is established, he has to be rung up and brought back.

"Wrong numbers" are often due to the subscriber who trusts his memory too well. "Cut-offs" are often due to the subscriber hanging-up or signaling when he should simply hold on. Delays in completing a connection are generally due to the failure of a called subscriber to answer the telephone promptly and to the practice of making a call and then hanging up, which requires the operator to ring the caller back to the telephone. Then there is the office boy, who is undoubtedly one of the most active curses of the telephone service.

Mr. Baker further says that if telephone subscribers as a body could be impressed with the importance of scrupulous accuracy in giving numbers, of always answering the telephone as promptly as possible, of always remaining at the telephone until the called station answers, and of always making calls in person and never by deputy, there would be a general and very marked improvement in the efficiency of the telephone service.—*American Telephone Journal.*

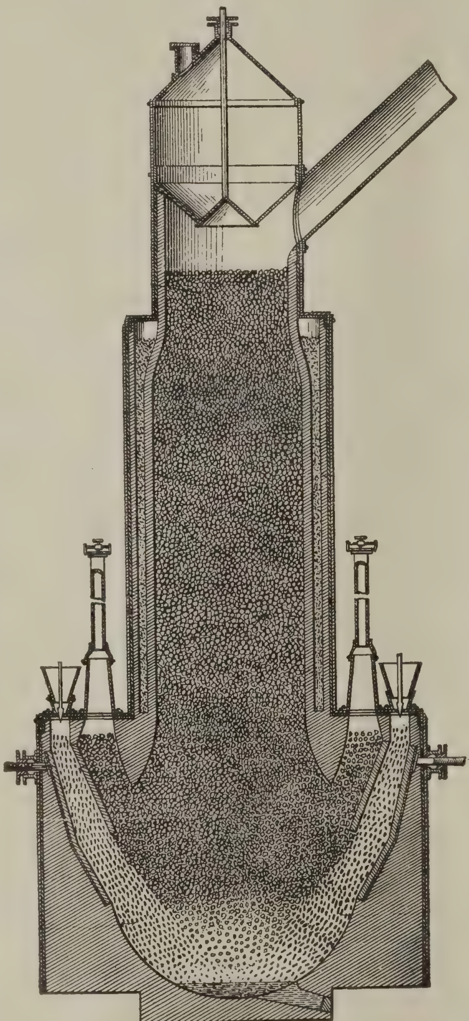
Testing Paris Green

Pure Paris green will dissolve in strong ammonia water, the solution turning a dark blue color. Impurities or adulterations will form a sediment. If a small amount is rubbed between two pieces of window glass it will turn white in places should it be adulterated. Paris green of good quality is intensely bright green and uniform. When adulterated the green loses something of its intensity, and is greyish-green and not always uniform.

Making Bisulphide of Carbon in an Electric Furnace

Electric furnaces are so closely connected in one's mind with the idea of intense heat that it is with something of surprise that a person comes to realize that they have outgrown that original field and are now successfully competing directly with coal, wood and gas for processes requiring only moderate temperatures.

But a few years ago the electric furnace was contrived, and its inventors made it for doing many things which were either extremely difficult with the oxy-hydrogen flame or entirely beyond its heat producing capacity. The melting of platinum was about the limit before the electric arc became trained to furnace work. Since then one has become used to its application to the reduction of aluminum, the making of calcium carbide, carborundum and many other products of refractory materials.



Cross-Sectional View of the Taylor Electric Furnace.

But today the electric furnace is proving that it can be used in many more ways. Although the electric arc can produce intense heat, it is not necessary that it should do so, and the amount of heat produced can be regulated to a nicety. In this alone the electric furnace recommends itself for large numbers of electro-chemical operations which only require a moderate temperature, but it has another quality even more valuable. That is, that the heat can be produced and applied just where it is needed.

It is well known how the intense heat of the arc is concentrated upon the carbon points to produce the arc light, and this same quality makes it possible to use the arc like a knife to cut or melt apart bars or plates of metal. A great metal tank on top of the Auditorium in Chicago was cut up into easily handled pieces in this way recently and removed. Burglars drill safes in like manner.

One of the clever purposes for which the low temperature electric furnace has recently been adopted is the making of bisulphide of carbon. It is also making rapid progress for glass making. Bisulphide of carbon is an interesting substance. Like its cousin, sulphuretted hydrogen, which is a sub-product of the same process, it is most decidedly unpleasant to the smell. The late Prof. Doremus used always to give his hearers express permission to hold their noses when he was about to let loose sulphuretted hydrogen among them at his lectures, and it is safe to say that the immediate neighborhood of a bisulphide of carbon factory is never likely to become popular for cottage sites or as a pleasure resort.

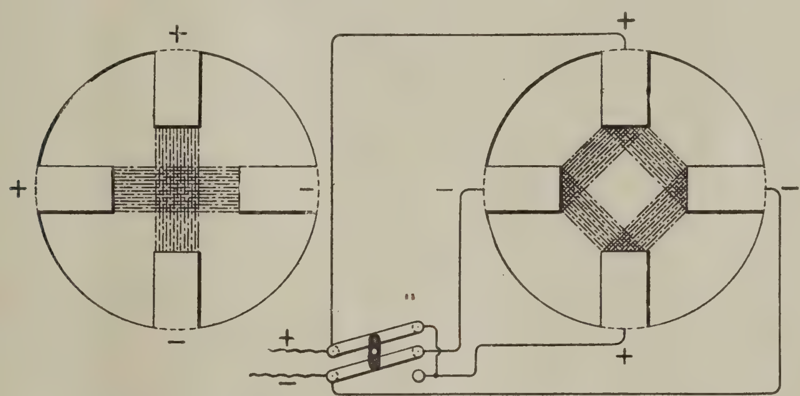
It is, however, an extremely useful substance in the arts, and for the destruction of vermin of various kinds it has no equal. Its vapor is not only unpleasant but poisonous. The vapor mixed with air is explosive, like that of benzine or naphtha, and the liquid itself is very inflammable. Vapor and liquid both can, however, be used with safety if the same care be used as is necessary in the case of benzine. The two liquids look much alike, but their composition is very different.

Bisulphide of carbon is a compound of sulphur and carbon in the proportion of one atom of carbon to two of sulphur —CS_2. It is formed by passing sulphur fumes over superheated charcoal, or bringing sulphur in contact with red-hot charcoal. Air must be excluded during the process, or else the sulphur would turn into sulphurous or sulphuric acids.

Bisulphide of carbon is a clear colorless liquid, heavier than water, and it volatilizes with great rapidity. The vapor is two and a half times heavier than air. This weight and its poisonous qualities are what make it so valuable to kill pests of the field, shop, granary, mill and household.

The grape phylloxera is killed by jabbing holes in the ground around the grape roots, pouring in some bisulphide and quickly closing the hole. Ants are killed in like manner. Weevils and mice in mills and granaries are killed by simply leaving vessels of the liquid about to fill the lower portion of the rooms with poisonous fumes. Woodchucks, moles and rats are killed by saturating a ball of rags with the liquid and poking this in their burrows and closing the burrows. Thousands of gallons are used every year in the west for killing gophers or prairie dogs. As a solvent the bisulphide is used largely in the arts. In the olive countries it is used to dissolve out of the olive pulp the oil which remains after the pressings. The recovered oil is used for soap making.

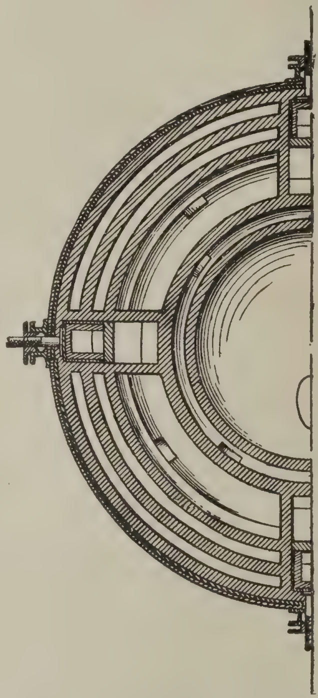
Something like 100,000 gallons a year are used in this country to dissolve gutta



Arrangement of Electrodes Whereby the Formation of Pillars is Prevented.

percha to make the well-known cement with which shoemakers put on "blind patches." A new use for it is as a solvent for the gums of the spruce wood in a process now extensively carried on abroad and about to be introduced into this country by which the fibre of spruce wood, prepared by the sulphite process, is turned into a beautiful artificial silk.

Bisulphide of carbon was discovered by Lampidius in 1796. Until recently it was produced in retorts heated externally by a coal fire or other suitable source of heat. Iron retorts have been commonly used, but these burn out every few weeks and have to be renewed at very considerable expense. Fire clay retorts have also been extensively used, but are not as good conductors of heat, so the heat is not as advantageously applied. But their first cost is less and their renewal is less frequent. The retorts have often been made elliptical instead of round, that their capacity might be increased and the heat be made to penetrate to the interior of the charge to better advantage, but even with this construction for any considerable production, a large number are required, for at best they can only be made of moderate dimensions, and the application of heat is very wasteful.


Sectional View of Annular Chamber for Feeding Material into the Furnace.

It was to meet these conditions that E. R. Taylor contrived the furnace which we are about to describe and set it up at Penn Yan, N. Y.

"In all work of this kind," Mr. Taylor says, "the electric furnace offers very great and obvious advantages. It enables one to get any required temperature, which can be under regular and absolute control in the interior of a container that can be kept at so low a temperature as to be uninjured by the high temperature of the reaction taking place in its interior. The proper temperature regularly maintained is probably one of the most delicate and important factors in most chemical reactions. When therefore to the above considerations it can be added that there is practically no limit to the size of such an electric furnace, except the limit of a market for the goods and an adequate supply of crude materials and electricity, the advantages of an electric furnace are obvious. In most operations requiring the application of heat, the aggregate loss of heat by radiation greatly exceeds the amount of heat successfully applied to the reaction itself. Whatever, therefore, will reduce this loss contributes greatly to the economy of the production."

In the furnace under consideration, this loss of heat by radiation has been provided against in an admirable manner. The very materials required for the reaction are supplied progressively toward the reaction zone of the furnace, absorbing the heat as it seeks escape, and they reach the active portion of the furnace at a temperature ready for the reaction.

In a furnace involving such reactions and giving off materials so unpleasant to deal with in a highly heated state, as is vaporized sulphur, movable electrodes offer many practical difficulties, and stationary electrodes used in the ordinary way would be of short duration. Both of these difficulties are avoided by the use of a constant and regular reinforcement of stationary electrodes, suitably arranged for the regular descent upon them of broken carbons, and this has proven in practice so effective that a furnace of this construction has been continuously run for many months. The bits of broken carbon used by Mr. Taylor are the refuse from the factories of carbons for arc lights.

The illustrations show the latest form of the furnace as patented by Mr. Taylor.

The furnace is 41 feet tall and 16 feet in diameter. It is supplied with current from a water power and at present uses a 4-phase current of 4,000 amperes and from 40 to 60 volts. The carbon, in the form of charcoal, is fed into the top of the furnace while the sulphur is fed into annular pockets about the base of the furnace. The production is about 11,000 pounds of bisulphide every twenty-four hours.

To prevent the forming of pillars between the electrodes there is an arrangement by which the current can be switched over and cross arcs formed between the adjoining carbons instead of those opposite one another.

Professor J. W. Richards, of the Lehigh University of Bethlehem, Pa., and president of the American Electro-Chemical Society, says of this furnace: "I think it is well known that this furnace of Mr. Taylor's has practically revolutionized the manufacture of carbon bisulphide in this country, and the size of the furnace is a revelation of what may be expected in the size of electric furnaces in the future."

Electrical Conductivity of Air

Prof. J. J. Thompson has made some most interesting experiments on the increase in electrical conductivity of air produced by its passage through the water. The air from a large gasholder, of about 350 litres capacity, was bubbled vigorously through water by making the air in the vessel circulate through a water pump. This treatment increased the conductivity of the air, and when the bubbling had been going on for some time the conductivity of the air was ten or twelve times the initial conductivity. When once the air has been put in this highly conducting state, it stays in it for a considerable time. A large part of the conductivity produced remains in the air forty-eight hours after the bubbling has ceased, nor does it disappear when an intense electric force is kept applied to the gas. The effect produced by the passage of the air through water is similar to that which would be produced if the bubbling produced a radio-active "emanation" similar in properties to those emitted by thorium and radium. The conducting gas can be passed from one vessel to another; it retains its conductivity after passing through a porous plug. Passage through a long tube heated to redness destroys the conductivity. It takes, however, a very high temperature to do this, temperatures less than 300 degrees or 400 degrees C. seeming to produce comparatively little effect. If the gas be passed very slowly through a long tube filled with beads moistened with sulphuric acid, the conductivity is destroyed. Unless, however, the stream of gas is very slow, the air retains a good part of its conductivity in spite of the sulphuric acid. Another point of resemblance between the "emanation" from radio-active substances and a gas in this state, is that, if a strongly negatively electrified conductor be kept in the gas for some time, the conductor becomes radio-active.—*London Electrical Engineer.*

Why Lighting Companies Should Take Care of Consumers' Lights

Company Care Best for Lights

By Arthur Williams

It need not be said that the standards in electric lighting should be the highest; not alone that the user shall receive full value in that for which he pays, but to advertise and broaden the field of electrical supply. As the incandescent lamp is the medium through which light is obtained, it is desirable for many reasons that the lighting companies should supply it and provide freely for its renewal. This is most conveniently done by including the cost within the schedule of the service charges.

The practice of those engaged in gas lighting, in renewing mantles and cleaning chimneys, sometimes with, sometimes without, special charge, is suggestive to those operating electric light stations. With the mantles in poor condition, or the chimneys black, the light cannot be good, and the results cannot be otherwise than harmful to the gas industry. This also is true of electric lighting; if the lamp is coated with dust a large percentage of the light is killed and the "tone" is lowered; if used overlong the light falls below a fair standard, becoming yellow, insufficient and unsatisfactory.

The English and continental practice has been largely, if not entirely, to require the consumers to supply their own incandescent lamps. This has led to the sale of lamps as general merchandise in hardware, crockery, grocery and other stores, by and to those who know nothing of lamp manufacture or purchase, other than from the standpoint of price. The result has been inexpert purchase, inferior lamps of low efficiency, causing high bills, and in the natural reluctance to abandon a lamp from which some light, however little can still be obtained, a general use prolonged far beyond any proper life, causing poor illumination. These conditions have undoubtedly retarded the development of the electric light industry in many of the cities abroad, and the companies, as well as the consumers, are the sufferers. Of the foremost managers and engineers, many seem to favor a change.

The American practice is the opposite of the European, the lamps being supplied and renewed free—free in the sense that the cost is covered within the monthly bill for current—directly by the supplying companies. The direct advantages include expert purchase, insuring high quality, and wholesale purchase, insuring lowest cost. These features are greatly to be desired by the company for self-evident reasons, and they cannot be obtained—at least in equal measure—where the individual consumers purchase lamps in the open market.

Whatever the terms for electrical service, the consumer expects and pays for light and judges the service by the results in light. Added to a company's liberal policy in lamp supply and renewal, the consumer should be informed that to get good results, his co-operation is necessary—that some attention to the lamps is incumbent upon him, and is justified by the improved results he will quickly receive. He would not hesitate to clean oil lamps and chimneys daily, and why should he object to cleaning his incandescent lamps as often as weekly. Very few, if any, of the supplying companies attempt to care for the individual lamps. Possibly, were such service undertaken, there would be sufficient compensation in the improvement generally in the character of the light, notwithstanding the additional cost of rendering the service.

In the question of lighting there is often involved a choice between plain and frosted glass and between various candle powers. Frequently frosted glass proves far more desirable and a lamp of eight candles is almost always sufficient in the hall, closet or cellar, and where a number are used, eight candles may be sufficient for general illumination. This reduction, however, should not be carried too far, as the volume of light should never be less than sufficient for the specific purpose for which it is employed. If illumination is obtained from a single lamp, in other than groups or special positions, the result can hardly be satisfactory if its power be of less than sixteen candles.

Standards of light for commercial as well as private use are becoming higher, not lower, as many suppose and advocate. This is evidenced by the increasing use of the arc lamp in electric, and the Welsbach in gas lighting. Other examples are found in the increased illumination of the streets and public places, and of the stores and show windows. In the principal streets the lighting effect is augmented by the diffusion of light from the stores and from the electric signs which are so rapidly increasing in size and number. The higher standards of light with which one thus becomes familiar are more than likely to be required in all our daily relations, though in some degree unconsciously or automatically.

Gas Companies' Care for Gas Burners

The advantageous results accruing from a gas company undertaking the entire care and maintenance of the lights and burners supplied by it with gas, as shown by experience in the City of Salisbury, England, have been interestingly described by Mr. N. H. Humphreys in a paper read before the Incorporated Gas Institute. Of the system he says :

"Its installation in the city dated from the commencement of the new public lighting contract in the autumn of 1898, and we have now 600 public lamps fitted with No. 2 or No. 4 Kern burners ; 200 outside shop lights, mostly fitted with two "C" burners in each ; and some 200 customers representing about 2,000 interior burners of various kinds, including No. 0 to No. 4 Kern "C," "York" and "Gem" Welsbachs. The whole forms a standing advertisement of the fact that gas as a lighting agent is not yet played out, but stands foremost in cheapness and efficiency that could not be secured by any other means.

The work of maintenance is essentially one of these things that, if worth doing at all, is worth doing well ; and any attempt to run it as a stop-gap in connection with existing duties and without increasing the present staff is not likely to prove satisfactory to either party concerned. It is worse than useless to take up the thing in a muddling, half-hearted sort of way, as something to fill up the spare hours of the men who read the meters or attend to the lamps; and if the directors expect to have it brought in without increasing the present staff it is better to let it alone."

The work in Salisbury was begun with the supplying and care of outside shop lamps.

"Our customers soon began to notice the lights and compare them with their own. The first evidence of this was a widespread notion that we were using a special quality of mantle and burner and there was a demand across the counter for burners and mantles similiar to those used in the street lamps."

The company next proceeded to take over isolated cases of indoor lighting. After about a year's experience it felt itself able to undertake properly any kind of work.

"We do not undertake maintenance work for less than one year, and it is understood that our terms cover the whole of the burners on the premises. If it is suggested that one or two burners are not often used, and are not worth including, we reply that it is not fair to give us the most risky and troublesome part only. This question has only arisen once or twice, and there has been very little difficulty of any kind. Our undertaking includes keeping glasses clean and burners in good order, and the renewal of mantles, rods, and plain glass cylinders when necessary, but no fancy glass or other parts of burners. If required to take over burners at present in operation, they must first be put in proper order at the customer's expense. A large part of the business is for new burners, and comes from customers who would not be likely to have the system at all if they were not relieved from the trouble of attending to it."

Care Costs 70 Cents a Year

The Gas Light and Coke Company, of London, England, has given notice that it is prepared to undertake the maintenance and renewal of the incandescent mantles and chimneys of consumers within its district. The charge to be made for the maintenance and renewal of mantles of the ordinary size will be at the rate of 9d. per quarter per burner. Consumers having less than four mantle burners will be charged for the maintenance of such smaller number a minimum rate of 3s. per quarter. Somewhat higher rates are charged for larger sizes. The company undertakes to send, periodically, competent workmen in uniform, who will clean and regulate the burners; replace mantles which are worn out or defective; and clean the chimneys and replace any which are broken.

Etching on Glass

Certain substances adhere so tenaciously to glass that on being detached they tear away scales. For etching glass, apply two coats of this glue and after twenty-four hours place in an ordinary kitchen range for a few hours, at a temperature not exceeding 105° F. The glue will detach itself with numerous flakes of glass. The designs may be varied by adding various salts to the glue. The best results are obtained from glue mixed with a little alum.

Iron, the Touchstone of Civilization

By the Hon. Abram S. Hewitt

(*Concluded from September.*)

[The remarkable prophetic paper read by the Hon. Abram S. Hewitt on February 21, 1856, before the American Geographical and Statistical Society, two installments of which were printed in the August and September numbers of The Electrical Age, is concluded below. The complete paper has also been reprinted by The Electrical Age in pamphlet form with a half tone portrait of Mr. Hewitt and a short sketch of his life. The pamphlet will be sent to any address in the United States or Canada, post paid, upon receipt of ten cents.—Ed.]

Having thus traced the progress of the trade in this country, and shown that its difficulties are only artificial and temporary, it only remains for me to investigate the geographical elements of our present make of iron, and to show in what parts of this great country are, and will be, the seats of its production.

Humboldt, in his Cosmos, has treated at length upon the influence of mountains, and their necessary concomitants, rivers, on civilization and the arts of life. The geographical location of the iron industry is dependent upon their influence. Our rich ores have their origin in the volcanic changes which produced the mountain ranges; and the corresponding valleys, with the river drainage, determine the spots where the ores shall be reduced and the metal transported to market. The Hudson and Delaware, the Schuylkill and Potomac rivers, drain the valleys formed by the great range of the Blue Mountains; while the Susquehanna, the Ohio, and the Mississippi drain the valleys formed on either side by the great Appalachian group. Still further west, the Missouri and its tributaries drain the eastern slope of the Rocky Mountains. In all these mighty valleys coal exists in boundless profusion, or is accessible to them by artificial avenues. The Hudson takes its source amid mountains filled with such incredible deposits of iron ore, that it is beyond the power of science or of numbers to compute the quantity. Lower down, its more recent formations are rich in secondary ores, especially in the valley of the Housatonic, which is part of what may be called the Hudson area. Anthracite coal has been made accessible to this region by means of the Delaware and Hudson Canal. The result is, that a large iron industry has, within a few years, sprung up on the banks of this noble river, which is destined to assume great magnitude. In 1855, the production in northern New York, in the Housatonic valley, and on the lower Hudson, between Troy and New York, must have exceeded 100,000 tons. New furnaces are building, and the resources for production are only limited by the quantity of coal, which can be procured at moderate rates. This city must ultimately become the focus of an iron industry that will rival Birmingham.

The Delaware with its main branch, the Lehigh, reaches into the coal region. The secondary ores abound along its shores, while the Morris Canal has made the great primitive ore resources of New Jersey easily accessible. Hence the earliest successful efforts to make iron with anthracite coal on a large scale occurred in this region, and from the cheapness of the raw materials, it must be the leading seat of the iron trade on the Atlantic slope. New York is the natural outlet for this region, and our far-seeing capitalists have already made provision for it by the construction of direct lines of canal and railway. The product of this region in 1855 was about 140,000 tons, including, as I always do, the make of wrought iron direct from the ore.

The valley of the Schuylkill has direct communication with the coal fields, but has to rely chiefly on secondary ores, which are doubtless abundant. Its production may be set down at 100,000 tons.

The valley of the Susquehanna has boundless resources in ore and coal, which, in 1855, yielded a product of at least 200,000 tons.

The valley of the Potomac, with equal access to coal and ore, produced about 60,000 tons.

Virginia and the remaining Southern States, with resources equally great, have made but little use of their advantages, and have produced not more than 40,000 tons.

The valley of the Ohio and its tributaries, and the valleys of the Mississippi and Missouri and their tributaries, have resources in the way of raw material, cheap food, facilities for transportation, and a local demand, which place them far above any region on the habitable globe. In 1855, western Pennsylvania, Ohio, Tennessee, Kentucky and Missouri produced at least 275,000 and probably 300,000 tons. A century hence, when the world will require its 100,000,000 tons of iron, more than one-half of it will be produced in our great West. The traveller who passes down its great rivers at night will be lighted on his way by the answering fires of 10,000 furnaces, so that the "ineffectual moon shall pale" before the mighty glow of human industry. The product will bind that mighty valley, with its hundred millions of freemen, to the rest of the Union with iron bands not so durable, but typical of the fraternal patriotism of this great country, blessed by bountiful Providence with every good and perfect gift.

The hasty enumeration of what has been done in 1855, showing a natural production of not less than a million of tons, of the value, when ready for market, as pig, bars or plates, of at least $50,000,000, proves that our iron industry has reached the same development as that of Great Britain in 1836. If our resources are as well managed for twenty years to come, we shall stand where she does now—that is, we shall make 3,500,000 of tons; and wild as some of the results at which I have arrived may seem, I do not hesitate to declare the opinion, that by 1876 we shall reach that mark.

Commercial revulsions will undoubtedly come hereafter, as they have heretofore, and check our progress; unwise tampering with the revenue laws, in favor of special interests, may cast a cloud over the horizon, and ruin those who are now in the business, to the temporary advantage possibly, and the permanent injury certainly, of the interests sought to be benefited; but the skill is now here, the works are now built, and in the hands of some more fortunate holder, to whom they will descend at a sacrifice, and who will have the advantage which every year makes in our favor, as against foreign competition, for the reasons I have enumerated, the works will be carried on and extended, and the country will reap the reward which unwise legislation has denied to those who have heretofore engaged in this industry, and may deny to those who are now in it.

I feel impelled to this tone of remark, by way of solemn caution to those who might otherwise regard the statements of this paper as substantial reasons for investments in the iron business. The time has not yet arrived when the laws which I have developed as in being have done their work effectually. The difference in labor and capital is not yet overcome; but it will be. A repeal of the duties on iron, and especially on rails, would go far to ruin the majority of those who are now in the business. We are steadily and rapidly approaching the point where this may safely be done; but we are not yet there.

But even this point has not been achieved without sacrifices. Many good men have fallen in the mighty contest. Of one, who brought a great mind and a great estate to this business, who, with a grasp of intellect too comprehensive for his day, took in all the great extent of the iron trade, and the demands of the world for its product, I shall not forbear to speak, although it may be an intrusion into his present retirement. I refer to Horace Gray, of Boston, whose merits and sacrifices will one day be recognized, and whose name will be recorded with gratitude when the coming historian shall trace the eventful history of what will be the greatest branch of industry in this country. I can only say that he has lived to see his ideas realized, so far as the trade is concerned, and all his enterprises successful in the hands of others—more fortunate, but not more deserving than he.

But if I were to pursue this subject I should tread on the graves of martyrs, and I forbear.

The iron business has not been a successful and profitable branch of industry in this country, if measured by the rewards it has brought to those who have carried it on. In England, on the contrary, it has been the richest of the prizes drawn from the great wheel of human industry. The same destiny awaits us here. It is a question only of time, but bearing in mind the obstacles which still strew the path of our successful progress, I can only suggest to those who propose to engage in the business the couplet from Hudibras, as conveying a wholesome warning:—

> "Ah, me! what perils do environ
> The man that meddles with cold iron!"

To those who have essayed these perils, and succumbed to them, I can only offer the barren consolation contained in the lines of another eccentric poet:—

> "Have you heard that it was good to gain the day?
> I also say it is good to fail—battles are lost in the same spirit as they are won.
> I sound triumphal drums for the dead—I fling through my embouchures the loudest and gayest music to them—
> Vivas to those who have failed, and to those whose war vessels sank in the sea,
> And to all generals that lost engagements, and all overcome heroes, and the numberless unknown heroes equal to the greatest heroes known."

And lastly, to those who have struggled thus far with doubtful success against the obstacles of insufficient means, of adverse legislation, and the thousand difficulties which assail the enterprising, I can say, in the language which Hopeful addressed to Christian, as he was sinking in the river which separated them from the Golden City,—"Be of good cheer, my brother; I feel the bottom, and it is good."

The practical results which this paper offers for your consideration are:—

1. That the United States have greater natural resources for the production of iron than any other country of the earth, in consequence of the moral elements which characterize the nation, the unlimited possession of mineral coal, the abun-

dance and richness of its ores, and the vast system of natural and artificial avenues of transportation which traverse the land.

2. That the difficulties in the way of a large production are purely social and artificial, viz.: the dearness of capital and labor, which obstacles are being slowly and surely overcome by the progress of the country, and the fact that the increase of consumption throughout the world will at an early day task the production of iron in Great Britain to its utmost limits, and consequently increase its cost and price.

3. That as the United States have no competitor but Great Britain, the surplus demand, over and above the power of Great Britain to supply, must be met by the United States, and that it would therefore be unwise for the national government, in order to benefit any particular interest, to adopt such legislation as would discriminate against the iron business, inasmuch as it would only retard progress that is inevitable, by bringing ruin upon those who have been pioneers in establishing a great branch of national industry, especially as it is now proven that American rails can be made at the average cost of foreign rails.

4. That the growth of the business hitherto has surpassed the corresponding growth in Great Britain; and as we may be said to have commenced 50 years behind her, we are at this day only 19 years in arrear, and may, under all the circumstances, reasonably expect to overtake and pass that country in the amount of annual production.

5. That owing to the superior richness of our ores (a point which I have not enlarged upon in this paper for want of space, and of adequate knowledge), it is probable that science will enable us to dispense with some of the intermediate processes now necessary for the production of wrought iron, and thus achieve an equality, in point of cost, with Great Britain, even before the equality in cost of labor and capital is reached. This point will require development in a special paper, and I would suggest that some gentleman of the requisite knowledge, theoretical and practical, be requested to prepare a paper on this subject.

Lastly. Considering the important influence which the wages paid to labor have upon the welfare of the laboring classes, and the successful prosecution of manufacturing industry, I would suggest that a paper, giving the past history and statistics of wages, both here and abroad, would be of great value and general interest.

Assuming the population of the world to be 900,000,000, the production, and of course the consumption, is at the rate of about 17 pounds per head.

In 1740, when we have the most reliable data, the consumption of iron did not amount to one pound per head. But the great fact to which I wish to call your attention, in order to deduce the practical results at which this paper aims, is the distribution of the present consumption among the nations of the world. In order to determine this point, I have made very careful calculations, which show the following result:—

Nations.	Production per head lbs.	Consumption per head lbs.
England	287	144
United States	84	117
France	40	60
Sweden and Norway	92	30
Belgium	136	70
Austria	12½	15
Russia	10	10
Switzerland	—	22
Prussia	50	50
Germany, Zoll Verein	50	50
Spain	4½	5

Turkey, and the uncivilized portions of the world, too little to be calculated.

A careful examination of this table will demonstrate conclusively that the consumption of iron is a social barometer by which to estimate the relative height of civilization among nations; for considering in what practical civilization consists (I exclude æsthetic civilization from this species of estimate), measuring by the actual comforts and conveniences with which social life is surrounded, what philosophic traveller, or student, will not classify the nations of the world precisely as the table arranges them: England first, United States second, Belgium third, France fourth, Germany fifth, Switzerland and Sweden about on a par, Austria next, then Russia, Spain, and Turkey, and the great outlying regions of barbarism?

You will not fail to observe another fact, that the large consumers are large producers in every case,—a fact which a little familiarity with the laws of trade and industry will show to be inevitable.

It is plain that the consumption of iron is rapidly on the increase, as well from the progress in the arts of life as from the increase of population, and the steady march of Christianity and civilization, like twin-sisters, into the regions of barbarism. This consideration has an important practical value in determining what future demand will be made upon the iron-making resources of the world; for, if it were as highly civilized as Great Britain, mankind would consume as much iron per head, viz.: 144 pounds, which would make a total annual consumption of about sixty millions of tons, or nearly seven times the present product.

How much time will be required to bring the world to such a degree of civilization, it is not for me to decide; but it is apparent that when it reaches this point the annual consumption of iron will be over one hundred millions of tons; for it is to be remembered also, that the annual consumption per head is increasing; that in 115 years it has increased seventeen fold. If the next century should show the same result, the consumption would be 300 pounds per head, requiring an annual make of 140,000,000 of tons.

But the population of the world is rapidly increasing, and in 100 years will probably be nearly doubled, which would raise the consumption to over 200,000,000 of tons per annum. I am aware that common sense stands appalled before these immense figures. Previous to this investigation, I have never allowed myself to look the facts in the face, and I am therefore desirous to submit them to the severest examination. Let me ask you, therefore, to measure the future carefully by the past.

From 1740 to 1855, the production of iron increased seventy fold. If the same rate of increase should prevail for 115 years to come, the annual make would reach 490,000,000 of tons, and it is to be observed that the ratio of increase has been an increasing one for each period of ten years since 1740, and not a decreasing one. Commencing with 1806, it required till 1824, a period of 18 years, to double the production in Great Britain. By 1836 it was again doubled, requiring a period of only twelve years. In 1847 it was again doubled, requiring eleven years. In 1855, a period of eight years, it had risen from 2,000,000 to 3,500,000, at which rate it would double in ten years.

Now, if the production of the world were to double only once in twenty years, the make, in

1875, would be	14,000,000
1895, would be	28,000,000
1915, would be	48,000,000
1935, would be	96,000,000
1955, would be	192,000,000

Figures, again, so enormous as to defy any man of common sense to stand before you and say that they will be realized. And yet, if any one had ventured the prediction in England in 1740, when the make was 17,350 tons, not so much as the yield of the establishment with which I am connected, that in 115 years the make would reach 3½ millions of tons, he would have been regarded as a lunatic, and told that all the men, and all the wealth, and all the mineral resources of Great Britain were not adequate to one-fourth of such an incredible production. Allow me to apply a further test to this matter. In Great Britain there is one mile of railroad to about eight square miles of surface. In Connecticut the ratio is about one to six. In the State of New York the ratio is about one to twenty. The habitable world would not be ever supplied with the conveniences for travel and transport if one mile of railroad were built for each ten square miles of surface. Now, according to the best authorities, there are 20,000,000 of square miles of habitable surface on the globe, which will ultimately require 2,000,000 miles of railroad. To lay and operate this quantity will require 600,000,000 of tons of iron, the annual wear and operation of which will demand at least 60,000,000 tons per annum. The consumption for railroads now absorbs about one-third of the make of iron; and it is apparent that while the use of iron for purposes for which it has been long applied is daily growing, each year brings forward new applications which seem to indicate that there is no practical limit to its use.

View the subject, then, as we may, whether by the history of the production of iron for the last 100 years, or by considering the consumption per head and the progress of civilization, applying only the law which we find at work and which no social Joshua has power to arrest, we are brought to the conclusion that, great as is the present production of iron, it is but in its infancy, and that the very smallest amount which will answer the purposes of the civilized world 100 years hence, will be 100,000,000 tons per annum. How and where, geographically considered, is this enormous quantity, or the half of it, or the quarter of it, to be made?

In order to solve this problem, it is necessary to consider what are the elementary conditions essential to a large production of iron. These are—

First. An adequate supply of the requisite raw materials; ore, limestone and mineral coal; for charcoal can only be used as we have seen, to an insignificant extent.

Second. These raw materials must be geographically so situated as to be brought cheaply together, for the value of raw material does not more consist in what it is, than in *where* it is—a fact too much overlooked in the mining projects of the day.

Third. There must be cheap means of transport to market.

Fourth. There must be sufficient density of population to insure labor at a moderate cost.

Fifth. There must be adequate capital to build and carry on the works.

Sixth. There must be the skill to manage them in the most economical manner.

Seventh. There must be indomitable energy and strict integrity in the management; that is to say, the iron business can only exist on a large scale where the people are essentially industrious, intelligent, energetic and honest.

You perceive that these elementary conditions are either natural, moral or artificial. They are all combined in a remarkable degree in Great Britain. The local distribution of the business, even within its narrow limits, has been determined by some or other of these conditions. The coal and ore and limestone are very generally interstratified throughout the island. Its small extent and insular position have made the combination of natural and artificial means of transport cheap and rapid. The people are hardy, intelligent, and singularly honest and persevering; their peculiar commercial and colonial policy, stretching to the utmost confines of the globe, for more than a century has made London the centre of the financial world, and consequently insures a large supply of capital at the lowest rates; the requisite skill and development of the mineral resources have been obtained by a century of experience, when foreign competition was religiously excluded by prohibitory duties, until England could make iron cheaper than all the world, and since then domestic competition has cheapened the processes and reduced the cost to the lowest practicable limits consistent with the maintenance of an adequate supply of skilled labor, which the aristocratic features of the government, and the small area of the island, have alike contributed to furnish at the bare cost of the necessaries of life; and withal the climate is free from great extremes of heat and cold, and favorable to the use of stimulants, which are supposed to be essential to those engaged in a business which demands at the same moment considerable intellectual vigor and great muscular strength.

Other nations, as will be seen, possess equal natural and moral resources; but in none at this day exist in such perfection all the artificial conditions which are essential to a large production of iron at the lowest possible cost. But there is a natural limit beyond which an adequate supply of raw materials cannot be cheaply procured; beyond which each additional ton makes all the other tons cost more; and there is a limit beyond which the demand for labor will raise its price. Moreover, the advantages which England possesses in the way of capital will not last forever, when the two continents are only ten days apart, and the extremities of the globe are pouring gold into the lap of each, as from two gigantic cornucopias, gilded one by the rising and the other by the setting sun. Other nations are striving to open up their resources and improve their domestic channels of communication, in order to enable industry to achieve its triumphs more cheaply, and thus lessen the disparity which now gives Great Britain so large an advantage.

Whenever, then, the increasing iron consumption of the world reaches a point which overtasks the natural resources of Great Britain, in the way of raw materials and labor, it is evident that it will cost her more to make iron than it now does. It, therefore, becomes a very interesting question to other countries, especially to their legislators and those engaged in the iron business, to determine whether Great Britain has reached or is approaching a limit when the demand will be large enough permanently to raise the price, so as to permit other countries to engage in the business without the aid of artificial stimulants to production. The enormous increase in the make of Great Britain, within the last three years, has had the effect to double the price of coal and ironstone, and the advance in the wages of labor has been very decided. The consequence has been that the Russian war, and the financial troubles of last year, have had no perceptible effect on the price of iron. The price would have fallen but for the fact that the cost of production would not admit of any material reduction. In other words, owing to the increased pressure for coal and ore and labor, it has cost much more per ton to make three and a half millions of tons last year, than it cost per ton to make two millions of tons eight years ago. I do not wish to be understood as saying, that even with the present demand Great Britain cannot undersell the world. Far from it: she can do so. But I do wish to say, that, if the addition of a million of tons to the demand has doubled the prices, the addition of another million to the demand would have a decided influence in still further advancing them; and that at length, in the progress of the world, a point would be reached beyond which the required iron could not be supplied at all.

Now, the facts and considerations I have enumerated would indicate that this period is not very remote. If so, it becomes interesting to inquire from what quarter of the globe the surplus is to come in the main. I think I shall be able to satisfy you that but one country can fulfill the required elementary conditions, and that country is the United States.

In the first place, the Anglo-Saxon race,—which, by the way, has an extraordinary faculty of incorporating all other races and still retaining its characteristic features,—alone combines the moral elements essential for the business. The French have great acuteness and unrivalled taste; the Germans have steadiness of purpose and frugality; but for downright courage and steadfast perseverance, steady economy and patient industry, mechanical ingenuity and ever-improving skill, strict integrity, and a high sense of accountability, all combined in one people, you must go to the Anglo-Saxon race in the old world, or its offshoot in the new.

In regard to the natural elements, I am ready to admit that abundance of iron ore exists in all parts of the world, scattered by the bountiful hand of a gracious Providence, as if to indicate that in case of necessity no nation should be without the means of independence for the essential element of progress, if such independence becomes desirable. In the United States this is particularly the case. But abundance of iron ore does not suffice for the *cheap* production of iron. Mineral coal must be also abundant and easily acessible. In order to indicate the relative position of the leading nations of the globe in this respect, I have copied a diagram from Taylor's great work on coal, showing the available areas of mineral coal in each country—by which it appears that the United States stand first upon the list; that out of 184,073 square miles of coal area, our country has 133,132, or nearly three-fourths the whole amount, and sixteen times as much as Great Britain and Ireland together. It is to be observed, moreover, that this coal exists in nearly every state in the Union, or where it does not exist, it is readily accessible to the main deposits of iron ore in the non-bearing coal states. At the most important localities for the purpose of making iron, immense bodies of coal exist above water level, whereas in England it has to be mined and raised from the depths of the earth. Measuring by the coal areas, and iron ore being equally abundant, it is the true standard, the United States can produce fifty millions of tons per annum with as little drain on its natural resources as Great Britain can produce three and a half millions; and in this connection it is essential that a most important fact be noted. I have stated that to produce three and a half millions of tons in Great Britain required the consumption of forty-five millions of tons of raw materials, or about thirteen tons to each ton of iron. In the United States, from the greater richness of the ores, and the more general use of anthracite coal, the same result could have been achieved with less than half the quantity of raw materials, thus economizing labor to an enormous extent. In point of fact, the materials for making a ton of iron can be laid down in the United States at the furnace, with less expenditure of human labor, than in any part of the known world, with the possible exception of Scotland.

In regard to our present and prospective means of communication, I need not attempt to enlighten a Geographical Society how far we surpass all other countries in our great rivers and greater lakes, in our 4,800 miles of canals, and our 23,-000 miles of railway, more than are possessed by all the world beside, and in our steady addition to them of 3,000 miles per annum; all forming a length of intercommunication so vast, that "distance literally lends enchantment to the view."

Endowed with these moral and natural elements to an extent unsurpassed by the most favored nations, it may well be demanded why we are not the largest producers of iron in the world; why the domestic iron trade is affected with a kind of periodical catalepsy; why our ironmasters have been perpetually knocking at the doors of Congress either for relief, or immunity from further legislation. By one portion of the community they have been regarded as importunate beggars for charity from the public crib, and by another portion as "rich nabobs," who desire a perpetual monopoly of a prosperous business. In behalf of these hypothetical beggars and putative nabobs, I crave your indulgence while I make answer, and I think myself fortunate that I am permitted to do so before a body who will pass judgment on the explanation in a calm and philosophic spirit.

In 1740, when the English iron trade began its wonderful career, this country was a comparative wilderness. A hardy population, scattered along the seaboard, barely succeeded in conquering for themselves the means of livelihood. The resources of the country were unknown, and no roads existed into the interior, nor was there any capital to be spared for the erection of works, from the resources of a community struggling for existence. Skilled labor was not to be found among a race who had quitted their ancient homes from a stern sense of duty at a time when operatives were proverbially ignorant and brutish. Notwithstanding these difficulties, the manufacture of iron took root; and as factories for the working of iron in the colonies were strictly forbidden by the mother country, the pig iron was chiefly exported to England, so that for the year 1771 the amount reached 7,525 tons. When the revolution broke out, the country was in a condition to supply the iron required for the great work of freedom; but so little capital existed, that the Continental Congress were forced to take up the business of ironmasters, and make in New Jersey chiefly the iron and steel required for the army.

Iron and Steel Production.

United States. 1901.	Long Tons.
Pig Iron	15,878,354
Bessemer Steel ingots	8,713,302
Open-hearth Steel	4,656,309
Other Steel	103,984
Ore mined (total)	28,887,479
Lake Superior	20,589,237
Coke (short tons)	
Connellsville	12,609,949
Pocohontas	1,279,972

Counting the metric ton as the virtual equivalent of the long ton, the world's production in 1900 was about as follows: Iron ore, 90,000,000 long tons; pig iron, 40,400,000 long tons; steel, 27,430,-000 long tons. Of the total world's production of iron ore in 1900, the United States produced over 30 per cent; of pig iron, over 34 per cent; of steel, over 37 per cent.

How the Telephone User and Operator are Protected Against Lightning

By G. Selwin Tait

(Concluded from September)

In Fig. 7 is shown a protective device for telephones, combining a carbon ground-plate, non-arcing fuses and heat coils. The interior connections of th s arrester—which is manufactured by the D. & W. Fuse Company—are shown in Fig. 8, *a a* being the two fuse cases containing the long non-arcing fuses; *c c* the carbon blocks of same design as in Fig. 5, separated from ground plate *f* by mica strips as before mentioned; *b b* sneak coils, so arranged as to open the circuit when an excess of current is present. The entire apparatus, mounted on porcelain, is installed where the line enters the building in order to make the ground wire as short and direct as possible.

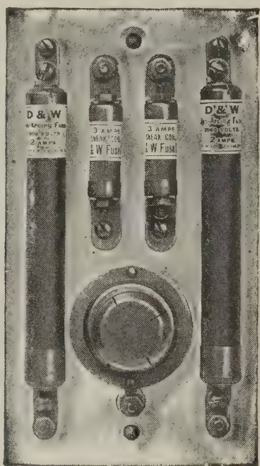


Fig. 7.

More complex than the difficulties encountered in the protection of single instruments were those which developed when the safeguarding of the apparatus at "Central" was attempted. It became necessary to install a complete arrester outfit for each and every wire entering the exchange, as lightning or any other excessive current entering the outside line would be conducted to "Central" as well as to the subscriber. To install a separate arrester—such as installed at the subscriber's home—was out of the question, as the large number required would not only have crowded out all other apparatus but spread out the wiring as well.

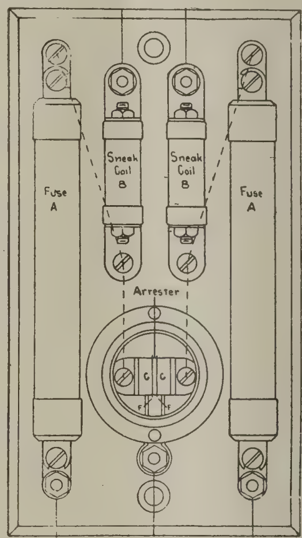


Fig. 8.

How the difficulty was overcome can be seen by reference to the following illustrations, where it will be noticed that the protective devices are placed in one or both of two p'aces—at the cable head and the distributing board.

Fig. 9 is one of the Burns cable terminals. In this illustration it will be noticed that the arresters are arranged in vertical rows and consist of a pair of carbon arresters and heat coils to each line; the carbon block arresters work as described before, and the action of the heat coils is as follows: When a sneak-current enters by way of one of the lines it goes to its respective spring, which is normally held in tension by a metal-capped piece of rubber surrounded by a certain quantity of German silver resistance wire. Now, if this current is of sufficient strength to cause any damage to the switchboard, it generates enough heat in the resistance coil to cause the hard rubber rod to become pliable, when it will collapse, allowing the spring to fly up and make contact with the ground-strip seen in the illustration, at the same time breaking the current which was flowing to the switchboard.

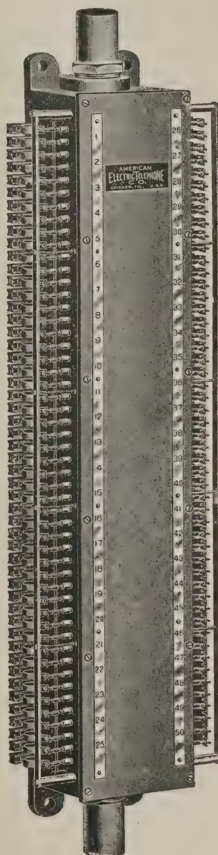


Fig. 9.

Another form of cable head arrester, manufactured by the Stromberg-Carlson Telephone Co., is illustrated in Fig. 10. In this form a grounded carbon strip runs the entire length of the terminal, over which pass two ampere fuse links, the object of this arrester being merely to protect the cables. The interior arrester made by this company is quite simple and yet very effective. Wire of a high resistance is used to suspend a spring, which at the fusing of the wire drops immediately on the ground strip, which is also connected with a local alarm circuit, so that when a line is open or broken it may be known at once.

Some companies prefer to put their arresters on the distributing-boards alone and one very neat form of this type—made by the Sterling Electric Co.—is shown in Fig. 11. The coils are represented as normal on the left of the illustration, and the right side shows how the spring pulls out the core of the coil when the said coil has operated by fusing its plug. The operation of this coil is as follows: The current enters from the line on the left of the illustration, as indicated by arrows *b*—up the strip to the heat coil, through the same, down the other strip to the lock-nut, through the same and out on the other side and thence to the switchboard; returning it enters at *a* and follows direction of arrows *a* up the strip through the coil, which is shown open in the illustration, but is normally closed, down the opposite strip *a* and out to the line as indicated by the arrow. It will also be noticed that carbon block arresters of the type before mentioned are located at the top of the illustration and are connected to the ground plate which runs through the centre of the device. The operation of this heat coil in the presence of a current which exceeds two-tenths of an ampere is to fuse the metal plug which releases the heat coil spring, as shown in the right hand side of the illustration. Here it will be noticed that

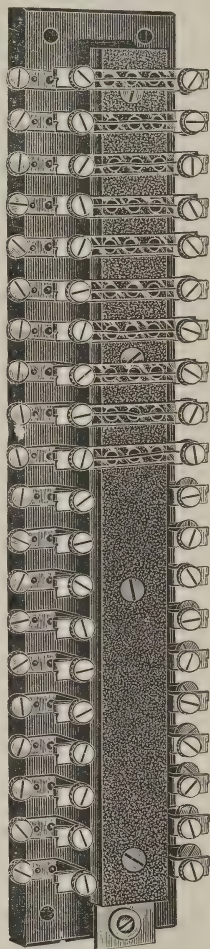


Fig. 10.

one of the springs comes in contact with the ground plate, while the other, which is connected with the switchboard, is disconnected from the line. An additional good point of this arrester is the alarm circuit whch is automatically closed by the release of the spring, as shown in the illustration, closing the alarm circuit and indicating to the "trouble-man" that a fuse has blown. He is then enabled to see at a glance which coil needs attention by the fact that the spring opens outwardly.

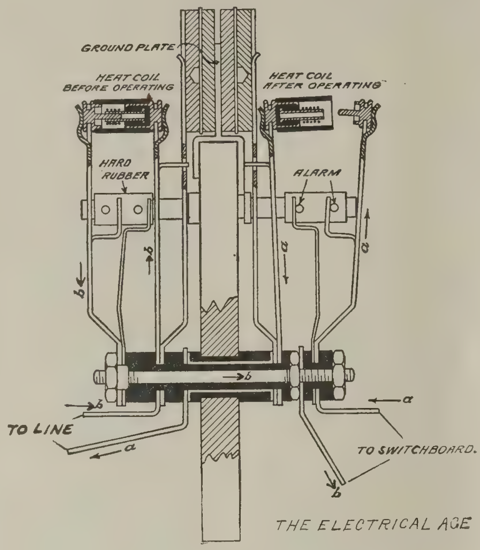


Fig. 11.

It will readily be seen that the chances of a discharge of lightning or other powerful current ever reaching either the operator at "Central" or the subscriber at his telephone are practically nil, and that contrary to popular supposition an up-to-date telephone is more a source of protection than of danger during a thunder-storm, as it is equipped with a lightning arrester of tested ability and proven merit. The lightning arrester means a vast saving of property, making the "burning out" of telephones practically impossible.

An Electric Cattle Goad

The "dumb driven" cattle, awaiting their fate in the stockyards, are now urged on to the slaughter pen by means of an electric goad. A stick fitted with brass points has passing through it an insulated wire, terminating in the brass points. The stick is from four to five feet long and the wire about twenty-five feet, thus affording quite a considerable radius of operation. The advantage of this goad over others is that while it expedites the animal's speed no bruise is left on the beef.

The work is done in one-half the time and with half the exertion. The effect on the steer of the magic touch is amusing to see. A steer touched on the left hip immediately throws his hindquarters as far as he can to the right. He cocks one ear straight ahead and one straight back, switches his tail and starts straight ahead, not caring for a second shock. There is a look of surprise in his eyes, and he seems to know that all the trouble lies in the end of that stick. He doesn't stop to get mad or howl. He has urgent business at the other end of the pen. This is exactly where the drivers and knockers want him. It completely does away with all back rushes and dragging in with chains, for just as long as the puncher is behind, the steer is just as far as he can get in front.

Refuse Destruction in England

At Grays Thurrock is a combined refuse destructor and electrical generating works in daily operation, the fuel being supplied by London's refuse. The power house contains two steam-sets of one hundred kilowatts each at from four hundred and sixty to five hundred volts, a balancer booster and an accumulator battery. The boiler room has two thirty by eight-foot Lancashire boilers adapted for coal firing. These, however, are only used when there is an insufficient supply of refuse to burn in the destructor, which is in a separate house. The destructor-house contains two two-grate Meldrum regenerative simplex destructors working in conjunction with a twenty by seven-foot Lancashire boiler and a regenerator for heating the air supplied to the furnaces. After leaving the furnaces, the gases pass through a combustion chamber, where most of the dust settles, then through the boiler flues and regenerator into the chimney, either direct or through an economizer. The dust may be raked out of the combustion chamber, boiler downtake and regenerator, so that the plant can be run for about three months without stoppage. The normal burning capacity of each furnace is one ton per hour, although it is capable of double this amount when necessary. The destructor does not work at its best conditions, nor does any which has to supply steam for a lighting load only, as the plant should work night and day, where, in the present instance, it only burns for six or seven hours out of the twenty-four.

An account of this plant given in a British contemporary states that when the fires had been out and the furnace doors left open for some seventeen or eighteen hours, the gauge indicated a boiler pressure of about one hundred pounds, and had the doors been left closed, steam would have blown off during the night, on account of the amount of heat stored in the brickwork.

The maximum load on the station is eighty k. w., and this is easily maintained by the consumption of about two tons of refuse an hour. On an average, twelve tons of refuse per day (about six hours) are burned. Two stokers and a trimmer are employed, so this averages one ton per hour per stoker, which means very easy firing, as double this duty might be obtained. The maximum output in k.w. hours per ton averages about 35.

The following figures from a seven-hours' test made on January 23rd last constitute, it is believed, a record for what may be called "London refuse," which has a lower calorific value than the refuse in many northern towns, more particularly colliery towns. The grate area is fifty square feet, the heating surfaces of the boiler and economizer are 600 and 1,408 square feet respectively:

Total weight of refuse consumed, including pots, tins, &c	26,684 lbs
Do do .... per hour	3,812 "
Refuse consumed per sq. ft. of grate per hour	76½ "
Total water evaporated	27,100 "
Do do .... per hour	3,871½ "
Water evaporated per lb. of refuse	1·01 "
Do from and at 212° F.....	1·22 "
Temperature of feed water	50° F.
Do water leaving economizer	299° F.
Average steam pressure	144 lbs.
Total heat units in steam generated	4,544,554
Heat unit from economizer (=21·2%)	967,750
Board of Trade units per ton generated last 4½ hours; the boiler blowing off	35··
Do do during 3 hours	424

These are the best results yet seen, and it is evident that under more favorable working conditions, these figures could be improved upon.

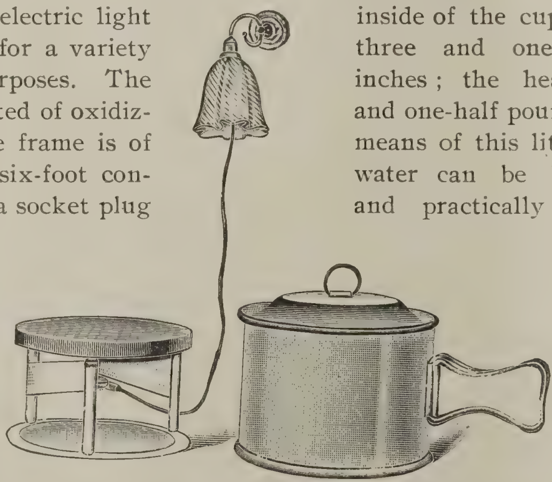
During the first part of the test the cooled brickwork would absorb a considerable proportion of the heat generated, and the figures show that the results in the last three hours were better than those covering a period of four and a half hours. It is only reasonable to suppose that the figures for the last hour alone would be higher than 42.4 units per ton, and might have been higher still if the test could have been prolonged to twenty-four hours.

It is equally obvious, judging from the temperature of the feed-water leaving the economizer, that the boiler is not well proportioned to the work; its length was restricted owing to the space available. A thirty-foot boiler would have increased by fifty per cent the length of the heating surface; that is, the gases would have had to travel for a distance of ninety feet in contact with the boiler plate, instead of only sixty feet as at present, and the temperature of the gases in the chimney would then have been considerably reduced.

"Neither smoke nor dust was visible from the chimney during our visit, nor was the locality of the destructor indicated by the smell. The only objectionable feature at all was the dust with its characteristic odor blowing from the clinker yard."

A Simple Electrical Heater

In the accompanying illustration is shown a useful little heater which may be attached by means of a cord and plug to any electric light socket and used for a variety of household purposes. The heater is constructed of oxidized steel, while the frame is of white enamel, a six-foot conducting cord and a socket plug with an adapter, so that the heater may be used with either a Thomson Houston or an Edison socket, accompanying the apparatus, while an asbestos table-pad permits it to be used on polished tables without injury to them from heat. The cup has a capacity of three half pints and is heavily tinned inside; its outside is of polished nickel. All the parts of the apparatus pack inside of the cup, which measures three and one-quarter by five inches; the heater weighs two and one-half pounds complete. By means of this little apparatus hot water can be had at any time and practically anywhere. It is an adjunct of value in the sick room or nursery. The apparatus is made by the Simplex Electrical Company of Boston, Mass., and is adapted to the ordinary one hundred and ten volt circuit, but can be furnished for use on circuits up to two hundred and fifty volts potential.



Electric Heater Connected to Electric Light Fixture.

Rawhide

Rawhide is used in the industrial world and for a great variety of purposes. The name is applied to two separate and distinct forms of the product, one the cured hide, or rawhide leather, most commonly used in rawhide belting and lace leather; the other, the hard or flint rawhide from which rawhide gears and pinions are manufactured. These two forms differ entirely, both in appearance and in the method of their manufacture.

In the making of rawhide leather, the object is to change the texture of the green hide as little as possible, and still to cure enough to make it soft, pliable and "leathery." It differs from ordinary tanned leather in that it retains the gelatinous substance of the animal hide, and also the original structure of the hide fibres. This means that it is not plumpened or thickened. Finished, pure rawhide leather is the same in thickness as was the green hide when it was on the animal's back, whereas tanned leather is thickened by the tanning process from 50 to 100 per cent. This difference gives the reason for the greater durability and toughness of rawhide.

In addition to belting and lacing, rawhide is used for power transmission, hydraulic packing, harness and halters, bridles, lariats, boot laces, and strapping for various purposes.

Hard rawhide, or flint rawhide, or dermaglutine, as it is variously termed, is used very largely in the manufacture of rawhide gears and pinions. This is simply the green hide put through a drying and hardening process to make it as hard and solid as bone. The method of making gears of this is to cement layers of the hard rawhide one upon another, under great pressure, bind the mass with metal flanges, and then to finish up, and cut the teeth in the same manner as is employed for an ordinary metal gear. Rawhide pinions are especially adapted for use on electrical machinery, as they are practically noiseless, elastic, and also extremely durable. They make possible the running of high speed gearing, where metal pinions would be out of the question. These pinions were first made in Chicago, about twenty years ago, and today are almost as commonly used as steel or iron. Hard rawhide is also used for the binding of trunks, the covering of riding-saddles and for various machinery purposes.

Rawhide has been used for ages for purposes where toughness and strength were required. The methods of its manufacture have developed with its uses.

In the earlier stage of its use it was merely dried hide and was prepared sometimes with the hair on and sometimes with it off. The hair trunks of a generation ago were covered with rawhide with the hair left on.

The fine rawhides of the present day are, on the contrary, prepared with high skill and methods which are the result of much study. Methods and machinery are the subject matter of many patents. Besides the patents each manufacturer has trade secrets in some of the processes.

White men found the western Indians making pliable rawhide of fine quality. The Indians did all the work by hand and the process was laborious and tiresome. The Indians removed the hair by sweating the hides, cured the hides in a solution of salts, and finally worked them soft and stuffed them with tallow and oil by manual labor.

The Chicago Rawhide Manufacturing Company was one of the earliest to adopt the principles of the Indian method of curing and to go into the rawhide business. This company placed rawhide belting and lacing on the market in 1878.

The removal of the hair by sweating

and without the use of lime is declared by this company to be one of the most important of the processes. This process is the same for hard or soft rawhides. The first difference between the two is in the nature of the curing solutions used. Here rawhide makers conceal some of their secrets, but the results are well known. In the one case, the hide comes out of the vats in a condition to be worked soft, while in the other it is ready to be dried into a bonelike substance out of which gears and other things as tough as steel can be made.

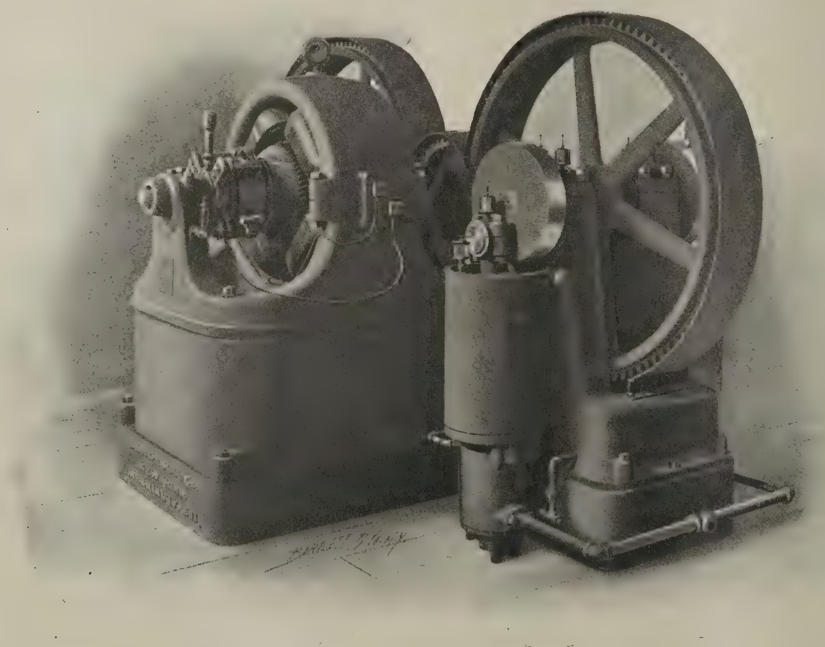
A Station System of Air Brakes

A new system for supplying compressed air for braking service has recently been installed on the Utica & Mohawk railway at Utica, N. Y., by the Westinghouse Air Brake Co., and its operation is proving very satisfactory.

Under this system, each car is provided with a storage tank for the compressed air, and these are filled at a charging station.

The station is provided with two high pressure, motor-driven Rand air-compressors of the "Imperial" type.

The accompanying cut shows one of the air-compressors. It is made up of twin vertical-compound compressors of a special type, so combined with a motor in a single unit as to be carried on a common base. Both compressors are driven by gears engaging with a single pinion on the shaft of the motor. They have intake air cylinders, 8 inches in diameter by 10 inches stroke, and second-stage air cylinders, 4 inches in diameter by 10 inches stroke, and both are single-acting. The combined capacity is an actual delivery of 100 cubic feet of free air per minute, compressed to a gauge pressure of 300 pounds per square inch. The Westinghouse motors used for these compressors are 30 horse power each.



Motor Driven Air Compressors in the Station of the Utica & Mohawk Railway.

Flame Telephony and Voice Recording

Since the wireless telegraph has become an acknowledged scientific fact, and even reached the distinction of commercial practicability, interest turns naturally to the possibility of transmitting the sounds of the voice from place to place with the same readiness as by the ordinary telephone, but without wires.

Although wireless telephony is among the probabilities, it involves for its success the solution of a much more difficult problem than that presented by the wireless telegraph. That some advance has been made in wireless telephony is evidenced by a recent dispatch from Berlin announcing that Ernst Ruhmer, a well-known scientist of that city, had succeeded in transmitting speech a distance of seven kilometers—something more than four miles—over a ray of light.

Transmitting speech by means of light is one of the most interesting and fascinating developments of modern science. The work which has been accomplished by Herr Ruhmer is of a particularly interesting character. He has not only succeeded in transmitting speech by the medium of light, but also through the use of the same medium, with photography added, has made speech record itself more accurately than can be done by the phonograph, and again, by employing light and electricity, reproducing speech in its ordinary tones from the phonographic record.

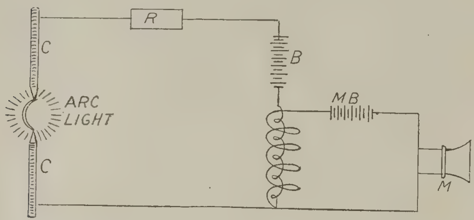
Telephoning without wires is more difficult than wireless telegraphy, for the special reason that the vibratory impulses to be transmitted are of a very different character. In telegraphy only a few impulses are needed to convey the message.

Refer to the Morse alphabet and you will see that its letters are made up of dots and dashes, sometimes employing but a single one of either to indicate a letter, and at the most employing only five.

Three electrical impulses, whether sent with or without wires, serve to make the average Morse letter in all cases, except through ocean cables where the number is doubled by the use of reversed currents. It makes little difference in telegraphing whether these impulses follow one another rapidly or slowly so long as they bear the proper relationship one to the other. In telephony it is very different. The voice must be reproduced by it through the reproduction of vibrations of great rapidity and this must be accomplished coincidentally with the speaking. Each vibration must be reproduced by the passage of an electrical impulse, and these vibrations in the ordinary range of the voice number from 500 to 1,000 a second.

Many methods have been tried for wireless telephony. The first of these and the simplest is a transmission of the currents through the earth. In this case the two wires leading from a telephone are carried into the ground, and at the receiving station the two ends of the circuit there are also led into the ground. If the earth were as good a conductor of electricity as copper wires, and no outside influences interfered, such a system might be made to operate at distances which would make it of use. But, as a matter of fact, the limits within which this method will operate are so small and the results so uncertain, as to render it useless.

Another form which requires no earth connection is that in which magnetic induction is employed. An induction coil is connected with the transmitter and this by its variations of magnetic energy reproduces the effect of the voice in a second instrument through the action of another induction coil. Such an instrument may be made to work within the limits of the laboratory, but hardly beyond.

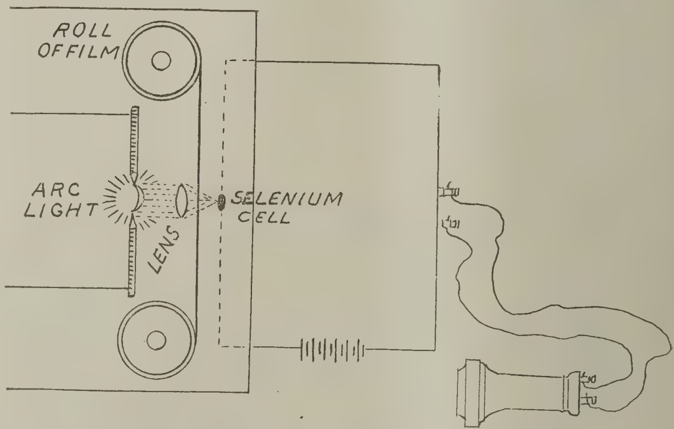


A Microphone Current Superimposed upon that of the Arc Light, Making a Speaking Flame.

The Hertzian waves used in wireless telegraphy are being experimented with for voice transmission, and although little has been accomplished as yet, it is by no means uncertain that the commercial solution will not be found in this direction.

The use of the light beam for voice transmission on the other hand, while it has made greater progress than any other method, does not bid fair to become of much commercial value, yet it is the most interesting of all the methods.

The susceptibility of flames to vibrations is well known. The flame from a gas jet may be made to speak with a very simple apparatus.



Reproducing the Voice from the Photographic Record.

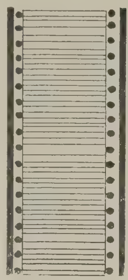
If a straight round flame from a pin hole burner be surrounded with a tube connected with an ordinary speaking tube the flame will take up the sounds sent through the tube and magnify them like a microphone.

Prof. Alexander Graham Bell experimented with flame telephony as long ago as 1880. His apparatus consisted of a mirror hung so that it could vibrate freely in consonance with the voice. A strong beam of light was thrown upon the mirror and this was reflected to the receiving station. The receiver consisted of a selenium cell. This reproduced the sounds in the telephone in accordance with the manner in which it was affected by the vibrating beam of light thrown upon it.

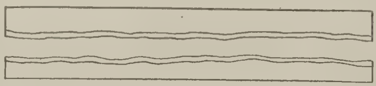
Prof. Bell's experiments were abandoned without his reaching any practical result.

His system differed from that of Herr Ruhmer principally in the sending apparatus. Each requires the selenium cell. In fact, without selenium it would be impossible at the present day to telephone over a light beam. Selenium has the seemingly peculiar quality of having its ability to conduct an electrical current rapidly affected by changes in the degree of light thrown upon it, just as other substances are known to be affected by changes of temperature. In fact, some scientists assert that it is the heat in the light that affects the selenium and not the light itself.

Herr Ruhmer's system of transmission is based upon the discoveries made by Dr. H. Simon in 1898 while he was conducting experiments with a direct current electric arc light. A buzzing noise made by the light attracted Dr. Simon's attention. After a lengthy investigation he discovered that the light was set in vibration by an electrical induction apparatus whose wires passed through that portion of the building and not from the light. Upon introducing an induction current into the light circuit itself it was shown that each circuit was very sensitive to the effect of the other. Following this up, Dr. Simon inserted a microphone apparatus into the circuit of the secondary induction apparatus and speaking into the microphone found that the flame of the arc lamp answered at once and repeated distinctly just what was said. In this way was created the speaking arc flame.


Voice Record Made by Cylindrical Lens.

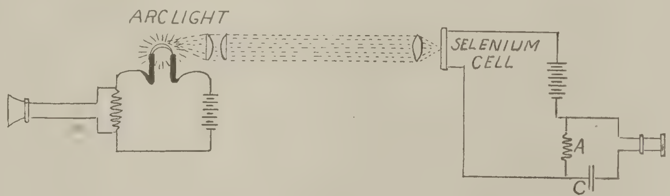
Herr Ruhmer took this as the foundation of the flame telephone. Simplifying the arrangement of Dr. Simon, he made his speaking arc light, without the use of an induction apparatus and without any special microphone battery, by merely introducing the microphone into the circuit of a direct current arc lamp with only a choke coil added to the usual apparatus. The super-imposing of the comparatively slight electrical vibrations of the microphone upon the arc light current was all that appeared to be necessary to make the light talk. Herr Ruhmer even carried this arrangement so far as to make a whole net work of lamps repeat what was said into the microphone by putting the microphone circuit into the generator field of the lamp system instead of upon the lead of a single lamp. By placing the arc flame in a vacuum its flickerings become speechless through lack of a medium to transmit their vibrations but here they still answer perfectly to the voice and are protected from outside influences.


First Record of the Voice by Photography.

The Arons lamp, which produces its arc flame between two quick-silver electrodes in a vacuum, meets this condition. Now we have reached the point where it becomes possible to transmit sounds over a beam of light.

Prof. Bell failed in light telephony for lack of power in his light.

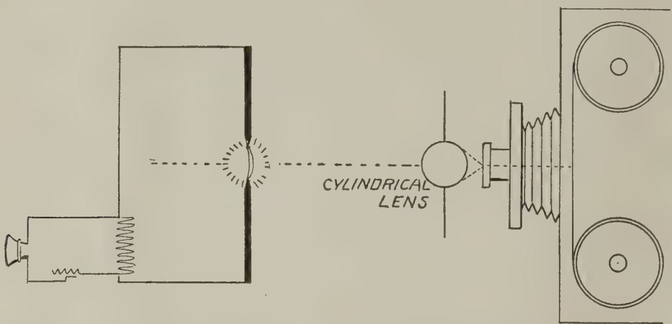
The electric arc light, more brilliant than any other, is also so concentrated within the arc that its rays may easily be gathered together by means of lenses and sent forth to great distances. This we do with the ordinary search-light. It is the search-light projector which Herr Ruhmer uses for his flame telephone. In the apparatus with which it is announced that he has recently transmitted the voice more than four miles he was using a search-light projector of 35 centimeters or about 10¾ inches in diameter. It is announced that in the near future he expects to use a projector of from one to two meters in diameter.



Telephoning Over a Beam of Light.

The receiving station, like that of Prof. Bell, depends for its operation upon a selenium cell. The flickering light from the transmitting station is caught by a lens and concentrated at its focus upon a wire of selenium. The selenium is in the circuit of the receiving microphone. The vibration produced by the voice in the arc light of the sending station varies the amount of light which falls upon the selenium cell, and this in turn and in like proportion varies the amount of current passing through the telephonic circuit of the receiving station. In this way it reproduces the sounds of the voices there exactly in the same manner and by the same means as the receiver of an ordinary telephone is made to talk.

Recording the voice by means of light is an entirely different operation,



Making a Voice Record by Means of the Speaking Flame and Photography.

except that the speaking arc flame is employed as the first medium.

When Herr Ruhmer began experimenting along this line, Edison had already made his mechanical recorder, the phonograph, and Waldemar Poulson was working on the telegraphone.

Ruhmer began his experimentation in this direction by testing the ability of the speaking flame to make a record upon a sensitized photographic film. He passed the sensitive film rapidly before a narrow slit through which the light of the flame could strike it. The slit was about one-sixteenth of an inch in width and of such a length as to admit of the seeing of both the carbon points through it when the eye was in the position of the photographic film. With this apparatus he succeeded in getting records which were sufficient to satisfy him that the vibrations of the flame were recorded, but the record was not sharply enough defined to admit of reproduction.

By substituting for the slotted metal a cylindrically ground lens this difficulty was overcome. It is the property of a lens of this character to produce at its focus an image which is not at all reduced in size lengthwise of the lens, but which is reduced to the mere thickness of a line in the other direction.

Placing the cylindrically ground lens with its axis across the line of motion on a long photographic film, the vibrating light of the speaking flame was thrown upon it. With proper motive apparatus the film was moved rapidly in front of the lens. The result was a record formed in lines so fine as to repeat distinctly practically every vibration of the voice of the speaker. The film having been developed and fixed forms a record which can be retained indefinitely. The reproduction of the voice from this record is accomplished by a reversal of the process by which the record was produced.

To make the record talk it is again mounted upon its rollers and wound from one to the other so as to be passed rapidly in front of the light of an arc lamp. The light passing through it falls upon a selenium cell and this in the manner already described changes its variations into vibrations on the disk of a microphone.

The principles upon which these results have been accomplished are very simple, but great ingenuity has been required to produce the delicate apparatus which has been found necessary to get actual results

A Standard Steel Channel for Tires

Hitherto there have been not less than ten different standards for steel channels used in applying solid rubber tires to vehicles. There has been no standard recognized among rubber manufacturers, each one making his tires to fit the particular channel he used. As a large part of the rubber tire business consists in re-rubbering wheels already fitted with channel, it has very often happened that the rubber would not fit the channel perfectly. This necessitated taking off the channel and putting on a new one, or, as was more often the case, putting the rubber on regardless of the fit, and thus making a defective job. As a result, a great many rubber tires have given poor service for this reason alone, as it is absolutely essential to have a correct fit between the rubber tire and the steel channel.

To the B. F. Goodrich Co. (Akron) belongs the credit of starting the movement which has resulted in a universal standard channel having been adopted by the manufacturers of solid rubber tires in the United States. The American Steel Hoop Company, of Pittsburgh, are now making a complete set of new rolls for producing standard channels, which will be ready in a month, perhaps.

Wanted—a Two Dollar Motor for Household Purposes

To the Editor of THE ELECTRICAL AGE:

Sir:—Why does not some manufacturer of electrical machines put on the market a practicable motor suitable for household use, which can be sold at the department stores ready for use for two dollars? I want such a motor, my wife needs it, my sons and daughters could use it and it would save work for the servants. The motor that I have in mind should be one that could be run by the ordinary incandescent light current and could be connected by simply screwing a plug into the lamp socket in place of the lamp. It should be mounted on a stand in such a way that it could be raised or lowered and turned or shifted into any position to adapt for various uses. My wife would use the motor for running her sewing machine, I would use it for running my lathe, the boys could hitch it onto their jig-saws, and every one in the house would want it at times for driving ventilating fans or some other purpose.

It need not be a motor with much power nor need it have a very high efficiency. What it most needs is to be low in price and so ingeniously arranged that it could be readily hitched fast to the various machines that it was to drive. Don't you think you could stir up someone to put such a motor on the market?

I think the makers of electrical novelties for household use are slow anyhow! I see a great many newspaper stories telling of how all sorts of things are being done in households by electricity—ironing, cooking, hair curling, lamp lighting and many others, but I do not see these devices generally on sale, nor do I know where to go to get them. But the thing which I want most now is the two dollar household motor. Where am I going to get it?

M. W. H.

New York, August 15.

The Most Ingenious Mechanical Device

What is the most ingenious single piece of mechanism ever made?

THE ELECTRICAL AGE desires descriptive answers to the foregoing question and will pay Five Dollars for each answer which it finds interesting enough to print.

For the answer which is finally considered the best Ten Dollars will be paid. Answers should contain from 600 to 1,800 words each and should be illustrated with drawings or photographs.

The Wagon Wheel

To the Editor of THE ELECTRICAL AGE.

Sir,— In answer to your prize offer issued September 1, in THE ELECTRICAL AGE, as to which is the most ingenious single mechanical device ever invented, I beg to say as follows:

It is the wagon wheel that is the greatest, most ingenious and most important single mechanical device ever invented.

So far as its greatness is concerned it would be hard to tell as to where civilization would be without it. Stephenson would have had a hard job to invent the locomotive if it had not been for some clever ancient mechanic who had invented this wonderful contrivance. The hundreds of thousands of miles of railroad lines and their networks would probably have never come into existence if it were not for the mind of its ingenious inventor. Volumes and libraries could be written without ever reaching the end, describing what civilization would have missed without the wagon wheel. We call it a wagon wheel, but it is a wheel under a locomotive, freight car, bicycle, automobile and every other vehicle that runs on the ground or tracks.

So far as its ingenuity is concerned, if one imagines himself back in an age where wagon wheels did not as yet exist, he could then appreciate how ingenious its inventor must have been, or how lucky was the thought from a mechanical point of view. When a new mechanical device is invented it is always done with a purpose to either economize or improve upon an old result or to bring about an entirely new result. So far as the result is concerned, for the expenditure of a few cents worth of grease per year, no other mechanical device in the world can justly claim such large results as the wagon wheel gives. Especially if one thinks how hard it would be to pull a load without any wheels under it.

It is more than likely that when the first wagon wheel was invented that it came forth either as a part of a wheel barrow or applied to a log of wood, the end of which was slotted and a circular body placed therein, with a shaft either in the wood or secured in the wheel. We pass over a wagon wheel very phlegmatically in our ordinary thoughts and entirely overlook what an ingenious piece of mechanical invention it is.

It is certainly the king of any and all of them. When one considers that the shaft of a wagon wheel has to be at right angles with the lengthwise centre line of the body of the wagon; that the top of a wagon wheel travels much faster than its bottom in ratio to the wagon; that the wheel on its outer periphery has a rolling motion and in its centre a frictional motion, but that the friction takes place upon such a small surface only, and consequently is brought down to a minimum, it can be plainly seen that its inventor must have either exerted a great deal of deep thought or that he was sublimely lucky in accomplishing these results.

In case of extreme necessity almost any mechanical device can be replaced with another. Thus the ingenious steam injector can be replaced with a pump, the hydraulic press with a screw press, the screw propeller with side wheels, and for almost everything there seem to be many substitutes, but a wagon wheel is a wagon wheel and I would certainly envy the inventor who could replace it with another invention. One maker may make his wheel of wood, another of iron, and still another may put a steel tire on the wheel. Again, one may place an iron tire on a wooden wheel, place ball bearings in its centre or add one or another of the hundreds of various contrivances and inventions made to improve the original wheel, but still it is a wagon wheel. It was invented, more than likely, thousands of years before we have any record of it, yet no one has been able to improve it in a generic sense. It is the same old wheel, it is the same old invention and it is the same old wagon wheel—some may call it tractional wheel, or any other fancy name, but it is, after all, a wagon wheel—the greatest and most ingenious, most brilliant and important single mechanical device ever invented.

Very respectfully yours,

JOSEPH MISKO, M. E.

New York City, Sept. 9.

Chlorhydrate of Turpentine

Chloride of turpentine—which up to the present day was obtained generally impure, but at a low cost—has lately been the subject of much care and study, with the result that methods have been found for the making of a pure product, and that this and artificial camphor, which is made from it, possess some remarkable qualities.

The great difficulty was to eliminate the sub-products formed at the same time as the product itself. These impurities are easily recognizable, from the fact that they render the chlorhydrate of turpentine acid and that they emit the chlorhydrate acid. A process of purification which makes all these sub-products disappear—which has been invented by M. Emile Callemberg, chemical engineer and counsel to the celluloid works at Lank-sur-Rhine—is described by L. Wertheimer, in *La Nature*.

Today the thing is accomplished, and artificial camphor has delivered all its secrets. One of the most important of these is causing a revolution in the manufacture of explosives. The product is obtained chemically pure, white and transparent as crystal. Its properties when mixed with high explosives of various kinds are summed up as follows:

(*a*.) In the explosives with nitro-glycerine base.

It is soluble in nitro-glycerine at a low temperature and in all proportions. All the world knows the danger of handling the terrible liquid, of which the least shock, the least friction, a sudden elevation of temperature, will cause the explosion. By the addition of the new product this extreme sensibility disappears. The nitro-glycerine becomes less sensitive to mechanical influences in proportion to the amount of the artificial camphor added to it.

The chlorhydrate of turpentine possesses besides the property of diminishing the temperature of explosion of the nitro-glycerine. This fact is of an incontestible utility in obtaining the security of explosives. Calculations show that the temperature of explosion is reduced to 1,312°. The authorized maximum is 1,500°.

The chlorhydrate of turpentine has also the remarkable property of lowering the point of congelation of the nitro-glycerine, which is 8° C. Dynamite cartridges containing three, four or five per cent of the product have remained several hours in the refrigerators where the temperature went from 10° to 15° C, without showing any alteration. This is an enormous advantage in climates where frozen dynamite cartridges cause numerous victims every month.

(*b*.) In explosives with a nitro-glycerine and cotton base.

The chlorhydrate of turpentine mixed with the nitro-glycerine dissolves the nitrated cotton and does this at an ambient temperature, forming, because of this, an irreproachable gum-gelatine. Ordinarily to gelatinise the cotton it is necessary to heat the glycerine, which is at once expensive and exceedingly dangerous. The dissolving of the new product in the liquid abolishes the cost and avoids the danger.

But that which is more curious is, that the chlorhydrate of turpentine, after having had added to it a dissolvant which disappears once its action is made when mixed with nitro-glycerine, can then dissolve all the nitro cottons, at whatever degree of nitration they may be and even the cottons called insoluble, and form with them explosive gums, clear, elastic, of a perfect homogeneity. These will not decompose and can themselves be used as explosives with or without the addition of other ingredients.

A comparison of the explosive gums with and without chlorhydrate of turpentine shows that their power was increased from 15 to 30 per cent each.

(*c*.) In the explosives without nitro-glycerine.

In the explosives with a base of nitrate of ammonia, or chlorate of potash, an addition of chloride of turpentine, which then furnishes the carbon of the decomposition, gives good results. It replaces the mono, bi or trini-tronaphtharines or benzols, and the resins, all expensive products, and gives results as good or better.

Another curious property of this body consists in this, that its point of fusion being 78°C, that of naphthaline 79.2°C, that after an addition of ½ per cent of this last to the chlorhydrate of turpentine, the point of fusion falls to 40°C. This permits of the incorporation of other products in an intimate manner and at low temperatures.

An addition of 5 per cent of chlorhydrate of turpentine made to hygrometrical substances, such as nitrate of ammonia or nitrate of soda, prevents humidity from disintegrating them. A mixture of turpentine and of naphthaline in fixed proportions, is uninflammable, whereas the two are each highly inflammable.

Camphor has been used to incorporate with the dynamites to render them less sensitive to shocks. At the end of three months the camphor was evaporated. With the chlorhydrate of turpentine, on the contrary, the same advantages are obtained and there is no danger of evaporation.

Digest

ENGINEERING LITERATURE OF THE MONTH

An Oil Burning Plant for an Electric Power Station

In the oil burning plant of the Houston Lighting and Power Company of Houston, Texas, oil is delivered on a spur track in front of the boiler-room in tanks of from 6,000 to 9,000 gallons capacity, and is unloaded by gravity into the storage tanks of the station. The latter are three in number, and built of steel, having 12,000 gallons capacity each. They are situated in underground waterproof vaults, over which is a galvanised-iron roof. These tanks are provided with heating coils for heating the oil in cold weather, so that it will not become too viscuous to flow freely and be handled by the pumps. The oil is pumped from the storage tanks into a small receiver, where it is heated to a high temperture by the exhaust steam from the pumps. It is then forced to the burners under pressure, the pump being automatic in its action, so as to maintain a constant pressure of oil, irrespective of how much oil is being used. A meter is placed in the oil feed line, which registers the amount of oil consumed. After the oil reaches the burner it comes into contact with live steam from the boilers, this steam expanding and atomising the oil.—*W. W. Reid, before the Southwestern Gas, Electric and Street Railway Association.*

A New Thermo-Electric Generator

A patent for a thermo-electric generator was recently issued to Charles B. Thwing. The positive of the thermo-electric element consists of an alloy in which iron predominates. For the negative element an alloy of nickel and copper is employed, having the proportions by weight of 1,746 parts of nickel to 1,264 parts of copper. The elements may be cast one upon the other or joined by brazing or other hard soldering. A solder composed of nine parts of copper to one of antimony, which has a heating point slightly below that of copper, may be employed, or copper alone may be used therefor. The thermo-electric generator consists of an aggregation of the above couples. The joints of the heater are compact and brought near to one another and close to the flame, a comparatively large portion of the element being in the path of cooling currents of air passing up through the generator between the outer side of the casing and the chimney.—*Electrical World and Engineer.*

A Paper Incandescent Lamp Filament

A filament for incandescent lamps, which is being used by the manufacturers of an English incandescent lamp company, is made of scrap paper, obtained from Sweden, reduced to a pulp by immersion in a chemical solution. The air and gases in the pulp are extracted by placing it under a glass vessel attached to an exhaust pump. This having been accomplished, the exhaust pump is reversed and the pulp forced through a small opening in the bottom of the glass vessel, emerging as a thin thread of gelatine. By passing this thread around a drum it is reduced to one-half its original thickness after drying. It is then ready for conversion into filaments, and is said to have a strength out of all proportion to what might be expected. These threads are then carbonized and made up into bundles of twenty-five of uniform lengths. Each bundle is then fixed on a carbon frame in such a way that no thread overlaps another. The frames are of all sizes and shapes, varying according to the size and shape of the filament required. The threads are then wound around, and the ends secured by an adhesive solution, after which they are packed in plumbago crucibles and carbonized at a temperature of about 100° C. When taken out of the crucibles they are easily detached from the frames, the adhesive solution and some string adjustments having completely disappeared. They have now a brilliant polish, which is afterward reduced by a process designed to secure evenness of resistance. The filament is now ready for fixing into the base of the lamp, which is treated in a vessel containing hydro-carbon gas. This apparatus is automatically operated, so that the lamp glows just long enough to take up the required quantity of carbon from the gas to offer the proper resistance to the electric current.—*Western Electrician*.

A New Electrical Furnace

Hudson Maxim has invented a new electrical furnace, designed for the treatment of highly refractory substances. The furnace is in the form of a revoluble cylinder, formed of a steel shell having a fireclay lining, within which is a centrifugally maintained auxiliary protective lining or bed that is a conductor. A plurality of radially disposed electrodes pierce the walls of the furnace and engage the inner lining, the outer terminals of the electrodes carrying segmental rings, against which suitable contact brushes bear. These brushes are so arranged that they engage different segments of the rings, and each brush is connected to a separate source of electrical energy. The material is fed to the surface from a suitable hopper having a worm in its lower end. The inner lining forms a common electrode, along which a constantly increasing electric current, secured from the successive series of electrodes, passes, and thus a very high temperature is obtained, which temperature increases toward the discharge end of the furnace.—*Electrical Review*.

Is Wireless Telegraphy an Electrostatic Effect?

In the course of some experiments made by Profs. Gore and Hammel relative to a system of signalling to and from moving trains, the question arose:

How far could a wire the length of a car be placed from a telegraphic circuit, one end being connected with a coherer, so that the inductive effect of the current might still be sufficient to effectively operate the coherer? They tried placing the wire at various angles with the telegraphic circuit, and found that the coherer responded even when apparently at right angles to the circuit. In subsequent experiments due precaution was taken to be assured that the effects were not the result of other than the causes mentioned. The antenna was placed quite accurately at right angles to the circuit. The coherer was effectively operated upon, making and breaking the circuit when the bare end of the antenna touched the circuit; when the end of antenna was near or some distance beyond the circuit; when the antenna was doubled around the circuit or doubled back on itself and the end connected with the coherer. The effect is greater when a helix, having a conductor for its axis, is connected to the antenna, either end, the middle, or both ends of the helix being connected to the antenna. Very decided effects were obtained in each of the above cases when one end of an open circuit was connected to a terminal of the secondary coil. In but a few of the cases were earth connections necessary, though the effects were increased by earth connections. The results obtained seemed to be due to the same cause that operates the coherer when an insulated conductor, near the end of the antenna, has its potential suddenly changed—namely, electrostatic induction. Prof. Gore thinks that the most plausible explanation of this phenomenon is that long distance wireless telegraphy is an electrostatic rather than a Hertzian wave effect. An oscillatory electrostatic stress between the conductor (earth) affected æther and the freer æther above the earth would produce waves that would be propagated around the earth. The better the earth conductor, the greater the electrostatic effect; the smoother the surface of the earth, the less the waves would be distorted and deflected. These are conditions which are found favorable for transmission of wireless telegraphic signals.—*Prof. J. W. Gore, in Electrical World and Engineer.*

Telephone Receiver for Wireless Telegraphy

Mr. L. Bleeckrode, while engaged in testing an installation for wireless telegraphy between the Hague, Holland, and a government lightship lying at a distance of sixteen kilometres from shore, devised a simple apparatus which yields excellent results. Two parallel pieces of carbon, like those used in an ordinary arc lamp, having a length of five centimetres, were placed on a square piece of wood, and a couple of dry elements and an Ader telephone placed in circuit. The circuit was completed by placing three or four ordinary sewing needles loosely in transverse directions on the carbon rods. The antenna of the signal mast is joined to one carbon, and the other is connected to the earth conductor. The letters of the Morse alphabet were very distinctly heard as shorter and longer taps in the telephone, and at the given distance telegrams were easily read by sound by a trained operator, and more quickly than they could be delivered by the usual coherer arrangement combined with the Morse writer.—*Electrical Review.*

Handling Liquid Fuel at Generating Stations

The following method is employed in handling liquid fuel at the generating station of the Los Angeles Electric Company, Los Angeles, Cal. The fuel is pumped from the main storage tank to the main furnace supply tank of 100-barrel capacity. In this tank the oil is heated to 80° F., and it then passes to a pair of small duplex steam pumps, which give it twenty pounds gauge of pressure. The oil then traverses pipes within the breeching of the boilers, which heat it to 190° F., then it passes on to the burners. The burner is of the spray type, using steam as the medium for spraying the oil. These burners consist of two circular disks, 1½-inch in diameter, slotted and arranged in such a manner that the oil, fed by a separate pipe to the lip of the upper disc, meets the steam at its orifice just under the lip. This steam forms a fantail spray which breaks up the oil into particles sufficiently small to ignite immediately by the heat of the brick lining of the furnace and the layers of bricks upon the grate bars. Each of these burners has an evaporation efficiency of 3,000 barrels of water per hour from and at 190° F. The sound of combustion produced by these burners is comparatively little. The flame fills the furnace box, covering the entire furnace box sheets of the boiler.

This gives active heat action to all of the evaporative service of the fire sheets, without unduly heating any one particular portion, and, at the same time, perfect combustion is taking place, as denoted by the absence of any colored gases leaving the stack.—*Oil, Mining and Finance.*

The Relation of Electricity to Plant Growth

In some investigations made at the Harvard Botanic Gardens, relative to the effect of static and kinetic charges upon plant growth the results appear to show that vegetable protoplasm is paralyzed and quickly killed by the conditions existing about the anode, while within certain fairly broad limits it is stimulated by the conditions about the cathode. For instance, seeds placed near the anode are always killed by current amounting to 0.003 ampere or more, if continued for 20 hours or longer, while seeds placed near the cathode have in most cases been but little affected, and under some conditions have been apparently stimulated by such currents. The experimenter tries to explain his obervations by a provisional theory, in which he assumes certain relations of plant growth to ionization of the soil. He thinks the effects are produced by the electrical charges of the ions, rather than by any mere chemical activity of the atoms.—*American Journal of Science.*

Electricity in a Modern Apartment House

A. L. Rice gives a very complete description of the electrical equipment of a New York apartment house. There are 18,000 electric lamps. Each apartment has a telephone. The elevators are hydraulic, the seven dumb waiters electrically driven and automatically controlled by a push-button system from any floor; the lift being about 200 feet. There is a complete system of ventilation provided. Air, tempered to 70° F., is supplied by two 140-inch blowers, each driven by a 30-hp motor. Each apartment is provided with a panel box; each has a meter and circuit breaker, and a separate feeder is installed for the current for electric cooking. The wiring is in concealed enameled conduits. The arrangement is such that all current can be taken from the street supply or from the generating plant, the change being made by double-throw switches and bus-bars on the switchboard. The lamps are supplied from a three-wire system; the motors for elevators, blowers, etc., from a two-wire system. A storage battery operates in parallel with the generators on the three-wire system. There are five generating sets; three of 250-kw, and two of 125-kw capacity.—*The Engineer.*

Cure for Electric Blindness

The increasing use of the electric furnace is the cause of much electric blindness, says a prominent physician

As soon as any pain is experienced from this cause, the eyes should be bath-twice a day in cold water, from 1½ to 2 hours each time, and one drop of the remedy given below put in each eye every three hours; the cold water baths should be timed so as to come midway between two applications of the eye drop:

Holocain muriatic (1-000)	3 grams
Adrenalin chloride (1-000)	3 grams
Distilled water	4 cu. cm

The patient should remain indoors and wear very dark glasses until the eyes are restored to their normal condition, and direct exposure of any light should be carefully avoided.—*American Electrican.*

Current Engineering and Scientific Notes

ABSTRACTS FROM THE FOREIGN PAPERS

Zodiacal Light

Comptes Rendus

M. Decombe has advanced a new hypothesis of the eleven year period of sun spots and of the zodiacal light. He considers that these periodic variations are of an electromagnetic character, and are propagated through what he regards as the residue of a flat solar nebula which extends far beyond the earth's orbit. The variations will die out in the course of time, but will persist, and have persisted, very long on account of the very slight damping they undergo. If they obey the ordinary laws of the vibrations of free plates, the sun must be at a ventral segment, and the circumference may be regarded as a nodal line.

The Castelli Coherer

London Electrical Review

The advent of the Castelli coherer has led to a considerable improvement in the receiving station of a wireless telegraph installation. It consists of two carbon electrodes, one at either end of the tube, enclosing between them two globules of clean, dry mercury, from 1.5 to 3 milimetres in diameter. The two globules are separated by a small cylinder of iron, which completes the circuit. The apparatus is self-decohering, and can be dismounted, cleaned, and regulated at will by the telegraphist on duty. The e. m. f. required with a good tube, carefully adjusted, is said to be from 1 to 1.5 volt, and it is also stated that a moist atmosphere should be avoided in the locality of the receiver, in that moisture has an injurious effect on those tubes which are not perfectly closed.

Synchronism Indicator

L'Industrie Electrique

This device is really a non-synchronous motor with identical stator and rotor windings, with two phases for use with single-phase alternating current, and with three phases for three-phase currents, being used for paralleling alternators. The stator is connected to the network and the rotor to the alternator, which is to be connected in parallel. In the case of single-phase current, the windings of the two phases are connected to two terminals, the one through a non-inductive resistance, and the other through a self-inductance as great as possible, in order to get as nearly as possible a phase difference of one-quarter of a period. It is so arranged that the magnetic fields produced in the windings of stator and rotor revolve in the same direction. It follows that at synchronism the rotor remains at rest in space, and that it turns in one direction or the other when one of the fields revolves more quickly than the other.

The Vibration of Telephone Diaphragms

Annalen der Physik

The vibrations of a telephone diaphragm were recorded by the author by means of a mirror stuck onto it, and a device consisting of an arc light, a point diaphragm, a system of lenses and a revolving cylinder containing a sensitive film. The first point investigated was whether a note received by the diaphragm gives rise to a corresponding series of vibrations of the diaphragm at once, or whether the vibration only gradually fell in with that of the air. The photographic traces of a tuning fork note show that the reaction is practically instantaneous, the "period of latency" not exceeding 0.0005 second. The maximum amplitude is attained as soon as two full periods have passed through. After that the curve for a constant sound remains remarkably constant. When the note ceases, the proper vibration of the diaphragm persists long enough to be seen and even heard, but it is greatly damped by a rubber plug attached to the center of the diaphragm. It also appears that the overtones which produce the rattling and clattering noises in the telephone are the more prominent the greater the force with which the note is sounded. The records show a sound whenever a sound is heard, and vice versa. In traces of complete words, however, the records show a number of details which are quite beyond the perception of the ear. He gives some interesting curves representing vowels and consonants, which are produced in the finest details.

Making Glass Electrically

Zeitschrift fuer Electrochemie

Successful experiments on glass-smelting by the electric arc seem first to have been made by F. H. Becker, of Cologne, in 1898, though there were laboratory trials earlier. The suitability of the electric arc was in so far doubtful, as the heat must not be too intense, lest devitrification result, nor of too short a duration. Becker, therefore, arranged his arcs in steps, usually three, on an inclined plane, each step representing a crucible, from which the glass flowed into a receptacle which was heated by coal or producer-gas. This combination of electric and ordinary heating was not satisfactory. Means were, however, found of combining the receptacle with the cooling furnaces, which were anyhow to be heated by coal or gas. Volker, also of Cologne, with whom Becker associated himself, made other suggestions which have been adopted in practice in the glass works situated at Plettenberg, Westphalia. Since the fused glass is a conductor of electricity, he provided electrodes on both sides of the receptacle, and kept the mass in flow for some time in this manner. To avoid any contamination of the glass with the carbon of the electrodes and its impurities, he placed the electrodes behind perforated diaphragms. Alternating currents are exclusively used in this system of glass-smelting, though the patents are not restricted to their use. Volker also made briquettes of the materials and of carbon, so as to melt the glass, not by the arc, but direct in a circuit of high resistance. Certain kinds of glass plates are produced in this manner. When the experiments had been continued for about a year, the Industrie Verriere et des Derives, of Brussels, took the matter up in conjunction with the Lenne Elektricitaets Werke, at Plettenberg. Colorless glass is obtained at the latter place, on both the Becker and Volker systems. The economy of the electric production left at first a good deal to be desired. The kilogramme of glass was originally produced at an expenditure of four horse power hours; the current consumption has now been reduced to one and one-half and one and one-quarter horse power hours.

Normal Permanent Magnets

Annalen der Physik

I. Klemencic, of Innsbruck, has made some interesting investigations about the proper preservation of normal steel magnets.

He found that ordinary gas piping makes excellent cases for magnets. He uses one-inch pipes in lengths of about six inches, lined inside with blotting paper; both ends are closed by screw caps and the bottom is cushioned with 1 centimetre (0.4 in.) of cotton. The experiments were made with Böhler steel needles, of the Kapfenberg Works, in Styria, which material Klemencic recommends for permanent magnets. The magnetic moment is, as might be expected, affected when the magnet is put in its gas-pipe casing; there may be an increase or a decrease. The effect is slight, however, and after a few days the moment remains constant. The magnets, it should be said, are placed in glass tubes, fitted with corks, and then put in the gas pipe. In that state the case with its magnet may be dropped without altering the magnetic moment.

In order to ascertain whether such a gas pipe, of 2 or 3 millimetres wall thickness, acted as a shield against external magnetic fields, the author placed a small coil inside the gas pipe (without a magnet) and surrounded the whole by a large solenoid coil. In weak fields the induction of the inner coil remained unchanged, but when the external field exceeded 140 C.G.S. units, the shielding afforded by the iron piping was not perfect, and the protection is hence not so efficient as one might expect. But several cases inside one another would answer.

Klemencic further investigated the after effects of steel hardening on its magnetic properties. After effects, like the depression of the zero of thermometers, may last for years, and might be expected in accordance with Ewing's views on magnetism. Klemencic magnetized the steel at various intervals after hardening it. When the magnetism follows immediately after the hardening, the magnetic moment decreases for months and years, rapidly for a few hours, then very slowly. The first determination could be made within a minute of the magnetism in a homogeneous field of 600 C.G.S. units; the diminution amounted to about twenty per cent. after sixty hours. As the period intervening between hardening and magnetizing is extended to several hours, the diminution of the magnetic moment proceeds much slower. If we reckon the time from the instant of hardening (instead of from the instant of magnetizing), the magnetic moments will be fairly the same for equal times, but different intervals between the two periods. The quality of the steel and the temperatures are of influence, the dimensions of the steel specimens apparently not. Gradual molecular re-arrangements are evidently taking place in the steel, which we can hasten, and thus "age" the steel, by keeping it in boiling water for some time.

Electrical Resistance of Steel

Journal of the Chemical Society, London

Equivalent quantities of carbon, chromium, and other elements dissolved in steel cause an equal increase of hardness, and determinations of the resistance of a number of samples of steel containing silicon, sulphur, phosphorus, and maganese indicate that the resistance is also equally affected by equivalent quantities of these elements. The dissolved carbon alone is of influence, the precipitated carbon having no effect, but experiments indicate that pure steel always contains about 0.27 per cent of dissolved carbon, a result in accord with many metallurgical analyses. The resistance of perfectly pure iron is hence 7.6 microhms per cubic centimetre; this value is less than any directly determined, but absolutely pure iron has never been investigated.

Soldering by Means of the Electric Arc

Revue Practique d'Electricite'

An interesting application of the electric arc for soldering is that for repairing evaporating kettles in caustic soda works. These kettles in time show corrosion of their partitions, due to electrolytic phenomena. The repairs have been made by means of a special rivet, but this simply served to aggravate the trouble. In applying the electric method the process is as follows: The opening is cleared out and filled up by a special rivet. It is then covered by a soft solder and a paste of borax. The positive pole of the generator is then connected to the kettle, and the negative pole, consisting of a copper rod held in special nippers, is applied, allowing 400 amperes at 125 volts to pass. Then a small piece of iron is placed upon the part and an arc formed. This fuses rapidly and fills up the opening, making a perfect joint. The electrodes employed are twenty-five centimetres in length and three in diameter. The current varies from 300 to 400 amperes, and a pressure of from forty-five to sixty-five volts.

Electrical Discharges Between Flames

Comptes Rendus

Semenow compares a straight flame with a pointed conductor, whose density of charge is, of course, greatest at the point. In the case of a flame, the charge produces a diminution of pressure within the flame. When the distance between two flames is too great to allow of the passage of a spark, brushes appear at both flames, but in the case of the positive flame the brush is attached to it by means of a luminous thread 1 cm. in length. When the flames are brought closer together the brushes are converted into a spark, and the current of air accompanying the positive brush contracts and forms the spark. There is no sudden transition of one form of discharge into another; *for* if a point wheel is substituted for the positive flame, its velocity of rotation diminishes steadily as the distance diminishes, and the brushes give way to the spark. The spark consists of a positive air current and positive metallic ions. He further proves that the negative air current proceeds in the opposite direction, and surrounds the spark like a sheath.

An Oxygen-Acetylene Burner

Bull. Soc. Franc. de Phys.

In a new oxygen-acetylene burner, in which the admixture of ether vapor is dispensed with and a much higher temperature is attained, one volume of acetylene is mixed with 1.8 volumes of oxygen, this quantity being intermediate between the quantities required for combustion to $C\ O$ and complete combustion, respectively. The pressure used is higher than that formerly employed, being that of 400 cm. of water, and the two gases are mixed inside the apparatus, back lighting being prevented by means of porous bricks. The nozzle velocity of the gases must be 100 m. to 150 m. per second. The flame has at its center a greenish dust of extremely high temperature, and only about 6 mm. long. Iron and steel can be soldered at the point with ease, and the flame neither oxidizes nor carbonizes the iron. Silica is fused in volatilized alumina; magnesia and Drummond lime are also fused. On diminishing the quantity of oxygen, the flame becomes luminous, and when it is projected onto chalk, calcium carbide is produced. With a higher proportion of oxygen the flame becomes oxidizing, as may be seen on fusing a piece of iron in it.

Hydro-Electrics in the Alps

By René de La Brosse.

Introduction.

First Article.

M. De La Brosse, Chief Engineer of Bridges and Roads of the department of Puy-de-Dome of France, in company with three members of the Chamber of Commerce of Clermont and a professor of physics at the University of Clermont, was appointed in the early part of 1901 to make a study of the principal hydro-electrical installations of the region of the Alps, by the Council-General of the department. The purpose was to gather information which would be useful to the council for its determination as to the management of the hydraulic forces of the department of Puy-de-Dome.

This department of France contains many streams capable of producing power, the total amount of which a preliminary study had shown was far in excess of any possible requirements for the ordinary purposes of traction or lighting and would be sufficient to furnish a large surplus which might be used for supplying power to many industrial establishments.

The region of the Alps was chosen as the scene for the studies of the commission because there, in various localities, were already established or in process of development, many hydro-electric establishments of great size, presenting altogether problems of power distribution and sale such as would naturally come before the council of Puy-de-Dome in the development of the streams of that district.

The commission visited sixteen separate installations. Of these, four were on the River Rhone, one on the River Giffre, two on the Arve, one on the Brede, one on the Cernon, one on the Lancey, four on the Romanche and two on the Drac.

The establishments on the Rhone, which were visited, were those of the Societé Lyonnaise des Forces Motrices du Rhone, which draws its power from the river at Jonage, and three belonging to the city of Geneva. The others visited were Pont du Risse on the Giffre; Servoz and Chedde on the Arve; Pontcharre on the Brede; Cernon, Lancey, Livet, Rouperoux, Les Clavaux and Sichilienne on the Romanche, and Avignonet and Champ on the Drac.

Each of these installations presented features of great interest. They differed from one another by the great diversity of their purposes as well as by the manner in which it receives its power or uses it.

In the case of the establishment at Jonage the current is used for lighting in the city of Lyon and for distribution throughout the city for the driving of machinery of many sorts.

In the city of Geneva one plant is devoted entirely to the distribution of water under pressure to be used for power purposes in the city and canton, for operating electro-chemical works and for street railways. Another is devoted entirely to lighting and traction purposes. In others, the current is used for the operation of railways, lighting, for distribution over a wide territory for driving machinery, for paper making, the operation of mines, the making of carbide of calcium, tiles and for many other purposes. Each installation is also remarkable for the manner of its planning and building. No two of them are alike and each one has been designed upon its own peculiar lines.

In one the stream employed is enormous in quantity and the motors are, in consequence, of great size. In another it is the height of the fall which gives the power and there the moters employed a e of a comparatively small size but operate with great speed. At one place the power is drawn from subterranean sources. At another a great canal is used. At another the stream is carried under pressure in a conduit down the side of a hill. Again, it is conveyed through vertical wells, while in still another case the conduit is carried down the bed of a river.

Certain power houses make a specialty of supplying current for but a single purpose while the greater number undertake special forms of distribution. At Lancey, for example, on a very modest stream, all the series for the employment of energy are undertaken, from the public lighting of an important valley to supplying power to operate a railroad, the electrical bleaching of wood paste and the operating of the many mechanical factors of a large paper factory.

The general tendency is to multiply the employment of the electrical force, and the prosperity of the installations seems to vary as the rate of the multiplicity of these employments increases.

Power houses distributing power for a single industry hold out with difficulty against the competition of rivals, while others which have seen the advantage of multiplying their customers, show every sign of prosperity.

The following is from M. De La Brosse's official report:

"It is, in fact, one of the most remarkable characteristics of the application of electricity that one can easily group together near a special source of energy, a great variety of industries, or can again transmit to a great distance with but a slight loss a great amount of energy.

"As an example, one can see established beside the dam of Chevres, a manufactory of perfumes, and a series of chemical factories where the electrical current is used for the production of aluminum, carburets, chlorates and of alkaline metals. Another example is that of the establishment on the Drac, between Avignonet and Bourgoin, which sends its current over wires for distribution 100 kilometers away. On the other hand, it is difficult not to be impressed with the boldness of these enterprises.

"The management of one of these great establishments does not hesitate to risk the investment of an enormous capital for the production of a force of 6,000, 8,000 or 10,000-horse power without even knowing at the time to what use the power will be put, well persuaded it would seem, that once the force were created employment would come of itself and be quickly remunerative. Experience seems to encourage these beliefs.

"The Societé Grenoble undertook the building of the dam on the Drac before finding a market for the energy which they were going to produce, but during the time occupied by the work of excavating they had been able to make contracts which assured them important markets and to make it certain that the entire power would be contracted for in advance of its production.

"Finally, the visitor is no less struck with the fact which at first seems paradoxical, that with only a given power producable the great producers of power do not hesitate to contract for the sale of a total amount of energy very much greater than that which they can produce, and even exceeding double the power at their disposal. Thus a power house which can produce a maximum of 10,000 horse power makes contracts for 20,000 or 25,000 horse power without being accused of imprudence. The reason is this: They contract for their power with a list of clients whose individual needs are not coincident at a set time. The maximum demand for light is at a time when other demands are diminished. The electro-chemical factories require power at a time when the traction companies consume less and so it follows that the 10,000 horse power of the power house can easily be made to serve an assemblage of needs of which the sum total, if demanded at a single time, would require 15,000, 20,000, or 25,000 horse power. This is one of the most effective features of electrical energy and illustrates the elasticity of this system. Thus ensues a great variety of solutions, and a variety not less great of applications. There is boldness of enterprises, and the final satisfaction of an assemblage of needs superior to the power produced. These are the four characteristics which mark so profoundly the hydro-electric installations of the Alps, and which have in the greatest degree impressed the visitors. We should say in advance that notwithstanding the many features which this study presents in connection with traction and electrical distributions in general, we had chiefly in view a study of the manner of locating hydraulic works, and only as a later consideration the transformation of the energy into electricity."

The Rhone Power House at Jonage

The first large power house visited by the commission was that of Cusset on the common of Villeurbanne, from whence is distributed the power of the Societé Lyonnaise in the city of Lyons and its vicinity. This enterprise is known generally under the name of "Jonage" because the power comes from that neighborhood.

The society is able to place at the disposal of the city of Lyons an aggregate of from 15,000 to 20,000 horse power. These are the principal features of the installation:

Length of Canal	Waste	3 kil. 100 meters
	Lead	15 kil. 775 meters
Width (at bottom)		100 meters

Height of fall varies from 8.50 to 12 meters.

Available Power	Low water 343 days a year for 19 hours a day	High water 22 days a year for 24 hours a day.
Gross	16,000 H. P. with a supplementary flow of 19.400 H. P. for 4 to 9 hours, according to the state of the river.	22,000 H. P.
Net, allowing 75 per cent efficiency for the turbines.	12,100 H. P. supplement 7.500 H. P. 4 to 9 hours a day.	16,500 H. P.

It will be remarked that the power disposed of exceeds the product of the water flow, multiplied by the height of the fall which will be

Low water.............. $\frac{100,000 \text{ litres} \times 12 \text{ m}}{100}$ = 12,000 H. P.

High water............ $\frac{150,000 \text{ litres} \times 8.50 \text{ m}}{100}$ = 12,750 H. P.

The company disposes in reality of a very much larger force, namely, 16,000 to 20,000 horse power net. This is because there exists near the middle of the leading canal a compensating reservoir of 160 hectares where superabundant waters are accumulated in preparation for the hours when the consumption of power is the greatest. The power house is built across the canal on piles which separate the rooms or chambers of the turbines. These chambers to the number of nineteen occupy the lowest story of the structure and on this is raised the power house proper, which consists of a large hall, twelve meters wide, and 145 meters long. The three middle chambers are reserved for the turbines with exciters of 250 horse power each and the sixteen others contain the turbines of the generating dynamos, each of 1,250 horse power.

The construction of these turbines presents many interesting details for which space could not be found in this short notice but which can be found in various publications.

The turbines are suspended by their vertical axes on a bath of oil under pressure which equalizes the weight. They have three tiers or crowns of blades and are in the form of a truncated cone. The turbines are governed by balanced cylindrical vannages. The speed regulation is accomplished by means of oil pressure motors. The speed is regulated to 125 revolutions per minute. The following sketch shows a section of the power house taken through the axis of a motor.

Exterior View of the Power House of the Cusset Works, Jonage.

On the vertical shaft of the turbine is shown a corresponding dynamo. It is an induction alternator giving a triphase current at 50 periods and 3,500 volts.

The current may be used by either lamps or motors without distinction after it has been reduced to 110 volts.

All of the power is brought to a general switchboard, and the power house requires but very few persons to operate it.

Drawing the water from the Rhone at Jonage was declared to be for the public benefit by a law of July 9, 1892. It is the only enterprise of a similar nature which exists now in France holding such concessions, but the number will soon increase. The works which were begun in 1894, were finished in 1898. They were, however, completed at the same time as were the works for the taking of the water.

The difficulties of excavation were considerable. Great perseverance was necessary, and the success accomplished has brought much honor to M. Raclet, the promoter of the project, and to the engineers who directed this vast enterprise.

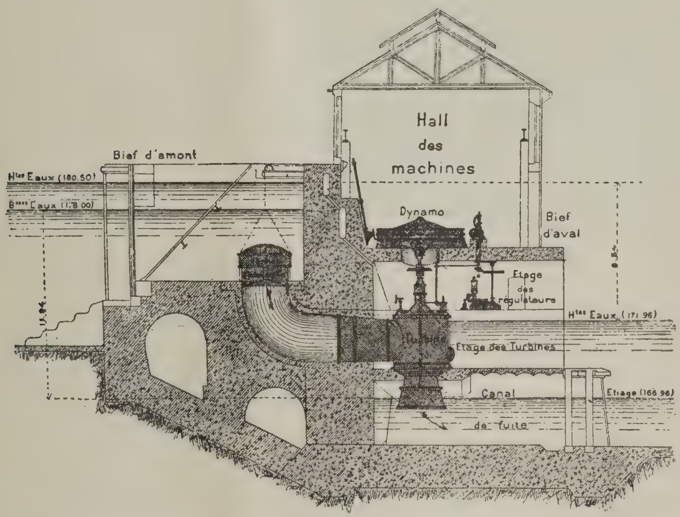
The work included the excavation of more than 5,000,000 cubic meters of earth; the building of more than 400,000 cubic meters of masonry and there were used over 2,300 tons of iron in the form of castings or steel, and it occupied the time of 2,000,000 working days, and included the use of sixty kilometers of railroad, twenty-six locomotives, more than 500 wagons, seven excavators and other machinery. The cost amounted to 40,000,000 francs, as follows:

	Francs.
Cost of establishment	5,465,000
Canal	22,015,000
Electric installation	9,102,000
Machinery	237,000
Various outlays	551,000
Profit and loss	590,000
Work in 1900	2,040,000

This figure has now been increased to 50,000,000 by a recent supplementary outlay and such is the confidence of the first suscribers in the final success of the enterprise that they have not hesitated to suscribe the total amount of the supplementary capital.

Notwithstanding the large amount involved in the undertaking, which in the beginning excited anxiety for a long time, it appears to-day to promise a satisfactory future. The Societé Lyonnaise already supplies more than 100,000 lamps and distributes current amounting to 7,000 horse power for motors.

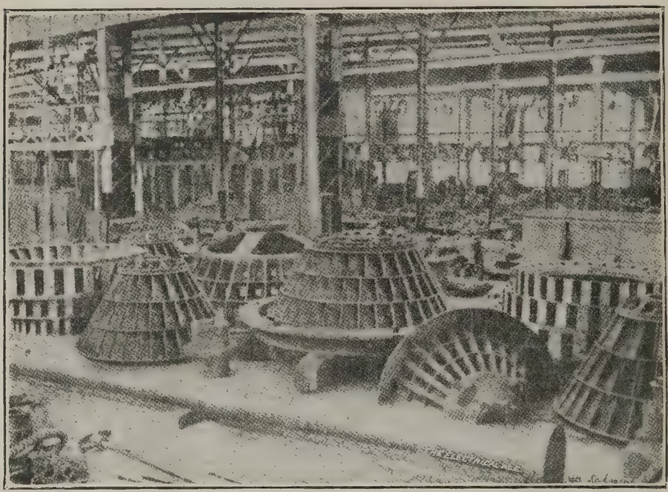
Each month the number of these subscribers increases at a rapid rate of progression, and notwithstanding that this is only the third year of exploitation, it seems certain that the annual receipts will soon reach the sum of 2,000,000 or 2,500,000 francs.



Cross Sectional View of Jonage Power House.

One of the features of electrical distribution is that it calls for no expenses beyond those involved in the investment, and these are relatively small, amounting in this case to only one fourth or one fifth of the maximum receipts. It is hoped that this year the receipts will amount to about 2,000,000 francs net, equaling four per cent of the capital employment and it is scarcely to be questioned that the future promises great results for this enterprise.

The electrical energy is supplied to subscribers for use in many forms, but before speaking of the conditions upon which the current is sold, it is proper here to state that originally the enterprise at Jonage was established only to distribute current for motors and not for light. The table of change in the law of July 9, 1892 provided for a tariff in which the charges decreased from a maximum on a scale of 720 francs per year per horse power for small motors of one-tenth horse power, to 250 francs per year per horse power for current supplying motors of fifty horse power or more. The average is $\frac{720+250}{2}=485$ or nearly 500 francs per year per horse power. These figures are high. Notwithstanding this the advantages of electrical motors are so considerable that their users steadily increase in number. It is true that the company has now seen the necessity of providing a more elastic tariff. It has established a system of charges which permits a subscriber to take the current when and in such quantities as he may like and pay only for that which he consumes. Thus, the present charge is 21 centimes a horse power for one-tenth of a horse power, and decreases to 7 centimes a horse power for fifty horse power or more. Besides, in order to develop the textile industries in the houses of the people, it has adopted a tariff at a fixed rate of 75 francs a year for each loom. The clauses of the law of 1902 interdicted the supply of energy for lighting without a previous authorization by decree. The Societé has obtained this authorization. Moreover, it has gained wisdom through various litigated questions with



Constructing the Jonage Turbines in the Workshops at Zuerich.

the gas companies, and today it supplies current for lighting at rates of 6½ centimes, 6 centimes and 5½ centimes a hectowatt, according to the class of consumers. The 100,000 lamps which the company feeds proves to what extent the Lyonnaise public appreciates these conditions. Such are the salient points of the power distribution at Jonage.

It is difficult to say too much in praise of such a great enterprise where the beginnings gave rise to such lively criticism.

The public for a long time doubted the success of the enterprise. The size of the outlay troubled the most confident and they asked themselves if the authors of so vast a project could be successful in their aims.

It was necessary to turn aside a whole river for a distance of more than eighteen kilometers; to render staunch a bottom of permeable gravel where the waters lost themselves by subterraneous filtrations; to find a market for power where coal could be easily brought by railroads and by the water ways of the Laone and Loire and of Saint Étienne, and to fight against the competition of gas, of which the price had fallen to twenty centimes a cubic meter.

Notwithstanding these conditions, apparently so difficult to meet, the work is finished, the power is created and a vast market opens to it.

The distributing system exceeds in extent 330 kilometers.

With Our Foreign Consuls

New Rubber Fields in South America.—According to a report received from Consul K. K. Kenneday, at Para, several syndicates are about to begin operations in the new rubber fields in Bolivia and Peru. The state of Amazonas having granted the exclusive privilege of receiving, cutting and packing all the rubber in that state to one wharf company, rubber growers and gatherers there are seeking to escape the new restrictions by moving into Peru, Ecuador and Bolivia.

The rubber fields of the lower Amazon, and especially on the islands, are slowly but surely failing, both in quantity and quality; but the decrease is more than made up by the development of new fields and the expansion of the old fields on the upper Amazon. While all the more important tributaries of the Amazon are supplying their full quota of rubber, and even making a promising increase, interest will focus in the now famous Acre territory and in southeastern Ecuador. In the regions reached by the Purus (of which the Acre is a tributary), Jurua, Beni, Madre de Dios, Javari, Ucayali, Japura, and other great affluents of the upper Amazon, which penetrate Peru, Bolivia, and Ecuador, there are illimitable rubber forests as yet unexplored, which will now be gradually developed. Bolivia continues to offer inducements for the colonization and development of her vast area of rich rubber and mining territory.

An Opportunity for American Manufacturers. — Consul-General Mason writes from Berlin that two articles for which there is an active and reliable demand in Germany are sulphate of copper (blue vitriol) and flake graphite. Any American exporter having either or both of these materials at command can find a ready agent for Germany by applying to Oskar Pascheles, 24 Gänsemarkt, Hamburg.

Automobile and Bicycle Exposition at Leipzig.—Consul B. H. Warner reports from Leipzig:

The Fifth Annual International Automobile and Bicycle Exposition will be held under the auspices of the Society of German Bicycle Manufacturers at the Crystal Palace, Leipzig, from the 18th to the 27th of October next. This year the exhibition will not be confined solely to automobiles and bicycles, but sewing machines, typewriters, cash registers, etc., will also be displayed. There is already a great demand for floor space at the exposition, detailed information in regard to which can be obtained by writing to Herrn A. v. Slawinski, General-Secretair, Internationaler Markt & Ausstellung von Motarfahrzeugen, etc., Krystall Palast, Leipzig, Germany.

A Threatened Danger to American Oil in South Australia.—It is reported, says F. W. Goding, consul at Newcastle, England, that an oil spring of good quality has been discovered in the southeastern district of South Australia. The spring is near the lakes which exist at the mouth of the Murray River, in the vicinity of the little town of Meningie, on the eastern shore of Lake Albert. The existence of petroleum in this desert region has been known for years. The oil exudes from the banks of Lake Coorong, and also from the more southern coast line. The quantity of the supply and the purity of the oil are questions for future investigation. Should this discovery develop into an established industry, it would seriously affect the importation of oil from the United States into this commonwealth, as most of the oil now used there comes from American ports.

The British Empire as a Coal Producer.—One-third of the coal mined in the world, says Consul F. W. Goding, of Newcastle, England, is produced by the British Empire.

According to reports made by the government geologists of Victoria and Queensland, there are no less than 62,000 square miles of coal-bearing country in the eastern states of Australia. The probable quantity of coal available (after deducting one-third for loss), in seams ranging from 2 to 27 feet in thickness, is not less than 240,448,053,000 tons. In Victoria there are beds of tertiary coal over 260 feet thick, and extensive seams of oil-bearing shale exist in New South Wales and Tasmania. The coal in New South Wales is estimated at 115,346,880,000 tons; in Queensland, at 83,310,000,000 tons; in Victoria, at 32,388,213,440 tons; in Tasmania, at 8,363,520,000 tons; in West Australia, at 1,045,440,000 tons. The royal commission on the coal resources of Great Britain computed that the quantity available in the British Isles was 146,480,000,000 tons, which amount, added to that of Australia, makes the enormous total of 386,928,053,000 tons.

The First Double-Track Railroad in Spain.—The new railroad now being built between Madrid and the important northern seaport of Bilbao marks a distinct advance and a complete departure from Spanish railway traditions, writes the United States Consul from Valencia, R. M. Barbleman. The line will not only be double-tracked, but the best equipment that modern industrial science can supply will be employed in its construction and operation. The distance, 261 miles, will be covered in about six hours. Firms in the United States desirous of making offers for furnishing the equipment for this line should lose no time in doing so.

The company which is building this line is the Compania Ferroviaria Vasco-Castellana, and seems to be a development of the Sierra Company, Limited, of London, England, which already holds the concession for 42 miles of railway, connecting its important mines in the provinces of Burgos and Logrono with the sea. This short railroad was primarily intended only for the transport of the company's minerals, but, on the urgent representations of the neighboring towns and of influential commercial bodies, it has been decided to convert it into a public railway and to extend it to Madrid.

The saving in distance between Madrid and Bilbao will be 85 miles, and Bilbao will thus be made the nearest maritime port to the capital. The line is to be finished and in working order within five years from its commencement.

Wireless Telegraphy for Correcting Chronometers

It has been suggested that wireless telegraph signals be sent to ships at sea from Greenwich and other observatories. Every day at 1 P. M. a time ball is dropped at Greenwich and Deal by electricity for the benefit of ships in the Thames and the Downs, and this system might be extended to vessels at sea. International regulations would preserve the signals from interruptions by other wireless signals. At stated times a short series of signals at intervals of a second would probably serve the purpose. These signals would also be used for inland clocks. A similar service might also be inaugurated at the oberservatory at Washington.

Personal

Mr. S. H. Draper has been promoted from the position of engineer on the Northern Pacific Railway to that of traveling engineer of a district on the Rocky Mountain division of the same road. Mr. Draper is an expert on the Westinghouse air brake, the system employed by the Northern Pacific.

Mr. Thomas O'Day, road foreman of engineers of the Erie Railroad, was recently transferred to the New York division of the same road. Mr. O'Day is successor to Mr. J. W. Johnson, who will take charge of the Delaware division.

Mr. W. B. Leach, with headquarters at Springfield, Mass., has been appointed master mechanic of the Boston and Albany Railroad. He succeeds Mr. C. H. Barnes, resigned.

Mr. Nichols, president and general manager of Nicholson File Company, has been elected executive head of the American Screw Company, Providence, R. I.

Mr. James Rowland Bibbins, who handed in his resignation as assistant electrical engineer of the Detroit United Railways, has accepted a position in the Westinghouse Companies' Publishing Department, Pittsburg and New York.

Col. Allan C. Bakewell, at the New York State Encampment of the Grand Army held at Saratoga Springs, was elected Department Commander. Col. Bakewell is second vice-president and general manager of the Sprague Electric Company.

Mr. H. P. Quick, who has severed his connection with the Boston Elevated Railway Company, will now be associated with Ford, Bacon & Davis, of 149 Broadway, New York, as steam engineer in charge of the design and construction of power plants for that company. He will be located at 1500 Grand Avenue, Kansas City, Mo.

J. W. Peterson, recently associated with the sales department of the Stanley Electric Manufacturing Company and the Northern Electrical Manufacturing Company, has received the appointment as vice-president and general manager of the Electrical Equipment Company, 939 Monadnock Block, Chicago, Ill.

Mr. J. C. Irwin, who has recently been appointed engineer of signals for the New York Central Railroad, is a civil engineering graduate of the University of Pennsylvania, and for some time has been associated with steam railway, electric railway and signal work.

Mr. William Martin, formerly with Roberts Bros., is now associated with the Standard Steam Specialty Company.

Mr. G. W. Brockman has handed in his resignation as superintendent and chief engineer of the Cold Spring Light, Heat & Power Company of New York and has accepted a similar position with the Newton Gas & Electric Company, Newton, N. J.

Mr. M. C. Guernsey has been appointed manager of the Home Telephone Company's office at Henryville, Ky.

Mr. A. N. Brady, it is reported from Japan, has purchased control of the gas works at Osaka and Tokyo.

Mr. R. C. Bliss, for some time representative of the Western Union Telegraph Company at Springfield, Ohio, has been appointed manager of the same company at Cincinnati, Ohio.

Mr. E. H. McKnight, at the head of the electric lighting company at Bowling Green, Ohio, has been elected president of the Ohio Electric Light Association. He will succeed Mr. W. T. White, resigned.

Mr. C. D. Shain, at one time prominent in Edison and General Electric forces in New York, is now devoting his entire time and ability to automobilism in which he has already succeeded in building a large and profitable connection.

Mr. J. K. Robinson, agent for the Westinghouse Electric and Manufacturing Company, has sailed from New York to Iquique, Chili, and will hereafter be addressed there.

Mr. E. Lec. Hegeman, a New York electrical engineer has started for Chili where he will associate with Mr. J. K. Robinson in the Westinghouse interests on the western coast of South America.

Mr. W. A. Cooper will succeed Mr. J. A.

Sheffield who for fifteen years has conducted the sleeping, dining, parlor cars and hotels over the entire system of the Canadian Pacific. Mr. J. A. Sheffield was compelled to resign owing to ill health. Mr. Cooper was Mr. Sheffield's assistant.

MR. ROPER ATKINSON, formerly with the Canadian Pacific has been appointed master mechanic on the Philadelphia & Reading Railway, with headquarters at Reading, Pa.

MR. W. F. D. CRANE, who has been associated with Sanderson and Porter, of 31 Nassau Street, as engineer, has lately joined the ranks of the American Stoker Company, 277 Broadway, where he will act as manager of the contract department. Mr. Crane will have his quarters in the New York office of the company.

MR. S. T. ALLEN, president of the Grey Eagle Consolidated Mining Company, has gone to Albany, New York, where he will open an eastern office.

MR. T. B. WHITTED, who has been connected with the General Electric Company of Denver, Colorado, for more than five years, has handed in his resignation which took effect September 1, and will assume the management of the mechanical and electrical departments of the J. J. Henry enterprises, which include gas, electric and power plants scattered throughout the West. He will also be chief consulting engineer of the Henry plants.

Franchise Bureau

The ELECTRICAL AGE intends to collect for reference purposes copies of every franchise issued by the various states to electric lighting, street railway and gas companies, and particularly those granted by special acts of legislation. All persons who can do so are requested to send copies of such franchises to the "Franchise Bureau, ELECTRICAL AGE." Copies not returnable.

Incorporations and Franchises

California

LOS ANGELES—The Western Electric Machinery Company has been incorporated by M. P. & L. C. Waite, J. W. Johnson and others with a capital of $50,000.

Ludlow & Southern Railway Company has been incorporated by E. H. Stagg, Charles Weir, Walter Rose and others with a capital of $25,000.

District of Columbia

WASHINGTON—Walter Motor & Power Company has been incorporated here with a capital of $1,000,000. Incorporators: H. Darneille, S. W. Smith, F. Smith, F. Walter and B. H. Brockway. To introduce the paddle wheel of Mr. W. L. Walter, Port Huron, Michigan, for power development.

Georgia

ATLANTA.—The Atlanta Water & Electric Company has been incorporated with a capital of $1,500,000. S. M. Smith is President.

Illinois

CHICAGO—The Chicago, Milwaukee Avenue & Inland Lakes Traction Co has been incorporated with a capital of $50,000. Directors: George Leininger, C. A. Lewis, A. J. Wittman and others.

Indiana.

AMBOY—The Amboy Home Telephone has been incorporated with a capital of $5,000.

COWAN—The Cowan Rural Telephone Company has been incorporated with a capital of $4,000. The directors are Abraham McConnell, Charles Springer, George W. Kabrick, Phillip Turner and others.

Iowa

LONE TREE—The Lone Tree Telephone Company has been incorporated with a capital of $5,000. The incorporators are: G. L. Day, J. M. Lee and others.

ADEL—The Linden & Adel Telephone Comhas been incorporated here with a capital of $6,000.

DES MOINES—District Telegraph Agency has been organized with a capital of $1,000. T. P. Cook is president and the directors are: T. P. Cook, F. H. Tubbs, W. J. Lloyd, J. F. Morgan and C. F. Patterson, all of Chicago.

Maryland

ROCKVILLE—The Kensington Railway Company has been incorporated with a capital of $25,000. Incorporators: B. H. Warner, W. M. Terrell, J. W. Townsend and others.

Minnesota

WHEATON—The Wheaton Electric Light Company has been incorporated with a capital of $25,000 by F. W. Murphy, M. J. Jacobson and others.

ST. PAUL—The Scott Grain and Telephone Company has been organized here with a capital of $15,000. Incorporators are: James Scott, Sara McNulty and Francis W. Sullivan.

The Duluth & North Shore Telephone and Telegraph Company has been incorporated with a capital of $25,000. Directors: Arthur Howell, William Elder, E. Frankfield, Eby Gridley and Leo. A. Ball.

Mississippi

CONEHATTA—The Conehatta Telephone Company has been incorporated with a capital of $500. Incorporators are: Floyd Loper, J. G. Brimson, A. B. Amis, J. B. Bailey and others.

Missouri

ST. LOUIS—The St. Louis County Electric Co. has been incorporated with a capital of $50,000. Incorporators: A. C. Einstein, C. J. Schnaus and O. J. Mudd; to manufacture, buy, sell and furnish light, heat and power.

Nebraska

CALLAWAY—The Callaway Telephone Company has been reorganized with Isaac Selby, president, J. W. Wieland, secretary and Ira C. McConnell, treasurer.

COZAD—The Farmers' and Merchants' Telephone Company has been incorporated here by John Anderson, William G. Anderson, Peter Kinnon and others. To operate a line from Cozad to Eustis with branch lines. The capital is $2,000.

EUSTIS—The Farmers' Mutual Telephone Company has been incorporated with a capital of $20,000 by John Anderson, William Walker, William G. Anderson and others.

WEST POINT—The Bankroft Independent Telephone Company has been incorporated by W. H. Watson, F. T. Rice, W. F. Sinclair and E. H. Morgan with a capital of $15,000.

New Jersey

JERSEY CITY—The Pan American Light & Power Company has been incorporated with a capital of $1,000,000, to manufacture storage batteries, etc. Incorporators: Edward P. Schmidt, Thos. F. Barrett, K. K. McLaren.

The Maxwell M. Mayer Electric Company has been organized with a capital of $1,000,000. Christian E. Hartshorn, Marshall L. Osgood and Paul E. Hirsh, all of Jersey City are the incorporators. The company will engage in the manufacture of electrical supplies.

TRENTON—The Monmouth Toll Line Company has been incorporated with a capital stock of $100,000. To construct and operate a line of telegraph or telephone in New Jersey. Incorporators are: George Evans, C. Frederick Long and Henry F. Atkinson.

CAMDEN—Atlantic & Chelsea Passing and Railway Company has been incorporated here with a capital of $250,000. Incorporators: Lewis P. Scott, Kane S. Green and others.

NEWARK—The International Towing and Power Company has been incorporated with a capital of $100,000. Incorporators: Edward T. Magoffin, Millard W. Baldwin and Harry H. Picking.

New York

BROOKLYN—The Electro-Sterlizing Company has been organized with a capital of $100,000. Directors: W. R. Chipman, A. S. Cestner, and Sylvester Easter.

ROME—The James A. Spargo Wire Company has been incorporated with a capital of $30,000. To make bare and tinned copper wire for the electric trade.

NEW YORK CITY—The Potosnia Electric Company has been incorporated with a capital of $700. Directors are: F. H. Southwick, C. L. Rossiter and W. P. Mason.

The C. E. Hewitt & Co. has been incorporated with a capital of $10,000. To deal in electrical supplies. Directors: C. E. Hewitt, E. R. Latham and H. Pressprich.

The E. B. Latham & Co. has been incorporated with a capital of $100,000. Directors: Ernest B. Latham, and John Lewis Owen.

The James H. Mason Company has been incorporated with a capital of $50,000. Directors: E. A. S. Barkelew, J. H. Mason and J. W. Noble, of New York.

MAMARONECK—The Subway & Westchester Construction Company has been incorporated with a capital of $400,000.

ALBANY—The Richmond Street Railway Company has been incorporated with a capital of $190,000. Directors: Waldo S. Reed, William T. Newkirk, Cornelius W. Van Vooris, Robert P. Barry, Jr. and others.

The Vermont & Whitehall Railway Company has been incorporated with a capital of $500,000. Directors: Daniel A. Slattery, J. Osgood Nichols, Kinsley C. Morehouse, Paul M. Mowrey, Ezra A. Tuttle and others.

MASSENA—The St. Lawrence River Power Company has been incorporated with a capital of $7.000,000. Directors: Henry P. Davidson, Mark T. Cox, William J. Wilson and others.

MINEOLA—The Mineola, Rosslyn & Port Washington Traction Company has been incorporated with a capital of $15,000. Directors: Isaac Odell, F. H. Parker, Gardner P. Harrington and others.

Ohio

COLUMBUS—The Toledo, Fayette & Western Railway Company has been incorporated with a capital of $10,000. Incorporators: Luthur Allen, F. C. McMillin, C. M. Stone, C. E. French and others.

Pennsylvania

PHILADELPHIA—The Electro Metallic Arch Company has been incorporated with a capital of $30,000. To do electroplating.

WESTFORD—The Westford Independent Telephone Company has been incorporated with a capital of $1,350.

SOUTH BETHLEHEM—The Souderton, Skippack & Fairview Electric Railway Company has been incorporated with a capital of $100,-000. E. S. Moser of Collegeville is president.

SHARON—The Sharon & West Middlesex Railroad Company has been organized here with a capital of $50,000.

ERIE—The Keystone Electric Company has filed articles of incorporation. Capital stock $400,000.

South Carolina

CHESTERFIELD—The Chesterfield Telephone Company has been organized here with a capital of $3,000. J. A. Welsh is president; D. T. Teal, vice-president; I. P. Mangum, secretary and treasurer.

St. Matthews—The St. Matthews Telephone Company has been organized with a capital of $1,500 by H. A. Raysor, Shep Pearlstine, and A. M. Able.

South Dakota

Pierre—The Whitney Electrical & Developement Company has been incorporated by Loring L. Smith, George R. Martin and L. L. Stephens, with a capital of $56,000,000.

Texas

Cooper—The Texas Long Distance Telephone Company has been incorporated by J. H. Gordon, James Patton, J. F. Henslee and R. M. Walker with a capital of $25,000. To maintain a telephone system in Delta and other North Texas countries.

Itaska—The Citizens' Telephone Company has been incorporated with a capital of $10,000, Incorporators: P. R. Stephens, L. E. Kerr, W. M. Buchanan and others.

Texarkana—The Texarkana Traction Company has been incorporated with a capital of $100,000. Incorporators: J. S. Trittle, M. C. Wade, R. W. Rodgers and others.

Austin—The Whitewright Telephone Company has been incorporated here by W. C. Fain, R. May and Little Selph, with a capital of $10,000.

Georgia

Atlanta—The Atlanta Water & Electric Company has been incorporated with a capital of $1,500,000. S. M. Smith is president.

Wisconsin

Dundee—The Dundee Water Power and Electric Light Company has been incorporated by L. C Arimond, A. E. Riehter and Mary Arimond, with a capital of $25,000.

Oshkosh—The Winnebago Telephone Company has been incorporated with a capital of $150,000. Incorporators are: A. B. Ferdinand, Walter Gold and Kate Kershaw.

Book Reviews

Finances of Gas and Electric Light and Power Enterprises

By Wm. D. Marks, C. E., Ph. B.; Wm. D. Marks, 216 The Bourse, Philadelphia. Pp. 4¼x6¾ in., 96; paper, $1 net.

In this pamphlet Mr. Marks sounds a strong note of warning against those schemes of expansion and consolidation which load up an industrial plant with artificial fixed charges which it can by no possibility meet, except, perhaps, by excessive charges to its customers. He also points out clearly the path by which consolidations and reorganizations may be made profitable. Perhaps the most interesting feature of Mr. Marks's pamphlet is that devoted to the methods of establishing prices for gas and electricity, and an analysis of the cost of producing incandescent light.

In the estimate as to incandescent lighting Mr. Marks finds that it actually costs the central station nine-tenths of a cent a day for each sixteen-candle power lamp, or its equivalent, simply to be ready to give service. With a fair profit added this sum must be increased to 1.3 cents a day. In addition to this the actual cost of supplying current to light each lamp is declared to be only .11 cents, or about one-seventh of a cent per hour. Applying these results and tabulating them, the author finds that a fair charge for a sixteen-candle power light should be 1.25 cents for one hour's service per day and but twice as much for ten hours' service a day. Among the interesting statements made by Mr. Marks is that 0.276 cent per lamp-hour is equivalent to .55 cent a thousand feet for sixteen-candle power gas. His conclusions on the subject of rates are as follows: "Prices must be fixed so as to produce a profit on the investment per annual unit produced."

Until electricity can be economically stored, no uniform price to all consumers will be judicially fair. Consumers using electric light or power for long hours are entitled to very low rates by meter; and those using them occasionally, or for short hours, must pay high prices.

Gas should be used for lighting under three hours a day. The work is one which should prove of value to everyone connected with either the operative or financial departments of lighting companies or of other electrical enterprises which might be consolidated with these.

Electrical and Magnetic Calculations.

By M. S. ATKINSON, M. S.; D. Van Nostrand Company, New York; Pp. 5x7½ in., 310; cloth, $1.50 net.

In his preface the author outlines the scope of his book, and then proceeds to contradict himself in the body of it. Professor Atkinson's idea was to have a textbook for the student of electrical engineering and one which would not be too complicated for the uninitiated to comprehend. The body matter is stated to be the result of the experience obtained by several years of teaching the rudiments of electricity, most of it having been prepared as an introduction to a course in electrical engineering. A book of this character has long been needed, but the author, instead of carrying out his idea as suggested, makes the fatal error of pre-supposing a knowledge of the higher mathematics on the part of his reader and a familiarity with the complex mathematical terms that are so bothersome to any but a trained mind. In omitting most of the complicated rules and formulæ common to such works, a mistake has been made, for while arbitrary rules and constants undoubtedly do prove unintelligible in many instances, it would have been better in this case to have made the explanations fuller and to have devoted less space to examples, which in most cases require at least some elucidation.

As a whole the book is good and indicates a scholarly mind. Its tenor is suited more to reference work than simple instruction, and as such it will be of interest mainly to the engineer. The formulæ and the tables are well arranged, the whole appearance of the book being good. There is, however, a multiplicity of terms of arbitrary origin, and on some pages typographical errors are notable. While the book cannot be wholly commended, it is undoubtedly of value for certain purposes, and in the hands of a competent instructor will be found useful in school and college work when there is some one by to carry out the suggestions made by the author.

Armature Windings of Direct Current Dynamos

By E. ARNOLD, Translated from the German by F. E. De Gress. M. E.; D. Van Nostrand Company, New York; Pp. 6x9, 124; illus, 146; cloth, $2.

This book is a beautiful piece of work prepared by Professor Arnold, of the Riga Polytechnic School, who endeavored to establish rules for the various windings of direct current machines, so as to enable the student independently to solve any problem of winding. Professor Arnold shows clearly the relationship between ring, drum and disc armature windings, and endeavors to give a general solution of the winding problem as applied to such machines, while in the latter portion of the book he shows several designs of connection which appear to be new. The plates with which this book is illustrated are in many instances complicated, but are everywhere well drawn and carefully executed, the designs being clear and intelligible even to the inexperienced electrician. So far as can be judged the translation appears to follow closely the original text and presents the matter in a concise and satisfactory manner. The book is of undoubted value as a reference work for consulting engineers or for those men in the shops where such problems are continually coming up. Every one who has had any experience in shop-work knows of the difficulties met in armature-winding and a satisfactory solution of the problem with definite rules of procedure in each case should meet with the ready approval of the engineering fraternity. The general mechanical get-up of the book is excellent.

Electro-Chemical Industry.

A new monthly periodical, devoted to the interests of that one of the new industrial results of science indicated by its name, made its initial appearance on September 1. E. F. Roeber is the editor, and the paper is published in Philadelphia. The first number contains forty-two pages of reading matter, all of which is of an interesting and valuable character to every person concerned with electro-chemical industries, as well as to that large and growing class of general readers who wish to keep themselves in touch with the developments of modern science and skill.

Catalogues

The Waterbury Brass Company has just issued a new catalogue which contains, in addition to descriptions and price lists of its goods, a set of tables of weights and measures which is of high value to every engineer or mechanic. These tables fill twenty-one pages of the catalogue. The catalogue is sent out free upon request.

The Crandall Packing Company's new catalogue of patent packings for steam, hot and cold water, air, gas and ammonia, is being distributed.

The Garvin Machine Company's new catalogue for September is devoted to screw machine tools and attachments.

Daylight and Wireless Telegraphy

In his recent lecture before the Royal Institution, in London, Mr. William Marconi said that he had noted a curious phenomenon in connection with the transmission of messages. A British report of the lecture says that a most interesting point to which Mr. Marconi referred is that at distances of over 700 miles the signals transmitted during the day often fail entirely, while those sent at night remain strong up to 1,551 miles, and are even decipherable up to a distance of 2,099 miles. This result may be due to the diselectrification at the very highly charged transmitting elevated conductor operated by the influence of daylight. He did not think, however, that the effect of daylight will be to confine the working of transatlantic wireless telegraphy to the hours of darkness, as sufficient sending energy can be used during daytime at the transmitting station to make up for the loss of range at the signals. It is probable, however, that had he known of that effect at the time of the Newfoundland experiments, and had tried receiving at night time, the results would have been much better than those actually obtained.

Describing the principle of his coherer, Mr. Marconi stated that it is by means of a magnetic detector that he has improved upon the coherer hitherto employed. He has found it to be more sensitive and reliable than the coherer, and it does not require so many precautions in the working. It may be possible, he said, with this system to receive messages at a speed of several hundred words a minute. At present, by the aid of the detector, thirty words a minute can be read.

Some Strange People

"Strange people we meet here sometimes," said the Old Platform Man on the Brooklyn Bridge the other night. There was a far-away look in the old man's eyes as he spoke, as if he were recalling many a curious incident that had occurred during his years of service. Scores of thousands out of the busy throng that cross the bridge daily know the Old Platform Man. For longer than most of them can remember his sonorous voice has directed them into the Bridge trains or warned them of danger. The adventures of the Old Platform Man have been plentiful. Many is the man, woman and child that he has pulled from between the cars and saved from death and mutilation. Thousands besides he has saved from danger, barring them away with his stalwart arms when they would have rushed into the moving cars.

His thanks have often been curses from men, beratings from women, and many a blow has been struck at him by passengers angered because he barred them from danger. No one ever heard him speak an angry or improper word in return. He has been with the Bridge ever since the towers were built. He came from the sea to work far aloft helping to spin the cables. He begins to look weary nowadays and to long for an easier job than standing on the platform twelve hours a day, seven days a week, and call: "The next train for Borough Park, West End and Bath Beach," or warn passengers against general dangers, until his lungs ache.

"They are strange people," he continued. "Tonight I picked up a pocketbook near the signal box where I have the tickets on which the train schedules are written. It was a big pocketbook and well filled out with money. That I saw at a glance, but I didn't have time to examine it. It was a busy time. I just glanced into it and saw that a good many of the banknotes in it had yellow backs.

"When anything of large value like that falls into my hands I generally hold it awhile before turning it in to the lost property department, because the person who lost it is pretty sure to come to look for it. This saves them the trouble of going over to the property clerk's office for their property.

"Pretty soon I saw an elegantly dressed man hunting around about where I found the pocketbook. It belongs to him, I said to myself, and watched him He looked worried. I strolled over, as if to look at the time cards.

" 'Beg pardon,' I said. 'Lost anything?'

" 'Yes,' he said, excitedly. 'I've lost my pocketbook.'

" 'What sort of a one was it?' I asked.

"He described the pocketbook until I was satisfied of his ownership.

" 'I guess this is it,' I said, handing it out to him. He grabbed it eagerly, glanced into it to see if its contents were intact, and, turning to me with a glare, he exclaimed:

" 'Why didn't you give it to me before?' and went off with a look as if he had discovered a thief.

Industrial Preparation of Liquid Air

M. D'Arsonval announces to the Academy that M. Claude has succeeded in contriving a machine which produces 20 kilograms of liquid air per hour with an expenditure of 25 horse power. This machine is founded on a very different principle from that of Linder.—*La Nature, Paris.*

A Monolithic Sea Wall of Cement

The impending completion of the sea wall running along the East river from East Seventeenth to East Twenty-fourth streets, in Manhattan, New York, will bring to a successful conclusion one of the most ambitious as well as important pieces of engineering work undertaken by the Dock Department of the city. To the engineer the work has presented an interesting feature in the use of concrete practically throughout the entire structure, demonstrating the excellence of concrete structures of this character. To the average New Yorker who has had occasion to visit the water front during the recent progress of the work it has been a source of deep interest, the spectacular features connected with it drawing crowds of onlookers during the entire period. The unwieldy floating derrick swinging lazily with the tide, with its huge, massive arms, creaking ropes and clanking chains, groaning underneath the weight of the heavy concrete blocks which it slowly swung into place, formed a picture well calculated to fill the spectator with awe and wonder. A diver, who superintended the placing of the blocks on the river bottom, gave the work a touch of romance usually lacking in operations of this kind.

Work on the sea wall was begun about two years ago, and the last gap, located at the foot of East Twentieth street, is being closed now, thus completing this interesting piece of construction. The site of the wall having been selected, a mixture of riprap and cobble was dumped down into the muddy depths, after which wooden piles were securely rammed down through the riprap into the river bed. The tops of the piles are fifteen feet below the mean low water line. The piles having been placed, huge blocks of concrete having steps formed in them—whose purpose will be set forth further on—and with grooves on their sides and three holes running through to permit of chaining and letting go, were lowered down from the deck of a floating derrick until they rested on the piles. Before this a mat composed of brush, poles, etc., had been placed on the piles. After the blocks were placed in position, granite blocks were lowered on to the steps mentioned before. In order to relieve the pressure of the water against the blocks, concrete to a depth of nine feet was dumped back of the wall, on top of which was then dumped riprap and cobble. As the sea wall has been built out a considerable distance from the old river bank, there remained quite a portion of the former river bottom which required filling in. This was done by dumping in a mixture of earth and ashes, and as this dumping was begun at the sea wall, the mud remaining was gradually forced back until having been compressed into a very small space it was allowed to dry out and then mixed with the filling-in material utilized to close up the remaining portion.

The concrete blocks used in this work were twenty-one feet high and ten feet deep at the bottom, tapering gradually until their thickness was reduced to four feet at the top. Each block weighed about seventy tons. They were made at the Twenty-fourth street yard of the Dock Department in huge wooden forms.

At the Battery, where a small breakwater has been constructed in the angle between the pier occupied by the Dock Department and that of the Fire Department, concrete structures of a slightly different character have been placed.

Here wooden forms with closed sides but open at the top and bottom, were lowered into the water. After being properly placed they were filled with hydraulic cement. After the cement had set the forms were knocked apart and removed. Surmounting the tops of the concrete blocks are granite courses, similar to those used in the uptown structure.

The use of concrete in this work is in line with the remarkable development of the Portland cement industry in the United States of late years. In 1890 there were sixteen works which produced but 335,000 barrels, while in 1900 each one of the sixteen works manufactured over 220,000 barrels. For the years extending from 1897 to 1900 the imports of cement into the United States exceeded 2,000,000 barrels annually, while in 1901 they were a little under 940,000 barrels. This disproportion is explained by the growing increase of domestic Portland cement, reaching from 13.2 per cent in 1891 to 96.2 in 1901. The total consumption of cement of all kinds in 1901 was 20,573,538 barrels, and the total domestic production was 20,068,737, valued at $15,786,789. About 7,000,000 barrels of this was produced in New Jersey and an adjoining district in Pennsylvania, and about 5,000,000 barrels in Michigan, where the industry has sprung up rapidly. The new Edison works at Stewartsville, N. J., which are now being run experimentally, have a capacity of 3,000 barrels a day, which can easily be increased to 10,000 barrels. Mr. Edison expects to make cement at 50 cents a barrel. He has predicted that the time would soon come when a man who wants a house will give the order to a cement worker, who will presently appear with his moulds and cast the structure of cement.

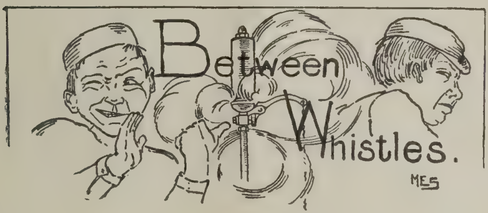
The cement industry has, in fact, acquired such importance that in each of the technical colleges and schools a course on cement has been made a part of the studies.

Portland cement is a sintered compound of clay and lime, having approximately the constitution of a half silicate with lime for its principal base, and alumina, ferric oxide and alkalis as minor essential constituents. When exposed to the air it hardens principally through the absorption of carbonic acid gas by the liberated lime, and in water through the formation of hydro-silicates out of those of its constituents that are reacted upon by the liberated lime that dissolves. The term hydraulic, which is given it, is due to its property of hardening under water.

The making of Portland cement dates back only about three-quarters of a century. In 1824 Jos. Apsdin, a bricklayer of Leeds, England, obtained a patent for the manufacture of cement, which he made by burning an artificial mixture of powdered limestone and clay. This material he called Portland cement from the similarity of its appearance, when hardened, to that of the sandstone from the Portland quarries in England. Previous to that Smeaton, the constructor of the Eddystone lighthouse, in looking for a mixture which would harden under water in place of the unsatisfactory lime mortar, to be used in building the foundation of the lighthouse, had found that the clayey limestones, when properly burned, produce a lime or cement which would harden out of contact with the air and under water. While Smeaton prepared his hydraulic cement from a blue limestone containing a considerable amount of clay, just as it came from the quarry, Aspdin, on the other hand, made an artificial mixture of limestone and clay. The superiority of Portland to natural or pure rock cements is not hard to understand when one reflects that, while it is easy to mix limestone and clay in any desired proportion, it would be very difficult to find them already mixed in just this proportion in nature.

From tables issued by the United States Geological Survey on the production of cement in this country, it is found that Portland cement is rapidly superseding both natural rock and slag cements in manufacture as well as use.

In building operations concrete has shown itself to be the only durable material maintaining its inherent good properties against the ravages of time and of the elements and having repeatedly demonstrated the protection afforded by it against fire hazards. Granite, otherwise durable, is the weakest of fireproof materials, flying to pieces in the presence of an ordinary conflagration, due to the different ratios of expansion and contraction of its component parts. Steel structural work, without its envelope of Portland cement, deteriorates rapidly in the simple presence of air and moisture, while under the attack of the sulphurous charged gases, due to the combustion of coal in commercial centers, this deterioration is quickened. This same is true of wood and limestone, which, according to the Government statistics, are shown to be the leading materials used in building construction in this country.



Workmen who know the kinks of their trades, the tricks played by machines and tools, and ready methods for meeting shop emergencies, are invited to contribute to this department.

Abuse of New Tools

To the Editor of The Electrical Age:

Sir,—Did it ever occur to you the little care and attention that are bestowed on the heavy tools in shops, especially the new ones?

The sole aim and ambition of everybody in the shop, from proprietor to cub, is to get the new machine belted and running on highest speed at about the same minute it is unloaded in front of the door. The time required to carefully wipe off the slush and get the transportation dust out of it and give all the working parts a thorough oiling is considered a dead loss and, of course, is not indulged in.

At last the belts are on, and our man has charge of the new tool. Our man, having hooked his overalls up another notch, is about to throw the shifter, when the foreman happens around and says by way of encouragement: "We expect you to bore one hundred more pulleys a day than you did on the old tool." And our man goes in to win a record and succeeds quite well until about four o'clock, when the spindle goes on strike for an increase of oil. Next day the damages are repaired and then it is found that the carriage needs overhauling. This is attended to, the work goes nobly on, when it is discovered that the lathe wont do accurate work. Result: discouragement; foreman uncomfortable; proprietor worried, and working up a grudge against the maker of the tool. All this because the foreman spoke the right words about two hours too soon. Such cases happen nine times out of ten.

Talk about pouring oil on troubled waters. There would have been no trouble had the oil been used in time.

J. A. L.

Brooklyn, Sept. 20, 1902.

The Electrical Age

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CHARLES A. LIEB - - - - PRESIDENT
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F. F. COLEMAN - - - - - - Editor

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THE ELECTRICAL AGE (Incorporated)
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TO ADVERTISERS

Changes for advertisements and new advertisements **must** be in this office by the **20th** of the month to be included in the issue of the month following. The advertising pages carry printed matter measuring five and a half by eight inches. Cuts intended for use on these pages should be made to accord with these measurements.

Correspondence and semi-technical articles, with suitable photographs for reproduction, or cuts, are invited. Accepted matter will be promptly paid for. We cannot be responsible for any unsolicited manuscripts, but when stamps are enclosed all unavailable matter will be returned. Postage must always be fully prepaid. Cuts to be available for illustrating articles must conform to the column or page measurements. The columns are 2½ inches wide. Cuts for single column use should not exceed that width. Cuts to go across the page should not be more than five inches wide, and full page cuts may not exceed 4½ x 8 inches.

Much interest has been awakened by the recent discovery of the metal radium and its isolation from the oxides of uranium in the ore pitchblende, and the results of a study of its remarkable qualities. The newly discovered metal belongs in a special group with uranium and thorium, and like them emits rays which resemble both the X rays and the cathodic rays, but its activity in these respects is many times greater than that of its sister metals. In addition, radium has the quality of giving out light, making other substances luminous, and of exerting other most curious effects. Many scientists, forgetting for the moment apparently that nature's laws are immutable, have shown a disposition to assume that here at last is a substance which violates all known laws and gives out energy unremittingly and endlessly without itself receiving energy from any source.

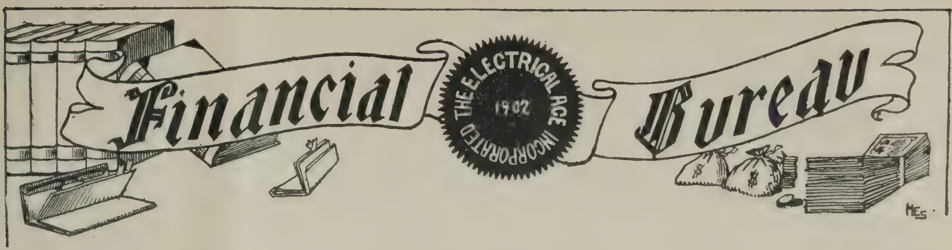
Such an assumption is absurd. The established facts, however, make it evident that in radium and its group of metals we have substances in which enormous disturbances are constantly created by some force equivalent to that which produces the X rays and cathodic rays in the vacuum tubes. It rests with the scientists to trace the source of these disturbances and the manner of their transmission rather than to assume the impossible. The powerful nature of the action of radium would seem to make this task possible of accomplishment.

It is an excellent thing for science that its votaries should be confronted every once in a while by some new phenomenon which challenges investigation. It stirs them up to new efforts where familiar phenomena, even though as remarkable in character, are passed by with indifference. Has anyone ever explained the source of power of the lode stone?

The natural magnet has been known since long before the first foundations of modern science were laid. It is certainly as remarkable in its way as the wonderful radium and what makes a fixed magnet and whence comes its power?

A Fifteen-Year Watch

A watch of the ordinary pocket size which has been invented by a Swiss watchmaker is said to run fifteen years with one winding. The watch is run by electricity, and in a severe test showed a variation of less than one second a week. It has been declared to be the equal of an expensive chronometer by the time expert of the observatory at Neuchatell.



Street railway companies, electric lighting companies and gas companies which desire their reports to appear in the Financial Bureau of THE ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Monthly reports are requested showing gross receipts and when possible operating expenses. Companies are also requested to furnish the highest and lowest prices for which their stock has sold in the market for the previous month.

Street Railway and Other Statements

Companies.	Date.	Gross Earnings. 1902.	1901.	Net Earnings. 1902.	1901
American Railways Co.	Aug.	125,159	91,152	......	......
January 1 to Aug. 31		753,287	584,162	......	......
Year June 30		370,384	274,623	302,732	226,106
Athens Electric Co	July	3,798	3,396	......	......
Jan. 1 to July 31		26,412	20,837	......	......
August		3,506	3,026	......	......
Jan. 1 to Aug. 31		29,918	23,863	......	......
Binghamton Ry Co	July	23,269	22,430	12,071	12,328
Oct. 1 to July 31		117,779	113,168	73,205	71,425
Brooklyn Rapid Transit Co.	July	1,236,400	1,203,761	528,264	445,266
Jan. 1 to July 31		7,489,179	7,167,002	2,344,587	2,339,926
Brooklyn Heights Ry	year to June 30	11,025,202	11,747,574	3,808,073	4,616,494
Bklyn Queens Co. & S.	yr. to June 30	825,877	......	396,053	......
Buffalo Gas Co.	Aug.	......	......	17,842	20,141
October 1 to Aug. 31		......	......	306,242	272,757
Burlington Vt. Traction	Aug	8,277	7,254	......	......
Jan. 1 to Aug. 31		45,668	39,665	......	......
Canton-Akron Ry.	Aug.	35,373	*19,344	......	......
Jan. 1 to Aug. 31		171,277	109,356	......	......
*For Canton-Massillon Ry. only.					
Charltn. Cons. Ry. Gas & El.	Aug.	45,217	45,474	14,026	17,168
Dec. 1 to Aug. 31		541,422	380,298	241,870	139,557
July		48,569	46,067	......	......
Chic. & Milwaukee Electric	Aug	25,529	24,042	18,309	16,562
January 1 to Aug. 31		128,059	112,961	75,232	63,391
Cin., Dayton & Tol. Tr.	Aug.	49,301	......	24,819	......
June 1 to Aug. 31		140,412	......	72,256	......
Cin., Newport & Cov. Ry.	July	77,887	76,620	35,034	30,599
Jan. 1 to July 31		500,137	461,258	209,307	179,385
City Electric, Rome, Ga.	Aug.	3,581	3,698	319	779
January 1 to Aug. 31		28,017	27,835	2,081	3,750

Companies.	Date.	Gross Earnings. 1902.	1901.	Net Earnings. 1902.	1901.
Cleveland Electric	Aug.	234,738	209,462	......	......
January 1 to Aug. 31		1,642,381	1,472,925	......	......
Cleveland, Painsville & E.	Aug.	23,760	20,770	11,964	11,154
January 1 to Aug. 31		125,966	105,362	59,036	51,769
Coney Is. & Bklyn.	April 1 to June 30	423,275	400,064	196,911	187,364
July 1, 1901 to June 30		1,503,125	1,462,395	599,135	631,074
Consolidated Gas of N. J.	July	......	......	16,933	14,492
Crosstown St. Buffalo	June 30 qu.	102,607	135,355	46,574	40,430
Dartmouth & West. St. Ry.	Aug.	21,066	17,556	......	......
Jan. 1 to Aug. 31		91,649	82,152	......	......
Detroit United Ry	Aug.	337,892	288,575	155,278	138,160
Jan. 1 to Aug. 31		2,255,077	1,963,511	982,571	887,937
2nd week September		67,282	60,344	......	......
Jan. 1 to date		2,397,441	2,090,119	......	......
Detroit & Port Huron, S. L.	July	44,699	43,759	19,013	24,289
August		53,187	46,501	27,458	24,392
July 1 to August 31		97,337	90,260	46,471	48,680
2d week September		8,119	7,264	......	......
January 1 to date		301,331	243,961	......	......
Elgin, Aurora & Southern	Aug.	43,507	37,295	21,378	20,201
Jan. 1 to Aug. 31		270,435	241,397	......	......
June 1 to Aug. 31		117,853	106,363	54,379	55,392
Interest, rentals, etc., Aug.		8,334	8,334	......	......
June 1 to Aug. 31		25 000	25,000	.....	......
Balance of net earnings, Aug.		......	......	13,044	11,867
June 1 to Aug. 31		......	......	29,378	30 391
Elmira W. L. & Ry	year to June 30	160,865	90,407	32,556	12,192
Galveston City	May	17,734	10,562	6,961	2,359
January 1 to May 31		56,714	41,021	10,280	10,317
Gas & E Co. Bergn Co. N. J.	July	23,537	22,191	10,105	10,082
June 1 to July 31		44,442	42,204	18,258	17,997
Gen., W., S. F. & Ca. Lk.	year to June 30	66,043	63,576	26,413	25,887
Georgia Ry & Electric	May	107,716	90,234	......	......
Jan. 1 to May 31		501,110	416,418	.....	......
Harrison Traction	Aug.	46,664	42,025	19,476	17,410
January 1 to Aug. 31		306,736	257,273	135,559	106,590
International Ry Co.	Aug.	371,785	*285,150	......	......
June 1 to Aug. 31		2,234,762	*1,787,764	......	......
*1900 figures.					
Interurban St. Ry	Mar 31 to Jun 30	3,755,235	......	1,939,998	......
Ithaca Street Ry.	year to June 30	79,633	74,417	def. 15,775	sur. 9,394
Jackson Gas L. Co.	Aug.	......	......	3,032	2,673
March 1 to Aug. 31		......	......	18,776	13,641
Jamestown St. Ry.	June 30 qu.	30,484	20,461	8,174	4,037
Laclede Gas Light. Co.	Aug.	......	......	81,120	70,436
Jan. 1 to Aug. 31		......	......	693,619	633,214

Companies. Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
Lake Shore Electric Ry........July	49,122	39,447	23,161	17,610
January 1 to July 31............	237,855	187,270	78,944	53,987
Lehigh Traction................July	7,170	13,397	......	......
January 1 to July 31...........	60,652	73,076	......	......
August	7,636	12,287	3,366	7,455
Jan. 1 to Aug. 31....	68,338	85,363	25,285	44,664
London Street Ry., Ont.........July	16,337	15,303	7,040	6,537
Jan. 1 to July 31...............	81,401	75,415	28,937	26,698
Los Angeles Ry................July	118,777	91,559	53,313	36,429
June to July 31....	804,129	609,197	359,533	239,076
Lowell Elec. Light Co..........June	14,748	13,340	4,639	4,510
July 1 to June 30....	191,289	178,960	67,764	56,483
Madison (Wis.) Traction........July	8,753	......	......	......
January 1 to July 31............	45,215	......	......	......
August.....	7,581	......	3,023	......
Jan. 1 to Aug. 31...............	52,796	......	15,889	......
Met. Str. Ry.........July to March 31	10,749,079	10,364,516	5,825,042	5,428,428
Met. West Side El. Chicago.....Aug.	155,153	125,947	......	......
January 1 to Aug. 31	1,243,555	1,094,338	....	......
Mexican Telephone............July	20,121	17,702	8,343	8,018
Five months....................	98,668	87,052	45,917	39,509
Milwaukee El. Ry. & Light....July	237,376	239,043	126,448	136,948
Jan. 1 to July 31....	1,512,005	1,362,807	788,773	674,248
Milwaukee Gas Light Co.......Aug.	......	......	46,186	35,359
Jan. 1 to Aug. 31...............	......	......	413,097	333,125
Montreal Street Ry.............Aug.	199,405	181,860	99,319	89,349
October 1 to Aug. 31	1,843,241	1,715,066	802,295	690,622
Muskegon Tr. & Lht. Co.......July	18,737	15,214	......	......
August.......	17,953	15,183	......	......
Nashville Railway............July	75,606	65,320	......	......
Jan. 1 to July 31...............	476,221	421,916	......	......
New London St. Ry. ....July	10,952	11,666	5,572	6,897
Niagara Gorge Ry... .....June 30 qu.	10,517	26,369	1,167	8,595
Northern Ohio Traction........Aug.	84,340	67,693	42,149	33,669
January 1 to Aug. 31............	484,407	403,558	216,266	171,593
Northwestern El., Chicago....Aug.	89,663	77,144	... ..	......
Jan. 1 to Aug. 31...............	752,048	655,722	......	......
Oakland Trans. Cons..... .....July	78,374	70,483	31,945	23,777
January 1 to July 31	527,860	......	203,298	......
Ocean Elec. Ry.......year to June 30	5,560	5,362	609	1,634
Olean Street Ry.... ....June	6,569	5,954	3,353	3,747
Jan. 1 to June 30...............	25,526	23,752	10,369	10,626
Ontario Lt. & Traction year to June 30	6,831	4,825	845	1,450
Oswego Traction ....June qu.	8,919	7,677	855	1,790
Annual to June 30...............	40,729	36,381	8,306	4,893

Companies. Date.	Gross Earnings. 1902.	1901.	Net Earnings. 1902.	1901.
Pacific Electric ....June	38,083	......	......	......
***Philadelphia Co** ....August	1,061,379	928,898	35,454	336,257
Jan. 1 to Aug. 31	9,023,183	7,953,307	3,956,905	3,682,784
* Includes Pittsburg Ry. Co.				
Railways Co. General year to June 30				
Income, interest, etc	24,618	50,626	......	......
Expenses	6,718	10,230	......	......
Net	......	......	17,900	40,396
Surplus	17,900	30,331	......	......
August	35.954	28,813	195,614	159,758
Sacramento El. Gas & Ry ...July	36,614	34,234	19,323	20,212
January 1 to July 31	256,088	233,099	......	......
Feb. 1 to July 31	222,483	200,993	122,432	106,431
St. Louis Transit ....Aug.	579,574	509,047	......	......
January 1 to Aug 31	4,169,336	3,801,408	......	......
Sioux City Traction ....July	24,378	21,553	......	......
June 1 to July 31	137,713	117,463	......	......
South Side El., Chicago ....Aug.	105,918	94,772	......	......
January 1 to Aug. 31	927,925	862,562	......	......
Springfield, Ill., Con. Ry. ....July	19,079	16,771	......	......
Jan. 1 to July 31	103,970	89,694	......	......
Toledo Bowling Green & S Tr..Aug.	24,340	16,849	22,307	7,824
Jan. 1 to Aug. 31	158,876	114,117	75,973	44,186
Toledo Railways @ Light....Aug.	138,642	124,491	68,753	71,134
Jan. 1 to Aug. 31	941,419	844,431	456,832	434,058
Toronto Railway....w. Sept. 13	38,608	38,866	......	......
Jan. 1 to date	1,253,961	1,135,123	......	......
Twin City Traction....Aug.	323,534	283,589	185,565	161,554
Jan. 1 to Aug. 31	2,327,426	2,031,771	1,266,717	1,086,056
2d week Sept.	69,101	68,416	......	......
Jan. 1 to date	2,509,195	2,200,021	......	......
Union, New Bedford....Aug.	38,390	73,106	......	......
Jan. 1 to Aug. 30	222,267	182,369	......	......
Union Ry N. Y., ...Year to June 30	1,021,759	916,009	322,003	348,458
Union Traction, Ind.....July	86,182	67,702	......	......
Union Traction, Albany....July	139,679	133,903	......	......
Jan. 1 to July 31	863,969	758,319	......	......
Year ending June 30	1,461,892	1,331,879	456,974	424,353
United Traction, Providence ..May	267,435	221,541	......	......
Jan 1 to May 31	1,109,735	989,296	......	......
July	267,435	221,541	......	......
Jan. 1 to July 31	1,109,785	989,296	......	......
Venango Pwr. & Trac. Co. ....July	25,595	14,511	......	......
July	......	......	8,232	......

Stated Reports of Companies

Western Union Telegraph Co.

*Statement for the quarter ending September 30, 1902.

	1902	1901	Changes	
Net revenue	$2,100,000	$1,949,316	Inc.	$150,684
Bond interest	252,550	239,040	Inc.	13,174
Balance	$1,847,450	$1,710,276	Inc.	$137,194
Dividends	1,217,110	1,217,005	Inc.	105
Surplus	$630,340	$493,271	Inc.	$137,069
Previous surplus	10,751,003	9,319,285	Inc.	1,431,718
Total surplus	$11,381,343	$9,812,556	Inc.	$1,568,787

*Figures for current quarter partly estimated, those of 1901 actual.

The actual returns for the quarter ended June 60, 1902, were: Net revenue, $1,892,476; bond interest, $254,770; balance, $1,637,706; dividends, $1,217,008; surplus, $420,698; previous surplus, $10,330,305; total surplus, $10,751,003

The company continues to show a gratifying increase, and there is no official evidence as yet that the loss of Pennsylvania Railroad contracts or competition by the Postal and the telephone companies has impaired its earning capacity. The company has paid 5 per cent dividends annually since 1882, and its earnings are the largest in its history. The Wall Street Journal figures the company's outstanding bonds at $19,660,000 and stock $97,370.000. The approximate results for the fiscal year ended June 20, 1902, compare with the actual results of the previous year as follows:

	1901-2	1900-1	Increase
Net revenue	$7,158,000	$6,685,248	$472,752
Interest	981,771	956,160	25,610
Balance	6,176,230	5,729,088	447,142
Dividends	4,868,007	4,868,007	......
Surplus	1,308,223	861,081	447,142

Net revenue is the balance after operating expenses, rentals and taxes have been deducted from gross earnings. The balance after interest in 1901-2 was about 6.3% on the stock, against 5.8% for the previous year.

International Traction Co.

ANNUAL REPORT.

Condensed balance sheet of June 30, 1902.

ASSETS.

Securities owned	$29,471,418 12	
Fifth-year four per cent collateral trust gold bonds in Treasury	2,267,000 00	
Accounts receivable	237,126 91	
Prepaid taxes	2,250 00	
Cash	6,128 49	
Total Assets		$31,983,923 52

LIABILITIES.

Capital stock, common	$10,000,000 00	
Capital stock, preferred	5,000,000 00	
Fifty-year four per cent collateral trust gold bonds	14,715,000 00	
Bills and accounts, payable	1,600,622 40	
Total liabilities	31,315,622 40	
By profit and loss surplus, being excess of assets over liabilities	668,301 12	
Total		$31,983,923 52

COMBINED INCOME ACCOUNT.

	1900	1901	1902
Surplus income of owned companies before charging dividends	$350,254 88	$528,389 22	$1,135,554 38
Income of International Traction Co. (interest on loans to owned companies)	70,832 28	132,839 24	208,917 09
Total income	$421,087 16	$661,228 46	$1,344,471 47
Deduct:			
Interest on bonds, I. T. Co	457,120 00	462,884 45	497,920 00
Interest, discount and exchange	5,209 61	58,749 44	78,526 89
Taxes	2,250 00	4,500 00	4,500 00
Sundry expenses	1,029 05	2,449 59	2,463 68
Total fixed charges, interest, etc	$465,608 66	$528,583 48	$583,410 57
Surplus for year	*$44,521 50	$132,644 98	$761,060 90

*Deficit.

This company was organized in January, 1899, for the purpose of consolidating and bringing under one management, with the natural resulting economies, a system of street railways connecting and serving a local population of over 500,000, and covering a territory embracing Niagara Falls and the Niagara River, where the natural scenery attracts annually more than 500,000 people. Sixteen separate companies were merged.

International Railway Co.

ANNUAL REPORT

The following is the combined operating statement of the constituent companies of International Railway Company. It does not take into account dividends declared, or other credits or debits to profit and loss account:

Fiscal year ending June 30.	1900	1901	1902
Gross receipts	$2,575,921	$3,129,094	$4,426,675 97
Operating expenses	1,374,673	1,574,887	2,256,481 44
Earnings from operation	1,201,248	1,554,207	2,170,194 53
Miscellaneous earnings	74,084	95,566	139,826 53
Total earnings	1,275,332	1,649,773	2,310,021 06
Fixed charges, including interest on floating debt to I. T. Co	925,077	1,121,384	1,174,466 68
Surplus	350,255	528,389	1,135,554 38
Per cent operating expenses to gross receipts	53%	50%	51%

(Trackage, equipment and operations of Crosstown Street Railway Co. of Buffalo included in the above.)

The earnings of the Pan-American Exposition period (May-November, 1901) were abnormal and are not therefore suitable for purposes of just comparison. The natural growth of the company's business may, however, be seen from the following comparison of gross earnings of the first seven months of 1900 and 1902:

January	209,175 51	250,149 69	19.5
February	190,591 39	225,159 66	18.1
March	206,239 45	256,340 69	24.3
April	198,093 78	246,848 54	24.6
May	203,389 22	259,470 41	27.5
June	213 823 48	266,065 46	24.4
July	241,556 95	322,117 19	33.3
Total	1,462,869 78	1,826,151 64	24.8

This corporation was organized in February last with $17,000,000 capital, all of which is owned by the International Traction Co. International Railway Co. has no funded debt, but it has assumed the payment of the outstanding bonds of its constituent companies amounting in the aggregate to $10,928,000. It is intimated that a substantial amount of the bonds will be retired at any early date.

Manhattan Elevated Railway, New York

GENERAL BALANCE SHEET JUNE 30, 1902.

Assets—	1902	1901
Road and equipment	$76,826,427	$68,432,898
Cost of leases	14,014,000	14,014,000
Other perm. investments, real estate	3,239,864	3,268,348
Supplies on hand, etc	569,919	347,908
Due on account of traffic	15,588	9,753
Other accounts	44,208	225,015
Cash on hand	221,847	150,697
Loans on collateral	3,763,522	9,604,416
Jay Gould suretyship	......	300,000
Redemption of bonds	4,592	9,000
Sundries	26,613	240,557
Total assets	$98,726,580	$96,602,594
Liabilities—		
Capital stock	$48,000,000	$47,999,700
Funded debt	39,545,000	39,554,000
Manhattan Railway 4% bonds, special	......	300,000
Loans and bills payable	......	......
Interest due and accrued	292,769	362,709
Dividends unpaid	7,358	27,358
Wages, supplies, etc	1,077,778	457,452
Taxes in litigation	3,377,301	2,660,911
Open accounts	68,260	53,118
Convertible bond certificates	42,035	42,035
Sundries	56,349	36,038
Profit and loss (sur.)	6,259,730	5,106,273
Total liabilities	$98,726,580	$96,602,594

The results for four years are as follows:

	1901-02	1900-01	1899-00	1898-99
Gross earnings	$19,665,911	$9,416,888	$9,138,573	$8,719,495
Operating expenses	5,518,585	5,253,230	5,232,620	5,261,167
Net earnings	5,147,326	4,163,658	3,905,953	3,458,329
Other income	625,800	836,384	831,325	340,600
Total	5,773,126	5,000,042	4,737,278	3,798,929
Fixed charges	2,699,671	2,677,706	2,707,765	2,678,417
Balance	3,073,455	2,322,335	2,029,513	1,120,511
Dividends	(4%)1,920,000	(4)1,920,000	(4)1,920,000	(4)1,380,000
Result	sur. 1,153,455	sur. 402,335	sur. 109,513	def. 259,488

Traffic figures show a very large increase. The number of passengers carried in 1902 was 215,259 345 as against 190,645,741 in 1901 and 184,164,110 in 1900. Known causes for this gratifying exhibit are improved facilities, the partial change from steam to electricity for motive power, an attractive system of transfers, and an uncommonly cool summer. The company is fast overcoming the effects of surface traction competition which was so apparent in the years from 1895 to 1899. The latter year the traffic fell away to 175,000,000. But the company has not gotten back to the banner year of 1893 when upwards of 221 million passengers were carried, but if a gain of more than 25,000,000 passengers can be made in one year, as shown by the latest annual report, what may be expected when the air lines are fully equipped electrically and completely as to rolling stock? Earnings so far in the current quarter are very satisfactory, being not only largely an excess of those of the corresponding period last year, but showing a relatively larger increase than was shown by the quarter ending June 30. In fact there is a steady increase from day to day, and it looks as if the road would be carrying 1,000,000 passengers daily before long. The east side lines are in full electrical operation, and the change is not only an economical one but immensely popular. At first only three cars could be run to a train because the manufacturers delayed equipment, but now each train has its full complement. Preparations are almost finished for operating the Sixth Avenue branch The company is paying four per cent on the stock and earning about 6½, but those who know about the inside business say it will not be long before the earnings will show 8 per cent earned annually. New York's steady growth of population, notably in the Bronx, is of great benefit to Manhattan. It is expected that the new East River bridge traffic will be quite beneficial to the elevated. What will happen when the underground roads are in operation is not yet worrying the management.

American Railways Co.

Balance sheet as of June 30, 1902.

ASSETS.	1902.	1901.	LIABILITIES	1902.	1901.
Cost stock and bonds	$3,468,196	$3,414,849	Capital stock	$3,751,000	$3,751,000
Bills and accounts rec'd.	2,830,460	164,409	Coll. Tr. 5% bonds	2,500,000	......
Taxes, capital stock to December 31, 1901.	1,687	1,687	Bills payable	875,000	1,245,630
Office furniture, etc	2,792	2,502	Bills audited	11,036	......
Eng. dept. instruments	744	108	Acc. ins. fund	29,442	20,294
Discount loans, not due	3,492	1,555	Int. accrued bonds	6,625	1,350
Interest on bonds owned	15,000	......	Int. accr. flt debt	3,730	......
Dividends decl'd not due (stock owned)	......	31,681	Bal. due sub. Cos	26,564	71,820
Due Page Construction adv	......	1,603,702	Profit and loss	330,855	206,313
Bridgeton & Millville extensions	......	4,870			
Port Norris exten., etc.	234 586†	......			
Coll. Tr. 5% bonds in treas	910,000	......			
Cash	67,303	71,041			
Total	$7,534,264	$5,296,407	Total	$7,534,264	$5,296,407

†150,000 Bridgeton & Millville Traction Co. first mortgage 5% gold bonds will be issued in part settlement of this amount.

COMPARATIVE EARNINGS.

	1902.	1901.	Changes.	
Gross sub. Co	$1,009,496	$814,297	Inc	$165,189
Gross	370,384	274,623	Inc.	95,761
Total deduction	$67,652	$49,517	Inc.	$19,135
Net income	302,731	226,306	Inc.	76,525
Div. (A. R. C. stock)	178,178	112,530	Inc.	65,648
Profit and loss, surplus	124,552	113,576	Inc.	10,976
Balance June 30	330,865	206,313	Inc.	124,552

The net income was roundly eight per cent on the capital stock. Three dividends of 1¾% each were declared for the year. During the year, the issue of $2,500,000 American Railways five per cent collateral trust bonds was made.

President DeCoursey says that there is good reason to believe that, with the extensions now in process of completion and the new plants being erected contiguous to the company's properties, the increase in earnings for 1903 will be relatively larger.

Union Traction Co., Philadelphia

Operations for year ending June 30.

	1902	Changes	
Number of passengers carried	325,801,963	Inc.	23,576,677
Receipts from passengers	$13,969,232.77	Inc.	$699,767 50
Operating expenses 45 $\frac{88}{100}$ %	6,402,338.24	Inc.	566,152.80
	$7,566,894.53	Inc.	$133,614.70
Miscellaneous receipts, interest, etc	148,925.53	Dec.	13,289.78
	$7,715,820.06	Inc.	$120,324.92
Licenses and taxes, paid and accrued	903,841.59	Dec.	126,121.87
	$6,811,978.47	Inc.	$246,446.79
Fixed charges, paid and accrued	5,733,939.94	Inc.	29,674.70
	$1,078,038.53	Inc.	$216,772.09

Operating expenses, including licenses and taxes, 52$\frac{81}{100}$%.

Financial Statement by the President, John B. Parsons.

ASSETS.	
Cash	$ 230,463.93
Fire insurance fund	242,995.00
Advanced to leased lines	6,659,555.06
Material and supplies	259,938.73
Construction and equipment	4,728,885.69
Real estate	617,837.88
Accounts receivable	30,426.90
Sundry stocks, bonds and mort'gs	5,225,703.36
Franchise account	90,248.75
	$18,086,055.30

LIABILITIES.	
Capital stock	$10,500,000.00
Income fire insurance fund	31,418.37
Accounts payable	204,191.50
Accrued maintenance accounts	218,819.52
Fixed charges, & taxes accrued	1,560,000.00
Open accounts due leased lines in 999 years without interest	902.568.28
Deposits of underlying companies	239,012.31
Trustee account	120.00
Profit and loss	3,097,429.27
	$18,087,055.30

This is the seventh annual report of the company. The following roads which were under constrnction at the time of the last report have been completed and are now in operation, namely: From Frankford to Germantown, via Orthodox and Arrott streets, Fisher's lane, Wyoming avenue, Fifth street, Olney avenue, Thorpe's lane and Chew street; and on Fifty-second street, from Lancaster avenue to Baltimore avenue; and on Forty-ninth street, from Chester avenue to Baltimore avenue.

The following bonds of the underlying companies fell due, namely: December 1st, 1901, $150,000 Lombard and South Streets Passenger Railway first mortgage 5 per cent bonds. These have been extended for 50 years at 3½ per cent interest. March 1st, 1902, $75,000 Hestonville, Mantua & Fairmount Passenger Railroad Company first mortgage 6 per cent bonds. These bonds have been paid off and a like amount of 3½ per cent consolidated mortgage bonds of the said company issued in their stead.

The fire insurance fund has been increased this year by the addition of the following securities: 525 shares Philadelphia Traction Company stock, $70,000 in first mortgages on real estate, $1 437.50 in ground rents, making total securities in fund: 3,625 shares Philadelphia Traction Campany stock, $279,200 Electric and People's four per cent stock trusts, $199,000 in first mortgages on real estate, and $1,437.10 in ground rents.

By action of the directors, $1,500,000 bonds were issued and the property duly leased to the Philadelphia Rapid Transit Co., which has operated it since July 1, 1902.

Financial Notes

Chicago City Railway will issue $1,000,000 additional stock.

Pueblo, Col. Gas & Fuel Co. has authorized a bond issue of $600,000.

United Traction & Electric Co. of New Jersey, increased their last quarterly dividend one-quarter per cent.

Memphis, Tenn. Union Railway Co., has filed its $1,000,000 mortgage, the Mercantile Trust Company, New York, being trustee.

Syracuse Lighting Co., N. Y., earnings for August increased 16½ per cent gross and net 42.95 per cent. Earnings of the gas company are included.

International Traction Co. syndicate has been dissolved by the payment of 4 per cent collateral trust bonds and preferred stock under the agreement of March 1, 1899.

American Railways Co. has sold to Bloren & Co. of Philadelphia, the remaining $150,000 Bridgeton & Milville Traction Co., half million first gold 5s due January 1, 1930.

Selma, Ala., Lighting Co. has filed a mortgage to secure $250,000 5 per cent bonds, dated July 2, 1902, and due July 1, 1932. West End Trustee Co., Philadelphia, trustee.

United Railways Co., San Francisco, earnings for August increased $100,000 over the corresponding month of 1901. We state this on the authority of Brown Bros. & Co., New York.

A suit to foreclose the mortgage of 1894, securing $60,000 bonds, has been brought by the United States Trust Co., of Kansas City, against the Citizens' Telephone Co. of St. Joseph, Mo.

Iowa Hematite Electric Railway, incorporated last June and which recently increased its capital from $25,000 to $250,000, has filed a mortgage at Wauken, Iowa, to secure $1,500,000 twenty-year 5s.

Manufacturers' Light & Heat Co. of Pittsburg, has increased its holdings of Tri-State Gas Co. stock from $949,700 to $1,410,966 by the issue of its own treasury stock to the authorized limit, five millions.

A Michigan Traction combination is reported from Detroit, involving all lines in the lower peninsula, excepting the United Railways and the Monroe & Toledo Co., and calling for from 30 to 40 millions capital.

Automatic Electric Co. of Chicago, has increased its capital stock from $2,000,000 to

$3,000,000, and intends to close the Strowger factory, acquired this year, and will move into a much larger building now being finished.

Worcester Railways & Investment Co., by consent of the Massachusetts Railroad Commission, will issue $350,000 new stock at $116 per $100 share for the purchase of real estate, rolling stock, equipment and building expenses.

Leominster & Canton Street Railways, (Worcester, Mass.) $148,000 5 per cent first mortgage bonds of 1887 are to be redeemed at 105 and interest, at the office of the Worcester Consolidated Street Railway Co. this month.

Clarence H. Mackay, of the Postal Telegraph Co., says there is absolutely no truth in rumors to the effect that negotiations are going on between his company and the Western Union Telegraph Co. with a view to consolidation or sale.

Consolidated Gas Co. of Pasadena, Cal., $250,000 capital, has passed to local capitalists and they have elected the following officers: J. H. Holmes, president; H. H. Markham, vice-president; W. R. Staats, secretary; F. C. Bolt, treasurer.

Electro Gas Co. shares, which were sold at auction last month for 117, was incorporated under the laws of West Virginia in 1894. The company owns calcium carbide patents for the manufacture of acetylene. A. N. Brady is one of the directors.

Alton & East Alton Railway & Power Co. is building an extension to East Alton, Ill., and has certified to an increase of capital stock from $100,000 to $25,000. This is a subsidiary company of the Alton Railway Gas & Electric Co.

Consolidated Railway Co. of Springfield, Ill, have funded $125,000 of underlying 6 per cent bonds by the exchange of $123,000 consolidated 5s. The old bonds were retired at 105. This leaves $100,000 underlying first mortgage bonds due 1911.

Curtis & Sederquist of Boston, have issued a circular offering at 101 and interest $50,000 5 per cent 50-year gold bonds (principal and interest—January-July—payable at the Colonial Trust Co., New York) of the Corning, N. Y. Gas & Electric Co.

Otis Elevator Co. subscriptions to new stock closed with the first of the current month and were limited to $1,090,000 of the $2,000,000 increase. The English branch has arranged to take over the business of R. Waygood & Co., and more new stock will be issued.

H. E. Griffiths is authority for the statement that the Stockton, Cal., Electric Railway proposes to issue $1,000,000 bonds. H. E. Huntington got control of the property last June and is applying for franchises to extend the system to Lodi and other suburbs.

Houghton Co. (Mich.) Electric Light Co. has executed a first mortgage to secure not exceeding $1,000,000 of 25-year five per cent gold bonds due January 1, 1927, but subject to call as a whole at 107½ and interest. Boston Safe Deposit & Trust Co. trustee.

Pacific Light & Power Co. of Los Angeles, Cal., has filed a mortgage with the Union Trust Co. of San Francisco, to secure ten million 40-year five per cent bonds, the first coupon payable January 1, 1903. It is proposed to absorb the San Gabriel Electric Co.

Toledo Railways & Light Co.'s $12,000,000 capital stock was, last month, listed on the New York Stock Exchange. Claude Ashbrooke of Cleveland, says the company earned 3 per cent last year and predicts a steady appreciation of the stock to above 50.

Dallas (Tex) Electric Co's property was sold at receiver's sale Aug. 5 for $300,000 to representatives of the Dallas Electric Light & Power Co., who are reported to be interested with A. K. Bonta and the Boston capitalists back of the new Metropolitan Street Railway.

Thompson, Tenney & Crawford are offering $150,000 of the $350,000 first mortgage 5 per cent sinking fund bonds of the Concord, N. H., Electric Co., American Loan & Trust Co., Boston, trustee. These bonds are redeemable at 107½ and interest after July 1, 1906.

New England Gas & Coke Co. assessment of $10 per share on the stock deposited under the plan of reorganization has been made payable on or before October 10. A foreclosure decree was entered in the United States Court last month, the amount due on the mortgage being $16,862,000.

Toledo & Western Electric Railway securities were offered some months ago for subscription on a basis of 90 and interest for the bonds and a $500 stock bonus with each $1,000 bond. In Cleveland last month, the bonds sold at 97½ to par and the stock at $23 to $25 per share.

W. J. Hayes & Sons, of Cleveland, are receiving subscriptions for $750,000 of the Cleveland, Painsville & Ashtabula Electric Railway Company's $7,000,000 five per cent first mortgage gold bonds, at par and interest, $1,000 stock bonus with each $1,000 bond. For extensions $250,000 are reserved.

A Jersey Traction Consolidation is reported from Trenton, having to do with a merger of the North Jersey, the Jersey City Hoboken & Paterson and the Central New Jersey Cos., by Gen. Samuel Thomas, Edwin Gould and other capitalists interested in the Staten Island Electric Traction to Elizabethport.

Rutland, Vt. Street Railway Co. bonds ($81,600) outstanding were called for redemption at the Rutland County National Bank last month, the holders having the option to exchange the same for an equal amount of the first mortgage five per cent 50-year gold bonds dated July 1, 1902, interest payable January 1 and July 1.

Belleville, Ill., Gas, Light & Coke Co., capitalized at $150,000, and having $50,000

4 per cent bonds, has passed under control of a syndicate, which includes Rudolph Kleybolte & Co. of Cincinnati, Turner & Herder of Belleville, Stephens, Turner & Foreman of East St. Louis and H. M. Byllesby and W. N. Horner of Chicago.

Cheyenne Light, Fuel & Power Company first mortgage 5 per cent gold bonds to the amount of $150,000 can be had through Chicago bankers (Mac Donald, Mc Coy & Co.,) who give a statement showing gross receipts to have been $50,196 and net $25,246. President F. E. Warren says extensive improvements are contemplated.

New England Electric Vehicle Transportation Co. paid a second dividend in dissolution of $1 per share last month. This makes $3.50 a share paid in all, and with the exception of a small dividend, to be rendered as soon as various suits now pending are settled, will be the final one. The company has converted about all its propertv into cash.

Detroit Telephone Company's first mortgage bonds are in default and deposits are being made with the Central Trust Company. It is explained that the Michigan Telephone Company bought control of the Detroit Company under certain franchise stipulations, but, not living up to the agreement, was ordered by the court to do so and an appeal is pending.

Lake Shore Electric Railway, of Cleveland, will issue $4,000,000 bonds for refinancing purposes. Of this amount $1,500,000 will be purchased by a syndicate of Cleveland business men, and the remainder of the issue will be held in escrow for the redemption of outstanding securities. The control of the road will revert to the syndicate upon delivery of the bonds.

Subscriptions for the 5 per cent bonds of the Springfield & Central Illinois Electric Railway are being received by the Columbus Finance & Trust Co of Louisville, Ky., at par with a bonus of 75 per cent in stock. The capital stock amounts to $1,500,000 and the bonds to $2,250,000. It is proposed to acquire the Springfield Consolidated Railway Co., and build a line to Girard, twenty-six miles and another to Riverton, six miles.

Chicago Corporations will have to pay a larger tax than ever the coming year. Assessments were as follows:

Peoples' Gas......	$14,725,000	Inc.	$5,675,000
Chicago Edison .	5,000,000	Inc.	1,500,000
Chicago Telephone	5,620,600	Inc.	1,510,670
Chic. City Railway	10,255,000	Inc.	3,255,000
Chic. Con. Trac. Co.	4,562,000	Inc.	3,064,000
Chic. Union Trac.	14,500,000	Inc.	3,780,400
Commonwealth El.	1,500,000	Inc.	1,205,000

Interurban Street Railway Co., lessee of the Metropolitan Street Railway Co. New York, will shortly open a new electric line between 109th street and Columbus Avenue and Cortlandt St., via Columbus and Ninth Avenues and Washington and Greenwich Streets. During last month the Company opened a new line between 116th street and Amsterdam Avenue and the Christopher Street Ferry via Amsterdam, Broadway, Columbus and Ninth Avenues.

American Light & Traction Co. will this month take over the Jackson, Mich. Gas Co. on a basis per $50 share of $41.67 in cash or 40 in preferred and 12 common stock of the A. L. & T. Co. The Jackson Co. has outstanding $310,000 40-year 5 per cent gold bonds. The American Light & Traction Co. has already absorbed the Consolidated Gas Co. of New Jersey and increased its own capital stock to $8,570,800 preferred and $4,444,400 common.

Interborough Rapid Transit Co. stockholders having voted to increase the capital stock from 25 to 35 millions to provide funds for building the new tunnel from Manhattan to Brooklyn, holders of voting trust certificates of record September 15, were offered the right to subscribe for the new stock at par in the proportion of 40 for 100 held. The first installment called amounts to 40 per cent. Contracts for the tunnel were signed last month.

Welsbach Co.'s second annual report shows total profits of $538,537, a decrease of $87,300, a balance after charges of $106,877, and a surplus of $36,877, being $73,004 less than the surplus reported for ten months ending May 31, 1901. President Mason says it has been the custom to pay the dividend in June. As the fiscal year closes May 31, it is impossible to have an accurate profit and loss statement compiled to June, therefore the dividend question will be taken up later for consideration.

Edison Electric Go., Los Angeles, Cal., will probably increase its capital stock to $10,000,000, of which, it is reported, $4,000,000 will be 5 per cent cumulative preferred, the plan being to consolidate the Edison of Redlands Light & Power Co., Santa Anna Gas & Electric Co., Pasadena Electric Co. and other junior corporations. Apropos the Los Angeles Electric Co., of which W. B. Cline is president, and Wm. H. Burns, secretary and treasurer, asks the stockholders to vote October 29, in favor of issuing $500,000 gold bonds.

New Orleans Railway's development was further advanced recently by the Finance Committee of the City Council reporting favorable on the bid of Herbert A. Bullard, of Cincinnati, for the construction of a municipal electric lighting and power system for $1,369-611. The Railways Company will, if their offer is accepted, take over the St. Charles Street Railroad at $210 per share, paying $50 per share in cash and the balance within two years at 5 per cent. per annum; or, in lieu of the $160, will make the payment in forty year 5 per cent. bonds.

National Trust Co. of Louisville, Ky., has issued a circular offering to buy not less than 80 per cent of the $700,000 capital stock of the Kentucky Heating Co., and it is believed this foreshadows a plan to consolidate the city's gas, electric light and street railway interests. It is proposed to give two shares of 5 per cent cumulative non-voting preferred stock in a new company, to be known as the Louisville Heating Co. for each $100 share of the old corporation. The total issue of the preferred is to be $1,600,000, of which $200,000 is to be held in the treasury, to be sold for cash at not less than par, the proceeds to be used for extensions.

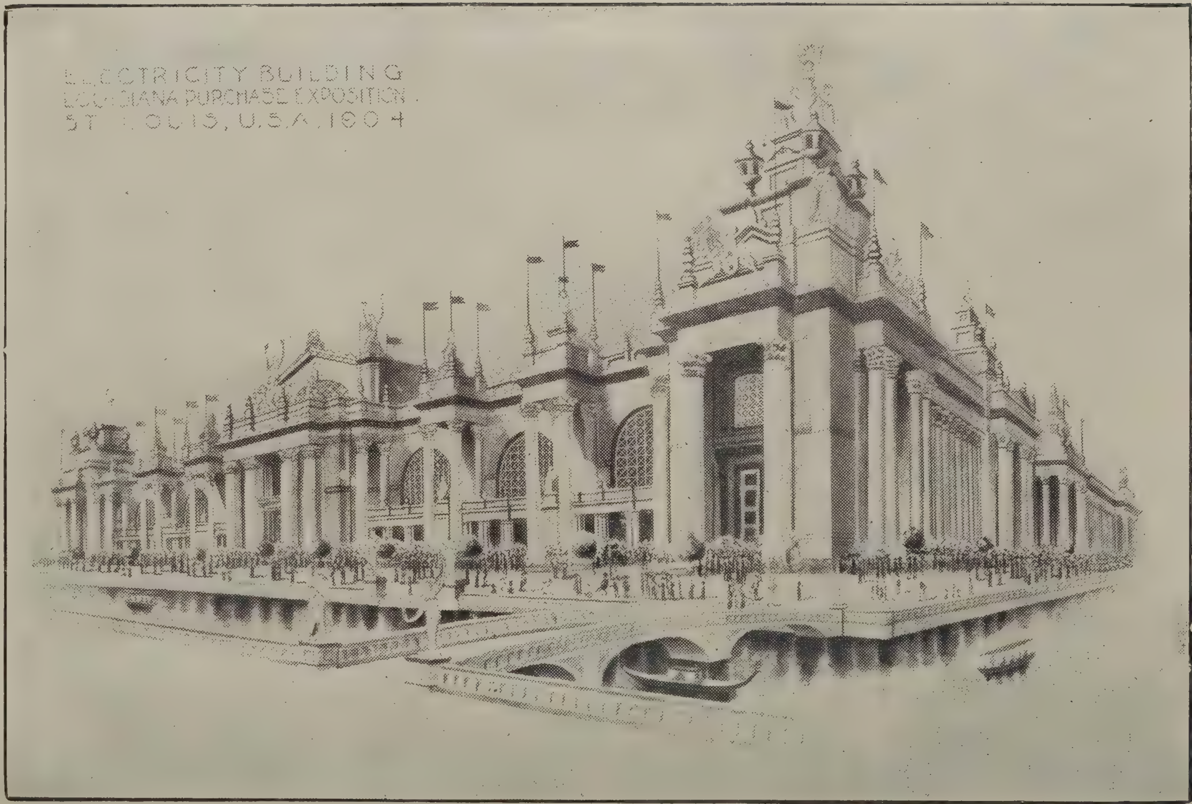
The Bank for Electrical Undertakings, of Zurich, owned by the Allgemeine Electricitaets Gesellschaft, of Berlin, in its yearly report, which has just been issued, thinks that American trust ideas must be adopted by the European electrical companies. This statement is the result of the crisis in the German electric industry. The present ruinous competition is working an infinite amount of harm. Much discussion regarding a remedy has been occasioned and the belief prevails that bringing the producing capacity of the works more in harmony with the demands of the market would bring about a more healthy state of affairs.

Cambridge Gas Light Co directors have asked stockholders to join a pool for mutual protection. The Massachusetts Gas Co. is a security holding company, formed by Kidder, Peabody & Co., and J. & W. Seligman & Co., in their plan to reorganize New England Gas & Coke Co., and take over the securities of several gas, electric light, heat and power companies, including those of the Cambridge, Brookline, Jamaica Plains, Dorchester and Bay State Gas. The Cambridge Co., which has paid 10 per cent on $700,000, has a surplus of $371,458. Directors, on discovering outside interests seeking control, appointed President Vinal, Treasurer Barnes and E. A. Hildreth a protectory committee

Cincinnati Traction Co.'s merger plans have made further progress. In August stockholders of the Mill Creek Valley Street Railway and of the Hamilton, Glendale & Cincinnati Traction Co. voted to consolidate the companies under the title of the Cincinnati & Hamilton Traction Co., capital $2,200,000, of which $1,100,000 is five per cent cumulative preferred The $1,750,000 capital of the Mill Creek Valley Co. was exchanged dollar for dollar, and the capital shares of the other company went in on a basis equal to 100 per cent in new preferred and 80 per cent in new common. September 30 the shareholders were to vote on a proposition to lease the property in the interest of the Cincinnati Traction to the Cincinnati Interurban Co., under a guarantee of 5 per cent on the preferred and from ½ to 4½ on the common.

Calumet Gas & Electric Co., of Chicago, is becoming important. It was incorporated early this year and now certifies to an increase of capital from $5,000 to $500,000. The name will probably be changed to the Calumet Lighting Co. Gas franchises were sold to the People's Gas Light & Coke Co. last year. Control of the Harvey Water & Light Co., has been acquired through the medium of the New United Water & Light Co., whose $200,000 of 5 per cent bonds are guaranteed by the Calumet. Granger, Farwell & Co. negotiated the deal, bondholders being offered 101 either in cash or in United Water & Light 5s at 97½, the stockholders to have 77 in cash or bonds at 90. The Calumet owns the plant on Chicago Heights and covers practically the entire electric light field south of Chicago to the Indiana State line. Samuel Insull, president of the Chicago Edison Co., and his associates, who control the Calumet, have also bought the Waukegan Electric Light Co., the Highland Park Electric Light Co., and the Evanston Electric Illuminating Co., the Highland Park plant serving the territory including Lake Forest on the north and Glencoe on the south. This, says a local paper, practically covers the field north of Chicago as far as and including Waukegan, excepting the Yaryan plant at Evanston.

The Copper Situation has been complicated by several expert statements as to the quantity on hand and by a general discussion of the trade conditions, but none the less it seems plain that there is too much copper in sight to expect prices to advance naturally and hold. It is evident to us that the consumption is enormous and will be for months to come; in fact it will increase when the anthracite coal strike is ended and the miners are able to meet the normal demand. Men of influence in the copper trade are endeavoring to restrict production through co-operation so as to facilitate the marketing of the surplus supplies, but if they succeed in getting the big producers to agree it is unlikely that they would favor an early advance in prices with a certainty of stimulating activity among the independent mine owners. Standard Oil methods injected into the Amalgamated Company management would doubtless be beneficial to the general situation in the long run and win back public confidence to a corporation which badly needs di versity of ownership. Two years ago under normal copper conditions this country was consuming at the rate of 25,000,000 pounds of copper per month, and at a normal yearly increase of 10%, the consumption to-day would be 30,000,000 pounds. No factories have been built and no new consuming demands have been created sufficient to bring this consumption up to 50,000,000 pounds, as some enthusiastic 'authorities' have stated. The latter figures would mean a copper famine, as that is just the rate of our production. We are adding to rather than diminishing our stocks of red metal, for assuming a consumption during August of 35,000,000, or a 40% gain in two years, there was left over, after balancing exports and imports, 3,747 tons, which increased the visible stock of copper just to that extent. When the so-called interrupted production again comes on the market, exports must show a marked increase, or the stocks on hand will increase more rapidly than they are now doing. Great activity in electric industries in Great Britain is expected to materialize before very long. The possibilities in this direction are very great since interurban trolley communication has so far hardly been introduced into the United Kingdom. There is still a great field in Continental Europe, and the equipment of electric lines calls for a large amount of copper. As such enterprises were held back by the Boer war there is all the more reason to expect their rapid prosecution as the European people emerge from the commercial effects of that long conflict. In some foreign circles views on the copper position are confident and higher prices for the metal are looked for.



Electricity Building for the Louisiana Purchase Exposition at St. Louis, Mo. For description see page 579.

The Marine Flyer Arrow finishing her world's-record mile off Irvington-on-the-Hudson, September 6, 1902.
Time: 1 minute 19.8 seconds.

From a photograph taken for the World.

The Yacht Arrow, the Swiftest of the Marine Flyers

By Francis F. Coleman

OVER the same waters where Robert Fulton ninety-five years ago succeeded in astonishing the world with the first successful steamboat, another American, Mr. Charles R. Flint, has recently made a new world's record by sending his little vessel Arrow over a measured mile in the astonishing time of one minute nineteen and eight-tenths seconds.

Think of it.

Think of the contrast between the Clermont of 1807 and the Arrow of 1902; between the speeds of the two and of the contrasted speeds of the Arrow and other objects which we are wont to regard as the synonyms of speed?

The two-minute trotting horse is yet to be developed. But even if he were here the Arrow would pass him in a race as if he were tied to a post, and at the end of a mile would leave him 1,769 feet behind, or a little more than one-third of the distance.

The swiftest running horse would be distanced almost as easily and would be more than a thousand feet in the rear at the end of the mile, while the greyhound and carrier pigeon would each have about all they could do to keep abreast of the wonderful marine flyer.

Of the vehicles for the carrying of human beings none can compete in speed with the Arrow, except the ice yacht and express trains. To drive a boat through the water at a rate of more than forty-five miles an hour means that she must cut her way through sixty-four feet of water in each second of time. The fastest of sprinters, making a hundred yards in ten seconds, does not run at one-half this speed.

The Clermont, amid the plaudits of an admiring crowd, started off on her first voyage to Albany in 1807, and "against wind and stream," as was admiringly said at the time, made 110 miles in twenty-four hours. This was a little more than four and one-half miles an hour. The Clermont was driven by a Watt engine of twenty horse power. The Arrow has engines which develop 4,000 horse power.

The Arrow made her record run on September 6 on the measured mile off Irvington, on the Hudson River.

This course begins at Ardsley and ends off the pier of Miss Helen Gould's place at Irvington. The course was laid off originally by private yacht owners, but later, at the request of Mr. Flint, was measured by officials of the United States Coast Survey attached to the steamer Bache. They took the measurements by triangulation, and after fixing the boundaries of the course, marked the ranges for these by erecting three range posts on the shore at either end of the course. The time of the yacht was taken by Wallace B. Flint, a brother of the owner, and an Associated Press reporter. These were the only persons aboard the Arrow during her run, except Captain D. C. Packard, Engineer Jefferson, S. Briggs and the men of the crew. The yacht left the Battery in New York at 12:35 p. m. and ran to the Ardsley pier. Here the owner and a party of friends left her, while the crew stripped her to racing conditions. Mr. Flint and his friends went to the finish line aboard another yacht.

Everything that would lighten the vessel that was not indispensable aboard was taken ashore. When the Arrow started for the record run at 2:50 o'clock she was displacing almost exactly seventy tons of water. This was eight tons less than her normal weight. Her fires were at their fiercest and were making steam so fast that, although her engineers were doing their best, they could not use it all. It spread in a cloud over her afterpart and in her wake. The tide, at the last of the flood, was practically at a standstill, but a strong southeast wind was in the yacht's favor.

The following table gives some of the most interesting details regarding the remarkable machine which now holds the world's record for marine sped:

Length over all	130 ft. 4 in.
Length water line	130 ft.
Beam	12 ft. 6 in.
Draft (normal)	3 ft. 10 in.
Depth amidship	9 ft. 4 in.
Weight of hull	21 tons
Weight of machinery	33 tons
Weight of engines (each)	11,500 lbs.
Weight of boilers and water	15.59 tons
Weight of boilers empty	12.86 tons
Horse power (indicated)	4,000

Weight per horse power of engines, boilers, all auxiliaries and water, 18 lbs.

Grate surface per I. H. P., 1.03 square feet.

Heating surface per I. H. P., 1.39 square feet.

Power for each ton of displacement, 57 H. P.

Those who watched the record-breaking run of the Arrow noted some remarkable features. Of these the most noteworthy, perhaps, because it relates so directly to the success of the Arrow, was the fact that the vessel, even at her highest speed, kept almost as even a keel as if she were at rest. She lifted a little by the bow as she shot through the water, but this was apparently upon the stern as a pivot, and the stern did not settle at all. Another remarkable thing about her was that she seemed to make no heavy waves, except the curls from her bows, and that she left a wake that was almost perfectly smooth. All of these features are admirably depicted in one of the accompanying illustrations, which shows the vessel at full speed, taken just before the finish.

These features are due to the model of the hull. This model, it is asserted by Captain Packard and Engineer Briggs, both of whom aided in her designing, gives to the Arrow lines which are probably the worst in effect that could be conceived up to a certain speed, but once that speed is reached and the initial water resistance is overcome, the lines are such as to give a return of speed somewhat in proportion to the power applied, instead of requiring the heart-breaking power-consumption of the ordinary model.

If one wishes to arrive roughly at the model of the Arrow let him take long, narrow pieces of cardboard. Pin them together at one end, and let this represent the bow of the boat. Now twist each piece gradually to the right and left respectively until at about two-thirds of their length from the bow they lie so as to make a flat bottom to the boat. Keeping the pieces still flat, now turn them upward at a gentle angle so that they will end only just below the water line. Just before the stern run ends each side of it is concaved until, as one looks at the design of the stern below the water line, it resembles a Cupid's bow. Under these hollows the two screws of the vessel are placed. The screws are each four feet in diameter. The purpose of the lines described is to bring to the screws a body of solid water for them to work in. The stern is cut off square.

Saloon and glimpse of Owner's Stateroom.
Photographed by Pierre P. Pullis.

When the Arrow is in action her water line at the surface is almost a perfect isosceles triangle, with this square stern as its base. The bilge lines of the moulded form are such that, although the little ship is very stiff as she sits at rest, she has only to lift a little as she gains speed to eliminate all the curves and to leave her stern the widest part of her in the water.

The Arrow is not only stiff in the water when at rest, but when she is speeding there is none of that unpleasantly suggestive wavering and wrinkling of the side plates which makes a passenger aboard the modern torpedo boat fear that the egg-shell structure will collapse at any moment. That this fear is well founded has been proven by the loss of the former champion for speed, the English torpedo boat Viper, and others. No light craft built with metal sides can be other than structurally weak. Small boat owners know this, but ship-builders do not yet seem to have realized it.

The Arrow is structurally strong. Her frames only are of metal. Her siding is of carefully fitted mahogany, put on in two layers. It is one and one-fourth inches thick altogether. Between the layers is a thickness of cotton duck and over this is spread a mixture of non-drying water-proof cement. Each layer of planking is independently fastened to every frame. The inner layer is made fast with Tobin bronze bolts and nuts, while the outer planking is held fast with Tobin bronze screws, which pass first through the frames and inner planking.

Oak forms the vessel's stern and keel and sternpost. Below the water line and wherever there might be any difficulty to get at it and renew it, no metal is used for frames or keels except steel. Higher up aluminum is freely used. The decking over the boilers is of aluminum also, but this has recently been covered over with wood.

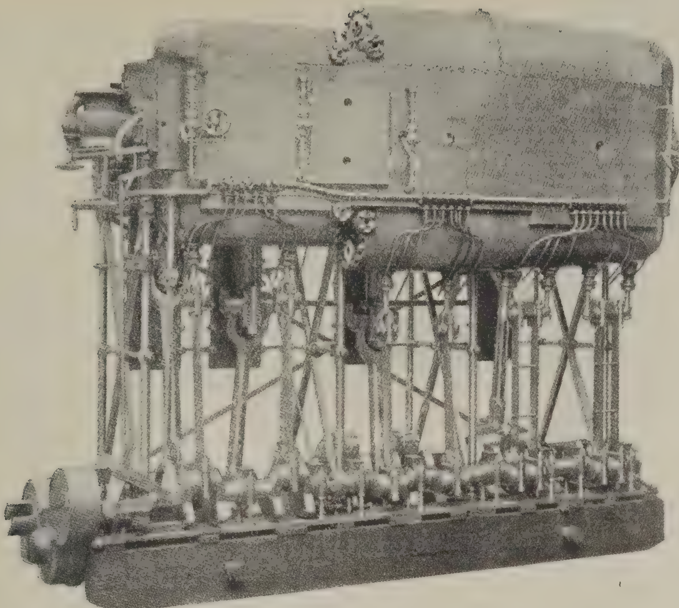
Eight-inch wide straps of steel riveted to planking and frames extend on each side of the vessel diagonally from amidship to stem and stern and take the hogging strains, while at the junction of sides and deck there is an angle of steel, plates of steel on each part of the structure and diagonal bracings.

Although the Arrow was built to be easily converted into a torpedo boat, and such boats seldom have room enough below to accommodate the men of their crews all at once, she is by no means cramped below decks. Her depth also gives head room to spare. As she is fitted up to-day she is "handsome and commodious."

Eight feet abaft the bow is a collision bulkhead, the compartment forward being used as a trimming tank and providing a large storage reservoir for fresh water. The crew's quarters are situated next abaft the collision bulkhead and extending the full width of the vessel for fifteen feet of its length. Ample accommodations are provided for twelve men. Next are located the officers' quarters, consisting of a double stateroom, which is also the full width of the boat and seven feet six inches long. Between the officers' quarters and the bulkhead at the forward end of the boiler space is the galley, which occupies the full width of the vessel for a length of ten feet six inches, and is provided with all the modern appliances and sufficient space for stores for an extended cruise. Next is the boiler room, which extends to the engine room bulkhead and occupies thirty feet six inches of the vessel's length. In this space are two boilers of the water tube type. Alongside of the boilers are the coal bunkers, which extend the entire length of the boiler space and have a capacity of about seventeen tons. Additional coal storage provides for a total capacity of about thirty tons, or a sufficient amount to enable the vessel to cruise upward of 2,000 miles Aft of the boiler space is the engine room.

Immediately aft of the engine room is the owner's stateroom, which occupies the full width of the ship and is seven feet six inches long. This room is handsomely fitted up and contains a large berth, chiffonier, clothes press, two wardrobes, bath and other toilet arrangements. The joiner-work is of bird's-eye maple.

Next aft is the saloon, which is thirteen feet six inches long and occupies



The Arrow's Engines.
Copyrighted by Palser & Potter, Newark, N. J.

the full width of the boat. It is luxuriously fitted up and contains a library, a buffet in each corner and gun racks. The saloon is arranged to be converted into four staterooms by hanging draperies. It is lighted by numerous clusters of incandescent lamps of variegated colors. The joiner-work is of English oak and the ceiling of Hungarian ash. The saloon is lighted by eight large port lights, besides being lighted and ventilated by a monitor top, through which leads the companionway. Aft of the saloon is a double stateroom finished in white ash. Aft of the stateroom is the after-collision bulkhead, and aft of this is a fresh water tank holding 600 gallons, and also a storeroom of 360 cubic feet capacity.

Two small boats are carried—a fifteen-foot cutter and a thirteen-foot dingy. The yacht is fitted with an extensive electric plant, capable of supplying sixty incandescent lights and a powerful search-light, and is also provided with two powerful blowers for ventilation and the supplying of forced draught for the boilers, surface condensers with circulating pump with special engines, independent boiler, feed air and bilge pumps and three powerful ejectors, having a combined capacity of over thirty tons of water per hour.

The boilers are of the well-known Mosher design with curved water tubes. They are two in number and offer 120 square feet of grate surface and 5,540 feet of heating surface. The working pressure is 400 pounds to the square inch, with 350 pounds at the engines.

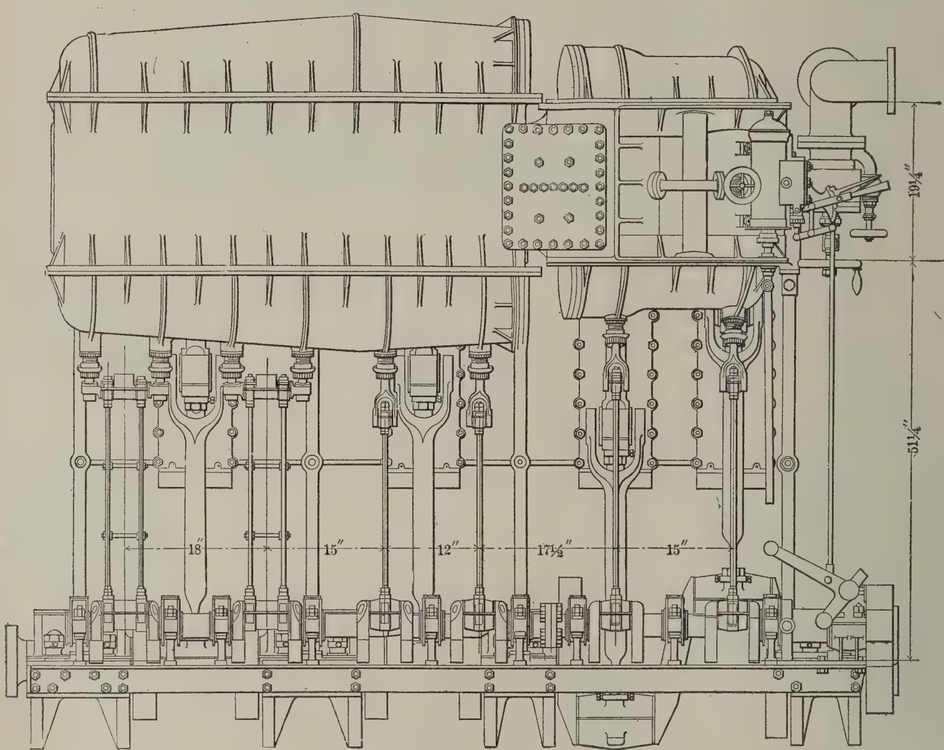
On account of unusual conditions, it was necessary to build a new form of ash pan. This consists of a closed flat tank of copper, curved to conform with the shape of the hull of the boat. The interior is provided with guide plates, and also with two valves. The first is a sea valve placed at the bottom, while the second is an outlet valve located near the top of the water line. These valves being opened, any heat effects from the fire raise the temperature of the water so as to create a circulation from the lower valve to the upper one in the side of the boat. The circulation is also assisted by means of a scoop when running at high speed. By this means the pan is automatically maintained in a cool condition.

The engine room and its contents are, naturally the features of highest interest in such a vessel. This room is twenty feet six inches in length. As originally designed the hull could never have accommodated the engines. It was broadened two inches and made four inches deeper in the moulding loft.

The main driving engines are the most conspicuous feature.

They were constructed by Lysander Wright, of Newark, N. J. They are of the quadruple expansion type, with cylinders of eleven, seventeen, twenty-four and thirty-two inches in diameter, the stroke being fifteen inches. Each engine is calculated to make from 540 to 600 revolutions per minute under a working pressure of from 350 to 400 pounds; the piston speed being about 1,800 feet. At 540 revolutions, with 350 pounds of steam at the engines, the combined indicated horse power of the two would be about 4,000. One condenser, having a cooling surface of 2,760 square feet, receives the exhaust from both engines.

A valuable feature embodied in the design of the engine, and one having a marked economical influence in the consumption of steam, is a system of reheater tubes placed between each of four cylinders. These are small brass tubes arranged in thick clusters about which the exhaust circulates in its passage from one cylinder to the other. The first reheater is supplied with live steam. The tubes of the second reheater, after receiving the exhaust of the first inter-



Arrow's Engines.—Detail Drawing.

mediate cylinder, are supplied with a portion of the exhaust from the high pressure cylinder. A portion of the exhaust from the first intermediate supplies the reheater tubes of the second intermediate, and so on. The entire system is so disposed that live steam can be used throughout, provided it is necessary.

The feed water before returning to the boilers is heated in a pair of patent four-stage or compound feed water heaters, which are placed near the boiler room bulkhead.

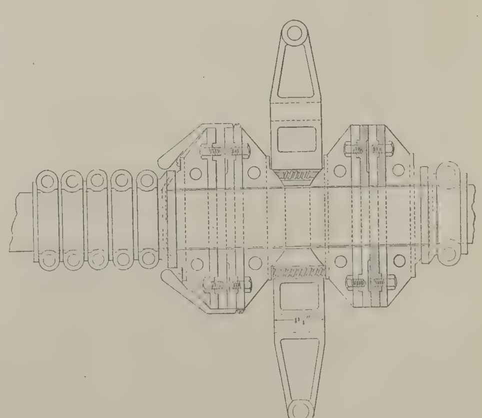
It is delivered to the boiler at a temperature calculated at 350 degrees. The condenser has 270 square feet of surface.

As auxiliary machinery there are in the engine room two engines for driving the blowers, an electric light engine and generator, one circulating air pump for supplying a vacuum when the air pumps attached to the main engine are not running, a hydraulic three-cylinder pump for operating the hydraulic thrust bearing, two auxiliary feed pumps for the boiler room, and two feed water heaters and condensers.

An important feature of the design of these engines is the arrangement of the columns and diagonal braces constituting the supporting framework of the steam and valve cylinders, and is designed to eliminate the danger of fracture, due to rapidly alternating compressed and tensile strains, to which the framing of extreme high speed and high powered engines of this class is commonly subject. The diagonal braces are secured together in pairs at their centers by means of a bolt and nuts, by the adjustment of which the supporting columns can be subjected to a compressive and the diagonal braces to a tensile strain which is intended to be in excess of any normal working strains which may come upon them. By this arrangement the supporting columns are at all times subjected to compressive strains only, varied in intensity as the working strains of the engine increase or relieve the initial stress due to the tension of the diagonal braces. These braces are in turn subjected to tensile strains only of varying intensity, but constant to the extent of taking up and absorbing practically all the initial elasticity of the structure. A remarkably rigid construction is thus attained, assuring a practically perfect alignment of the engine at all times and greatly reducing vibration, since the initial or starting movement, without which there can be no vibration, is effectually prevented.

The hydraulic thrust bearing referred to above is one of the new features designed especially for this vessel. It consists of two pairs of steel disks placed one upon each side of the center frame. These disks are made of steel, hardened and ground to absolute accuracy of their contracting surface. Each inner disk is provided with an annular groove, while the other two disks are plain, and are connected to the shaft by collars. The inner disks are held normally against the others by a spring, and are prevented from rotating with the shaft by the frame.

The hydraulic pumps are connected with the annular groove, each pair of



Details of Hydraulic Thrust Bearings.

disks being provided with oil collectors, which convey the oil back to the pump reservoir after it has passed through the bearing. The operation of the device will be easily comprehended. The oil forced into the annular chamber separating each pair of disks has no outward passage except by passing between the surfaces of the disks in contact. Therefore, when the pressure of the oil exceeds that of the pressure caused by the thrust of the screw, and which holds these surfaces in contact, they separate and permit the oil to flow between them in an exceedingly thin film. The pressure of the pump being adjusted to slightly exceed the thrust of the shaft, the device becomes automatic in its operation.

Each screw shaft has a bearing of this sort besides the ordinary thrust bearing.

The story of the later types of marine flyers begins really with the building of the Turbinia in England by Mr. Parsons, the inventor of the Parsons steam turbine.

The Turbinia made a run on April 10, 1897, which made marine architects gasp. She was only a little boat, 100 feet long, and yet she attained a speed of more than thirty-one knots. Later, at the Queen's Jubilee, the Turbinia made a record speed of thirty-four and five-tenths knots, or at the rate of forty miles an hour.

Conditions at 31.01 knots an hour:

Revolutions of engine per minute	2,100
Steam pressure at boiler	200 lbs.
Steam pressure at engines	130 lbs.
Vacuum	13½ lbs.
Calculated thrust	946 h. p.
Calculated indicated power	1,576 h. p.
Total weight of machinery	22 tons
Horse power per ton of machinery	72.1 h. p.
Length of hull	100 ft.
Width of hull	9 ft.
Weight of hull	15 tons
Weight of main engines	3 tons 13 cwt.
Weight of coal and water	7½ tons

When the Turbinia made her record speed she worked under a boiler pressure of 225 pounds, her engines made 2,200 revolutions a minute, she evaporated water at a rate of 30,000 pounds an hour, and it was calculated that she developed 2,100 horse power.

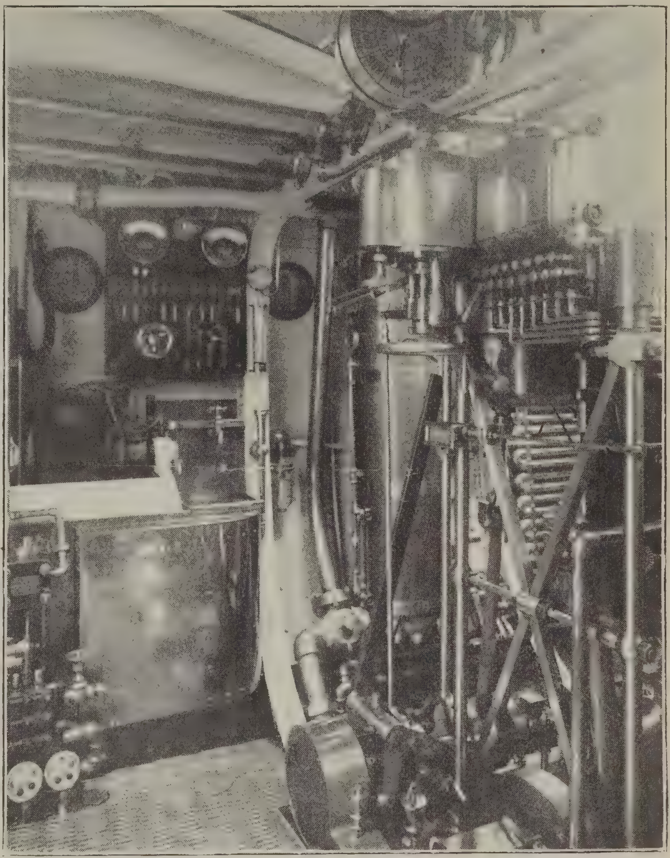
The turbine driven torpedo boat Viper, built by Mr. Parsons, held the fastest of modern records. She has made a mile at the rate of 36.82 knots, or 42.48 statute miles an hour. The Viper has since been lost at sea.

It will not be inappropriate for purposes of contrast to give here a brief description of the latest launched ocean leviathan, the Kaiser Wilhelm II. She is the property of the North German Lloyd line and was launched recently at the Vulcan yards in Stettin. She is to be finished in time to make her first trip from Bremen to New York in April of next year.

The Kaiser Wilhelm II. is built according to the German Lloyd requirements for the highest register of the four-deck ship class. Her double bottom is divided into twenty-six water-tight compartments, while the hull proper is divided by seventeen bulkheads into nineteen water-tight compartments, each compartment having separate outlets to the promenade decks. Her seventeen pumps are said to be capable of discharging 9,360 tons of water per hour. The construction of the stern is very similar to that of Kaiser Wilhelm der Grosse, excepting that the plating below the water line, inclosing the screw shafts, and above the rudder is cigar shaped, leaving a large arched space on each side between the center line and screw shafts, running forward and gradually tapering for a distance of about twenty-five feet into the common hull shape. This has been done in accordance with the requirements of the German Admiralty, at whose disposal the ship will be placed in the event of war.

There are four sets of four-cylinder expansion vertical engines, with surface condensers, each set working on three cranks, two sets for each propeller shaft. The engines are balanced after the Schlick's patent. They are set up in pairs, one behind the other, so as to bring a water-tight bulkhead between each pair, thereby increasing the safety of the vessel. The steam will be produced by twelve double-end and seven single-end boilers, which will work at 225 pounds per square-inch pressure.

The ship's accommodations are for 775 first-cabin passengers, 343 second-class passengers and 770 steerage passengers.

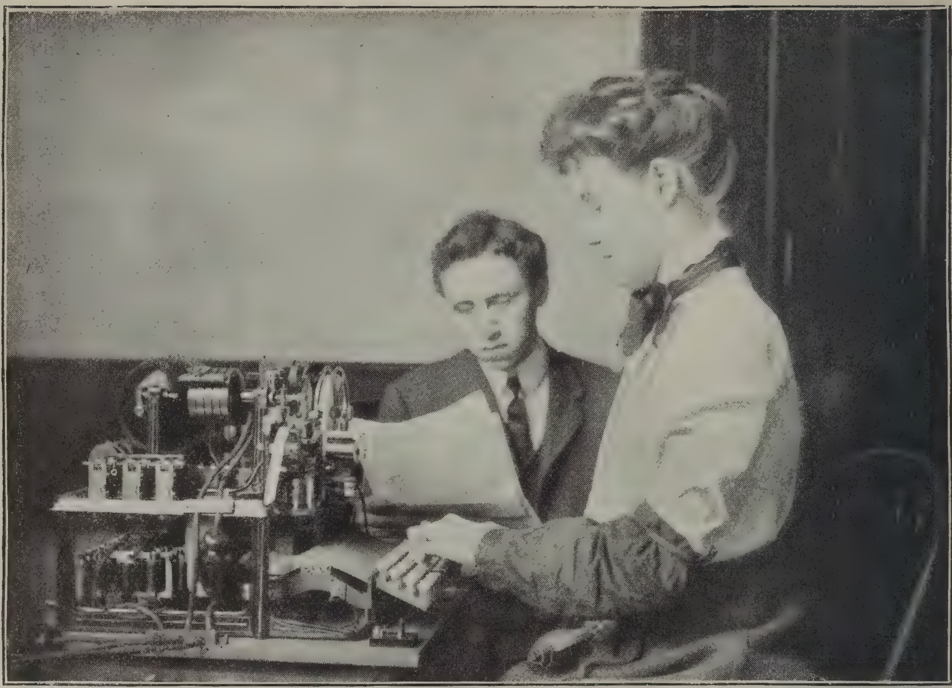


Scene in Engine Room, showing the Elaborate Switchboard.
Photographed by Pierre P. Pullis.

She will cost $3,806,571, or 16,000,000 marks. She is to make not less than twenty-three knots an hour, and it is expected that she will exceed this by a knot at least. She will have engines which will develop 38,000 to 40,000 horse power and will burn probably 750 tons of coal a day. Her crew of 600 will consist mostly of mechanics of one sort or another and coal passers.

Here are the sizes of some of the big and famous ships:

Name of Ship.	Date.	Length Over All. Feet.	Beam. Feet.	Depth Feet.	Draft. Feet.	Displacement. Tons.	Speed. Knots
Great Eastern	1858	692	83	57½	25½	27,000	14.5
Paris	1888	560	63	42	26½	15,000	20.5
Lucania	1893	620	65	43	28	19,000	22.1
Kaiser Wilhelm der Grosse	1897	649	66	43	29	20,000	23
Oceanic	1899	704	68	49	32½	28,500	20.7
Deutschland	1900	684	67	44	30	23,200	23.5
Kronprinz Wilhelm	1901	663	64	43	30	21,280	23.53
Celtic	1901	700	75	49	36½	37,700	16
Kaiser Wilhelm II	1902	706½	72	52½	....	26,000	24



Rowland Telegraph System.—Sending a Message.

The Rowland Multiplex Printing Telegraph System

WHEN the late Henry A. Rowland, Professor of Physics at Johns Hopkins University, announced some years ago the discovery of a method of rapid automatic telegraphy by the use of powerful alternating currents it was recognized by many scientists that the system, if practically applied, would probably create a revolution in telegraphy.

Professor Rowland ranked among the foremost in his profession, and stood shoulder to shoulder with such great electricians as Tesla and Edison.

Knowing that his days were numbered and working in the shadow of death, Professor Rowland devoted the last five years of his life to the perfecting of his invention. Professor Rowland was warmly supported by Doctor Gilman and Doctor Remsen, not only morally, but financially. The Physical Laboratory was freely placed at his disposal during the entire course of his work in developing his invention, and he was allowed the greatest latitude as to the disposition of his own time with relation to this special work. The university continued to extend a helping hand even after Professor Rowland's business friends had organized a company to carry forward the work, and it may be said that this admirable extension of university aid has continued up to the present time. Aided also by the financial and moral support of Bernard N. Baker, Alexander Brown and F. H. Hambleton, all well-known men of Baltimore, Professor Rowland was enabled to proceed so far in his studies that to-day the Rowland Telegraph Company has the system of his discovery so far perfected that its first commercial line is in practical operation, with every prospect of its proving the telegraphic wonder of the age.

The line now in operation extends from Berlin to Hamburg, in Germany. The company has several other contracts for European lines.

The description of the Rowland system, printed below, was prepared for "The Electrical Age" by the company's engineers, and is the first complete description of the system ever printed.

The attention of Europeans was drawn to the Rowland system through an exhibit made at the Paris Exposition under the personal supervision of Professor Rowland. The exhibit received the grand prize, two gold medals and one bronze medal.

The simplicity of operation is the first feature which attracts attention. Unlike the usual systems of rapid telegraphy, no preliminary translation of the message into punched slips or other form is necessary.

The sending operators sit before machines which work like typewriters. Four operators may work at once at each end of a wire. They send the messages exactly as if they were written on a typewriter. At the other end of the line the message is automatically printed on a slip or sheet of paper as it would have been had the operator been using a typewriter. The receiver has nothing

Receiving Messages by the Rowland System.

to do but to cut the messages and send them out.

More wonderful still, the operator at the far end of the line has perfect control of the spacing and lining operations of the machine, just as if the machine were within reach of his hand.

Type-setting machines may be connected directly to the telegraph line and press dispatches set up in type automatically as they come over the wire. Or the strip-punching machine of the monotype casting systems could be operated directly in like manner.

Another application of the invention is shown in a system for brokers' use. One wire between two large cities may have radiating branches at each end to eight different brokers' offices, in all sixteen offices. They will all be able to use this wire at the same time, as if they had separate wires, and the communication will be secret, for it is impossible to mix up the messages, as it is impossible to "tap" a wire and steal messages sent by the Rowland system. In this "Brokers" System will be found the nucleus of a general system, like that of our telephone systems, by which a subscriber may call up any other subscriber and communicate with him. Under such an extension of a telegraph system, a business man would be able to dictate a letter to his stenographer, who would call up "Central," get his correspondent, telegraph the letter in letter form, printed and convenient to be filed for reference; the answer would be returned in the same way, the whole correspondence having the advantage of being recorded.

Description of the Rowland System

An examination of a diagram graphically representing an alternating current will show how it may be altered or modified in a number of different ways, any one of which modifications may, by proper methods, be used for sending signals over a line.

Fig. 1 shows an alternating current broken. At B a positive half-wave is cut out. At C and D two half-waves of opposite signs have been increased in height, and at F a positive half-wave has been turned into a negative half-wave. If the alternating current were, for instance, made to trace itself on chemical paper the above different modifications

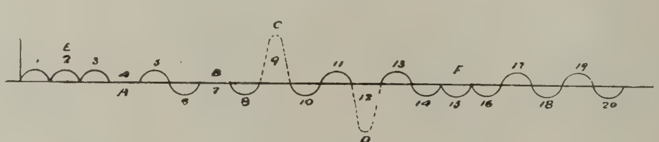


Fig. 1
Modifications which May be Produced in Alternating Current Waves.

which has had certain of its waves modified in six different ways. The minus half-wave 2 at E has been reversed, the minus half-wave 4 at A has been cut out—namely, the circuit was broken during the time the half-wave would have naturally continued had the circuit not been of its half-waves could readily be interpreted as six different signals.

In the present system cut-out positive and negative half-waves are employed for sending the signals over the line. A single signal is, however, made to consist of a pair of cut-out half-waves which are not adjacent. This method leads to the so-called system of "wave groups." This is a very important feature of the invention, which may be described as follows:

Grouping of the Waves

Consider an alternating current consisting of a series of positive and negative half-waves, as shown in Fig. 2.

We may divide these half-waves into groups, as A, B, C, D, and X, leaving an extra half-wave between each group. If we now cut out of each group two or more of its half-waves a signal may be made to consist not of one cut-out half-wave but of a combination of half-waves cut out from a group. For instance, if the half-waves 1 and 3 are cut out from group A this could be interpreted to mean one thing, while if the half-waves 1 and 4 were cut out, this combination would mean another thing, and so on through all the possible combinations of the different half-waves in the group. In practice, in the Rowland system, the signals are made up by cutting out any two half-waves not adjacent. We then have the following possible number of different signals which may be obtained in this way from a group of eleven waves.

1-3, 1-4, 1-5, 1-6, 1-7, 1-8, 1-9, 1-10, 1-11.
2-4, 2-5, 2-6, 2-7, 2-8, 2-9, 2-10, 2-11.
3-5, 3-6, 3-7, 3-8, 3-9, 3-10, 3-11.
4-6, 4-7, 4-8, 4-9, 4-10, 4-11.
5-7, 5-8, 5-9, 5-10, 5-11.
6-8, 6-9, 6-10, 6-11.
7-9, 7-10, 7-11.
8-10, 8-11.
9-11.

This gives a total of forty-five positive different signals, any one of which may be sent over the line during a time in which the current makes eleven alternations.

The Rowland system, in practice, makes use of five groups of waves with one extra half-wave between each group. In Fig. 2 the groups marked A, B, C, D have 11 half-waves each. The signals sent over the line which are afterwards translated in a number to be shown,

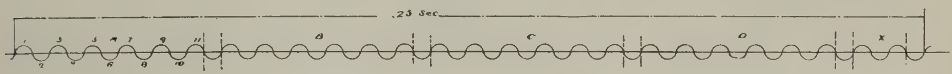


Fig. 2
How Waves May be Cut Out for Telegraphing.

into printed characters, are made by cutting out some of the different combinations given above, of two half-waves from each of these groups. The fifth group marked X contains three half-waves, two of which are at certain times cut out automatically for purposes to be described later on.

Speed of Transmission of Signals

Professor Rowland found that he could employ with advantage about 208 alternations of the current per second, and hence the 52 half-waves illustrated in Fig. 2 will pass over the line in one-fourth of a second; that is, any group of waves, as the group A will repeat itself four times each second.

Suppose there are four sending operators and each operator is assigned a special group of waves. Each time his group of waves recurs he can cut out from this group two half-waves; that is, send one signal over the line. Thus, four operators utilizing the groups A, B, C and D can send four different signals each quarter of a second. Thus, 960 different signals may be transmitted over the line in one direction in one minute. It should be noted that the signals are, in reality, sent over the line in succession, although the process occurs so rapidly that the four different operators appear to be sending their four different signals simultaneously.

Multiplexing the messages is the term applied to the above process of sending several different signals transmitted by different operators over the line in one direction, though in such rapid succession that they may appear to be sent simultaneously.

The system, moreover, is also duplex. As will be more fully explained, the term duplexing means the sending of two different signals from opposite ends of the line in opposite directions. It will be shown later that the two signals sent in opposite directions may be transmitted at identically the same instant.

Since this system, then, is a multiplex duplex system, its total capacity for one wire is four different signals each way in one-quarter second, making a total of 1,920 signals that can pass over the line per minute.

Professor Rowland, moreover, developed his system so that the figures, the letters of the alphabet and some extra signs are automatically printed in such a manner that each operator by writing on an ordinary Remington keyboard prints at the end of the line opposite to himself on a page eight inches wide. These pages of printed matter have the general appearance of an ordinary sheet of type-written matter with letters and figures printed in block type. (See page 558 for specimen of the printing.)

Forty words per minute is an ordinary speed for a practical operator, so that altogether the eight operators may be printing over an ordinary telegraph line 320 words per minute.

Synchronism

For converting the signals sent over the line in the form of combinations of cut-out half-waves into printed characters the present system requires that between certain parts of the rotating mechanism at each end of the line perfect synchronism be maintained. By this it is meant that two wheels in far separated cities shall revolve at exactly the same speed, and, furthermore, that when a certain point marked on the circumference of one of the wheels is in a particular angular position a corresponding point on the other wheel shall be in exactly the same relative angular position.

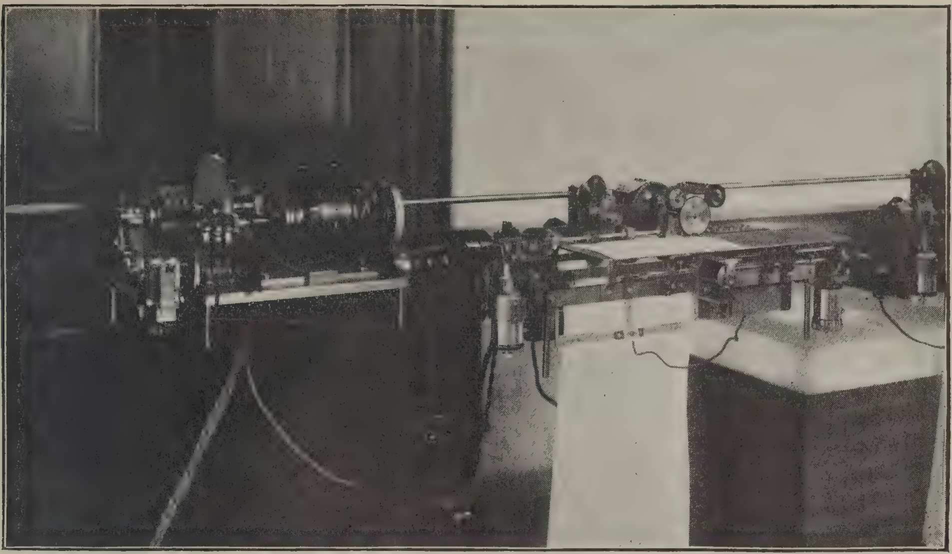
The practical attainment of such synchronism constitutes one of the chief features of the system. This feature has been so perfectly realized in practice that the synchronism has never failed or given any practical difficulty whatever. The certainty of its action is independent of the length of line between any two stations. This accomplishment opens the door to a host of other important electrical and mechanical inventions, for, if, as will appear later on, cut-out wave signals can be converted into printed letters, they may also be readily converted into a variety of mechanical operations, be it the steering and operation of a torpedo boat, the loading and handling of large guns at a distance or the operating of a distinct type-setting machine, etc.

Having now outlined the chief principles of the invention, an outlined description may be given of the practical means by which the chief operations are performed.

Method of Obtaining Synchronism

The endeavor to obtain perfect synchronism for telegraphic purposes has often been made. The failure to accomplish it has prevented several otherwise ingenious and carefully worked-out systems of printing telegraphy from becoming a practical success.

It might at first sight appear that, since an alternating current is employed in the present system, synchronism could



The Synchronizer Connected to Receiver.

be easily obtained by merely passing the alternating current through a small single phase motor. But experience has shown that this is not sufficient, on account of a phenomenon which engineers call "the pumping" of two machines which, otherwise, run synchronously. This phenomenon may be easily and beautifully illustrated as follows: Connect up electrically an alternating single phase motor with an alternating single phase dynamo and fasten to the shaft of one a disc on which are painted white stripes radially. The number of these stripes should preferably be the same or an even multiple of the poles of the dynamo. On the shaft of the other machine place a disc of tin with narrow radial slots cut in it to correspond in position with the stripes painted on the disc. The two machines with the discs attached to their revolving shafts should be so placed that the face of the painted disc may be observed by looking through the slots cut in the tin disc. When now the two machines come to rotate at the same velocity, the painted stripes observed through the slits of the other disc are plainly visible and appear nearly stationary. It will, however, generally be observed that the white stripes appear to oscillate backwards and forwards through an angle of several degrees, like the balance-wheel of a watch. This observation proves that the speed of the motor is first gaining and then falling behind that of the generator, with an

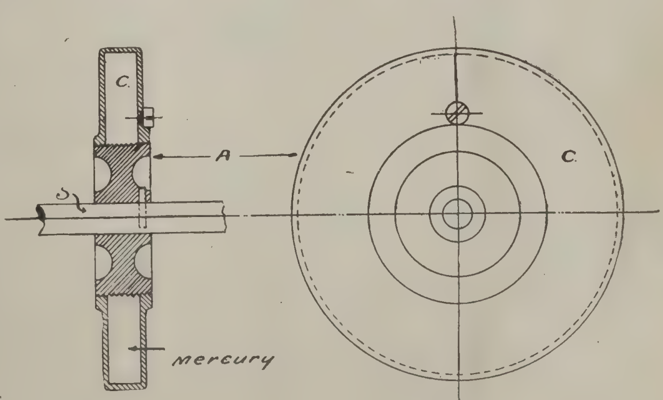


Fig 3
Mercury Wheel to Prevent "Pumping" in Synchronizing.

oscillating motion. This is the so-called "pumping" of synchronous machines, and it often becomes so great that the two machines are thrown completely out of step.

For telegraphic purposes, the pumping must be entirely eliminated. This has been accomplished by employing a device called a "mechanical damper," which has been constructed in a number of different ways, but all the various forms involve the same principle, which will appear from the description which follows:

In Fig 3, S is the shaft of a single phase alternating current motor of small size. A is a wheel of aluminum, in which is cut a circular channel, C. This channel is completely filled with mercury and the wheel A is rigidly fastened to the shaft S.

Conceive the shaft and wheel with its contained mercury to be revolving at a high speed. If the speed of the shaft is subject to an oscillating decrease and increase, the mercury, on the other hand, will tend, by its inertia, to revolve at a uniform velocity, and a friction is, therefore, produced between the mercury and the walls of the aluminum channel when their speeds are unlike. This causes the oscillations or "pumping" to dampen and the shaft to have a smooth, uniform rotation. The device is simple but effective, and without it a perfect synchronism would be impossible.

The synchronizer itself consists of a small alternating single-phase four-pole motor of special design. The armature is made of four flat coils without iron and has a diameter of about three inches. The synchronism is maintained by local currents. The line current, of from thirty to seventy milliamperes, has only one function to perform, in keeping two tongues of a polarized relay of a special design in constant vibration. One of these tongues is employed, by the manner in which it makes certain contacts, to complete the local circuits which print the characters, and the other tongue serves to send positive and negative local currents through the coils of the synchronizer in a manner to preserve the synchronism. Fig. 4 shows the way in which this is accomplished.

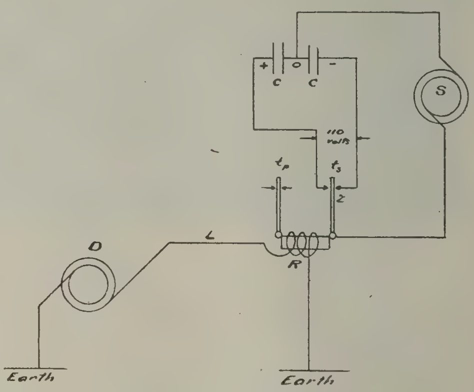


FIG 4

Line Connections to the Synchronizer.

The current from the alternator D on the line L keeps the two tongues tp and ts of the polarized relay R in constant vibration. S is the small synchronous motor, the shaft of which also carries the damper described above. One terminal of the synchronizer is attached to a wire which joins two one-microfarad condensers, C, C, in series, and the other terminal is attached to the insulated tongue ts of the relay. The contact points 1 and 2 of the relay are attached to the two terminals of the two condensers, which are in turn attached to the terminals of a 110-volt direct current circuit, which keeps the condensers charged. An inspection of the diagram will show that, as the tongue ts vibrates between its contacts, positive and negative currents are alternately sent through the synchronizer coils. In this way the synchronizer is made to run in synchronism with the dynamo D without the main line current being passed through it.

The synchronism obtained in this manner is so precise that, in the experiment described above, the stripes appear absolutely stationary, and if the motor is forcibly thrown out of synchronism it will regain it in from three to six seconds.

To further perfect the synchronism and to make the synchronizer self-starting, there are used, revolving between end and into the main line, and part around the other coil, magnetizing the core oppositely to the first current, and into an artificial line. The method will be made clear from the following description and a reference to Fig. 5:

In Fig. 5, A and B are two stations at opposite ends of the main line L. Ra and Rb are two differentially wound main-line polarized relays. Da and Db are two alternating current dynamos, which may or may not be running in

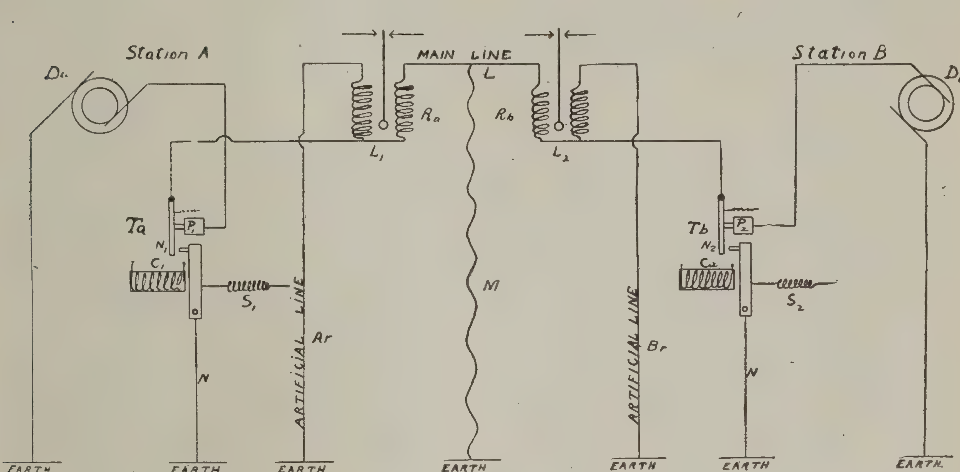


Fig. 5
How Duplexing is Accomplished.

the same field poles as the synchronizer coils, some coils through which a direct current is passed. The coils, together with their commutator, form a small direct current motor, which starts the synchronizer and also relieves it from doing any work beyond that of maintaining the synchronism.

Duplexing

In order to duplex, namely, to send signals over the line in opposite directions, at exactly the same instant, a dynamo and a differentially wound relay must be used at each end of the line. The current coming from each dynamo divides, part passing round one coil of the differentially wound relay at the same synchronism. Ta and Tb are two transmitters.

If the coil C1 of Ta be energized, its armatures will break the circuit to the relay Ra at P1 and immediately complete another circuit at N1, which connects the middle of the relay coils to earth. The transmitter Tb operates in the same manner. When the coils of Ta and Tb cease to be energized, the springs S1 and S2 return the armatures to their original position. Now, suppose that the circuit from the relay Rb be broken at P2 and made at N2 by energizing the coil C2 of Tb at station B. The current from dynamo Da at station A will enter the coils of relay Ra at L1 and there divide. Part of the current will pass through the right-hand coil of Ra over the main line, thence to earth, by way of the contact N2. A portion of this same current will have leaked off the line to earth, as at M, and a small portion will go through both coils of the relay Rb and to earth, by the artificial line at station B. The other portion of the current of the dynamo Da, entering the relay Ra at L1, will pass through its left-hand coil, magnetizing the core in the opposite direction to that portion which passed through the right-hand coil, and then to earth by the artificial line at station B.

The resistance, the capacity and the self-induction of the artificial line Ar may now be varied until it imitates the real line L with its leakage, capacity and self-induction. When this is accomplished, the current which enters at L1 will divide into two equal portions, half passing through the right-hand coil and half through the left-hand coil of relay Ra. Since these two equal currents flow in opposite directions through the two equal coils of Ra, the core is unmagnetized, and the tongue of the relay will not vibrate but stick against its left, or its right-hand contact, to whichever one it was last carried. If, when this condition is maintained, the circuit is broken at N2 and again completed at P2, the current from dynamo Db at station B will pass over the line L and through the right-hand coil of relay Ra at station A, magnetizing its core and causing its tongue to vibrate. Thus, when the artificial line Ar is properly balanced against the main line, an operator at B can send signals over the main line by merely breaking and making the circuit at P2. In like manner, with the circuit broken at P1 and made at N1, the artificial line Br is balanced until the relay tongue Rb remains at rest, when the current from Db passes through its coils, but again vibrates when it receives current from dynamo Da at the opposite end of the line.

Thus, if a signal consists in bringing the tongue of either relay Ra or Rb to rest, that is, in making its tongue stick against one of its contacts, it is seen that the tongues of both these relays may be brought to rest either simultaneously or separately, or, in other words, if at the same instant the operator at A and the operator at B simultaneously energize the coils of their respective transmitters, both relay tongues come simultaneously to rest, and two signals have been sent in two opposite directions at precisely the same instant. It is curious to note here that when two simultaneous duplex signals are sent over the line there is zero current on the line.

Method of Cutting Out the Waves

The operation of cutting out the waves, for transmitting the cut-out wave signals over the line, is performed on an ordinary Remington keyboard. These keyboards are so constructed that the keys can only be depressed at intervals, corresponding to the passage of 52 waves over the line, that is at intervals of about one-quarter second. The locking device which times the depression of the keys is called the "clapper" and unlocks the keys four times per second, that is, each operator can cut out four different wave combinations, and so send four different signals over the line, in one second. Each of the four keyboards can only cut waves out of the group which is assigned to it; the manner in which this is done and how the waves can be cut out near the point of zero current over the line may be understood by a reference to the following diagram:

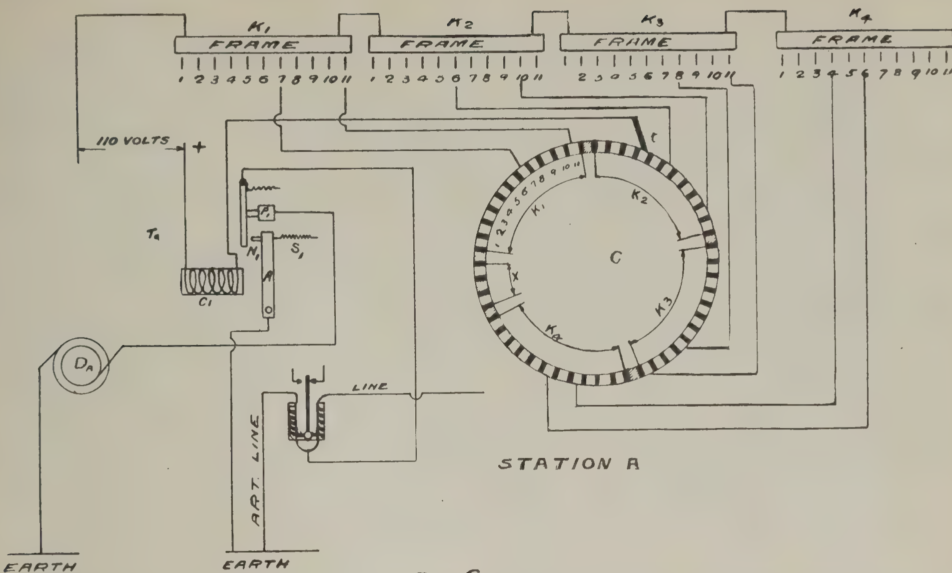


FIG 6

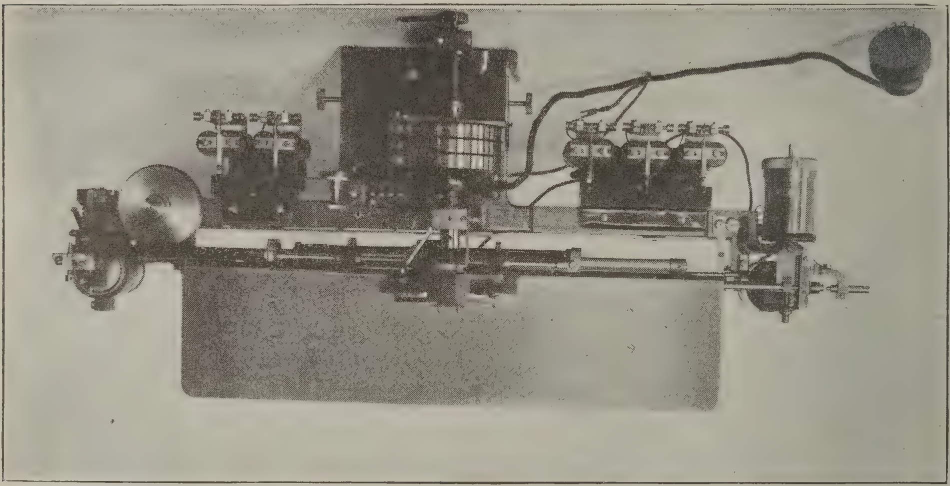
Device for Cutting Out the Signal Waves.

In Fig. 6, K1, K2, K3 and K4 represent the four keyboards. Each keyboard is supplied with 11 insulated contact springs, 1, 2, 3, etc. To the frame of each keyboard is attached the negative terminal of a direct current 110-volt circuit. When any one of the 41 keys, belonging to a keyboard, is depressed, contact is made with some two of the 11 contact springs. The contacts made will be the combination which corresponds to the letter marked on the key C, which is a so-called commutator or "sunflower." It is similar in construction to the commutator of a small dynamo, and has 52 segments insulated from each other. There are four sets of segments, which are connected respectively to the 11 contact springs of the keyboards K1, K2, K3 and K4. The remaining eight segments are some of them entirely insulated, while others are connected to devices for cutting out waves used for automatic signals, but which are not shown in the diagram. In other words, the segments are divided up so as to correspond with the groups of half-waves shown in Fig. 2. The group A is connected to the contact springs of keyboard K1, the group B to the contact springs of keyboard K2, etc. Corresponding to the half-waves between the groups A, B, C, etc., there are insulated segments which are shown in cross-section in the diagram. A brush or trailer, t, travels around the commutator C in synchronism with the dynamo Da, being geared to its shaft. This trailer passes from the center of one segment to the center of the next, while the current from the dynamo, Da, makes half a wave. When the brush is at the middle of a segment, the current from the dynamo is supposed to be passing through zero value.

If a key be now depressed on keyboard K1, contact with the frame of this keyboard will be made with two of the contact springs, as, say, 7 and 11. When the trailer, sweeping around the commutator, reaches segment No. 11, which is connected to contact spring No. 11, the current from the 110-volt circuit flows momentarily from the positive pole through the coil C of transmitter Ta to the trailer t, from there to the segment

No. 11, thence to the contact spring No. 11, to the frame of the keyboard and back to the negative terminal. This current causes the transmitter Ta to draw back its armature A and thus break the dynamo circuit at P, which goes to the relay and line, and at the same time the line is connected at N1 to earth. Immediately, when the trailer passes off from segment No. 11, the Spring S1 pulls the armature A back, completing the line circuit with the dynamo D. Thus, a half-wave of group A (see Fig. 2) has been cut out of the line circuit. When the trailer arrives at segment No. 7 the same operation is repeated, because the there will be an interval of a half-wave between these occurrences. This is found to be necessary for the proper operation of the main-line relay at the receiving station.

It is now perfectly evident, from the manner in which these half-waves are cut out and the signals sent over the line, that each operator works independently of the others and that no conflict between the signals which are sent by each can possibly occur; and it is also seen that four entirely different and independent signals can be sent in one direction in the one-fourth second that the trailer takes to pass around the



Latest Form of Receiving Instrument.

contacts which are made at the keyboard continue for a period equal at least to the time that the trailer takes to pass over the 11 segments which are connected to that keyboard. In like manner the operators on keyboards K2, K3 and K4 can cut out, by depressing some one key, any two waves from the group of 11 which belong to them. An insulated segment is placed between each two groups of 11 waves, so that, in case the last half-wave of one group and the first half-wave of another group is cut out, commutator. Moreover, from the explanations given above regarding the method of duplexing, the cut-out waves sent over the line are seen in no way to affect the action of the home main-line relay. This relay can only be affected by the cut-out waves which are sent to it from the distant station. Thus, the process is made clear how eight different and totally independent signals may be sent over the line in one-fourth of a second, or 1,920 in a minute.

The operation of cutting out the waves

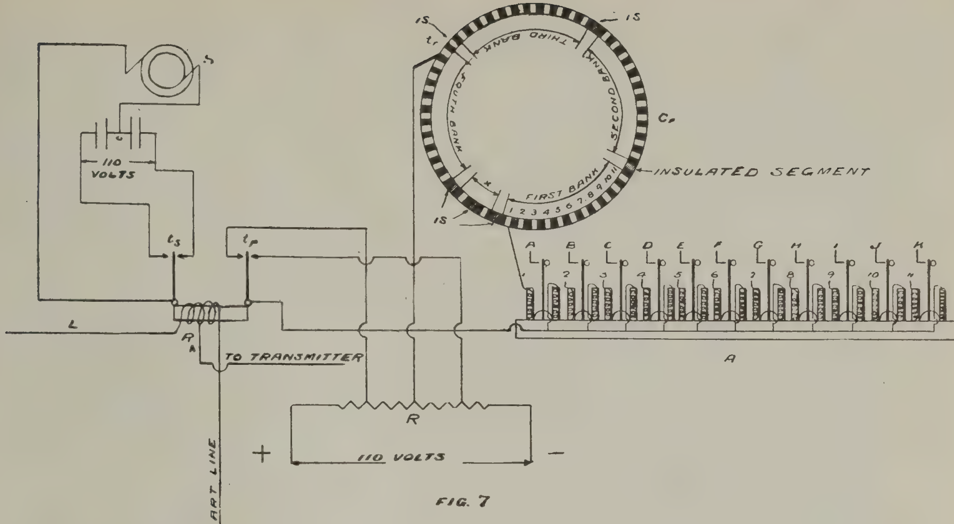


FIG. 7

Receiving Apparatus.

at the other end of the line is precisely the same. So far, however, we have seen that the signals which are sent over the line appear at the distant end merely as two momentary pauses in the otherwise constant vibration of the tongues of the main-line relay. We will now first show how these transient signals are translated into a readable record and then, afterwards, into printed characters.

Manner in which the Signals are Received

Since the two ends of the line are in all respects alike, any description which will apply to one end will also apply to the other.

Referring to Fig. 7, L is the main line and Ra the main-line polarized relay. This relay has two insulated tongues which vibrate synchronously with the alternating current waves arriving over the line L. The tongue ts controls the synchronizer, S, which operates in the manner described above. The tongue tp has the functions to be described. C is a "receiving" commutator, practically identical in construction with the "sending" commutator described above. Sweeping around this commutator, which has 52 segments, there is a brush, or trailer, tp. This trailer is connected by gearing to the rotating synchronizer S, but with a speed reduction of 13 to 1. The commutator may be rotated through a small angle, giving an adjusting, so that when the trailer tr is in the center of a segment the relay tongue tp is at that instant against either a left-hand or a right-hand contact. R is a resistance of several hundred ohms, to the terminals of which is connected a 110-volt direct current circuit. A is a bank of small polarized relays, called the "selecting" relays. There are, in reality, four such banks of 11 relays each. Only one bank, however, is here shown. Each of these four banks correspond to a keyboard at the sending end of the line. One terminal of each of these relay coils is connected to a segment in one of the groups of 11 segments of the commutator C. The other terminals or "tails" of all the coils of all the relays are connected to the insulated tongue tp of the main-line relay Ra. As the tongue of this relay vibrates btween its contact points and the trailer travels over the commutator segments, synchronously with the vibrating tongue, the 44 relays will receive, in succession, momentary currents through their coils. The relays 1, 3, 5, etc., of each bank will receive a current through their coils in one direction, and the relays 2, 4, 6, etc., a current in the opposite direction. Thus, the tongues of the relays of even number would receive an impulse in one direction, and those of an odd number in the opposite direction. The windings, however, of relays of odd numbers are reversed, and this makes the tongues of all the relays receive, in succession, an impulse in the same direction as the trailer passes over the segments of the commutator to which they are attached. Thus, while the current on the line is unmodified, the tongues of all the "selecting" relays will receive an impulse in the same direction once each time the trailer makes a complete revolution. These repeated impulses, together with the magnetism in the tongues of the relays, hold them against their back-stops and away from the contact points A, B, C, etc.

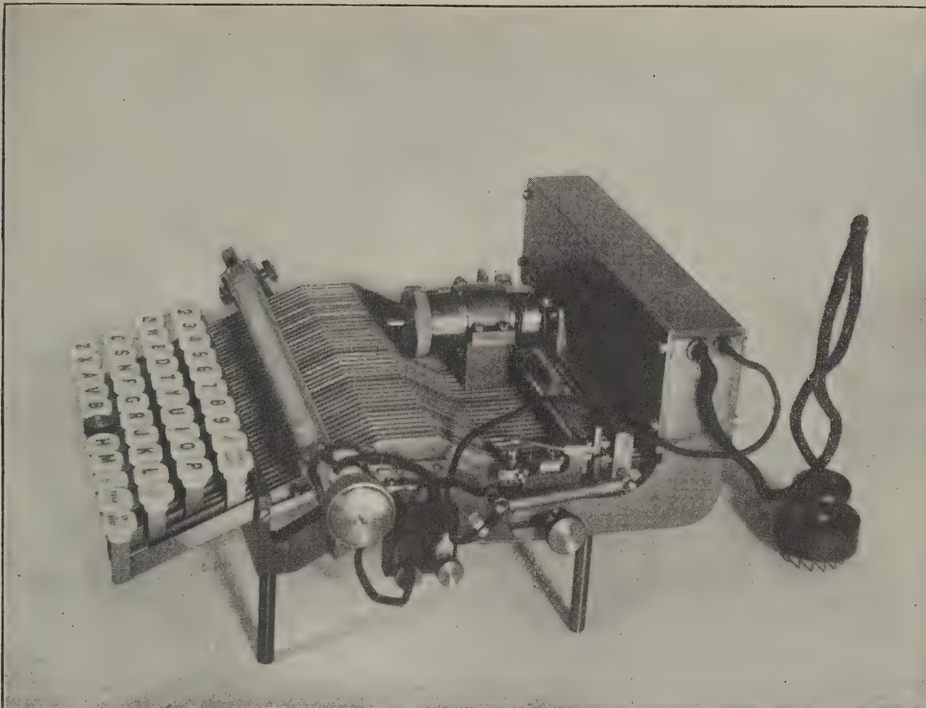
The cut-out wave on the line will now be indicated in the following manner. When the wave is cut out, the main-line relay tongue tp will at that instant cease to vibrate and will remain against the contact point to which the previous wave had carried it. The trailer in the meantime passes on to a segment such that, if the main-line relay tongue had been carried over, the selecting relay attached to that segment would have received an impulse to take it against its back-stop. Now, however, this selecting relay will receive a current through its coils in a reverse direction to what it would have received had the main-line relay tongue continued to vibrate. Its tongue will, therefore, be thrown against its contact point and will remain there until the trailer has made a complete revolution. When the trailer returns to the segment to which the relay is attached, unless some wave is again cut out, the relay will receive an impulse which will return its tongue to its back-stop again. Thus, waves which are cut out at the far end of the line are reproduced at the near end by the tongues of the selecting relays which correspond to the wave cut-out, being thrown against their contact points T, B, C, etc., and there remaining during one revolution of the trailer. As each of the four keyboards at the far end of the line operates a corresponding bank of 11 selecting relays at the near end, the depression of any key of the keyboard, which cuts out two waves, will cause two relay tongues in the bank corresponding to that keyboard to be thrown against their contact points. A practiced observer could readily interpret the cut-out wave signals sent over the line by merely observing the movements of the tongues of the selecting relays. Tongues 1-3 sent over might be interpreted to mean A, 1-4 to B, etc., through the 45 possible combinations given above.

But in the present system these signals are automatically translated into ordinary figures and letters of the alphabet which are printed upon a sheet of paper eight inches wide. It now only remains to show how this is accomplished.

Automatic Transmission of the Signals into Printed Characters

The page printer, by means of which 41 different characters may be printed in type, involves the following essential features:

First—A light type wheel of steel about 2 inches in diameter, on the circumference of which the 41 characters are engraved. This type wheel revolves



The Sending Instrument.

continuously at the end of a horizontal shaft which turns synchronously with the trailers.

Second—A light paper carriage which carries the paper that is fed from a roll underneath the type wheel when new lines are made.

Third—Devices for thrusting the paper forward to make the lines, and sideways to space the letters, and a back carriage device to return the paper to a position where a new line of printing is to start.

Fourth—A small printing magnet, which operates a hammer or platen which strikes the paper up against the lower side of the rim of the wheel, at the moment when the character to be printed has turned to its proper position above the hammer.

Fifth—A set of polarized relays, called the "distributing" relays, which serve the purpose of making contacts at proper moments for sending current to the printing magnet to print, to a liner magnet to line the paper, to a spacer magnet to move the paper sideways, and to a back magnet which allows the carriage to return the paper to the proper position for beginning a new line.

Sixth—A so-called "combination commutator," the function of which will appear from the following description:

Fig. 8 shows diagrammatically the combination commutator, the tongues and contact points of one of the four banks of the "selecting" relays, and also a part of the connections of a page printer. The combination commutator is made up of three parts or circles, C1, C2 and C3. Each of these circles is divided into segments of different widths with insulation between; t1, t2 and t3 are three brushes or trailers, which sweep together around the commutator in the same time as the trailers on the sending and receiving commutators, and, being on the same shaft with the type wheel, turn also with it. These trailers, as they come to bear upon different combinations of segments of the commutator, complete, together with contacts made by the relays of one of the four banks, circuits which actuate magnets that print the character and shift the paper. Rd is one of the four "distributing" polarized relays. The current, through its coil b, brings its tongue against the back-stop S, and a current, through its coil f, brings its tongue against the contact point k. P is a small printing magnet, which, when energized, causes the hammer or platen, h, to strike the paper up against the rim of the revolving type wheel. This is done so rapidly that the type wheel may continue in constant rotation, although, being attached to the shaft by means of a spring, it may, momentarily, pause. X and Y are the positive and negative terminals of a 110-volt direct current circuit. The spacer, liner and back magnet, and the distributing relays which actuate them, are, for the sake of clearness, not shown in the diagram. A letter is now printed as follows: Two half-waves having been cut out of

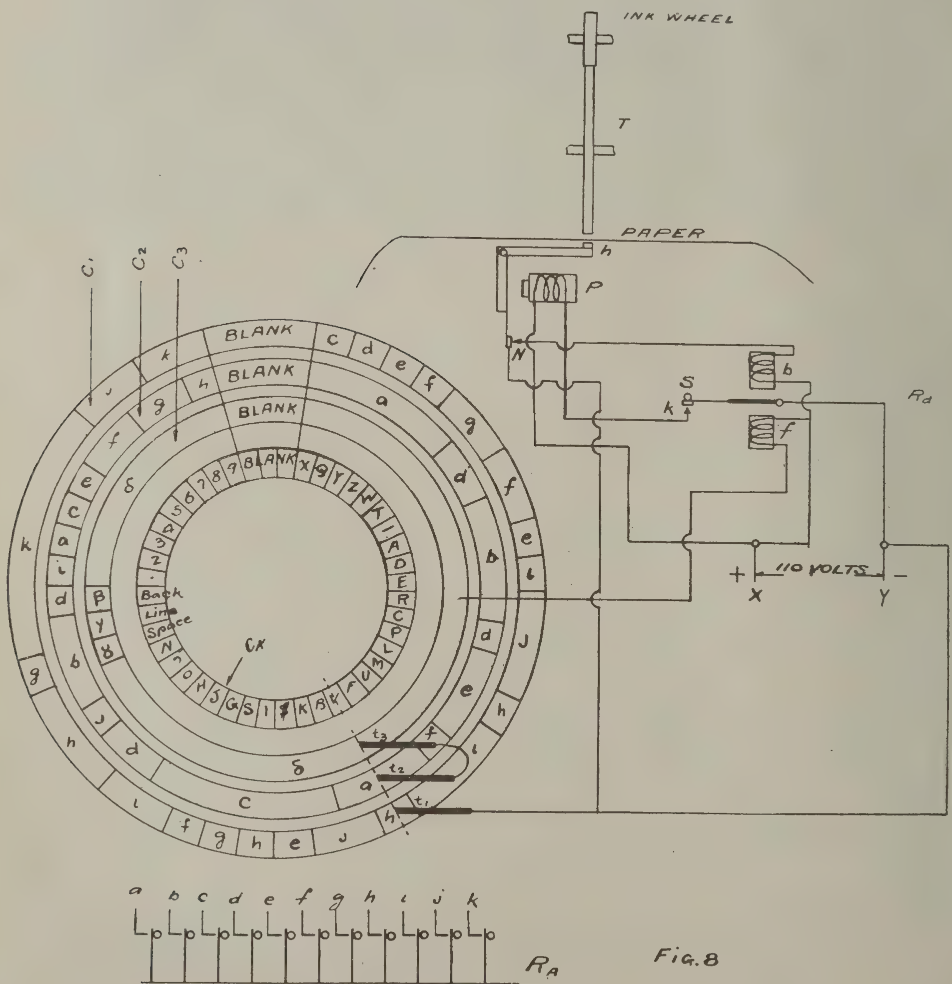


FIG. 8

Combfnation Commutator.

a group of waves to which the bank of selecting relays Ra belongs, two of these relay tongues are thrown against their contact points, where they remain until a reverse impulse returns them to their back-stops. Suppose contact is made with the contact points a and h, then, after a certain time, the trailers t1 and t2 will have arrived on segments of the combination commutator, which are respectively connected to the contacts a and h, and the trailer t3 will then be in this case on the segment S. It may be noted that the inside circle C4 shows the position of the letters on the type wheel corresponding to the combinations of segments on the combination commutator. The following circuits are now completed: The current starting from the positive pole X passes through the coil f of the "distributing" relay Rd, throwing its tongue against the contact k. Thence it passes to the segment S and out through the trailer t3 and into the trailer t2, thence into the segment a of the commutator connected to the contact point a. From there through the tongue of the relay and by the frame of the relays of the bank to the tongue, making contact with contact point h, thence to the segment connected to this contact point h and thence by the trailer t1 and its connection back to the negative terminal Y. It may be stated, in passing, that all segments of the combination commutator are connected to the contact points of the same letter of the bank of relays Ra.

At the instant that the above occurs, the type wheel, T, has turned into a position so that the letter engraved upon its rim, and which corresponds to the combination of segments a-h on the combination commutator, is just over the platen h. In this case the letter would be V. At the same time, contact being now made at k, a circuit is completed which makes the platen strike the paper up against the type wheel and so prints the letter. This circuit is from X through the coil of the printing magnet, P, to the contact k and back through the relay tongue in the negative pole. At the instant, or just before, the platen, h, strikes the paper against the type wheel, a contact is completed at N, which permits a momentary current to pass through the coil, b, of the relay Rd, thus returning its tongue to its back-stop. A further circuit which is not here shown, is also automatically completed, which causes the paper to shift sideways under the wheel through the distance of a space between letters; that is, "spacing up" is automatically accomplished. In this manner thirty-eight characters may be printed. Three combinations, as g-b, k-b, k-d, are reserved for spacing, lining and backing the paper at the will of the operator at the far end of the line. The segments, a, y, b, on the combination commutator are attached to coils of the polarized relays (not shown), which distribute current to magnets that perform the above function. If the operator at the other end of the line should neglect to send the "back signal" which returns the paper and attempts to print beyond the edge of the sheet, then the carriage will carry the paper back automatically when the end of a line of printing is reached. This, however, a practiced operator never does, because, at the sending end, an automatic device on the keyboard shows the operator just how far he has printed on a line.

The operator, being able to space, line or back carriage at will, paragraphing, etc., can be accomplished the same as on an ordinary typewriter.

Corresponding, of course, to each of the four keyboards at the other end of the line is a page printer and a bank of "selecting" relays. All four of these page printers appear to be operating simultaneously.

The waves in the extra group X (Fig. 2) are used, one to automatically ring a bell if anything disturbs the synchronism or the printers are turned off and one is used to "find the letter" when the apparatus is first started up. Finding the letter means bringing the trailers of the sending commutator at one end of the line and the receiving commutator at the other end upon corresponding segments of their respective commutators. For example, when the apparatus is first started up and synchronism has become established, the trailer on the sending commutator at a particular instant might rest on, say, the twentieth segment, and that of the receiving commutator on the fiftieth segment, but an automatic device operated by one of the cut-out half-waves of group X will cause the trailer on the receiving commutator to lag behind until it is at the same instant on the segment of the same number as the trailer of the sending commutator. When this has taken place the two trailers continue to revolve in perfect synchronism, and always maintain the same relative position on their commutators.

It has only been attempted in the above description to give a bare outline of the features of this remarkable invention. Much more might be said in regard to the many ingenious devices used and the new mechanical and electrical features employed. The apparatus is throughout full of beautiful physical principles and most ingenious electrical and mechanical devices. One very important feature of the apparatus is the natural way in which it divides itself into distinct units, so that if one unit becomes deranged it may be immediately replaced by another without stopping the operation of the rest of the apparatus. Thus, considering one end of the line only, there are four keyboards, all exactly alike, which may be replaced singly by others by merely breaking eleven wires joined together by a multiple connector. There are four page printers which can also be operated, singly or together, and be immediately replaced by others in a like manner with the keyboards. There are four similar banks of eleven polarized relays each. If anything deranges one of these banks only that printer to which it belongs is affected.

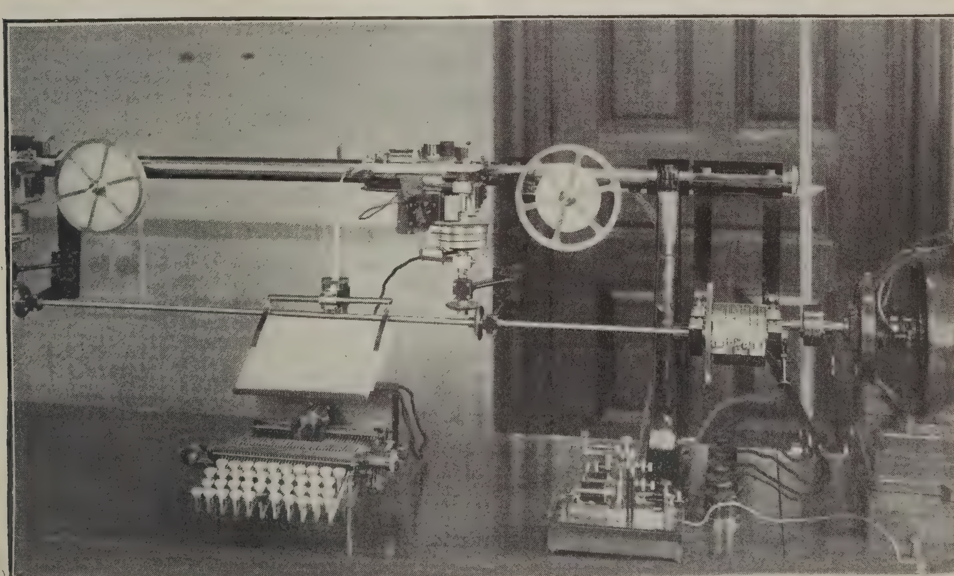
This being the case, we have thought that a clearer idea of the appearance of the apparatus as actually constructed will be obtained by showing a picture of one of each of these units rather than by giving a single view of the entire outfit as installed at one end of the line. Thus, Fig. 9 is a photograph of a keyboard; Fig. 10 shows a page printer; Fig. 11 a synchronizer, the receiving commutator and letter finder. A specimen of the printing is shown in Fig. 13. It will be noted that the operator has spaced and lined and paragraphed the printing in the same manner as would be done on a Remington typewriter.

Later Improvements

The mechanical operation of the page printers has been improved and the keyboards have been entirely redesigned since the foregoing was written. The main distinction between the old and the new keyboards is that the new keyboard makes combinations electrically. The page printer performs the same functions as the one described, but more perfectly, and functions of minor importance have been added, such as the rapid feeding out of a telegraphic blank—in less than three seconds. The former description assumed that the alternating waves on the line were divided up into five groups —A, B, C, D, X—fifty-two waves being used for the purposes of printing with four printers, signalling and finding the letter. Fifty-six waves are now divided into four groups. Eleven of the waves in each of the four groups are used for the printing; one wave in one of the groups is used for finding the letter, and three waves—one taken from each of the remaining three groups—are reserved for purposes of signalling. The signalling can be accomplished in a variety of ways. Morse instruments, one at each end of the line, can be worked duplexed at a slow speed. It is preferable, however, to place at each end of the line, in addition to the four page printers, a small tape printer, which prints simultaneously at the rate of fifteen words a minute each. While the eight printers of the Duplex System are in operation for the transmission of telegrams the two stations can correspond with each other regarding the business of the offices or for the purpose of correcting errors. The system, therefore, may be called with propriety a Decaplex System.

The new machines have the additional important feature that all the messages transmitted are simultaneously recorded at the sending station. The recording at the sending station is done on a tape in printed characters. The tape passes directly over the keyboard and before the eyes of the keyboard operator. (The photographs represent the tape recorder raised to the level of the eyes of the operator, but in the latest form developed it passes directly over the keyboard.) This home recording of the messages is accomplished without loss of speed in the eight regular transmitters and without additional complication in the keyboards.

A feature of the apparatus as now constructed is the manner in which it is subdivided into interchangeable units. Each printer, keyboard, bank of relays, transmitter and the main-line relay constitute an independent unit, which, in case of a failure or a breakdown, can be replaced by another like unit. As such an interchange can be effected instantly neither the apparatus as a whole nor any portion of it is put out of operation more



Sending Intrument and its Connections.

than a moment by the mechanical failure of any of its parts.

The system is kept in electrical adjustment, as far as the main line is concerned, much more easily than are other telegraphic systems. The duplex line is thrown out of balance only by a considerable change in the insulation resistance of the line. Actual trial has shown that a 300-mile line can be connected to earth at its middle point, through only 2,000 ohms resistance, without upsetting the duplex adjustment sufficiently to spoil the printing.

In view of its maintenance in electrical adjustment and its interchangeable units the system may be kept operative under conditions which would upset any other than the Morse system, operated simplex.

The octoplex system can transmit to greater distances without relaying than other multiplex system hitherto known. It has been successfully operated under government tests over lines of 550 miles, and it is anticipated that it will work perfectly without relaying between New York and Chicago. Methods have, however, been devised by Professor Rowland for automatically relaying the messages.

The system has advantages in the operation of lines subject to line disturbances. As the alternating current is employed, condensers may be used in series with the main-line relays; no amount of direct current on the line, resulting from leakage to trolley lines, etc., can produce a harmful disturbance.

The apparatus has reached a standard form; the parts have been constructed with jigs, and are interchangeable.

Methods of Line Operation

Aside from the operation of the system between two main terminal stations, most of the applications which involve the division of its octoplex capacity of transmission among stations separated by a considerable distance require the use of some sort of automatic relaying

INDICAZIONI DI URGENZA

IL GOVERNO NON ASSUME ALCUNA RESPONSABILITA CIVILE IN CONSEGUENZA DEL SERVIZIO DELLA TELEGRAFIA.

LE TASSE RISCOSSE IN MENO PER ERRORE OD IN SEGUITO A RIFIUTO O IRREPERIBILITÀ DEL DESTINATARIO DEVONO ESSERE COMPLETATE DAL MITTENTE

Ricevuto il .... *190*....................

Pel circuito N.................... RICEVENTE ....

UFFICIO TELEGRAFICO
DI
ROMA

ILLMO SIGNORE
FEDELE CARDARELLI, ROMA.
DIRETTORE, MINISTERO DELLA
POSTE E DEI TELEGRAFI.

SIR, THE APPARATUS FOR INSTALLATION UPON THE LINE ROME..NAPLES IS WELL ADVANCED IN PROCESS OF MANUFACTURE AND WE HOPE TO DELIVER IT DURING THE COMING WINTER.

WE HAVE THE HONOUR TO REMAIN, SIR,
YOUR OBEDIENT SERVANTS.
THE ROWLAND TELEGRAPHIC COMPANY.

Fac-Simile of Rowland System Telegraph Message. Reduced; Full Size, 8 inches wide.

device. An automatic relay for the Rowland system is constructed in one of several different ways: for general use the following method is considered the best on account of its flexibility. The general idea may be expressed in a few words.

At a relaying station the incoming signals are received on a bank of eleven selecting relays in the same manner as at a terminal station. These relays, instead of operating an automatic printing device, have their eleven contacts connected to a sending commutator in the same manner as the contacts of a keyboard; they operate the usual transmitter which transmits the proper modifications to an alternating current impressed upon the local line by a dynamo at the relaying station. This dynamo is run in synchronism with the dynamo at the originating terminal or with the dynamo at the main central of the system.

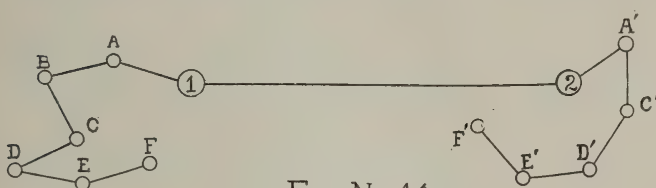


Fig. No. 14.

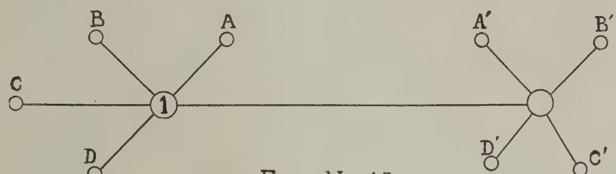


Fig. No. 15.

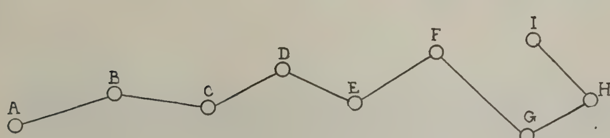


Fig. No. 16.

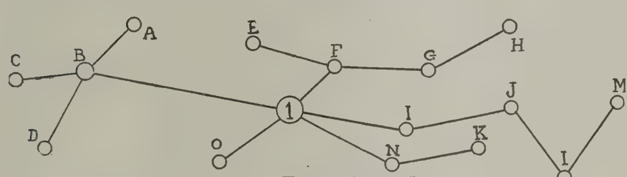


Fig. No. 17.

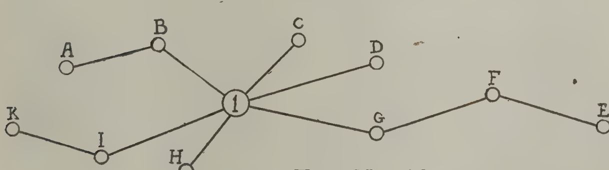


Fig. No. 18.

Diagrams, with a brief statement of the operation in each case, are here shown to illustrate various applications of the Rowland system. It is not deemed necessary in the present article to enter into the technical details of these systems of operation; but it may be remarked that only such are presented as have been experimentally proved as operative or used in the operation of actual lines.

In regard to all of these methods some general remarks which apply to all may be made. In all cases the octoplex capacity may be distributed in any convenient manner; that is, in place of having eight operators at a speed of forty words per minute each, the number of operators may be doubled and the speed of each halved; or any number of operators may be had, with the limitation that the aggregate speed of the apparatus shall not exceed that of the eight operators at forty words. In cases where branch lines radiate from a central these lines may be 300 miles long or longer. Or, in case of slightly different apparatus placed at the terminal of the branch, these branches may have any length up to the maximum of the system. Way-station lines may have any length up to 300 miles.

In Fig. 14 are shown two centrals, 1 and 2, connected by a trunk line. Passing out from each central is a branch containing a number of stations in series. At 1 and 2 there is an automatic repeater.

At the way stations A, B, C, etc., is a single or multiple outfit, as the case might be.

Communication may be established so that one station, A, corresponds with another, A1; another station, B, to a station B1; or, by additions to the apparatus, more complicated and general methods of communication may be established if such should be desirable.

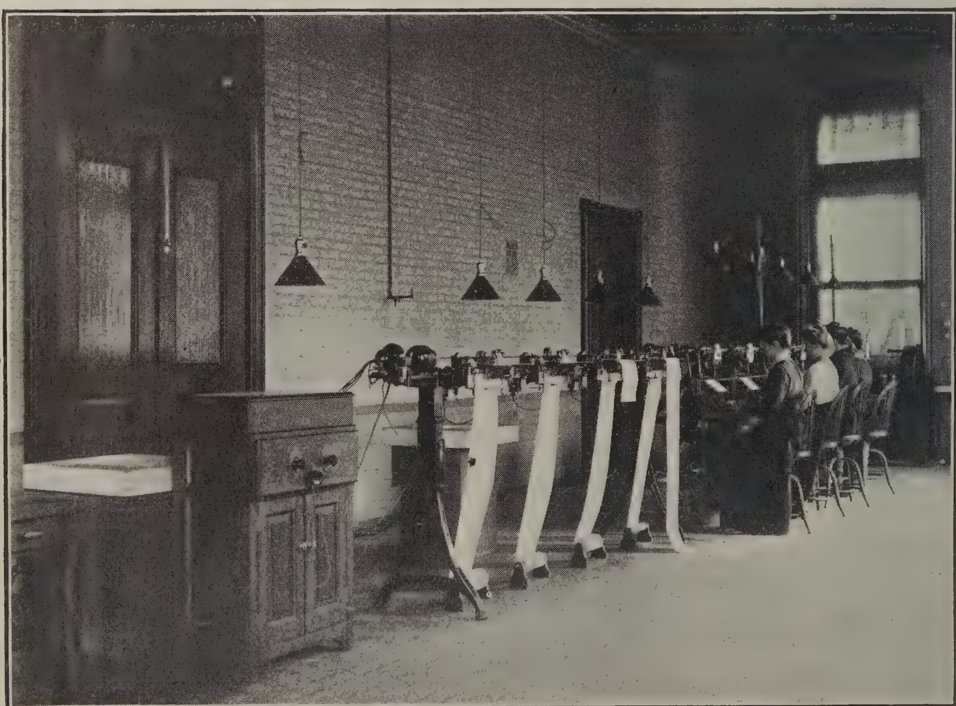
Fig. 15 shows two centrals, 1 and 2, connected by a trunk line, and at each central a number of radiating termini. At each central is an automatic repeater. At each branch terminal, A, B, etc., is a single or a multiple outfit, as desired.

In Fig. 16 is shown a way-station line A number of stations are connected in series. At A is the apparatus.

At B, C, etc., are single or multiple outfits. Here independent communication may be had between A and any other station or stations to the extent of four, each station having a rate of forty words a minute.

In Fig. 17 is shown a distributing system. Here the apparatus at the various points is substantially the same as given at various corresponding points of the systems previously described.

In Fig. 18 is shown another distributing system, which has the addition of transmitting devices at all the sub-stations.



Four Messages Being Sent at Once from One End of a Single Wire and Home Recorders Making Duplicate Copies.

Hydro-Electrics in the Alps

By Rene de La Brosse

Geneva's Three Systems

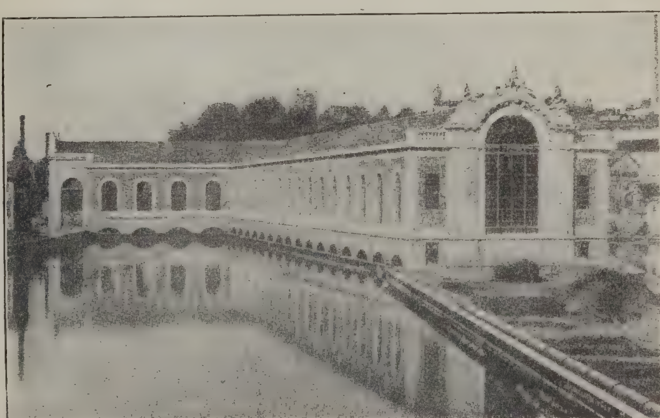
Second Article

THANKS to the courtesy of M. Butticaz, General Superintendent of the Industrial Services of the City of Geneva, we were able to visit the elevating power house of the Coulouvreniere, the central electric station and the power house of Chevres, which distributes in the city and canton of Geneva the electrical energy received at the slope of the Rhone from below the junction of the Arve.

Power House of the Coulouvreniere

The power house of the Coulouvreniere presents from the point of view which specially occupied us an interest which was historical. It marks particularly a step of importance in the series of industrial procedures for the transformation of energy, and offers without doubt in chronological order one of the latest examples of a distribution of force which is perfectly combined with others and very happily realized, using an agent other than electricity. It is, in fact, water under pressure which is the vehicle of energy.

The history of the circumstances which determined the municipality of Geneva to create toward 1883 this interesting distribution cannot find place here. We will only say that the city has been obliged at several periods during the course of the nineteenth century to modify and increase its distribution of water. In the present century a French architect (Abeille) installed an elevator machine which, with various additions, sufficed for a long time, to meet the restricted needs of the epoch. Another of our compatriots, Engineer Cordier, was called in 1838 to create a new and more powerful elevator machine with Poncelet wheels and force pumps, which sufficed till toward 1862. At this epoch (1868) M. Callon, professor at the Central School of Paris, installed a Girard turbine capable of elevating 4,000 litres of water a minute fifty metres high. The installation, retarded by divers ac-



Power House at Coulouvreniere

cidents and by the war of 1870, was not put in operation until 1872, and was continued in use till 1886, when the present installation was created.

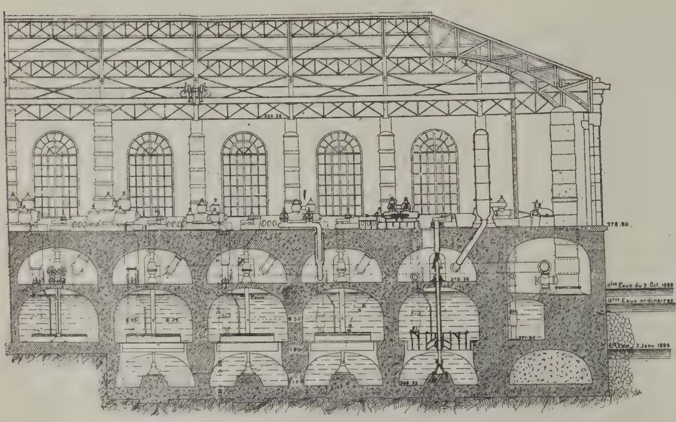
We remark with pleasure the calling of our compatriots during this long period to the honor of giving the city the hydraulic apparatus which it lacked. But its rapid development very soon exacted more efficiency, as the old system gave but 12,000 litres of water a minute. In 1880 the house of Escher, Wyss & Co., of Zurich, was called to install two auxiliary machines (steam) of about 300 horse power, but the ever-increasing demand soon made it necessary to completely modify the process of distribution.

To what must we attribute this rapid rise in the consumption of water, and above all of water power, in a city of relatively only secondary importance? To a concatenation of circumstances which we will here indicate at least summarily. For one thing the City of Geneva, since 1870, made considerable growth, which caused, of course, an increased consumption of water in the households and in the streets.

Another cause was that M. Engineer Turrettini, whose name is connected with all the progress accomplished in the region, established in 1871, in an industrial house in the city, as an experiment, for the benefit of a company for the manufacture of surgical instruments, an hydraulic motor, using a column of water and oscillating cylinder. This effort was crowned with success, the number of motors increased rapidly and the sale of water under pressure soon became a source of considerable receipts for the city; so much so that it was necessary in 1883 to study out a programme for distribution which could easily extend beyond the city to the twenty-five communes round about.

This programme was put into force with prudence at several periods between 1883 to 1890. It did not cost less than ten million francs.

It comprises two distinct reservoirs at a low and a high pressure (40 and 140 metres), with a total development of about 240 kilometres of mains, and distributes altogether 3,000 horse power. These systems center upon the power house of la Coulouvreniere, established on the left arm of the Rhone. The power house is provided with twenty centripital turbines with vertical axes, each of 210 horse power and each working two groups of suction and pressure horizontal pumps. The return conduits are furnished with large air regulators which maintain a constant pressure.



Power House at Coulouvreniere.—Sectional View.

It does not come within the limits of this study to give a detailed description of this power house, which interests us solely as an example of a rare and original solution of the problem of distribution of energy by water under pressure.

We will only say that the average price of a cubic metre of water sold for power varies between 2 centimes, 6 to 4 centimes and 5 centimes, and that the annual revenue has followed a rapidly ascending scale, so that the mean receipts are to-day in the neighborhood of 1,300 francs from each user.

Before terminating this short description of the distribution of water under pressure in the City of Geneva, it will not be uninteresting to remark that, if the needs which she has satisfied had manifested themselves some years later, the solution would have been entirely different.

In 1883 the employment of electricity had been begun, and this only in the form of timid experiments. The experiments which resulted in the most celebrated transportations of force had not yet taken place and the most audacious engineers had not dared to predict that which has been realized since.

M. Turrettini, in his report in favor of the project, passed in review the different methods of transporting power known to that epoch—1883. He cited the systems of telo-dynamic cables as applied at Bellegarde, Schaffouse, Fribourg and Zurich, which had enjoyed favor for some years; the system of compressed air employed at the excavating of the large tunnels of Mont-Cenis and of Saint-Gothard, but of which the mediocre return of power less than 50 per cent. did not warrant general use, and finally he explained that the electrical transmissions did not yet give a practical and industrial solution of the problem. It is true that he considered only the direct current system at 500 volts pressure. They were far at that time from the use of the polyphase currents of 10,000, 20,000 and 25,000 volts of to-day.

"But the moment is not far," said he, "when one will apply with advantage this mode of transmission in our city."

Meanwhile, and as it was necessary to have immediate results, he concluded his report in favor of water under pressure. It was thus that the City of Geneva found itself using a system perfectly rational for the epoch, but which would no longer be considered as satisfactory.

This solution, so interesting, marked, so to speak, the end of an epoch. "If the studies were to be made now," wrote in 1890 the Administrative Counsellor of Geneva, "some modifications would without doubt be made to the general plan. Among others the distribution of force by electricity would be on a par with hydraulic transmission. Nothing, besides, prevents the use of electrical transmission to utilize the force of a certain number of turbines which still remain to be put in place. The study is ready and the execution comes next."

"When the Administrative Counsellor wrote these lines," said Mr. Turrettini, "he did not doubt that the facts would respond more quickly to his hopes than he could think; he did not doubt that two years later he would find that to meet the demands from the City of Geneva the concession by law of a right to build a second water-power force more than triple that of the first would be asked for, and that less than ten years later in view of the absorption by industries and by the public service of the output of this second power house it would be obliged to ask the concession for a third fall more powerful than the second."

In fact, as we have said above, the power house of Coulouvreniere marked the end of an epoch. The era of electricity was opening.

Power House at Chevres

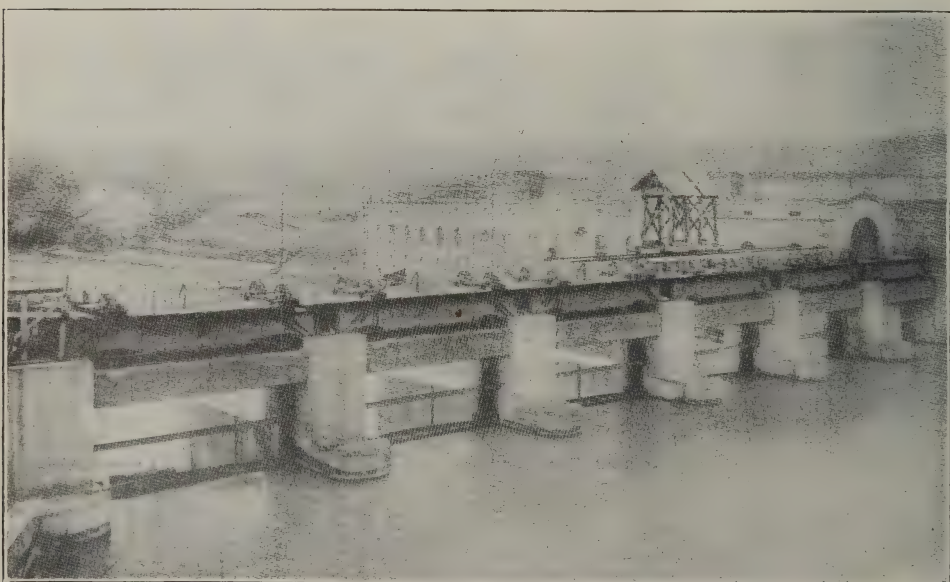
The power house of Chevres was created in the period from 1893 to 1898 to satisfy the increasing demand for energy.

Similar to that at Coulouvreniere, the power was obtained from the slope of the Rhone, but the agent of distribution in place of being water under pressure is the electrical current.

Formerly various persons had investigated the power of the stream that could be drawn from the river at the rapids, and to which powerful flow Lake Leman forms so admirable a regulator. In 1882 M. Merle d'Aubigne, Director of Services of the City of Geneva, had considered cutting a tunnel of 1,300 metres in length, capable of supplying twenty cubic metres of water per second at low water. The house of Escher, Wyss & Co. had considered the building of a dam giving forty metres fall and producing 5,600 horse power, but the time had not yet come when electricity was ready to provide such a general solution to the problem. It was only in 1892 that the movement took a decisive form. The world was then in possession of the experiences of Creil, of Vizille, and of Francfort, the canal at Jonage was commenced, and from all parts of the world examples of the successful transmission of power by electricity multiplied themselves.

The City of Geneva could not hesitate longer when confronted by these demonstrations, and the municipal council adopted in May, 1892, a project of works for the production and use of a force of 12,000 horse power to be established on the Rhone, below the confluence of the Arve.

A law of November 2, 1892, authorized the city to establish for that purpose a dam, a power house with turbines and the buildings for the management and transmission of the force "by a system to be fixed ulteriorily." Remark this last phrase, which does not prejudge the



The Dam at Chevres

mode of transmission of energy and leaves the question in suspense. We shall soon see how this was resolved.

One finds in this law of November 2, 1892, several particularly interesting points. We will note these as follows:

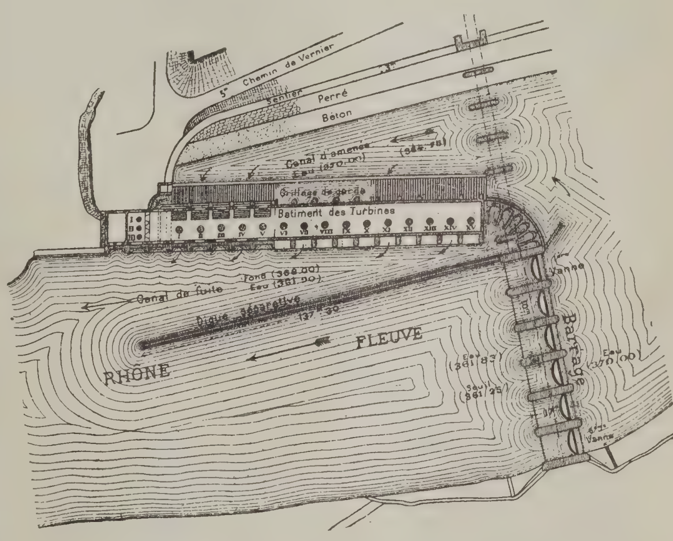
First. The concession is given by the State to the City of Geneva for a term of 99 years, terminating on November 3, 1981;

Second. The city, grantee, is bound to restore to the workshops on the Rhone the amount of power which they were then using from the river;

Third. The State reserves to itself a part of the benefices after the deducting of 6 per cent. for interest and abatement of the expense of first cost.

It is well here to note and bear in mind that enterprises of this kind, on account of the risks they carry and of the considerable capital that they require, have need of long abatements, and can scarcely, in general, accommodate themselves to short terms, which would tend to reduce the value of the ordinary concessions for public works. For this reason the Swiss concession of Chevres, with the French concession of Jonage, constitute examples deserving of serious thought if one wishes to encourage capital to carry on weighty affairs and to content itself with low tariffs, both of which are advantageous to the public.

One will remark in the second place the obligation placed on the concessionee of restoring to the pre-existing installations the power of which they had before enjoyed the use in preference to paying an indemnity for dispossession.



Plan of Works and Dam at Chevres.

Finally, the State reserves to itself a part of the benefits to be derived after the remuneration of the capital. This action appears at the first glance less justifiable.

In France the participation of the State in benefits is usually limited to the reimbursement of the advances made. It is true that, in this case, the State means to assure itself of other advantages like that of receiving energy under special conditions for public services, and that this will be extended without doubt to the benefit of the Departments and to the Communes. It is true that, in the case under consideration, the concessionee, being a city which forms in itself the greater part of the State, the distinction loses much of its interest, and so much the more in that the whole State of Geneva is interested, as one will see later on, in the prosperity of the affair, since the distribution of the energy is capable of extension to all parts of its territory. Under these conditions a prelevy of 6 per cent. for interest and abatement of capital assures it a sufficient remuneration. After the account returned for municipal service the repayment of the expenses borne by the city for the power house of Chevres was raised to 5.60 per cent. for the tax of 1899.

The power house is situated on the Rhone, 7 kilometres below the junction of the Arve, below the village of Vernier.

It comprises a large dam formed of six metallic gates, each of 10 metres opening, and separated by piers of concrete of 3 metres in thickness, a canal 137 metres in length, the building of machines and of divers annexes.

The dam is 75 metres long. It rests on a construction of concrete 16 metres high, 1m. 10 thick, and is covered with thick oak planks for protection against the gravel which escapes between the piers. The working of the gates is done by hand by means of cranks, two men, by exercising an effort of 17 kilograms each, raise the six gates 0m. 75 in an hour, or a single gate 3m. 70 in forty-five minutes. Each gate is built of eighteen iron plates, stiffened by nine parabolical frames. Each weighs 50 tons. They are balanced each on four cables of steel of 33 millimetres diameter, and each supports a water pressure of 360 tons. Above the gates runs a foot-bridge for working. The dam, commenced in 1893, was finished in January, 1894; it is entirely built of concrete, with Portland cement for the piers and the foundation.

The campaign of 1894 was devoted to the construction of the buildings for the machinery, founded on the bottom rock of the river, and in the inclosure of two sluices. A single pump sufficed for the exhaustion of the water. It rested on eighteen joists or rails 7m. 50 in length, separated by piles 1m. 50 from center to center, set in concrete.

The power house of Chevres contains fifty-eight turbines, of which three are for the excitors and the remainder for the dynamo generators.

They are of two different types; those for exciting (150 turns a minute) give 150 horse-power, the others an average of 1,000 horse-power each. They all come from the house of Escher, Wyss & Co., of Zurich.

The height of the fall of Chevres is very variable. In low water the fall is 8m. 50, and only 4m. 30 in high water. It was therefore necessary to find a combination which would give a power almost constant, notwithstanding the considerable variations of the fall, according to the seasons. The difficulty was complicated, besides, from the necessity of securing under all circumstances a speed of rotation sufficiently high (eighty turns at least per minute) for the driving of the dynamos. This problem has been solved in a very ingenious and satisfactory manner by the division of the total fall into two stages, corresponding to the several states of the river.

For this purpose each vertical shaft carries two turbines, one above the other. The lower one is specially established for the period of low waters, where it operates alone under the fall of 8m. 50, and develops 1,200 horse-power. The upper turbine serves conjointly with the other during the high water, and is combined with it in a manner to give from the summer fall of 4m. 30 800 horse-power. In each case the speed of rotation remains constant.

The units are of two different types, for the construction was by steps, running over a period of several years (1895-99). Those of the first type (1893-96) are suspended on a bath of oil under pressure.

Each turbine has its gate, with its governor in connection with the corresponding regulator. This last is put in action by the shaft of the turbine. It acts on the apparatus of hydraulic regulation (a pressure of oil of about 15 atmospheres) in a very prompt manner,

Electric Generators at Chevres.

the organs of regulation following instantly the indications of the tachymetre. The compensation is made so rapidly that when there is produced, for example, a sudden variation of 300 horsepower in the resistance, the number of turns varies but 3 per cent. for a few seconds, and then returns immediately to the normal speed.

The flow per unit varies according to the seasons between 11 cubic metres and 21½ cubic metres per second. The average power of the house is from 12,000 horse power to 15,000 horse power. At the top of each vertical shaft is mounted the corresponding generating dynamo.

The alternators at Chevres are disposed so as to produce either single or diaphase currents by making a slight change in the arrangements.

They have exteriorily the aspect of large clocks 4m. 50 in diameter and 2m. 20 in height. Numerous openings facilitate access to all the parts and insure their ventilation. Altogether the arrangement is strong and simple.

The switchboard is divided into three parts, and contains thirty-four panels.

From the power house go the primary lines. Those which feed Geneva comprise two subterraneous lines, and aerial lines feed the several neighboring Communes.

Each subterranean line carries 2,500 volts, and contains four conductors of 490 square millimetres of working section. The seven cables which constitute a conductor are insolated in a concrete of resin of vaseline in the interior of a masonry aqueduct. The aerial lines, consisting of four strands each, have sections proportionate to their output. This is from 28 to 98 square millimetres.

The system, which is now 160 kilometres in length, keeps increasing rapidly. It should soon reach to the south bank of the lake, or even to Corsier. On the opposite side it reaches to Versoi and to the French frontier at Fernex. The power house of Chevres distributed in 1899 5,000 horse power for electro-chemical use, 4,500 horse power for motors and lighting (55,000 lamps), and more than 1,850 horse power for certain special motors, making in all 11,430 horse-power. One foresees the near utilization of the total energy given by the fall.

The kilowatt-hour at leaving the power house cost in 1889, without interest or charges, 0.0047 franc. The gross receipts for 27,500,000 kilowatts sold were 512,444 francs. This was equal to 0.0186 franc per unit.

The cost of establishing the power house of Chevres was 8,500,000 francs. The budget of the last inspection (1900) showed a profit of 435,700 francs, being a little more than 5 per cent. of the capital invested. On the other hand, the expense of exploitation (223,000 francs) has left a net recepit of 289,377 francs.

The increasing sales are shown by the following table:

Years.	Gross Receipts.	Expenses.	Net Receipts.	Kilowatts Produced.
1897....	178,412 fr.	110,143 fr.	68,269 fr.	3,669,876
1898....	269,137	129,390	139,947	9,517,262
1899....	512,544	223,167	289,377	28,066,480
1900....	630,635	295,000	335,635	31,111,451

The future of this great enterprise seems assured, the net receipts of the last inspection represents already nearly 4 per cent. of the capital invested, and the continual progress shown by this table does not leave a doubt of the larger value to be shown at the next inspection. The whole of the force will probably be utilized in a few years. This is explanatory of the fact that the authorities are already contemplating the creation of a new source of energy below Chevres, and it also justifies the confidence which this sort of undertaking inspires in those who are witnesses of their rapid development.

The power house of Chevres sells energy at the rate of 8 centimes per hectowatt-hour for lighting; for from 150 to 750 francs the horse power year, according to the amount of power used, and from 8 to 25 centimes a kilowatt-hour for small motors.

Central Station of the Island

The old central station of the island is fed at present by water under pressure sent from the power house of Coulouvreniere and by the diaphase alternating current sent from Chevres. It produces direct current at 110 volts for lighting, distributing it with a three-wire system, and a current at 560 volts for the service of tramways.

The transformation of the alternating current into direct is made by means of two rotary commutators for lighting and of three for traction.

Such, very incompletely summed up, are the principal features of the great hydro-electric installation of Geneva. Their study is particularly interesting from the fact that they show united in the one territory a great variety of methods for the transport of energy and a variety as great for its employment.

Finally, it is interesting to note that, to guard against the irregularities of the water power at Coulouvreniere, the city has established there a centrifugal pump of 1,000 horse power, driven by current sent from the power house of Chevres, and capable of raising 380 litres per second to a height of 140 metres. This detail shows well the superiority of the second installation to the first, for this, notwithstanding its incontestable qualities, has had to have recourse to Chevres in order to assure itself at all times of a regularity of output which of itself it was powerless to guarantee.

The whole of the hydro-electrical plants of Geneva have cost about 22,000,000. The municipal service has drawn from it 7½ per cent. This return is the best proof of their utility.

Used Sawed Ties and Didn't Know It

By Joseph E. Ralph.

A RAILROAD is truly a world within itself and the diversity of subjects that have to be considered by the officials runs through a wide range. The old incumbent has records and precedents to guide him, but a newly appointed superintendent, generally with experience limited to one department, is sometimes sorely tried. Success—measured in economy of management—is the thing expected; unwise expenditures may mean a set-back.

The writer was confronted with a tie problem while acting as a division superintendent on one of the trunk lines and could not make up a precedent. The tie specifications of the company were very explicit: The ties must be of just such a length with the ends sawed square, of just such a thickness, of not less than such a face measurement, and they must be hewed and true and without twist. Of these specifications, the one most strenuously insisted upon was that the ties must be hewed and not sawed. The supervisor reported that a mountain saw mill had sawed out a lot of ties from the ends of some unusually fine white oak logs. He said they were about the finest eight hundred ties he had ever seen. But they had the fatal defect of having been sawed instead of hewed. If we bought them we could not ship them to the main line, nor use them on our track, and the number was more than we were likely to be able to use for private sidings for several years. But at thirty-five cents as culls, the price at which they could be bought, they were too good an investment to let go. Regular white oak ties cost sixty-five cents. I bought the lot, but with many misgivings.

Not long afterwards Engineer H—— was instructed to remodel one end of a large yard with the switches and tracks on a newly adopted plan and to have it ready for the annual track inspection. He wrote to our division offering an extra ten cents each for a specially fine six hundred feet of white oak ties—to be above reproach.

Here was our chance! But there were the tell-tale saw marks on the ties, and Engineer H—— had the reputation of being the hardest material inspector to impose upon in the company's employ. But a plan suggested itself. I called in the master carpenter and bridge builder.

"How many jack-plane bits have you got?" I asked.

"About two dozen."

"And how many plane-blocks?"

"Half a dozen."

"All right," I said; "take them up to the mill and teach the men to jack off those ties so as to get out every saw mark, but not to make them look too smooth."

The bits were well rounded.

We allowed the mill owner five cents

a tie, and he gave the men two cents as piece work and so got the job rushed. Engineer H—— was so delighted with the ties that I got him to allow us an extra five cents each. He never suspected that I had led him into a serious infraction of the company's rules.

When the track inspection struck our division the supervisor and myself came in for special praise; our ties (and some upwards of four hundred in an additional order) were the one point above all others that made the success of the piece of show track; they were fine and so true; no such ties for surface had ever before been seen. We kept straight faces and an humble demeanor and said nothing.

One of the peculiarities of that system was the appointment of superintendents from the engineer force, and their first assignment was to single-track divisions. About two years after the tie incident Engineer H—— was appointed as superintendent of our division.

He was a good fellow and a good superintendent. He was proud of the reputation he had earned while an engineer-in-charge, and apt to boast that no one had ever imposed upon him in the matter of material.

On one of these occasions, actuated by the perversity that seems to cling to humans, I felt that I could not further resist temptation, and I told him how we had imposed upon him. At first he bridled up quite indignantly and denied the possiblity of his having been so deceived, and it was not until the supervisor corroborated the story that he fully believed it. When he was convinced, he said we had been very cute, but that after all we had given the company the best lot of ties he ever saw, and had made for our division a neat little profit, besides having found a way to make a perfect edge-tool cut surface that beat any hewed tie ever made for level surface and uniform thickness.

My connection with the tie industry was short lived, but I have often thought since that a joint sawing and planing outfit could be run through the woods like the travelling sawmills and would make better ties for less expense than the old hewing process.

A Wear-Compensating Chain Gear

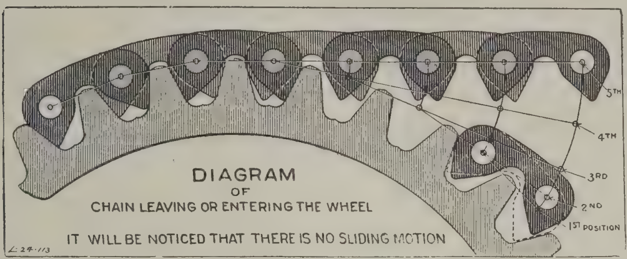
THE Renold silent chain gear, which was introduced into this country from Europe within a year, marks the latest advance in devices for the transmission of power.

Chain gear of one sort or another has been used for driving purposes for generation after generation, but it was looked upon as but an unrefined way of transmitting power, and was used, as a rule, only for purposes where the conditions would not admit of the employment of belts or wheel gear.

The development of the safety bicycle, with its chain and sprocket connection between pedals and driving wheel, probably did more to call attention to the mechanical possibilities of the chain than anything else had done for centuries. It also showed where the faults of the chain lay.

With sprockets and chain-links, all new and properly cut, no more perfect gear can be desired. In this condition the links and teeth work together exactly like two properly made gear wheels. Tooth and link roll upon one another without the least sliding friction, and the only parts needing lubrication are the pins which unite the links.

With such a gear, protected from dust and dirt and working through a bath of oil, the loss of power is very slight and the wear upon it is insignificant. But these are conditions which can but seldom be met.



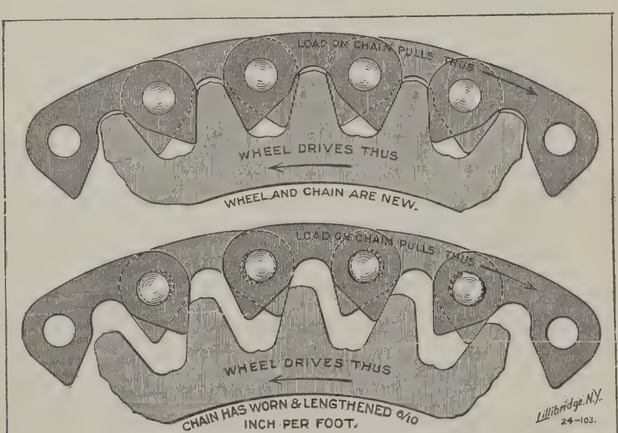
Under ordinary conditions wear begins at once, and proceeds rapidly. The result is a lengthening out of the chain, bringing the links further apart, and at once destroying the accuracy of the pitch line upon which depends the absence of sliding friction in the working. Teeth and links begin to cut and rattle, and soon such a chain is using up a large part of the power which it should transmit. Bicycle riders discovered this to their cost, and in later days the auto-car owners found themselves confronted with the like trouble.

In the automobile chain gear is almost indispensable. To protect the driving machinery from the strains of jar it must be on a spring-suspended structure, and the connection to the driving wheels must have that elasticity which can only be found in a belt form. But it must also have a rigidity and strength which can only be got by the use of a metal belt.

There are scores of other uses where the metal belt, working with the absoluteness of wheel gear, is more advantageous than any other means of connection.

For connecting electric motors to driven machinery—and, in fact, for making any connection where the driving pulley or wheel is of much smaller diameter than the driven one—the linked metal belt is of the highest value. It is also desirable for machine tools where all the movements of parts must be kept in a certain relationship to one another.

For these reasons the Renold chain sprang into wonderful popularity from the moment its superior qualities became known. Few articles of manufacture have come into such extended use in the short time that the Renold chain has been upon the market. Its peculiar feature is that it is designed to automatically compensate for the wear at the pin-holes and to always keep the teeth



of the chain meshing properly with the teeth of the driving and driven wheels. The manner in which this is accomplished and the general construction of the chain are clearly shown in the accompanying cuts.

A New Superheating Boiler

MANY valuable and wonderful results can be obtained through the use of superheated steam. Superheated steam is an exceptionally hard thing to produce. The problem is a difficult one. Any vessel containing steam alone and exposed to a hot fire will rapidly burn out. If the steam contained be under pressure the result would naturally be disastrous.

Steam cannot be superheated while it is in contact with water. It will, then, be seen that the inventor, trying to solve the problem of producing superheated steam is between the horns of a dilemma. If he endeavors to protect his boiler with water he cannot superheat his steam; if he endeavors to superheat the steam he burns out his boiler.

The superheaters which are now used are placed far away from the fire, where the gases of combustion can only reach them after these have been greatly cooled by contact with the regular heating surface of the boiler. As they are applied they are comparatively small affairs, equaling only about one-tenth of the heating surface of the boiler. Their action is by no means constant nor reliable. Notwithstanding these disadvantages the use of superheated steam has proven to contain such elements of economy as to make its more extended use extremely desirable. Engineers who are experts in the matter of steam production and use declare that, by superheating, a very considerable portion of the great losses now sustained in the use of steam and the steam engine may be avoided.

The newly invented boiler, which we are about to describe, it is asserted by the inventor, will not only produce superheated steam in abundance, but will also enable the users to take advantage of several new principles for the encouragement of evaporation which are now entirely unknown to those engaged in the present way of steam making. It is asserted that crude tests have already been made with a boiler of the new design, working side by side with one of an older type, and that these tests have shown absolutely satisfactory results. The inventor is Mr. Joseph Misko, M. E., of this city.

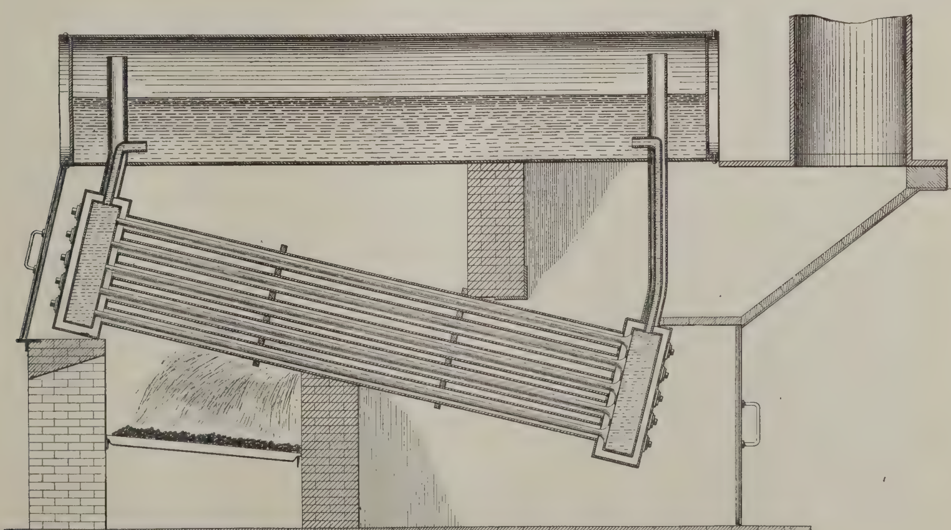
"This invention," Mr. Misko says, "turns the entire boiler into a superheater. The fire heats the steam direct instead of the water; the water merely serves as a reservoir for the further supply of steam as the latter is used, and to cool the steam to a certain degree and to counteract the tendency of the fire to burn out the vessel containing the steam."

The principle upon which this new boiler is designed is very simple. It is based upon the fact that, if the steam to be superheated be spread in a thin body immediately behind a plate upon which the fire acts, and that if just back of this thin stream of steam there is placed a body of heat-conducting material, that this last-mentioned body would carry away such surplus heat as it was not desired to impart to the steam itself, thus imparting to the steam the degree of superheat desired, while at the same time protecting the heating-plate from being burned out.

If we take a tube, say 3 inches in diameter, and place within it another tube 2¾ inches in diameter, there would be left a space one-eighth inch across all around between the two tubes. If, now, we lay this double tube down at an angle, and at the lower end so connect its two parts as to allow water to enter the inner tube and to allow steam to enter the space between the two tubes, then we have the characteristic feature of the Misko boiler. In this way the water is steam-jacketed. If we expose this tube and its contents to the action of a hot fire, maintaining the angle at which the tube lies, the fire will heat the steam and the water of the inner tube will cool it. The outer tube, it is asserted, can never burn out because it can never become hot enough. As fast as the heat goes into the steam the water of the inner tube absorbs it. The water of the inner tube becomes heated and ready to provide a new supply of steam to be superheated as rapidly as that steam which has already been superheated is drawn away for use in the engine.

The amount of superheat which would be given to the steam in such an apparatus would depend entirely upon the distance between the inner and the outer tubes. The narrower this space the greater would be the counteracting effect of the water in the inner tube and the less the superheating. It has been calculated that, if this space were reduced to the one-one-thousandth part of an inch, the counteracting effect of the water would be so great that it would be impossible to superheat the steam at all. On the other hand, it has been calculated that, if the steam space were 1 inch across, then the water would practically lose its effect, and the vessel holding the steam would be burned out.

In the accompanying illustration the invention is shown as it might be applied to an ordinary Babcock & Wilcox boiler. Here it will be seen that the two ends of the inner tubes are connected with the water in the steam drum. The steam space between the two tubes is connected



The Misko Steam-Jacketed, Double-Tube Superheating Boiler.

with the steam space of the steam drum. The pressure on the inner tube is the same upon either side of it, and it, therefore, has no strain to sustain. This tube can be made almost as thin as tissue paper. The cooling effect which would be attained by the use of a very thin tube would allow for making of the steam space larger than it could otherwise be. This would allow of a superheating of a greater amount of steam in a given time.

"It must be understood," Mr. Misko explained, "that the steam in the space between the tubes traverses and circulates at an enormous speed, colder steam taking the place of that which has been superheated. The question would be which of the two—the fire or the water—would run away first with the thin film of steam. The steam hardly stays one-tenth of a second in the superheater. Will the outer jacket burn out or not? If it does burn out, the whole invention is not worth two cents. If it does not burn out and the distance between the two tubes can be adjusted to an absolutely reliable point, this is then one of the most far-reaching and valuable inventions that has ever been made. It would thus be possible to safely furnish a sufficient increase of heat to steam to have it remain as steam, even when it had been expanded in the cylinder of an engine from a very high initial pressure down to the pressure of the atmosphere.

"It seems unnecessary to speak of the economy that might thus be produced. Everyone knows that steam is 1,700 times as large in volume as the water from which it is produced, and, if steam can be prevented from becoming largely water while it is expanding in the cylinder of an engine, then a much greater amount of work can be got out of it than is secured in present practice.

"The principle of my invention is to heat the steam first instead of the water, then superheat the steam, at the same time keeping the temperature of the water below its evaporating point, and to allow the superheated steam to come into contact with the surface of the water in the steam drum, thus making the steam do the evaporating. Instead of having the evaporation proceeding at all points at once throughout the boiler, I would evaporate only on the surface of the water, freeing sufficient steam on the surface of the water to make it constantly replace the volume of steam used in the engine. The wet steam from the surface of the water then goes through the superheating process; from there out of the boiler direct, without mingling with the wet steam, and to the engine, ready to do its work. This would result in an economy absolutely unattainable up to the present day. Superheated steam is the dream of all the steam engineers.

"Another principle involved in the design of this boiler is to keep the water throughout the entire boiler at absolutely the same temperature and thus prevent its circulation. It should be understood that circulation in the present boilers is desirable and absolutely necessary; but it can also be seen that when the entire boiler is steam-jacketed, this would be unnecessary.

"Another advantage which I claim for this boiler is that its use will naturally do away with the formation of scale. There is no scale in steam."

Mr. Misko also points out that it would be practicable to copper-plate the entire inner surface of such a boiler after all the tubes are joined together and thus prevent all possibility of galvanic action between the various parts of the boiler, if copper tubes were used for the heating surface.

Some Curious Results in Superheating Steam

By J. Emile Coleman, M. E.

ANYTHING relating to the production or use of superheated steam is to-day of high importance. Although the employment of superheated steam is still comparatively rare, yet it is bound to increase with the demand for economy in power production, and this increase will be the more rapid as the steam turbine is introduced in place of the reciprocating engine.

The purpose of this article is to call attention to some curious effects observed in the use of superheating steam which came to my attention recently while making a test of a 300-horse-power De Laval steam turbine at Trenton, N. J. The test of the turbine was described by me in the Electrical Age in July.

In giving the results of that test I said, referring to the variation of about 23 per cent. in steam consumption between full load and three-eighths load, that "it is safe to say that it would have been much less if the steam had been superheated throughout as it was for the full load run. The lack of superheat with the lighter load is due to the fact that the superheating power of a boiler falls off with its load."

The boiler used in the tests was of the water-tube type, and was fitted with a superheater. Its rated capacity was 250 horse-power. The turbine was developing a little more than 300 horse-power at a steam consumption of about 14.3 pounds per horse-power hour, so that the boiler was carrying only about 65 per cent. of its full load. The steam pressure was maintained at as nearly 200 pounds gauge as possible.

The accompanying diagram gives the more important readings taken during this test. From this it may be seen that the average amount of superheat was about 60 degrees Fahrenheit. During a three-quarter full-load run of the engine the boiler only produced about 16 degrees of superheat, while with one-half full load and lighter loads the steam was not superheated at all. This falling off of the superheat with light loads has been observed with many boilers, and may be accounted for by the fact that the fire is not forced so much, and the heating surface being the greater per pound of steam produced, the furnace gases are cooled so rapidly by the water-heating surface that, on reaching the superheating surface, they are not effective.

The graphical log, showing the variation of pressures and temperatures throughout this test, is particularly interesting, because of the remarkable resemblance between the two diagrams representing the temperature of the steam and the degrees of superheat.

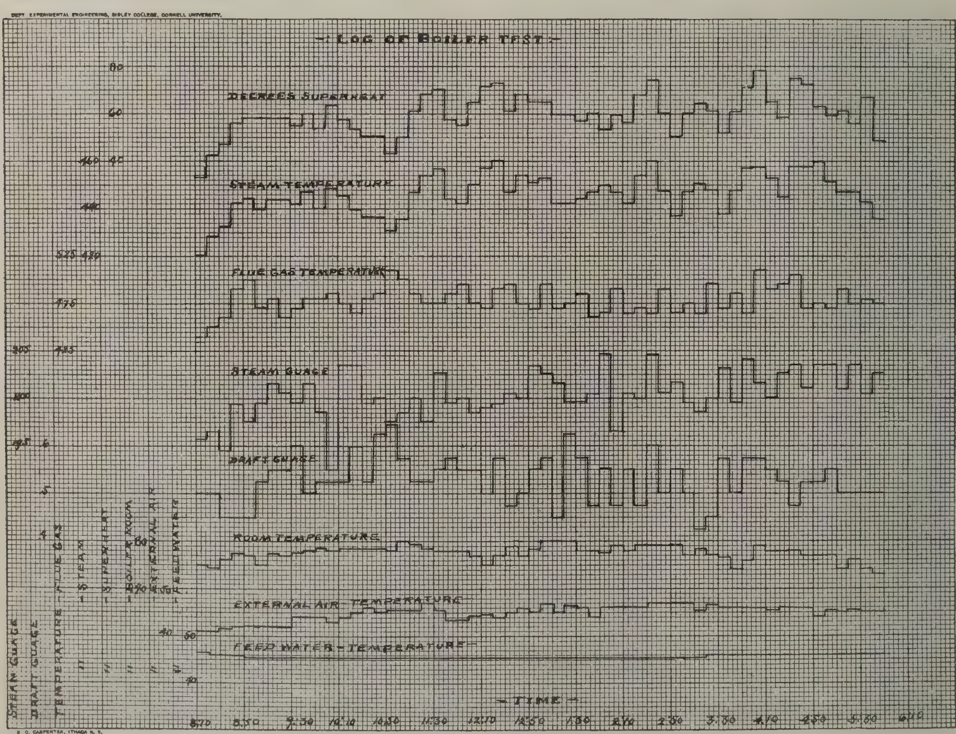
If one of these lines were superimposed upon the other the two would almost coincide. If we subtract the degrees of superheat from the steam temperature the result would be the temperature of dry and saturate steam at the boiler pressure, and it would practically be represented by a straight line.

Glancing now at the diagram representing the steam pressure we see that it does not coincide at all with either that representing the temperature of the steam or the degrees of superheat, and that it might well be represented by a straight line, as it should if the temperature of the dry and saturate steam were represented by a straight line. The oscillations in the steam pressure would naturally be greater than those of the temperature if both were drawn to the same scale, as at 200 pounds gauge pressure a change of 3 pounds pressure corresponds to but one degree change in temperature of dry and saturate steam. The temperature of the escaping flue gases could also be best represented by a constant average value.

It would seem, then, from these diagrams that, where the load is great enough so that the boiler will produce a fair amount of superheat, the superheater is quite sensitive to changes of the temperature of the furnace gases.

With the reciprocating engine high degrees of superheat have not been practical, because of the moving parts under steam pressure that must be lubricated. With steam turbines this is not the case.

It is the opinion of the writer that the best results from turbines will probably be obtained by the use of highly superheated steam at ordinary pressures, although the turbine is well adapted to extremely high pressures.



Log of Boiler Tests Showing the Relationship of Superheat in Steam to the Load on the Engine.

Where the Heat of Coal Goes

Good anthracite coal will produce, when burned properly, 12,000 to 14,000 British thermal units. A heat unit is the equivalent in power of 778 pounds raised 1 foot high in one minute. A horse power is the raising of 33,000 pounds 1 foot high in one minute or its equivalent. A horse power, therefore, would require, in theory, 2,545 British thermal units an hour to produce it.

This means, in theory, that a pound of average anthracite equalling 13,000 British thermal units should produce something more than 5 1-10 horse power.

As a matter of fact, in the test power plants, worked to their full capacity, it takes nearly ten times as much coal to produce each horse-power as theory demands. Some five steam plants, worked to their full capacity, such as those in great steamships, are said to give a horse-power for each 1½ pound of coal burned per hour. In good modern plants 2 pounds an hour per horse-power is, however, nearer to the amount consumed. In smaller plants and older ones the consumption often reaches 4 or 5 pounds an hour. Where does all the surplus heat go to? It is wasted.

The following table shows the losses. It also suggests remedies:

Heat Losses.		Heat Units.	Heat Units.
Two pounds coal		26,000	
Loss up chimney	22	per cent.	5,720
Loss through grates, coal	1	" "	260
Radiation from boiler ..	5	" "	1,300
" main pipes...	1.56	" "	504
" auxiliary pipes	22	" "	57
" from engine..	2.08	" "	540
Exhaust, main	57.31	" "	13,806
" auxiliary......	1.40	" "	364
Total loss	86.35	per cent.	22,452
Converted to power	13.65	" "	3,548
Total			26,000

Horse Power of Boilers

Here is a simple method of calculating the horse-power of boilers of various sorts:

For horizontal tubular boilers multiply the square of the diameter in feet by the length in feet and divide by five. Example: Diameter 3 feet, length 10 feet.

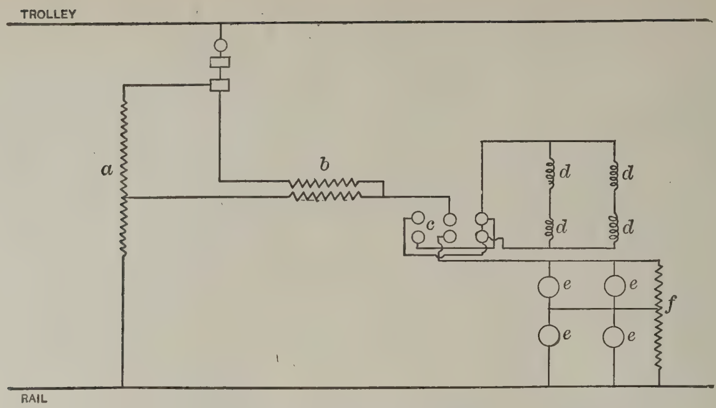
Square of 3 equals 9, multiplied by 10 equals 90; 90 divided by 5 equals 18 horse-power.

For vertical tubular boilers, multiply the square of the diameter in feet by the length in feet and divide by four. For flue boilers, multiply the length by the diameter and divide by three. For boilers of the locomotive type, multiply the square of the diameter at the waist by the length over all and divide by six.

New Device for Automoblile Men

An automobile circuit-breaker for use in charging automobile storage batteries, designed to protect the batteries from damage through over-charging, has just been put on the market by the Westinghouse Electric and Manufacturing Company.

The principle of its operation is the automatic opening of the circuit when the charging voltage across the battery terminals rises to a predetermined point, dependent upon the nature of the battery and its voltage or number of cells. The device is made in two varieties.



Automatic Circuit-Breaker for Auto-Car Charging and it's Connections.

One with a single heat coil is for use with ten-cell batteries, and the other, with two coils, is used for charging twenty-cell or forty-cell batteries, according as the coils are connected in multiple or in series. For convenience in adjusting the circuit-breaker its scale is graduated in volts and calibrated at the working temperature of the coils.

It is asserted by the manufacturer of the new device that experience has proved that 90 per cent. of the injuries suffered by storage batteries has been the result of carelessness or ignorance in charging, and that this can be prevented by using the new circuit-breaker.

The accompanying illustrations show the new circuit-breaker and also the manner in which it is introduced into the charging circuit, and the method by which the two-cell instrument is arranged with its coils in series and in multiple. Tables are furnished showing the point at which the instrument is to be set so as to make it trip at a given point when the temperature of the charging room, varying from 40 to 100 degrees Fahrenheit.

An Electro-Volcanic Theory

The following interesting suggestion in regard to the causes of the "glacial age" and of the present eruption of Mount Pelee were contained in a letter sent recently to the Editor of "The Electrical Age" by Mr. F. Cope Whitehouse, of New York City:

"Professor Assmann, of Berlin, showed by means of a balloon, which released a parachute carrying a barometer and a thermometer, that, at 12½ miles altitude, the temperature was 80 degrees Fahrenheit. Now a chimney would disturb the air some considerable distance above it. I have never seen a calculation of the height of disturbances due to one of those big chimneys used for chemical works, but I suppose that a balloon might feel at least a mile above its mouth. Mount Pelee would certainly be uncomfortable for, say, 10 (!) miles above it.

"My theory is that the 'glacial age' was due to the disturbance of the cold immediately above the surface of the earth, the diversion of a current of cold air—it might be of a temperature of 200 degrees Fahrenheit—and its precipitation on the earth. Is this the cause of our cool summer? The electric discharges from Mount Pelee were a 'circuit.' What was the other pole? Why? Was it a 'thermo-electric' disturbance?"

The Electricity Building at the St. Louis Exposition

LOCATED on the main central avenue of the ground, and forming one of the leading elements of the Exposition picture, will be the building devoted to electricity at the St. Louis Exposition in 1904. The building will have a frontage of 650 feet to the north and 525 feet towards the east, facing the main lagoon. A better comprehension of the size of the building can be obtained when it is understood that the length will equal that of about three city blocks.

The design is a bold columnated treatment of the corinthian order. The columns are carried well down towards the ground, to give height to the facades The facades will be well accentuated by elevated pediments and tower effects over the four main entrances and at the corners. Over the accentuated places, as well as over the twin columns, which form a pleasing variation of the treatment of the facades, opportunity for ample sculptural decoration is supplied.

The fenestration is bold and appropriate, giving ample light and substantial wall treatment. On two sides of the building are to be loggias, which will add pleasing effects of light and shadow. There will be numerous openings on the facades, such as exhibitors always seek in selecting their exhibit space. The plan of the building is simple and well treated, showing an effect to supply as much exhibit space as is possible with the 292,000 square feet of floor space. The exhibit space is compact and symmetrical. An extensive balcony will sweep around four sides of the building, supplying 100,000 square feet of additional space.

An enormous traveling crane, to be used in the installation of the big electrical machinery, which is to be shown in the building, will run on tracks in the western bay. The doors of the building will be of gigantic dimensions, eleven by eighteen feet. The building will have 176 trusses, the largest span being eighty-two feet in length. One hundred and eighty-five tons of iron and steel will be used.

A novelty in the construction of exposition buildings appears in the specifications, which provide for a temporary stairway to be put up of rough lumber and to be taken out before the completion of the building. The stairway is to lead to the roof. The object of this is to make the building a show place during construction so that visitors may ascend to the roof, without the necessity of climbing ladders and crawling through scuttle holes, and to make it possible for women to get a view from the same point to which men might ascend by ladders.

The areas under roof of some of the successive world fairs were as follows:

London, 1851	21 acres.
Paris, 1867	37 acres.
Philadelphia, 1876	56 acres.
Paris, 1889	75 acres.
Chicago, 1893	200 acres.
Paris, 1900	125 acres.
St. Louis, 1904	250 acres.

The attendance of visitors was as follows:

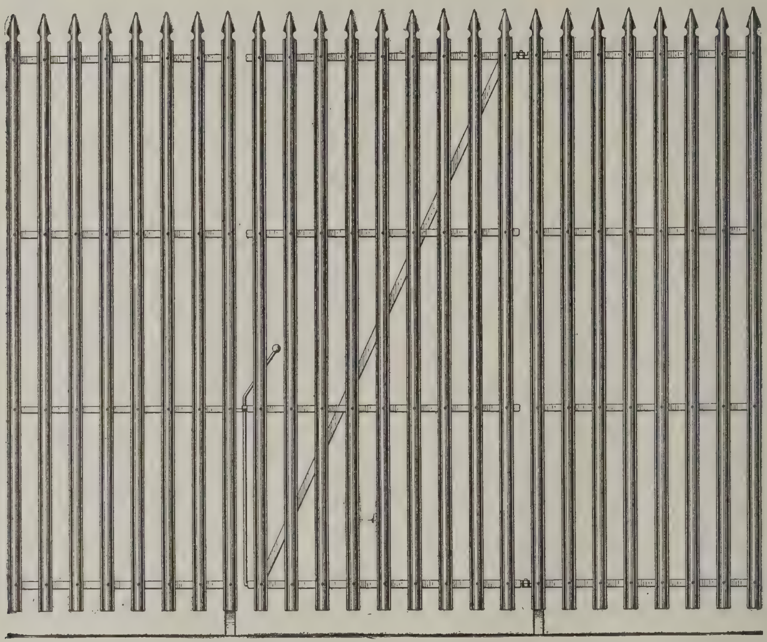
London, 1851	6,000,000
Paris, 1867	10,000,000
Philadelphia, 1876	10,000,000
Paris, 1878	13,000,000
Paris, 1889	32,000,000
Chicago, 1893	28,000,000
Paris, 1900	48,000,000

The expenses incurred, as nearly as

this can be determined, are as follows:

Paris, 1867............ $4,000,000
Philadelphia, 1876...... 8,500,000
Chicago, 1893........ $35,000,000
St. Louis, 1904, estimated at between $45,000,000 and $50,000,000.

A Novel Fence for the Exposition Grounds



Pressed Steel Fence Made for Exposition Grounds.

Every great enterprise is a stimulation to invention, and the cause, either directly or indirectly, of renewed activity along industrial and commercial lines. It is in these ways that they pay.

The St. Louis Exposition has already caused one new article to be produced and put on the market. This is a fence made of pressed steel. The initial form of this fence—of which we give an illustration—was designed to inclose the Exposition grounds. Since the fence was selected for this purpose and a contract entered into for it, the manufacturers, Mesker & Brother, of St. Louis, have developed several other forms, which they have put on the market commercially. These forms are adapted for use about residences, in parks and cemeteries, and, in fact, wherever an ornamental fence is desired.

All complete, made to measure and ready to set up, these fences are sold for fifty to sixty cents a running foot. Each part of the fence—posts, rails and pickets—are made of sheet steel of a suitable weight pressed into a form to give them strength and, at the same time, to give them an ornamental design. The parts are held together then with bolts.

It is interesting to note that the pressed steel fence is but an addition to a line of industry already well developed. The same manufacturers show many things made of pressed steel which are interesting. Whole store fronts of pressed steel are shown in their catalogue, and the making of these includes, of course, the making of all such separate details as columns, sash, doors, cornices, window sills and lintels. They make skylight frames, roofing steps, stairways and many other articles, all by like processes. Each of these has its ornamental features impressed into the metal during the operations that give its useful form, just as is the case with the pressed steel fence.

The Most Ingenious Mechanical Device

What is the most ingenious single piece of mechanism ever made?

"The Electrical Age" desires descriptive answers to the foregoing question and will pay Five Dollars for each answer which it finds interesting enough to print.

For the answer which is finally considered the best Ten Dollars will be paid. Answers should contain from 600 to 1,800 words each, and should be illustrated with drawings or photographs.

The Screw

Editor of "The Electrical Age":

Sir—The screw appeals to me as being the most ingenious single mechanical device ever invented. Besides being one of the most powerful of the six mechanical powers, it is practically indispensable to the manufacture of all mechanical commodities, tools and machines, from the simplest household necessities to the greatest of the engineering feats of the day. It was probably first used as a power pure and simple, and then, from time to time, was modified and developed to meet the needs of divers inventors, until to-day, when the screw has invaded every branch of industry, to wield there its sovereignty forever.

Until about sixty-six years ago screws for putting work together were made by hand, and their use was not very extensive. But about that time, the demand having suddenly increased, an American, whose name has not survived, with characteristic energy and genius, invented a machine to manufacture them in quantities. That American did the world an inestimable service.

There is no record of when, how or by whom the screw was invented. If by any individual, his must indeed have been a master mind of his time. It was the height of ingenuity to have conceived the principle upon which an inclined plane twisted spirally around a center would raise or lower upon its own surface immense weights with the expenditure of proportionately but little energy. One could make a life study of the screw and never learn the end of its manifold uses. Our very door-knobs are held together by screws; our great steamships are propelled by them. These are two extremes. Try to traverse the devious path of usefulness of the screw between; life is too short, is it not?

The builder stiffens high brick walls with long steel rods running through the building, connecting wall to wall, and adjusted and held in place by screws and nuts on their ends. Thousands of corks are drawn daily all over the world. The screw has served this purpose successfully for generations. The engineer finds that only with bolts, nuts and simple screws can he construct his works with that fineness of adjustment combined with strength and economy of weight and space so necessary to the success of modern machinery. The tool of a lathe must be exactly adjusted, and must travel with unfailing evenness. Here again the screw asserts its eminent usefulness, and not only in this instance, but in like manner in the cases of numerous valuable lead screws used for many purposes. And again we have transport screws or conveyors, which have in so large a measure helped to solve the great mercantile problem of moving grains and other material in bulk. The screw is also used as a feeder in many valuable devices down to small meat choppers for household use. In chemical, philosophical and electrical instruments the screw has proved itself of incalculable value to scientific research. The carpenter's work would indeed be crude without the screw in the various forms in which he finds it useful.

How does Edison's wonderful phonograph make its record except through another application of the ingenious screw? In describing the screw and its application the difficulty lies only in pointing out in what walks of life it has not made itself indispensable. It is one of the factors of civilization. Suddenly eliminate from the world the screw and from the minds of mankind its principle, and the wrecks of all the great industries would come tumbling down at our feet, undoing at a stroke the slow progress of generations, and leaving us to rebuild on mechanical lines not yet conceived of.

There are still many "screws loose" in this old world of ours, but let us thank God for sending us the ingenious mind by which was conceived the principle of the screw!

Philip H. Coleman.

Brooklyn, N. Y., October 20.

Fire, the Greatest of Man's Productions

[The following letter from a bright correspondent, who is but twelve years of age, shows that "The Electrical Age" arouses an interest among the younger generation as well as among those of maturer years. It also opens up a field of speculation which is of wide interest. Which of man's inventions or discoveries has proved to be the greatest and most useful? We shall be glad to receive communications upon this subject.—Ed.]

To the Editor of "The Electrical Age":

Sir—The greatest and most ingenious single mechanical invention is, no doubt, the wagon wheel, as your correspondent of last month argued; but there is a wider question. That is, What is the greatest of any and all of the inventions ever made? My answer to this would be the artificial production of fire.

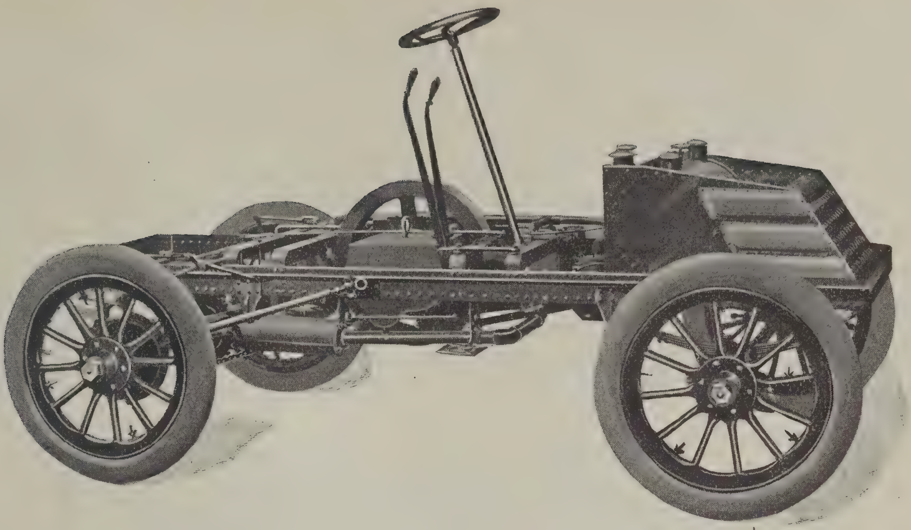
The making of fire by artificial means was very likely the first invention that man ever made. It is the mother of all inventions. Before the ingenious ancient discovered that fire could be made by rubbing two pieces of wood together humanity had to live on roots and fruits or raw meats. Nothing was cooked.

As no industry could exist without a fire, so there were no industries. If this matter is looked into carefully it will be found that the first production of artificial fire was the very beginning of civilization and industry, and is really their foundation stone.

If any one could have a perpetual patent on the production of artificial fire all the nations of the earth would have to pay tribute to him.

William Allen Willetts.

52 East Fifty-sixth street, New York City, October 20.



The Auto-Car of 1902.—Chassis of the Winton Car, an American Type.

The Auto-Car of 1902 and 1903

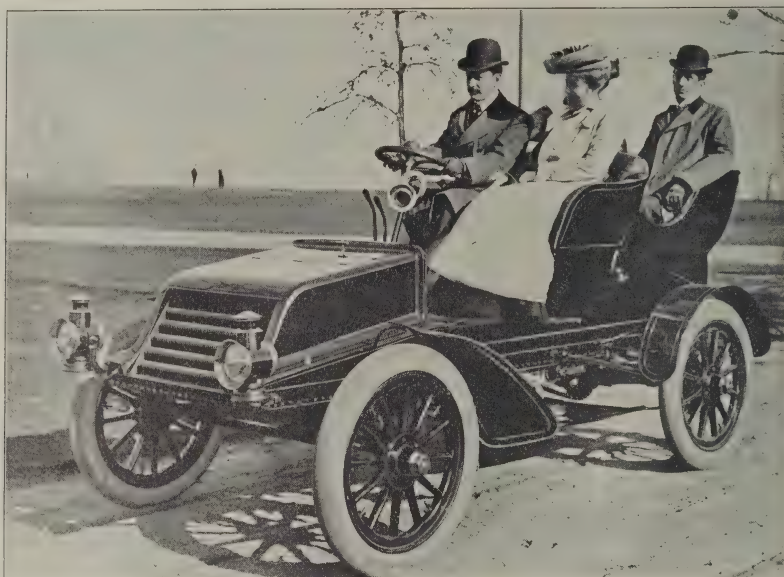
By C. J. Field

WITH the fall closing of the active selling season for automobiles, the time is opportune to review the developments made during the year in the design of auto-cars, and to forecast the principal features which are likely to appear in the machines for the coming year.

In electric and steam-driven motor cars the principal development during the year has been in the increase of mileage capacity. In the electric car this has been accomplished through improvements in the oxide battery and parts of the apparatus, giving to these cars an increase of from 10 to 20 per cent. of running distance upon a single charge without an increase in the weight of the battery. Thomas A. Edison's new storage battery, which was the most promising development of the year, is not yet in the market, and the assumption is that Mr. Edison has found that there are still details regarding it which do not satisfy him. Steam-driven motor cars have had their running capacity increased from a limit of 15 to 20 miles to double this distance, and, in the case of cars that have been provided with condensing apparatus, even to 100 miles. This class of car was restricted in the past by lack of capacity in the water and oil tanks; by changes in design these tanks have been largely increased in capacity.

Another interesting development has been the bringing forward commercially of cars in which the gasolene motor has been combined with an electric plant for the driving of the cars. Two combinations of this general character have been made. One of these is typified by the Fisher truck and omnibus. In this system a gasolene motor is coupled to an electric generator which charges a storage battery. The vehicle is operated by electric motors, which take their current from the storage battery. In the second type the gasolene motor operates a dynamo motor, which is connected to the driving wheels through a clutch, and, under ordinary circumstances, the revolving of the dynamo by the gasolene engine drives the carriage. There is, however, combined with this a storage battery, which serves as an auxiliary source of power. Whenever the car requires less than the full power of the engine to drive it the dynamo stores up the surplus power in the storage battery; when the car requires more power, the current is drawn from the storage battery, and the dynamo acts as a motor assisting the engine. The battery is used also to start the gas engine or the car through the motor.

The gasolene motor continues to be the principal favorite, and improvements which have been made during the year in this type of car make it probable that its supremacy will be maintained during the coming year. Other fuels than gasolene have been tried for this class of car. Kerosene oil has been experimented with, and has proved satisfactory for stationary work, and there seems to be little doubt that before a great while a successful motor car will be made to be operated by this fuel, but it is questionable if it replaces gasolene as the popular fuel. In France and Germany a strong movement is on foot to introduce the use of alcohol. That alcohol can be successfully used for this purpose has been demonstrated, and its use will probably occur in countries where it can be had without the payment of large sums for taxation. The desire to use it is based largely upon the fact that in Europe alcohol is a domestic agricultural product, whereas gasolene has to be imported, and costs from two to three times as much as it does in this country.



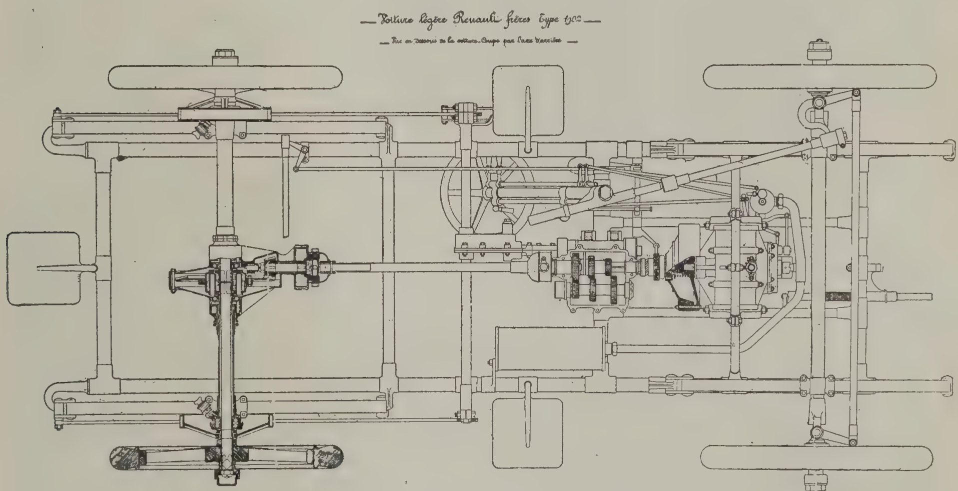
American Type.—General View.

Gasolene motor cars may be divided into two general classes. These are the standard American type, with horizontal motors, and the French and German type, with vertical motors located under the bonnet of the car, which is placed in front. The tendency seems to be directly in favor of a more general adoption of the vertical motor type. The reasons for this are largely outside of any direct question of advantage of either style of engine. One of the most important matters which has led to the more extended introduction of the vertical motor has been that it allows of more certainty in the operation of the sparking apparatus. In the horizontal motor there was a tendency for surplus oil to get beyond the piston and to smut up the sparking apparatus, thus rendering it inoperative. If the amount of oil were kept down in the crank pit there was a chance of the motor not being sufficiently lubricated. This difficulty is removed by the use of the vertical motor. The advocates of the vertical motor also assert that its general wearing qualities are also superior to those of the horizontal motor, and that this is especially so in the larger sizes. The adoption of the horizontal motor in the American type of cars was probably due in greater part to the fact that these motors lend themselves more readily to the design of car which looks like the horse carriage without the horse.

American manufacturers in designing their motor cars in the past endeavored to maintain as nearly as possible the styles and forms of carriages with which the public was already familiar.

The French and German idea is to recognize the fact that a motor car is a locomotive machine, and to subordinate the design to that idea.

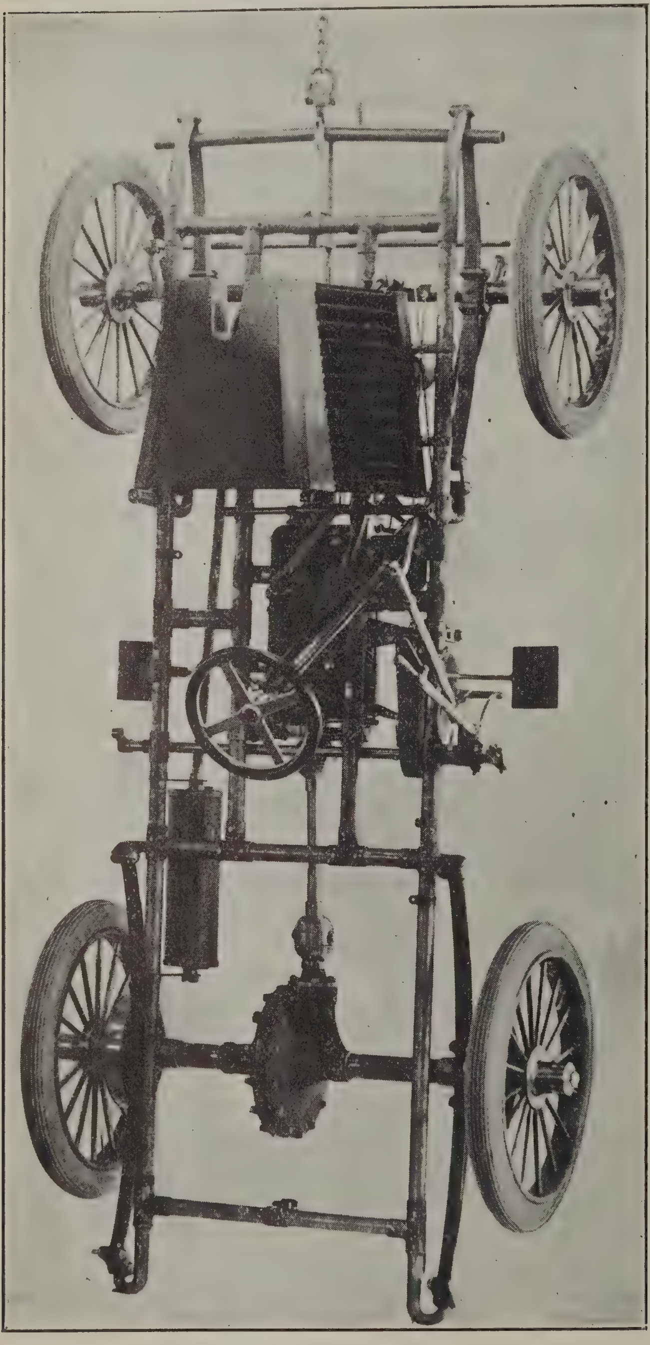
In the American type the motor is usually placed under the floor of the car and coupled to the change speed gear, and from there driving the carriage through the medium of a single chain running to the driving axle. The best known types of these cars are the products of the Haynes-Apperson Company, the Winton Motor Carriage Company and the Packard Company. Apperson Brothers, who were formerly identified with Haynes & Apperson Company, are building a car along lines which they believe are representative of the best American and French practice, retaining the feature of the double horizontal cylinder motor, but changing the position of the motor to a position under the



Foreign Type.—Detailed View.

bonnet in front, and also using a French style of carriage body.

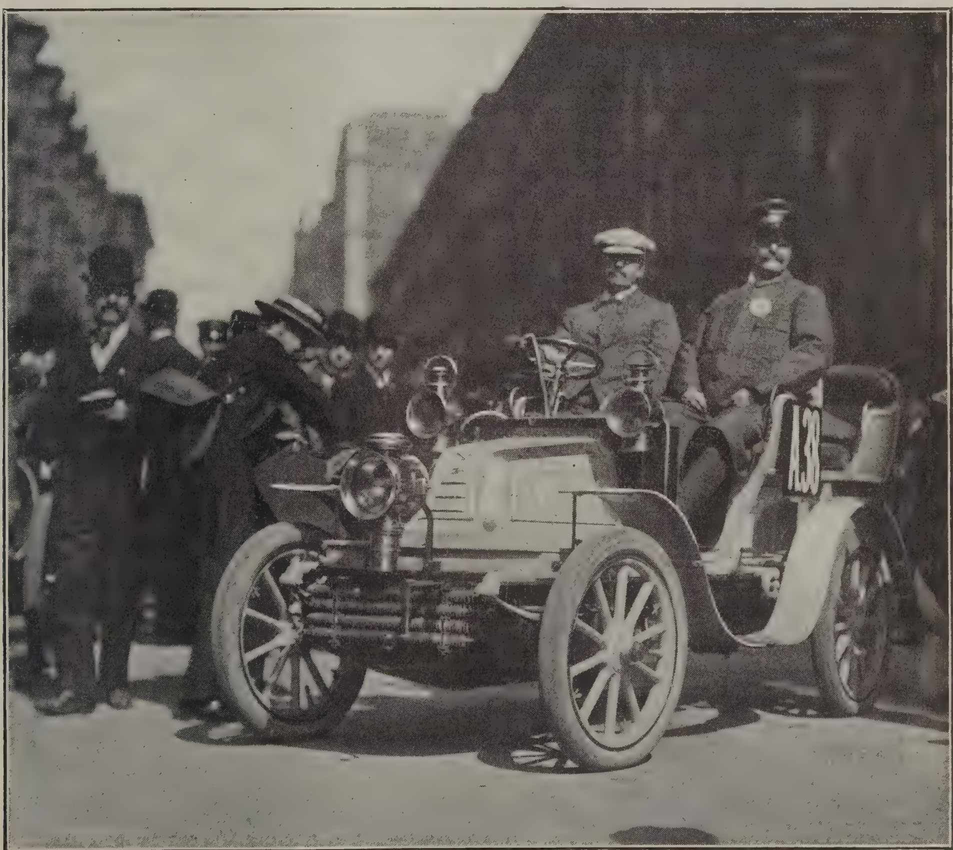
The French and German type of car is divided into two general sub-classes—the light car, or voiture legere, and the heavier car, or voiture, as they are termed in France. The lighter type may use one, two or four cylinder motors, but more generally uses a two-cylinder motor, located under the bonnet in the front. They are driven through a change gear, connected by a universal jointed shaft—which carries at its other end a bevel gear meshing into another bevel wheel—to the driving axle. Cars of this type have been developed in this country by several companies, the most prominent of which are the Peerless Company, the Ward-Leonard Company, the Berg Company, the Auto-Car Company and the Waltermobile Company. The heavier style of car is fitted usually with two or four-cylinder motors, placed forward, and connected to the change speed gear in the same general manner as is used with the lighter class of car. The motors use a longer stroke and slower rotating speed. The cars are driven through the two rear wheels by means of a chain to each wheel running from the two ends to a counter shaft placed crosswise of the car immediately behind the change gear. Prominent



Chassis of Car of Light European Type.

in the advancement of this type of car are the Daimler Company, the Berg Automobile Company, the Robinson-Pope Company and the Locomobile Company, with its Riker car, and Mr. Bostwick, in his production known as the Pan-American car. These heavier cars of the French type are just in the beginning of their development in this country, and nearly all of this type of car in use here to-day have been imported from France or Germany. Among the more prominent examples of imported French and German cars of the latter class are those of the make of Renault, George Richard, Darracq, de Dion, Clement and Decauville. Among the heavier types we have the Panhard, Mercedes-Simplex, Mors & Peuget and the Napier, a well-known English car, and one which won the Gordon Bennett cup race in France this year.

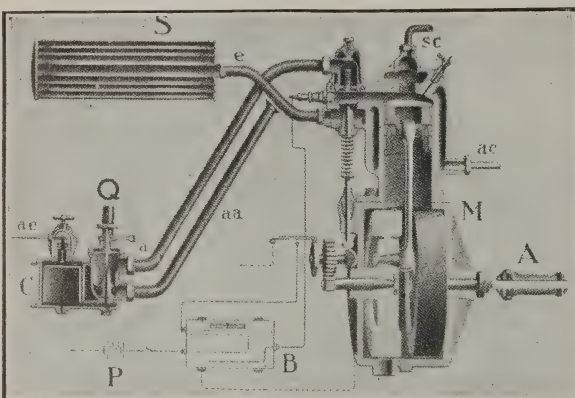
Although the manufacturers of motor cars abroad secured a long start in the business, and as a result of the experience thus gained are turning out to-day more different makes of successful cars than we are in this country, the American manufacturer is now rapidly overcoming this lead. Even in the factories of motor cars abroad the skill of the American machinist and mechanic is recognized by the use there of American machinery and tools, and, in many instances, American machine screw parts and forgings, and other parts are bought



French Type of Auto-Car.

and put on cars and reimported here on the completed cars.

The type of motor generally used for automobiles is that known as the Otto four-cycle engine. With the varying loads and conditions incident to motor-car work the four-cycle motor has proved more generally satisfactory than the two-cycle motor so commonly used for marine work. Few persons, excepting those directly connected with the manufacture or the handling of these engines know exactly what is meant by the term "Otto four-cycle" or "two-cycle" engine. The cycle referred to is not a revolution of the engine, as might be inferred, but is a cycle of movements which follow each other in constant order, the whole completing one entire operation of the engine. The proper name for the Otto four-cycle movement is the Otto four-stroke cycle. This cycle is made up as follows:



Carburetter, Engine and Muffler.

In the first stroke or movement of the piston the piston descends and draws into the cylinder a mixture of gasolene, vapor and air; in the second stroke the piston returns to its former position, and in doing so compresses the charge of air and vapor. When the piston again descends is produced the third stroke, in which the actual work of the engine is performed. At the beginning of this stroke the compressed air and vapor is fired by an electric spark; the gases thus produced drive the piston down with force. The fourth stroke, which completes the cycle, expells from the cylinder the gases formed by combustion. The piston is now in position to begin a new cycle of movements.

It will be understood from this that, with a single-cylinder motor, only one useful stroke occurs in each two revolutions of the engine; with a two-cylinder motor there is one useful stroke in each revolution, while with a four-cylinder motor there are two useful strokes in each revolution.

Among the most important features of the gasolene motor is the carburetter or vaporizer, where the gasolene and air are made into the proper mixture before their introduction as an explosive mixture into the cylinder. The older and simpler type of carburetter is merely a plain can partially filled with gasolene, having an opening through which air is admitted from the outside, and another opening through which the air and vaporized gasolene are drawn from it into the engine. Gasolene is rapidly vaporized at the ordinary temperature, and, in, order to make a proper mixture with air, it is only necessary to draw the air across the surface of the gasolene and to regulate this movement by the means of properly sized valves at the two sides of the tank. The plain tank carburetter was satisfactory enough for stationary work, but when it was subjected to the shocks and jars of a traveling car the mixture of vapor and air produced by it was extremely variable and unsatisfactory in its results. This has resulted in the banishment of this type of mixing tank and

German Type of Auto-Car.

the adoption of what is called a "level-float" type of carburetter.

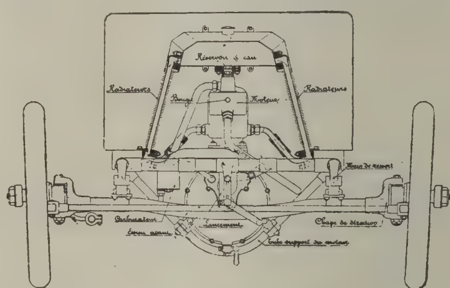
This carburetter was first developed upon the Daimler type car. It consists of two chambers. The gasolene is fed into the first of these by gravity or pressure from a tank located at any convenient point on the machine. In this chamber is a float, which controls a needle valve, thereby regulating the supply of gasolene which should go through to the second chamber. The second or vaporizing chamber has in it a small spraying nozzle, in which the gasolene rises to within one-eighth of an inch from the top of the opening; it is regulated at that level by the float in the first chamber. In the top of the vaporizing chamber is an opening directly connected with the suction valve of the motor, and in some cases this is controlled by a regulating throttle operated by a governor. In the bottom of the vaporizing chamber is an opening for drawing in air, which may be either warm or cold. As the air is drawn through this chamber it passes around the spraying nozzle that the suction stroke of the motor drawing from that the necessary supply of gasolene to form the proper explosive mixture. The main arrangement of valves and other details of the carburetters is varied in many ways by the different manufacturers.

The gears for changing the speed of auto cars are a very important feature. The gasolene motor, as at the present manufactured, has a wide range between its maximum and minimum power through the medium of throttling, and it is possible to directly vary the speed of the car through a considerable range by this control. This, however, is not sufficient to meet all the demands, and it is therefore necessary, in order to obtain high speed on the level or a maximum of power in going over hills or through mud or sand, to use some system of variable speed gears. The general systems used for this purpose are of three kinds: the first, known as the sun-and-planet gear; the second, in which the driving and driven shafts are provided with different sets of gears properly proportioned and arranged to operate by friction or belts, and the third, which is known as the shifting-gear method. This last, which is mechanically of the crudest character, is the one most generally used, and seems to be the most satisfactory. It consists simply of two shafts—one coupled to the motor with a clutch coupling and bearing one set of gears, and a second shaft bearing another set of gear wheels sliding upon it on a square sleeve. In using these the gears are simply shifted from one to the other, the clutch coupling between the driving shaft and the engine being released while making the change.

The great heat developed in the cylinders, due to the igniting of the explosive charge, makes a water circulating system for cooling the motors, one of the most important parts of a successful motor car. It is desirable to keep the temperature of the water a little below the boiling point in order not to lose the water through evaporation. On most of the cars the water is kept in circulation by means of a small pump of the cylindrical or turbine type, which is connected to the motor by a friction or gear drive. A later method of maintaining the circulation of the water without the intervention of mechanical means is accomplished by the use of what is known as the thermo-syphon system. In this system a tank of water is placed above the motor and connected directly with the top of the water jacket around the cylinders. From the outer edge of the tank radiate a considerable number of pipes, each covered with radiating points, and these extend downward at an angle away from the cylinder until their lower ends are nearly on a level with the bottom of the water jacket, when they turn inward and are connected with the lower portion of the water jacket.

The operation of this tank is simple: The water in the water jacket, heated by the explosive gases, rises into the tank, and then flows over into the radial pipes; there it is cooled by the air, flows naturally to the bottom of those pipes and into the bottom of the water jacket, again to take up heat and rise into the tank, maintaining thereby a natural circulation.

The electric sparking circuit for firing the compressed charge in the motor is probably the most troublesome of all the parts in a gasolene motor. It is the cause of fully 95 per cent. of the troubles connected with the motor. These troubles are due in many cases to the neglect



Thermo-Syphon Water Cooler.

of small details, to improper installation and a lack of consideration of the elementary principles of electrical engineering. The duty of the sparking apparatus is very simple: it is merely to produce a spark at a determined moment during the third stroke of the cycle, which will fire the charge of compressed air and gasolene vapor. It is usually so arranged that the operator may vary the time when the spark is produced for the purpose of obtaining different results as to speed. Two methods are used for producing the spark. One is known as the wipe-spark system, in which the spark is caused by the metal-sparking points coming in contact with one another inside of the cylinder, causing the spark with the closing and breaking of the circuit. The system more generally used is that known as the "jump spark," in which the spark points are stationary in the spark plug, one being connected with the shell of the motor, making a ground, and therfore only the other side requiring an insulated wire. There is a commutator on the primary part of the circuit to vary the time of the explosion and to cause the opening and closing of the circuit.

Current for operating the sparking device is usually obtained from four dry battery cells. The duty required of these cells makes it necessary that they should be of excellent quality. They are often required to furnish current for from 500 to 1,000 sparks per minute. Many of the cheap cells upon the market break down under these demands after only an hour's work. The better forms of dry batteries will operate a sparking system for from 1 to 2,000 miles of travel. It is, however, always desirable to carry a duplicate set of cells. Abroad it is customary to use two storage battery cells for this purpose. In some types of car the current is furnished by a dynamo operated by friction gear from the motor. The disadvantage of this system lies in the necessity of giving the motor several turns before the sparking current acquires sufficient power to fire the charge. Whenever any trouble occurs with a gasolene motor car the first place to look for it is with the sparking system and plugs.

Wheels and tires have each received a great deal of attention during the past year. Solid rubber tires have proved to be preferable for electric cars used for commercial purposes, which travel at a speed of not more than 10 to 15 miles per hour over street pavements; but for all greater speeds and for use over country roads it has proved absolutely necessary to use the pneumatic tire, both for the ease and comfort of the passengers and for the protection of the machinery of the auto-car. The double-tube tire is coming into general preference on account of its ease of repair and greater resilience. It has a great advantage also in the quickness with which repairs can be made to it on the road in case of puncture.

I have tried in the foregoing statement to describe the main features of the present successful types of pleasure and touring cars, and also to describe in general the features which our present experience shows produces the most successful cars of to-day. The cars which will be most generally used in the near future are of the type having a two-cylinder motor with a capacity of from 10 to 25 horse power for cars with a speed of from 25 to 30 miles per hour and carrying four or five persons. Cars capable of carrying from four to six persons will be of a somewhat similar design, but will have four-cylinder motors capable of producing 15 to 20 horse power. This type, geared to slower speeds and provided with heavier frames, will also meet the general requirements for commercial work.

Much has been printed recently regarding cars having engines of from 30 to 60 horse power, and they are even building now cars as powerful in some cases as 100 horse power, but such cars are totally unfit for pleasure use. Their power can only be used to full advantage on a racing course, and when they are used elsewhere it is to the detriment of automobile sport, and is, beyond question, producing a strong feeling of opposition in the public mind. While the pleasure car represents a greater part of the development of the gasolene motor car up to to-day, the car for commercial use is rapidly coming forward, and during the next year there will undoubtedly be a very extensive development in the use of gasolene-driven cars for parcel delivery, trucking and omnibus service. In Europe the automobile omnibus is already quite extensively used. This use would have been much larger had it not been for the fact that manufacturers found a more profitable and readier market for all the cars that they can produce for pleasure purposes. The American automobile industry will, beyond question, show a development in the next five years which has only been equaled by the electrical industries during the past decade.

Curious Changes in Massachusetts' Industries

Industries in Massachusetts have undergone some interesting changes in recent years, according to a report just made public by the U.S. Census Bureau.

From 1895 to 1900, the returns show that in general manufacturing there was an increase of nearly twenty-two per cent. in the average value of all products, with an increase of 21.66 per cent. in the number of manufacturing establishments. Business was much more prosperous in 1900 than in 1895. The increased value of products was 21.90 per cent., while the increased cost of material was but 19.87 per cent. and of labor but 18.30 per cent.

Mucilage and paste manufacture shows the greatest increase of any. In the five years it grew 920.92 per cent. in the value of its products. Carpenters' work showed an increase of 209.52 per cent.; japanning, 19.20 per cent.; locksmithing, 182.48 per cent.; flavoring extracts 181.17 per cent., and the manufacture of women's clothing, 160.11 per cent. On the other hand, certain industries showed decided retrogression. The manufacture of men's and boys' clothing in shops fell off $3,587,259, or 26.72 per cent.; that of bicycles dropped off $1,599,586, or 37.07 per cent.; the building of bridges and wharves fell off 15.34 per cent., and the making of distilled liquors lost $1,388,831, or 61.84 per cent. Paper making showed curious changes. Fine paper making increased $1,201,749 in amount, while the making of news quality fell off 11.90 per cent., or $416,234, and that of wrapping paper, 50.43 per cent., or $1,466,027.

Other industries which showed a loss were piano making, 5.96 per cent.; plumbers' supplies, 42.96 per cent.; silver and plated ware, 1.62 per cent.; and stamps and stencils, 6.09 per cent.

Gas Engines in the United States.

The gas engine has reached a stage of popularity scarcely realized until one is confronted with actual figures. The United States Census reports show that in 1890 the total capacity of gas engines used in the country was but 8,930 horse-power, while in 1900 it had increased to 143,850 horse-power. From only .01 per cent. of the total power used in the United States in 1890, the gas engine had increased to 1.3 per cent. in 1900, or an increase during the decade of 1,510.9 per cent. This is a larger increase by far than that of any other form of primary power production. There were 14,884 gas engines reported in 1900, which includes those using illuminating, natural and producer gases, and gasoline or kerosene motors. The average horse-power was 9.7 per cent.

The Electrical Age

Incorporated April, 1902

CHARLES A. LIEB, - - - - President
A. G. GREENBERG, Secretary and Treasurer

F. F. Coleman, - - - - - - Editor

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TO ADVERTISERS

Changes for advertisements and new advertisements **must** be in this office by the **20th** of the month to be included in the issue in the month following. The advertising pages carry printed matter measuring five and a half by eight inches. Cuts intended for use on these pages should be made to accord with these measurements.

Correspondence and semi-technical articles, with suitable photographs for reproduction, or cuts, are invited. Accepted matter will be promptly paid for. We cannot be responsible for any unsolicited manuscripts, but when stamps are enclosed all unavailable matter will be returned. Postage must always be fully prepaid. Cuts to be available for illustrating articles must conform to the column or page measurements. The columns are 2½ inches wide. Cuts for single column use should not exceed that width. Cuts to go across the page should not be more than five inches wide, and full page cuts may not exceed 4½ x 8 inches.

American Street Railway Association Meeting

THE American Street Railway Association held its twenty-first annual meeting at Detroit on October 8, 9 and 10. At the same time and place the Street Railway Accountants' Association held its sixth annual meeting.

The meetings were notable both for the amount of interest manifested by the members and for the interesting exhibition given in connection with them by manufacturers of every character of apparatus for the equipping street railways. Ladies in great numbers accompanied the members and remained during the time of the meeting. The more serious business of the time was supplemented by a theater party, excursions and a banquet.

The papers read at the meeting of the American Street Railway Association were as follows:

"Discipline of Employees by the Merit System" — Metropolitan Street Railway Company of Kansas City, by W. A. Satterlee, general superintendent; "The Steam Turbine: Its Commercial Aspect," by E. H. Sniffen, of Westinghouse, Church, Kerr & Company; "Signals for Urban and Interurban Railways" — Old Colony Railway Company of Boston, by G. W. Palmer, Jr., electrical engineer, and "The Adjustment of Damage Claims"—Chicago City Railway Company, by M. B. Starring, assistant general counsel.

Mr. H. H. Vreeland, the retiring president, delivered a long and interesting address.

The result of the elections for officers for the ensuing year was as follows:

American Street Railway Association: President, Jere C. Hutchins, Detroit United Railway; first vice-president, W. Caryl Ely, International Railway Company, Buffalo; second vice-president, W. Kelsey Schoeff, Cincinnati Traction Company; third vice-president, P. S. Arkwright, Georgia Railway and Light Company, Atlanta; executive committee: the president, the vice-presidents and H. H. Vreeland, New York; R. T. Laffin, Worcester, Mass.; Andrew Radel, Bridgeport, Conn.; Walter P. Read, Salt Lake City; Willard J. Hield, Minneapolis; secretary and treasurer, T. C. Pennington, Chicago.

Street Railway Accountants' Association: President, Henry J. Davies, secretary Cleveland Electric Railway Company, Cleveland, Ohio; first vice-president, Irwin Fullerton, Detroit; second vice-president, D. Dana Bartlett, Boston, Mass.; third vice-president, J. B. Hogarth, Denver; secretary and treasurer, W. B. Brockway, Birmingham, Ga.; executive committee: the officers and H. C. Mackay, Milwaukee, Wis.; O. M. Hoffman, Lancaster, Pa.; Elmer M. White, Hartford, Conn.; a fourth member, to be named by the committee.

One of the best features of the meeting was the publication of the "Daily Street Railway Review," by the Windsor & Kenfield Publishing Company, of Detroit. This was a handsome illustrated journal containing about thirty large pages of reading matter in each number, and in the four numbers giving a full account of the entire proceedings, with much other matter of interest.

Book Reviews

American Municipal Progress

By CHARLES ZUEBLIN, Professor of Sociology in the University of Chicago. The MacMillan Company, New York. Pp. 4¾x7¼ in., 380; cloth, $1.25 net.

Prof. Zueblin presents in this book a temperate but forceful argument in favor of the municipal ownership and operation of many of the enterprises which serve the general needs which are now operated by private individuals or corporations under franchises. Whether the reader be in favor of such extensions of the municipal functions or not, he will find in this book much matter of interest and value. In its chapters on "Transportation," "Public Works" "Sanitation," "Public Schools," "Public Libraries," "Public Buildings," "Parks and Boulevards" and "Public Recreation," there is a wealth of carefully gathered facts and although the author's theories are evident, all through in the treatment of these themes, there is no evidence that he has at any time attempted to distort the facts to bolster up his arguments. Every student of the important question of municipal functions will find the book valuable.

"A Book of Curves," illustrating the operation of chloride accumulators in railway and lighting service, has just been issued by the Electric Storage Battery Company of Philadelphia. "In presenting this book of curves, which graphically illustrates the actual operation of batteries of chloride accumulators in their typical applications to electric railways, central lighting and power stations, isolated lighting plants, etc.," the Electric Storage Battery Company says it believes "that it is submitting data which will be of assistance in the solution of problems concerning the economical generation and distribution of electric power."

Central station men will find the book of high value, and others will find it of interest. As the work is issued incidentally for advertising purposes, it is given away.

Catalogues

The Royal Electric Company issued for October an interesting pamphlet describing in detail its induction type alternating-current generators, with cuts illustrating each of the parts and the windings.

The New York Edison Company's bulletin for September contains illustrations showing the electric illumination of the Adams Dry Goods Company's store in Sixth avenue.

"Electric Locomotives for Surface Haulage" is the title of an eighty-page pamphlet just issued by the Westinghouse Electric Manufacturing Company. It is the purpose of the pamphlet to present the advantages of electricity as a motive power applied to locomotives for surface hauling, its earlier development having been mostly for mining service.

The Christenson Engineering Company's first catalogue of electrical machinery, just issued, is both handsome and useful. In the fifty pages of printed matter are comprised descriptions of motors, generators and transformers, and to these are added working data and descriptions of parts.

The Green Engineering Company has just issued catalogue "C," describing the Green traveling link grate. The catalogue is noteworthy not only for the beauty and clearness of its cuts and printing, but also because of the clearness of its descriptive text.

The Fort Wayne Electric Works has issued a new instruction book, entitled "Wood-Measuring Instruments," superceding their previous pamphlets on the same subject. It contains full directions for installing the various styles of electric meters made by the company.

Selling Gas for Daytime Use

By E. G. Cowdery

[In a recent expert report upon the condition and business of the Milwaukee Gas Light Company, made by Alexander C. Humphreys, the following remarkable statements were made: "The total sales for the year 1901 were 1,178,194,400 cubic feet, of which 51.4 per cent. was sent out in day time and 48.6 per cent. in night time. The annual sales per capital are now estimated at 4,140 cubic feet. The maximum daily output to date has almost reached 5,000,000 cubic feet." The fact that these sales were nearly double the sales per capita in many large and prosperous cities, and the further fact that more than one-half of the whole amount was sold during the day time, made it clear that in Milwaukee there must be at work some extraordinary influences for promoting the use of gas. What these influences are is told in the following article from the pen of Mr. E. G. Cowdery, the general manager of the works.]

I HAVE been asked to explain how the output of gas in Milwaukee has been so evenly distributed during the several hours of the twenty-four, and how it is that the day sales equal the night sales.

Back in the 80's gas companies sold most of their gas for illuminating purposes, and consequently, the bulk of the output was distributed during but three to four hours out of the twenty-four. Much discussion was thereby provoked on how to develop a demand for gas that would keep the mains in use to something near their capacity through a longer number of hours, and thus increase the output per dollar of investment, thereby enabling lower prices for the output.

Lack of proper appliances and the high price of gas had combined to prevent its extensive use for cooking or heating purposes. The question before the gas companies was whether they should take the initiative and reduce the price, thus stimulating the output, or wait until the output grew naturally to a point warranting a reduction in price. The former was the course generally adopted, and everywhere the output grew in greater proportion than the reduction in price.

Gradually gas companies learned that the more effort they put into the placing of gas-consuming devices the more of an object it was made to the consumer to use these, and the greater was the introduction of them.

Previous to 1887 the Milwaukee Gas Light Company had been unsuccessful in its efforts to place in use gas ranges and other appliances to any extent. Some extra effort that year was successful to the extent of getting into the use of customers of the company sixty gas ranges. The following year these sixty were directly responsible for the placing of 120 others, with comparatively little effort on the part of the company. The ranges were sold at the wholesale rate, and connected up by the company. Following this were the years 1889 and 1890, during which additional effort and advertising on the part of the company resulted in a growing number of ranges going into use.

On January 1, 1891, the price of gas was reduced from $1.20, net, for all purposes to $1, net, for gas used for illuminating purposes, and 80 cents, net, for gas used for fuel purposes. During that year 1,650 gas ranges were added; the following year about 2,400, and in 1893 about 3,000. In 1894 less effort was used in this direction, it being thought that the use of gas for domestic purposes was so well established that it would advertise itself and continue to grow in an equal or an increasing proportion. One year was sufficient to demonstrate that this was not so, and that the following of such a policy would not result in a development such as was possible under more progressive methods. In 1895, therefore, the policy was well established of promoting the business each year to such an extent as the returns seemed to warrant. The result has been that the sales of gas for the year 1901 for both fuel and light purposes were practically the same, or 49.1 per cent. for fuel uses, and 50.9 per cent. for lighting.

Tables which have been prepared showing the increase in the sales for fuel purposes each year from 1891 to 1901, both inclusive, show that such increases exactly kept pace with the increases of the day output. For example, the sales for fuel purposes in 1901 were 503,000,000 cubic feet over the sales in 1891 for the same purpose, and the day output, from 6 a. m. to 6 p. m., was 480,000,000 cubic feet more in 1901 than in 1891, thus showing that the point sought to be gained—of developing the output through a greater number of hours in twenty-four—was directly on account of the promotion of the use of gas for domestic fuel purposes.

To further illustrate this, the day output in 1891 was but one-half of the night output of the same year, whereas the day output for 1901 exceeded the night output by 36,000,000 cubic feet; or, to state it in a different way, 51.4 per cent. of the output of the twenty-four hours was sent out between 6 a. m. and 6 p. m., and 48.6 per cent. between 6 p. m. and 6 a. m.

To show more clearly how the ouput has been distributed through the various hours of the twenty-four the following table is submitted, showing the output each hour for the twenty-four hours of the day, commencing at 6 p. m., June 9, 1902; and opposite these figures is the output for each hour of the day, December 24, 1900. The comparison is made in this way to show also, at the same time, the difference in output between a summer day and a winter day.

	June 9, 1902. Cubic Feet.	Dec. 24, 1900. Cubic Feet.
6 A. M. to 7 A. M.	116,700	110,000
7 " " 8 "	114,700	208,000
8 " " 9 "	166,100	156,000
9 " " 10 "	111,100	154,000
10 " " 11 "	175,100	131,000
11 " " 12 "	244,000	184,000
12 M. to 1 P. M.	194,500	106,000
1 " " 2 "	144,200	128,000
2 " " 3 "	139,000	177,000
3 " " 4 "	98,500	127,000
4 " " 5 "	148,400	277,000
5 " " 6 "	223,600	478,000
6 " " 7 "	263,800	434,000
7 " " 8 "	201,600	363,000
8 " " 9 "	285,700	342,000
9 " " 10 "	227,500	229,000
10 " " 11 "	141,100	301,000
11 " " 12 "	83,100	133,000
12 M. " 1 A. M.	71,000	128,000
1 A. M. " 2 "	49,100	25,000
2 " " 3 "	66,800	91,000
3 " " 4 "	42,900	57,000
4 " " 5 "	35,500	96,000
5 " " 6 "	48,200	107,000
Average hourly make	140,000	183,000

In addition, the consumption of gas in the summer months has gained over the winter months during the ten years, thus in another way more nearly averaging the send-out of each day in the year, much to our advantage. In July, 1891, the smallest month in the year, the average daily output was 47 per cent. of the average daily output during December, the largest month in the year. Constant growth in this percentage has taken place, until, in the year 1901, the month of July was 65 per cent. of the month of December.

In 1890 the total sales of gas for all purposes were but 1,900 feet per capita; in 1901 the sales for fuel purposes alone were 1832 feet per capita, and the sales for light remained at 1,900 feet per capita, making the total sales 3,889 feet per capita, or double the sales per capita of 1890.

The use of gas for fuel purposes is greater for domestic uses in gas ranges than for any other purpose. Heating of water for general use is second in importance, and the usé for intermittent heating is third. The great development in the use of gas for fuel purposes up to the present time has not been due to its extensive use for manufacturing or power purposes. During the last three or four years development on this line has been undertaken, and has met with considerable success. It is used in this city for manufacturing purposes to a considerable extent in crucible furnaces for melting copper, brass, zinc, babbit metal, etc., in tinning and galvanizing furnaces, in brazing and small forging furnaces, in furnaces for heating rivets, for heating soldering irons, heating Japan ovens, branding machines, meat broilers, rendering kettles, confectioners' furnaces, roasting coffee, and for tire setting. About 4 per cent. of the present product of the Milwaukee company is sold for these purposes. An equal amount is consumed through the use of gas engines, there being an aggregate of about 3,000 horse power in such engines in daily use in the city.

The use of gas for general house heating purposes has not been developed to the successful stage; that is to say, where it is used throughout the year to the exclusion of other fuels. The most economical manner for the use of gas for such purposes is in connection with the hot-water system and direct radiation. With such a system gas can be easily applied, with the result that 20,000 feet of gas is the equivalent of 2,000 pounds of anthracite coal. The saving in the cost of the care of the fire and the handling of the ashes, to say nothing of the saving of dirt and bother, greatly reduces the difference of cost in favor of gas.

The Milwaukee company now has sixteen to twenty houses using gas fuel through the medium of hot water heaters, which are connected with the regular heating system as auxiliaries. The regular coal heater is used during the time of continuous cold weather in the winter, and the gas heater is used the balance of the time, and intermittently as an auxiliary to the coal heater during the winter. The expectation has been to educate the people, as well as ourselves, in the use of gas for general heating purposes. In this way we calculate that, in course of a series of years, the gas would grow into popularity, while the experience would perhaps enable us to see our way to selling gas at lower figures for such purposes.

The Milwaukee company has learned so much of the advantages and possibilities in the developing of the use of gas for fuel that similar methods have been followed for several years in developing its use for lighting purposes, and considerable progress has been made among the poorer classes in bringing gas into use in place of kerosene.

Taken altogether the gas interest is still in its infancy, and capable of development far beyond the present expectations of most of us.

Gas Turbines Next

Steam turbine engines have so proven their high qualities beyond any question that many engineers are now considering the possibility of producing a gas turbine, to be driven by the products of combustion, as are the gas, gasoline and petroleum engines of to-day.

The problem to be solved is that of producing a continuous combustion of gas under pressure and under complete control. While this appears difficult to-day, there seems to be little doubt of the ultimate success of this work, and when it has been accomplished the gain will be even greater than has been indicated above. It will mean an abandoment of one link in the chain of transformation as used to-day. The energy liberated in the furnace will be conducted at once to the prime mover, doing away with the boiler and rendering the generating station independent of the water question. It will mean that we will have made one step nearer the final goal, the direct conversion of the energy of coal into electrical energy.

A Double-Filament Incandescent Lamp.

A new incandescent lamp known as the "Economical" has been put on the market. It is of the double-filament type, designed to save current when only a small amount of light is needed. By means of a switch worked by cords on either side of the bulb or by turning the bulb in its socket the current can be shifted from the ordinary filament to one of only one-candle power. It is useful as a night lamp for the hall, bedroom or sick room.

Digest

Engineering Literature of the Month

What Automobiles are Doing With Superheated Steam.

There is a probability that the steam automobile may be the means of convincing locomotive users that great economy of heat may be secured by the use of highly superheated steam. An automobile made in Cleveland, O., has a sort of flash boiler which delivers steam at about 700 degrees Fahr. In tests, and in ordinary every-day service, this machine has displayed extraordinary economy in the use of steam and there appears to be no difficulty experienced with the lubrication of valves and pistons. Another automobile having a flash boiler is the Serpollet, a French machine, which holds a fine record for speed and efficiency. A peculiarity of these high steam automobiles is that there is no objectionable escape of exhaust steam, the vapor passing out being nearly imperceptible.

Of course, a flash boiler would be impracticable for a locomotive, but superheating might be accomplished by means of the smoke box gases. This is a line of experiment worthy of the attention of Mr. M. N. Forney and other engineers who are laboring to improve the locomotive engine.—*Railway & Locomotive Eng.*

Asbestos Mantles.

Several technical papers had recently short notices regarding Saubermann's patent protecting the use and treatment of asbestos fiber for manufacturing therefrom incandescent mantles. According to the *Gummi Zeitung*, the references made were partly incorrect and generally misleading, in so far as asbestos fiber treated by Saubermann's process is recommended as an incandescent mantle material for all kinds of flames, whilst, as a matter of fact, it is only applicable with very hot flames, such as are obtainable with acetylene, hydrogen and compressed gas. With ordinary coal gas, asbestos possesses no advantages whatever over the materials now used in mantle making. The asbestos used for this purpose has to be fused first in the bunsen flame, an operation which can only be effected with fine and long fiber. The long-fibered, possibly soft grades, such as the Italian, are specially suited for the asbestos mantle, and with the introduction of this mantle these are certain to be in greater demand than at present, provided, of course, improvements in acetylene generating and lighting have first surmounted the serious difficulties in the way of a more general application of this illuminant. Fused asbestos emits a clear white light without a greenish or yellowish tint, and of such an intensity that 12½ to 13½ normal candle powers are obtained with a fiber weighing 0.02 gram, and a consumption of 10 liters of acetylene per hour. Asbestos, as mantle material, is still further improved by impregnation with certain salts, mainly with nitrates of the beryllium group. These metals are of more frequent occurrence, and less costly than those, the oxides of which are utilized in incandescent mantles, but were not applicable to this purpose before the advent of the asbestos mantle. Now, however, their different salts, exposed to the great heat at which asbestos melts, have been observed to enter into such close combination that one appears to be dissolved in the other. The salts of the alkaline earths, as, for instance, calcium nitrate, behave similarly, especially if feebly ceriferous.—*Engineering Review.*

Electric Power for Agriculture in Germany.

In a paper read before a recent conference of German electrical engineers, Dr. Haas, of Hanover, referred to the electric power supplied to agriculture in that neighborhood, says Consul-General Hughes at Coburg. The greatest demand for current was for the operation of threshing machinery; although energy was also used for driving pumps, hay presses, straw-cutters, etc. Of the total horse power installed, 77 per cent. represented purely agricultural operations and 8 per cent. factories, although the former only yielded 53 per cent. of the receipts. On an average, the annual revenue per horse power installed amounted to $6.73 (as compared with from $17.03 to $36.50 in towns) at a price of 57 cents per kilowatt hour, and the average period of use did not reach 150 hours, as against 500 hours in towns.

Railroad Construction in Indo-China.

Consul-General Skinner writes from Marseilles, France, that the government of Indo-China has been authorized by the President of the Republic to issue bonds to the extent of $38,600,000 for the construction of the following railroad lines in the distant colony: Haïphong to Hanoï and to Laokay, Hanoï and Nam-Dinh and to Vinh, Tourane to Hue and to Quang-Tri, Saigon to the Khanh-Hoa and to the Lang-Bian, and Mytho to Cantho. As the governor-general of Indo-China has considerable latitude in the matter of conceding the exploitation as well as the construction of the railroad enterprises now in hand, this subject is not only important on its financial side, but suggests openings for American builders and furnishers. Probably, the most speedy method of securing information would be by addressing the Minister for the Colonies at Paris.

Experiments with Fireproofed Wood.

A series of tests of wood treated with various fireproofing processes was carried out recently at the Massachusetts Institute of Technology under the direction of the new Insurance Engineering Experiment Station. In general a temperature of 3,500 deg. F. seems to have reduced both treated and untreated wood to charcoal rapidly and easily, both of them blazing while exposed to the heat, although the treated wood ceased to blaze in a few seconds after being removed from the furnace, while untreated wood continued to flame for several minutes.

In another experiment, intended to test the comparative resistance of the two kinds of wood to this temperature, it was found that it took about a minute longer to reduce the treated wood to charcoal than the untreated wood. At lower temperatures the fireproofing treatment appeared to be more effective. At 1,800 deg. F. both the treated and untreated woods blazed and were reduced to charcoal; but when simply dropped on a red-hot iron plate the pieces of treated wood merely charred at the point of contact, while untreated wood blazed up and was consumed.

In the final experiment a block-house was built of pieces of each kind of wood and subjected to fire for five minutes. The treated wood burned where most exposed to the fire, but not readily, resisting for 10 minutes before it fell, while the untreated blocks blazed up, and the structure fell in five minutes. In this test different samples of fireproofed wood were used together, and it was observed that some samples resisted the fire longer than others; but our contemporary's reporter says that some sticks simply painted with fireproof paint "withstood the flame fully as well as the woods treated to a fireproofing solution which soaked through the entire stick."—*N. Y. Times.*

Gas or Electricity for Small Motors.

An excellent opportunity to compare the cost of gas and electricity for small power installations is furnished by the figures prepared by the manager of one of the large printing establishments in New York City. Power is used chiefly to run linotype machines and small job presses. At present two motors are in use, a 15 horse-power gas engine and a 25 horse-power Crocker-Wheeler electric motor, the latter installed some time in 1901. The average load carried is only about 10 horse power; but occasionally a much heavier load is thrown on, necessitating a large capacity motor. City illuminating gas is used, costing $1.05 per 1,000 cubic feet. Electric current is taken from the Edison mains, and the price is 10 cents per electrical horse power, subject to a discount of 50 per cent. and 5 per cent., making the net price 4.75 cents per horse-power hour.

A comparison has been made between the two months, October 9 to December 11, 1900, when the gas engine alone was used, and the two months, October 4 to December 5, 1901, when the electric power alone was used.

The results are summarised in the following table:—

	Gas Engine. 1900.	Electric Motor. 1901.
Period of use	Oct. 9 to Dec. 11	Oct. 4 to Dec 5.
Total hours machines were run	697	686
Cost of gas or current used	$106.68	$250.30
Average cost per hour	15.3 cents	36.5 cents

—*Progressive Age.*

The Cast Steel Wheel Coming.

Ground was broken last month for new works to be erected at Butler, Pa., for the purpose of rolling solid steel car wheels. Tests of the machinery will be made at the works of the Bethlehem Steel Co., where it is being built, before it will be set up, in the new Butler plant. The plant will begin business with a daily capacity of 400 car wheels, which will show a tensile strength of 85,000 pounds, their durability equaling that of the rolled steel tire locomotive wheel, which make a mileage of about 30,000 for every 1-16 inch of wear. That basis would insure about one million miles for the steel wheel. The guarantee required by the M. C. B. Association from makers of cast iron wheels is that they shall run 60,000 miles.—*Rail. & Loco. Eng.*

Petroleum Briquettes.

The French Navy is experimenting on petroleum briquettes, made by the Gonnet process, with a view to their adoption. They are said to be composed of 97 per cent. of carbon and 3 per cent. of hydrogen. Volume for volume, they are half the weight of coal, and leave no more than from 2 to 3 per cent. of residue. There is no cinder, the briquettes preserve their form like coal when burning, there is no smell and no smoke, and they may be damped without deterioration. They burn without exploding or sending off sparks, and give a large and clear flame. The mean calorific value of these briquettes is 13,000 calorics. Other briquettes are made, half coal and half petroleum. They are cheaper, but are less advantageous owing to their density and less heat-producing power, which is 9,00 calorics. The oil used comes from the United States, the French article containing too much fatty material for the purpose. When made from cheap petroleum and sold in large quantities the price of the briquettes is about the same as that of coal.—*The Trade Jour. Review.*

Benzol-Aniline Manufacture in Russia.

By N. Pantiuchoff.

The manufacture of benzol and therefrom of aniline colors from petroleum has been a task which Russian chemists have set themselves for a long time past. Practically speaking this question had long been solved in the laboratory, but nearly a quarter of a century was occupied before it was found possible to commence the manufacture of benzol from petroleum on an industrial scale. It was only last year that the Russian Benzol-Aniline Manufacturing Company was formed, and works were erected at Kineshma, the plant being built according to the patents of Mr. A. N. Nikifforoff.

By the kind permission of the directors of the company I was able to visit their Kineshma works at the beginning of August, and, without going into technical details, I will endeavour to give some data which will throw light on the conditions of manufacture.

The manufacture of benzol from the petroleum by Mr. A. N. Nikifforoff's method is based on a double distillation with decomposition of crude oil or petroleum residuals. The distillation is carried out in cast iron horizontal retorts, the first one at 500°C, and the second at 1,000°C. under increased pressure. At the time of my visit to the works only two furnaces were working for the primary decomposition. These furnaces were capable of working continuously for two or three days. By this distillation, according to the inventor, 38 per cent. of "valuable pitch" was received, about half of which is composed of aromatic hydrocarbons, and this pitch in the course of the second distillation produces benzol, etc. The gas, coke, and heavy hydrocarbons received in course of the two distillations it is proposed to utilize for fuel purposes. Altogether it is expected that from the crude oil distilled will be received 12 per cent. benzol and toluol, 1 per cent. anthracene (33 per cent.), and 2-3 per cent. naphthalene. In order to obtain the pure product the benzol is submitted to two more distillations, the last one in a Savalle column. It is proposed to place the benzol on the market already converted into aniline oil, which has a wide application in dyeing black goods. At present the works are only able to treat 100,000-150,000 poods of crude oil, *i. e.*, to obtain 12,000-16,000 poods of benzol. According to an approximate estimate, the cost of producing 90 per cent. benzol will be 1 rouble per pood, and of the aniline oil 6 roubles per pood. The price of aniline oil in Moscow in 1901 was 10-11.25 roubles per pood.

The present time, however, is not very favorable for the appearance of Russian benzol on the market, as the price, owing to over-production, has fallen to a considerable extent. Benzol of 90 per cent. was quoted in London at 11d. per gallon; in the middle of the year it declined to 9d. per gallon, and with the fall in the price of benzol, there is an increase in the number of schemes for its utilisation for various purposes, such as illuminating, the manufacture of black, and generally, as a cheap raw material, for various chemical products, such as Orthonitrophenol, picric acid, etc. The price of anthracene has also gone down from 1s. 9d. per gallon in 1900 to 2d. in 1901.

The above prices, with an import duty on crude benzol of 20 copecs and on refined benzol of 150 copecs per pood, would enable petroleum benzol to compete with the other product on the Russian market. In 1900 and 1901, there was only 2,000-3,000 poods of benzol imported into Russia, the remainder of the coloring materials produced from benzol came in a finished or semi-finished state in the form of aniline oil, aniline salt, etc.—*The Petroleum Industrial and Technical Review.*

With Our Foreign Consuls

American Mining Interests in New Caledonia.—The International Nickel Company, which was recently organized, is composed entirely of American capitalists and controls much of the finest mining land in New Caledonia. In connection with Le Mickel Company, of Paris, it will practically control the nickel production of the world. G. M. Colvocoresses, the U. S. commercial agent at Nouméa, New Caledonia, states that the mines of New Caledonia have for some time exported considerable quantities of nickel and chrome to the United States, and these exports are certain in the future to increase very largely. The feeling on the island is cordial to all American enterprise, and should the Oceanic Line make its proposed change of route, stopping at Nouméa, one may expect to see this colony dealing almost completely with commercial houses in the United States. There will then be an excellent chance for firms upon the Pacific coast to do direct business with Nouméa, as merchants here realize that they can buy supplies much more advantageously in our country than in Australia or Europe, provided the transportation facilities mentioned are afforded.

Electric Incandescent Lamps in the Netherlands.—There seems to be a market for American electric incandescent lamps in the Netherlands, says Consul-General Listoe, at Rotterdam. Glow lamps are imported in every quantity, from lots of 50 or 100 to 1,000 or more and come mainly from German, English, Belgian and Swiss manufactuers. The 1902 market price for lamps is twelve cents, various discounts being granted according to the size of the order. The Nernst lamp of the Allgemeine Electricitäs Gessellschaft costs forty-eight cents. The import duty on lamps is five per cent., inclusive of packing. Competition is very keen, but if American lamps can compete in price and quality with those of German manufacture there will undoubtedly be a good market for them. There are no special underwriters' regulations applying to incandescent lamps with reference to the base. Most of the lamps are fitted with the ordinary Edison or with the Swan bases.

Fire Exhibition in London.—Consul-General H. Clay Evans writes from London, England, that an international fire exhibition will be held at Earl's Court in that city from May to October, 1903. Juries of high expert knowledge will award a limited number of diplomas for medals to exhibitors in the different groups and classes. The London Exhibitions, Limited, will provide floor space at the rate of ninety-seven cents per superficial foot, with a minimum charge of $194. There will be no further expenses to exhibitors beyond the equipment of their stands and the transportation of their exhibits. The exhibit will include fire prevention, fire fighting, fire calls, salvage work, ambulance service, water supply, insurance, municipal section, history, literature and art, and scientific and social. Fire brigade and ambulance tournaments, displays and competitions have been arranged for and it is also intended to hold an international congress of experts in connection with this exhibition.

Uralite.—Oliver J. D. Hughes, Consul-General at Coburg, describes a new fire proof material called "Uralite," the patented invention of a Russian artillery officer and chemist named Imschenetzky. He says in part:

Uralite is composed of asbestos fiber, with a proper proportion of silicate and bicarbonate of soda and a small amount of chalk. In a soft form, the sheets are like asbestos board; harder, they resemble finely sawn stone and have a metallic ring. It is a non-conductor of heat and electricity, is practically waterproof (and may be made entirely so by paint), and is not affected by atmospheric influences, nor by the acids contained in smoke in large towns, which rapidly destroy galvanized iron.

It can be cut by the usual woodworking tools; it can be painted, grained, polished, and glued together like wood; it can be veneered; it does not split when a nail is driven through it; it is not affected when exposed to moisture or great changes of temperature.

The process of manufacture is akin to that employed in paper making. The asbestos is mixed with an equal weight of whiting, if white uralite is being made; or if gray or red uralite is needed, this is replaced by carbon black, or red oxide. The whiting is first reduced to a cream by beating it up with revolving paddles in a mixer. This is passed through a sieve for the removal of accidental impurities, and thence in to a "hollander." The asbestos is next added, the usual charge being 5½ cwts., and then the coloring matter. The whole is worked up into an emulsion by revolving screws and beaters, for a quarter of an hour or so, and there is a further separation to remove any sand which may have hitherto escaped detection.

The uralite pulp then passes to a machine designed on much the same lines as that employed in making paper boards. The pulp is delivered over riffle boards onto the endless revolving blanket, and passing through a series of rolls is partially dried and compacted. It then passes onto a revolving drum at the end of the machine, on which some fourteen or fifteen thicknesses are deposited before the required thickness is attained.

The large sheets, as they are taken from the drum in their pliable state, are quickly cut to smaller ones, measuring 6 feet 2 inches by 3 feet 1 inch. These sheets are piled up, alternating with sheets of wire gauze or sheet iron, to a height of about 40 inches. The pile is then placed under an hydraulic press and the pressure slowly increased, so that at the end of half an hour it is equivalent to about 200 pounds per square inch. This is maintained for one and one-half hours, and the pile is then left to harden for twenty-four hours, after which the sheets are removed to go to the storing rooms. Here, they are placed vertically in racks on trucks, and pass through a series of stoves with graduated temperatures. The stoves are gas fired. They are then steeped in a solution of sodium silicate, washed, left to dry, and again passed through a stove, after which they are steeped into a solution of sodium carbonate, and washed and dried as before. These subsequent operations are repeated as often as required for the final hardening of the sheets, and the entire process occupies several days. The sheets are stacked for some days and again passed through the stove, being then ready for use, though I understand that, like timber, they are the better for a little seasoning.

Current Engineering and Scientific Notes

Abstracts from the Foreign Papers

The Progress of the Steam Turbine.

[*The Electrical Review, London.*]

TO-DAY I propose to review the progress and the present position of the steam turbine both for land and marine work, and to consider how far it has actually established its position as a rival of the reciprocating engine.

The compound turbine commenced to be used in this country in 1884 for driving dynamos; by 1890 about 360 such plants had been set to work, in size from 4 horse power to 120 horse power, the total aggregate at this date being 5,000 horse power; by 1896, 600 turbo plants had been sold, the total aggregate at that date being 40,000 horse power, and the largest individual plant of 600 horse power.

At the present time 800 turbo plants have been sold, aggregating 200,000 horse power, the largest being of 3,000 horse power, On the Continent, Messrs. Brown, Boveri & Co., of Baden, Switzerland, took up the manufacture of compound turbines in 1900, and have sold twenty plants, with an aggregate of 29,000 horse power, the largest being of 5,000 horse power.

The British Westinghouse Company has lately contracted with the Metropolitan and District Railway Company for the supply of ten turbo-alternators of 5,000 horse power, and several plants of moderate size have also been built by the Westinghouse Machine Company, at Pittsburg. The total aggregate of turbines at work and on order of the compound parallel flow type for generating electricity in England and on the Continent and elsewhere is now not far short of 300,000 horse power.

The economic results of the steam turbine for the generation of electricity have compared favorably with those of the reciprocating engine. The steam consumption is generally less, and the running costs, notably the upkeep, expenditure on oil and attendance are also less. There is also generally a considerable saving in the first cost of the plant, the housing and foundations.

The lowest steam consumption so far recorded has been 173 pounds per kilowatt hour, with a 1,000 kilowatt continuous current plant, one of several built for the Newcastle & District Electric Lighting Company. This figure corresponds to about 10.2 pounds of steam per 1 horse-power hour. There seems to be no doubt that still lower steam consumptions per horse-power hour will be reached in turbines of large size working with superheated steam and a good vacuum.

Several turbine plants have been tested after being at work for a considerable time in order to ascertain if any increase of steam consumption occurred with age, and in all cases no observable increase could be detected.

The adoption of the steam turbine system of propulsion in vessels of large size, such as Atlantic liners, cruisers and battleships, will be attended with very considerable advantage, more so than in the case of smaller vessels, for the large turbines that would be suitable for such vessels would be cheaper to build, lighter in weight and occupy less space in proportion to power. The design of such large turbines presents no difficulties beyond those that have already been successfully disposed of.

What Becomes of Metals.

[*Invention.*]

We are taught that in this world nothing is utterly lost. Coal is burned, but it returns to the earth ultimately in other forms—the ashes renewing the soil and the gases being re-embodied in vegetation. So the metals, though they may be worn away in use, are not lost, but return to mother earth.

M. Ditte has been studying this matter, and finds that as a usual thing metals, after serving their life in the arts, go back to nature in their original form. Iron and tin are reconverted into oxides; copper, into oxides and sulphides; silver, into sulphides, and lead, into sulphides and carbonates. Gold and platinum, usually found pure, disappear through friction and mechanical action and are very little oxidized. In the soil the more or less altered metals are further changed by saline substances and water, and are slowly washed into cavities, to form metalliferous deposits for the use of future centuries. The only trouble is that the metals thus returning to the soil will be scattered so thinly that it will not pay to recover them.

Utilization of Exhaust Steam.

[*L'Industrie Electrique.*]

A remarkable instance of a successful reclamation of waste energy is described in a recent issue of "L'Industrie Electrique." At the mines of Druay, on the Straits of Dover, the exhaust steam from the hauling engines had heretofore been allowed to escape to the atmosphere, the intermittent operation of the engines and the difficulty of applying an efficient expansion rendering condensation impracticable. A Rateau steam turbine was, however, installed, and driven by the steam from the low-pressure cylinder of the main engine. The turbine is coupled to two 100-kilowatt dynamos, which run a a speed of 1,600 revolutions per minute, and generate current at a pressure of 240 volts. The turbine consists of seven discs of 90 centimeters in diameter, fitted with vanes, the outer case being 110 centimeters in diameter and 120 centimeters long. The steam pressure on admission to the turbine is below that of the atmosphere; at trials made it was found to be about 13 pounds per square inch, absolute. The turbine exhausts into a condenser at a pressure of 3 pounds per square inch. Under these conditions an output of 310 electric horse power was obtained, with a consumption of 40 pounds per electric horse power hour. In order to overcome the irregularity of the steam supply, due to the intermittent working of the main engines, a novel form of regenerator was devised by the builders of the turbine. This consisted simply of an old boiler filled with several tons of scrap iron. In passing through this the steam gave up part of its heat, falling, for example, from 195 degrees C. to 98 degrees C. When the main engines stop the process is reversed, the condensed steam being re-evaporated. When necessary, however, steam may be supplied direct from the boilers through a reducing valve. Although particulars as to the size of the main engines and the actual total cost of the energy reclaimed are wanting, the installation is worthy of note in that it shows that in the turbine expansion can be carried to a much higher degree than in the steam engine without disadvantage; for, as is well known, in the latter it is not economical to expand steam below a pressure approximately equal to that which is necessary to overcome the friction of the engine.

Reducing the Air Resistance of Fly Wheels.

[*Electrical Engineer, London.*]

Some tests tending to reduce the waste of energy due to the resistance which a fly wheel offers to the air were recently made at the generating station at Nuerenberg, Germany, and some interesting conclusions were arrived at. The above station is equipped with two 450 horse-power tandem compound engines directly connected to the dynamos and running at a speed of ninety revolutions per minute. In order to reduce the air resistance the fly wheel—which was a very heavy one with arms of a channel section—was covered with sheet iron. To test the amount of energy lost the dynamo was made to run as a motor and thus drive the engine and flywheel at no load. When the latter had no protecting covering it was found to absorb 13,300 watts, but when the covering was replaced it took only 9,874 watts, thus showing a gain of 3,326 watts, or 5.7 horse power, this being 1.2 per cent. of the power of the engine. Counting the current price per kilowatt hour and a day's run of seventeen hours, it was calculated that this represented an economy of nearly $280 annually. Another test of a similar nature was made upon a 630 horse-power engine, and showed an economy as high as 30 horse power, of 4.8 per cent. of the engine power, which was gained by properly diminishing the air resistance of the flywheel.

Timely Electricity.

[*Electrical Engineer, London.*]

An ingenious method of timing was recently introduced at an automobile race-meet held at Welbeck, England. A wire was laid across the track close to the ground, and as this was depressed by the wheels of a motorcar an electric current was sent up which stopped the watch. At the finishing point another watch was in synchronism with the first, and was also automatically stopped by the car as it passed the post. By the aid of a specially laid telephone the two sets of time-keepers exchanged the figures and made the necessary subtraction, and by this means the speed of each car was ascertained to within a fifth of a second.

Tesla Discharges.

[*Elec., London.*]

Wesendonck.—A paper in which he criticized the work of Moehlmann on Tesla discharges by ordinary means ("Digest," August 30). He points out that there is a great difference between a static and an oscillatory discharge; in the former there is a greater negative discharge from a point, while in the latter there is a greater positive discharge. This difference cannot be brought out by placing a plate opposite the point, since the side discharges are too important. Even with an apparently pure negative discharge positive electricity streams out from the sides of the conductor. It is, therefore, necessary, in order to get at the total discharge, to surround the point with a hollow conductor. He describes an experiment with one of Himstedt's Tesla transformers. An Exner electroscope showed nothing but a positive discharge. When the point discharged freely into space a probe or flame collector, mounted on one side, showed no negative electricity, unless an earthed disc was placed pretty close in front of the point at the same time. Here, therefore, the central positive discharge was surrounded by a kind of negative sheath. But a hollow conductor completely surrounding the point only acquired a positive charge, evidently due to an excess of positive electricity.

Personal

Mr. Geo. H. Walbridge, it is reported, has severed his connection with Messrs. J. G. White & Co. of 29 Broadway, and organized the firm of G. H. Walbridge & Co., consisting of Mr. Walbridge, Mr. Bruckman, Mr. Post and Mr. Averill. Their offices will be at 32 Broadway.

Mr. Daniel Hemengray writes from Europe that he is soon to be ready to return and take up the glass business after an enjoyable trip.

Mr. Alexander McKenzie is now on his way to Sao Paulo, Brazil, to construct extensions for the Sao Paulo Tramway Light & Power Co. and to become general manager of the system. He was formerly identified with the Toronto Railway Co., of Toronto, Ontario.

Mr. John Fritz is to be entertained at dinner given in his honor at the Waldorf-Astoria on Friday, October 31. This occasion will also signal the successful founding of the John Fritz Gold Medal to be awarded for achievement in the industrial sciences.

Mr. H. H. Vreeland, at the last annual meeting of the Metropolitan Street Railway Association referred to the enormous losses during the last twenty years, to capital and labor, from strikes and stated that it was his opinion that this great waste was the result of the failure of mutual knowledge between employers and their men.

Mr. W. H. Gray of Indianapolis and of the firm of Townsend, Weed & Co., has been spending some days in New York City.

Mr. R. W. Conant of Cambridge, Mass., has been showing the use of his testing instruments to some of the railway officials in this city.

Mr. J. C. Harrington has added to his factory the necessary equipment for making Medbury insulation, moving the old Medbury plant to Newark, N. J.

Mr. C. P. Wilson from Capetown, South Africa, is now visiting the United States in order, as he puts it, "to be in touch with the up-to-date railway material and men."

Mr. J. C. Dolph, who first came to this city representing the Eureka Tempered Copper Co. of North East, Pa., is now with the Standard Varnish Co., and is showing excellent samples of various types of formed armature coils covered with insulating varnish and compounds manufactured by his company.

Mr. W. W. Conway, of the New York Switch and Crossing Company, reports that business with them was never better than at the present time.

Mr. Harry Douglas, of Ann Arbor, Mich., and Samuel Douglas of Detroit, have purchased the controlling interest in the Ypsilanti Gas Company.

Mr. Edwin R. Weeks, consulting engineer, has taken into partnership William R. Kendall and Walter M. Newkirk, to continue in practice with them as consulting engineers under the firm name of Weeks, Kendall & Newkirk, 604-7 New Nelson Building, Kansas City, Mo.

Mr. Robert Lozier of the Bullock of Cincinnati, after a brief visit to New York, has returned to his duties at the factory.

Mr. F. H. Treat, Superintendent of South Side Mills, Jones & Laughlins, Co., has resigned. He came from the American Steel & Wire Co.'s plant at Newburg, O., of which he was general superintendent. He enters into business for himself in Pittsburg as consulting engineer.

Mr. Carl Schwartz of Germany, who has been prominently identified with important construction work both in his own country and Russia, has been making a tour of inspection of the leading electrical plants in the United States.

Lord Kelvin received the degree of Doctor Honoris Causa from the University of Christiana, at the celebration of the 100th anniversary of the birth of Neils Henrik Abel, the famous Norwegian mathematician.

Mr. G. M. Gest has been awarded the contract for building the conduit system for the Schenectady railways, Schenectady, N. Y.

Profit-Sharing by a Street Railway Company

By J. Buntzen, General Manager

THE British Columbia Electric Railway Company (Limited), of London, owner of the street railways in the cities of Vancouver, B. C., and New Westminster, has recently entered into an arrangement with its employees whereby it voluntarily agrees to continue to pay all of the men their wages or salaries at current rates, and in addition to divide among them at the end of each year one-third of all the clear profits after a 4 per cent. dividend has been paid to the stockholders. It is estimated that the dividend to the men will amount in the first year to about $30 each, to $50 each at the end of the second year, and that in five years it will reach the sum of $100 each. "The Electrical Age" requested Mr. J. Buntzen, general manager of the road, to tell its readers how the profit-sharing system came to be adopted and what it was sought to gain by its means.

[Below is Mr. Buntzen's reply.—Ed.]

There was no immediate cause for the adoption of the profit-sharing scheme other than the desire that should come naturally to every employer of labor—to work in harmony with his men rather than to fight with them. That the profit-sharing idea as between capital and labor is the only correct one from a moral point of view is, of course, beyond dispute. But business is not based on morals only, and the selfish motive enters into both sides of any agreement. Again, here the profit sharing, properly understood by both sides, should satisfy all just demands.

To labor it gives the incentive to good work that lies in an interest in the results of its work beyond the mere wages paid, and to capital it gives, in return for a share of its profits, new values created by willing and intelligent work instead of mechanical routine, by stopping of careless waste on the part of the employees, and by the beneficial sympathy of the general public in place of the hostile feeling now so frequent where strikes and lockouts are considered the proper way of striking the balance between capital and labor. Unfortunately I have not the time to go as fully into these questions as I should like to. Below I give you, however, a few extracts from my letters to our Board of Directors and to our men, setting forth what I considered the advantages of the profit-sharing idea to both parties:

Extract of letter to the directors:

"Shortly, my idea is this: After the ordinary shareholder has received a dividend of 4 per centum (4 per cent.) any additional profits available for dividends will be divided as follows:

"Two-thirds to the shareholder.

"One-third to the regular employees.

"It may seem to the shareholders that this would be giving away their legitimate earnings, but on careful consideration I think it will be seen that more will be gained than lost. The labor question is a difficult one to solve. Men naturally try to get higher wages whenever possible, and sometimes when it is not possible. The result is trouble, ill feeling, unrest. And surely it is better for the shareholder to meet the demands of the employees for higher wages out of the actual earnings than to be called upon for unreasonable advances which the earnings do not justify. Strikes or lockouts, whatever their ultimate results, are poor means of adjustment. Every one loses, not only in a financial way, but also in the loss of that mutual confidence which is essential to the success of all co-operation between capital and labor.

"The basic wages must necessarily be at standard rates, that is, for skilled labor union wages, and for unskilled labor the ordinary wages paid locally for that class of work. To ask the men to accept lower wages now on the supposition that their share of the profits would make up the balance would never work, and I would never recommend any such arrangement, which would only bring about suspicion and distrust instead of confidence and goodwill.

"I wish it distinctly understood that what I recommend is to pay the men standard wages, and, in addition, give them a share in the company's profits beyond 4 per cent. on the ordinary stock, and I base my recommendation on the grounds that, in my opinion, the increased interest in the company's welfare on the part of the employees created by the new system will add so much to the company's success that employees and shareholders will all be the gainers by it.

"As the scale of wages already provides remuneration in proportion to the responsibility of the positions, I would recommend that the employees' proportion of the profits should be divided equally among them, all being considered as units in making the company a success."

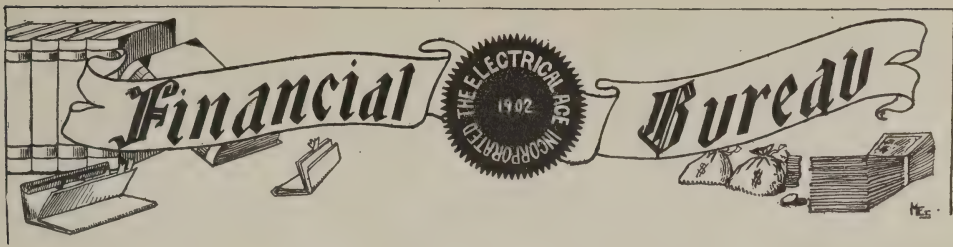
Extract of letter to the employees:

"I have always believed in paying the best wages possible, because I believe that to be the way to obtain the best work possible, and I do not blame anyone for trying to better himself financially. Nothing is more natural as long as it can be done without injuring the other party to our combine, the shareholder, be he the owner of 200 shares or of two, who has invested his money in our enterprise.

"We must protect the shareholder's fair interest on his money or we will be unable to raise that further capital from time to time, without which our business cannot go on.

"The company's ability to pay wages entirely depends on its earning capacity at the prices it is allowed to charge. That earning capacity has so far yielded 4 per cent. to the ordinary shareholder, but we are progressing. Thanks to the steady increase of our population, thanks to the ability of our directors to interest new capital in our enterprise, enabling us to meet all fair demands by the public for a good service, and last, but not least, thanks to the good and careful work of the employees, I hope we will soon have sufficient profit left for larger dividends, and my proposition to the directors above referred to is that hereafter all regular employees of the company shall receive as their share of its profits one-third of the amount available for dividends after the ordinary shareholder has received 4 per cent.

"In other words, you would practically become shareholders in the company without paying for your shares, and there is no cutting of wages involved in the scheme."



Street railway companies, electric lighting companies and gas companies which desire their reports to appear in the Financial Bureau of THE ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Monthly reports are requested showing gross receipts and when possible operating expenses. Companies are also requested to furnish the highest and lowest prices for which their stock has sold in the market for the previous month.

Street Railway and Other Statements

Companies.	Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
Athens Electric Ry.	Sept.	$4,417	$3,880	$2,796	$2,719
Jan. 1 to Sept. 30		34,335	27,743	20,613	16,420
American Rys. Co.	Sept.	160,950	82,131	.....	.....
Jan. 1 to Sept. 30		860,237	660,293	.....	.....
Binghamton Railroad	Aug.	23,547	21,490	11,223	10,604
Jan. 1 to Aug 31		141,326	134,658	84,428	82,029
Brooklyn Rapid Transit Co	Aug.	1,226,954	1,132,385	594,867	448,364
July 1 to Aug. 31		2,463,355	2,330,942	1,189,163	963,308
	Sept.	1,124,383	1,080,158	516,802	415,548
July-Aug.-Sept.		3,587,738	3,411,100	1,705,965	1,378,855
Burlington Vt. Traction	Sept.	6,480	5,520	.....	.....
Jan. 1 to Sept. 30		52,148	45,185	.....	.....
Citizen's Ry. & Lt. Musk, Ia.	Aug.	9,041	6,184	4,888	1,273
Jan. 1 to Aug. 31		54,331	46,689	19,691	.....
City Electric, Rome, Ga	Sept.	3,512	3,508	291	393
Jan. 1 to Sept. 30		31,529	31,343	3,372	4,143
Cohoes City Ry	July 1 to Sept. 30	7,061	6,741	1,569	922
Jan. 1 to Sept. 30		19,366	18,464	3,238	927
Cleveland Electric	Sept.	217,967	229,789	.....	.....
Jan. 1 to Sept. 30		1,860,348	1,702,714	.....	.....
Cleveland Elyria & West	Aug.	32,571	27,307	.....	.....
Jan. 1 to Aug. 31		189,505	158,561	.....	.....
	Sept.	27,430	30,464	15,083	15,464
Jan. 1 to Sept. 30		216,935	189,025	97,537	85,587
Cincin. Dayton & Tol. Tr	Sept.	44,090	.....	21,040	.....
June 1 to Sept. 30		184,502	.....	93,296	.....
Cincin. Newport & Cov	Aug.	96,118	74,525	42,823	28,784
Jan. 1 to Aug. 31		707,432	535,784	311,002	208,169
Cleveland P. & E	Sept.	19,498	18,822	8,464	9,174
Jan. 1 to Sept. 30		144,464	124,184	67,500	60,943

Companies.	Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
Detroit Port Huron Shore Line.	2d week Oct.	$6,794	$5,697	.....	.....
July 1 to latest date		146,274	133,465	......	.....
Detroit Up. Ann Arb. & J	Aug.	30,655	.....	.....	.....
	Sept.	30,530	.....	.....	.....
Detroit United	Sept.	323,618	282,330	$146,626	$129,043
Nine months to latest date		2,578,095	2,245,812	1,129,196	1,016,979
Duluth Superior Traction	Aug.	51,457	41,763	24,952	21,872
Jan 1 to Aug. 31		349,226	296,084	165,590	134,474
Duluth Sup. Tr. & St. Ry	Sept.	46,378	38,933	.....	.....
Jan. 1 to Sept. 30		392,901	332,410	.....	.....
East Ohio Traction	Aug.	21,902	16,515	.....	.....
	Sept.	21,008	17,792	.....	.....
Elgin Aurora & Southern	Sept.	37,806	34,169	17,533	17,080
June 1 to Sept. 30		155,659	140,532	71,912	72,472
42d St. M. & St. N. Ave					
Apr. 1 to June 30		223,705	210,235	96,416	46,960
July 1 to June 30		815,172	697,748	372,619	228,641
Geneva Waterloo S. F. & Cay. L.					
July 1 to Sept. 30		25,826	23,691	14,034	12,471
Harrisburgh Traction	Sept.	38,390	35,709	15,876	12,636
Jan. 1 to Sept 30		345,126	292,982	151,435	119,226
Ithaca St. Ry	July 1 to Sept. 30	26,526	26,562	7,938	1,218
Jan. 1 to Sept. 30		62,430	61,732	def. 3,232	def. 5,933
International Railway	Aug.	369,535	285,150	186,575	171,852
Kingston Consol	July 1 to Sept. 30	36,900	.....	17,662	.....
Jan. 1 to Sept. 30		87,030	.....	37,454	.....
Lake Shore Electric Ry	Aug.	47,968	44,454	.....	.....
Jan. 1 to Aug. 31		285,823	231,724	.....	.....
Lehigh Traction	Sept.	6,379	11,688	2,854	7,467
Jan. 1 to Sept. 30		74,717	97,051	28,139	52,131
Lowell Electric Light Co	July	15,448	12,961	4,276	2,327
London St. Railway, Ont	Aug.	16,102	16,260	6,403	6,913
Jan. 1 to Aug. 31		97,503	91,675	35,340	33,611
Milwaukee Light, Ht. & Tr	Sept.	35,349	31,549	17,852	15,435
Met. West Side Elevated	Sept.	164,626	132,339	.....	.....
Jan. 1 to Sept. 30		1,408,131	1,227,677	.....	.....
Madison Traction	Sept.	6,538	.....	1,118	.....
Jan. 1 to Sept. 30		59,334	.....	17,007	.....
Milwaukee El. Ry. & Lt. Co	Aug.	242,508	210,061	.....	.....
Jan. 1 to Aug. 31		1,745,610	1,567,316	.....	.....
	Sept.	255,818	209,533	145,082	115,946
Jan. 1 to Sept. 30		2,001,428	1,776,849	1,054,920	898,510
N. Y. & N. Shore	July 1 to Sept. 30	42,076	47,487	19,456	21,913
Northwestern Elevated	Sept.	95,925	81,098	.....	.....
Jan. 1 to Sept. 30		847,973	736,821	.....	.....

Companies.	Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
Nashville Railway	Aug.	$73,070	$61,932	.....	.....
Jan. 1 to Aug. 31		549,291	483,848	.....	.....
New London Street Ry	Aug.	12,427	11,592	$6,840	$6,797
Jan. 1 to Aug. 31		51,519	48,745	19,422	18,204
July 1 to Aug. 31		23,379	23,258	12,412	13,694
Oakland Trans. Cons	Aug.	84,531	74,088	38,874	28,882
Jan. 1 to Aug. 31		612,391	.....	242,172	.....
	Sept.	82,116	70,285	.....	.....
Jan. 1 to Sept. 30		694,507	.....	.....	.....
Orange Co. Traction	July	13,069	13,287	6,621	8,320
Jan. 1 to July 31		55,381	55,170	20,043	23,159
Oswego Traction	July 1 to Sept. 30	13,990	16,798	5,170	6,861
Pacific Electric	July	63,932	.....	29,640	.....
	Aug.	68,607	.....	.....	.....
Philadelphia Co., Pittsburgh	Sept.	1,085,792	938,215	426,263	363,345
Jan. 1 to Sept. 30		10,108,975	8,891,528	4,383,167	4,046,129
Railway Cos General	Sept.	26,126	20,753	.....	.....
Jan. 1 to Sept. 30		207,749	167,159	.....	.....
Light Companies	Sept.	1,903	1,602	.....	.....
Jan. 1 to Sept. 30		15,894	14,654	.....	.....
Syracuse La. & Baldwinsville					
Apl. 1 to June 30		18,903	18,800	3,679	3,984
Syracuse Rapid Transit	Sept.	61,164	53,992	.....	.....
Sacramento El. Gas & Ry	Aug.	41,246	34,864	20,110	19,156
Jan. 1 to Aug. 31		297,334	267,963	.....	.....
Feb. 1 to Aug. 31		263,729	235,857	142,542	125,637
St. Louis Transit	Sept.	561,921	500,486	.....	.....
Jan. 1 to Sept. 30		4,731,257	4,301,894	.....	.....
Sioux City Traction	Aug.	22,512	20,944	.....	.....
Jan. 1 to Aug. 31		160,225	138,407	.....	.....
South Side Elevated	Sept.	114,858	101,941	.....	.....
Jan. 1 to Sept. 30		1,042,783	964,503	.....	.....
Springfield (Ill.) Cons. Ry	Aug.	17,594	16,672	.....	.....
Jan. 1 to Aug. 31		121,564	106,366	.....	.....
	Sept.	18,758	16,015	.....	.....
Jan. 1 to Sept. 30		140,322	122,381	.....	.....
34th St. Crosstown	Apr. 1 to June 30	119,672	110,993	51,612	49,108
July 1 to June 30		455,668	396,948	178,519	157,904
Toledo Bowling G. & So. T	Sept.	21,974	17,585	9,015	8,697
Jan. 1 to Sept. 30		180,850	131,702	84,988	52,883
28th @ 29th Sts	Apr. 1 to June 30	48,257	45,462	20,270	16,023
July 1 to June 30		180,510	177,119	74,031	60,607
Twin City Rapid Tr. 2d St	Oct.	66,225	62,330	.....	.....
July 1 to latest date		2,786,441	2,443,496	.....	.....
Union of New Bedford	Aug.	38,390	33,106	.....	.....
June 1 to Aug. 30		222,267	182,369	.....	.....

Companies.	Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
United Tr., Albany City	Sept.	$132,606	$122,200	$26,750	.....
Jan. 1 to Sept. 30		1,137,299	1,007,394	.....	.....
Union Traction of Ind	Aug.	94,413	74,257	.....	.....
Jan. 1 to Aug. 31		618,061	471,582	.....	.....
	Sept.	85,679	68,663	.....	.....
Jan. 1 to Sept. 30		703,740	539,245	.....	.....
United Rys. San Francisco.					
Six months to June 30		2,541,296	.....	1,001,409	.....
Venango Power & Tr. Co	Aug.	24,310	15,728	9,510	.....
Westinghouse Air Brake.					
Year to Aug. 31		8,559,503	7,869,857	2,928,695	$2,981,342

Stated Reports of Companies

Edison Electric, Boston

ANNUAL REPORT.

The operations of the company for the last two fiscal years are given in the following table and include, for the sake of comparison, the Boston Electric Light Co. and the Suburban Light & Power Co., both of which were acquired during the year.

	1902.	1901.	Changes.
Gross	$2,460,158	$2,367,359	Inc. $92,799
Expenses	1,510,427	1,449,629	Inc. 60,798
Net.	$949,731	$917,730	Inc. $32,001
Other increases	25,981	13,948	Inc. 12,033
Total increase	$975,712	$931,678	Inc. $44,034
Interest and dividends	859,614	879,285	Dec. 19,671
Surplus	$116,098	$52,393	Inc. $63,705

BALANCE SHEET.

Assets—	1902.	1901.
Installation	$11,951,626	$5,708,060
Liverpool wharf	225,912	225,912
Cash on hand	165,914	64,557
Stock on hand	361,160	78,440
Notes and accounts received	246,778	121,366
Open accounts	37,613	88,152
Total	$12,989,005	$6,286,487
Liabilities—		
Capital stock	$7,850,400	$4,310,500
Tr. mort. bonds	1,250,000	180,000
Notes and accounts paid	1,247,789	792,177
Dividends payable	196,260	107,762
Installation new stock	....	....
Res. for maint.	654,000	506,000
Sundry open accounts	....	41,403
Premium on new stock	1,660,387	333,535
Accrued interest and taxes	69,217	....
Profit and loss	60,951	15,109
Total	$12,989,005	$6,286,487

Metropolitan Street Railway

BALANCE SHEET AS OF JUNE 30, 1902.

Assets.	1902	1901	Changes.
Road and equipment	$48,969,309	$35,385,331	Inc. $13,310,979
Stocks and bonds	22,565,471	21,683,428	Inc. 882,043
Bills receivable	287,966	2,245,601	Dec. 1,957,635
Supplies on hand	———	163,618	Dec. 163,618
Open accounts	9,000,569	718,792	Inc. 8,281,777
Cash on hand	6,259,221	8,136,074	Dec. 1,876,853
Add. between leased lines and construction	19,680,279	22,201,902	Dec. 2,521,623
Total	$106,489,817	$90,534,746	Inc. $15,955,071
Liabilities:—			
Capital stock	$52,000,000	$52,000,000	———
Funded debt	21,750,000	21,750,000	———
Bills payable	———	2,006,736	Dec. $2,006,736
Third Avenue lessor constr. account	3,722,128	1,116,171	Dec. 3,394,043
Interest due and accrued	137,500	401,274	Dec. 263,774
Rent. and div. accrued	38,033	1,082,143	Dec. 1,044,110
Taxes	297,799	———	Inc. 297,799
Unpaid coup.	25	———	Inc. 25
Accounts pay	55,911	———	Inc. 55,911
Open accounts	60,852	774,957	Dec. 714,105
Profit and loss (surplus)	5,427,568	5,403,465	Inc. 24,103
Contract account with Interurban Co.	27,312,248	———	Inc. 27,312,248
Total	$106,489,817	$90,534,746	Inc. $15,955,071

Interurban Street Railway

The statement covering the old Metropolitan System, from April 1, 1902, to June 30, 1902, and the Interurban Street Railway Co. from Dec. 9, 1901, to June 30, 1902, compares as follows:

	1902	1901	Changes.
Gross	$2,259,176	$2,206,489	Inc. $52,687
Expenses	1.416,429	1.095,538	Inc. 320,891
Net	$842,747	$1,110,951	Dec. $268,200
Other Income	692,026	449,235	Inc. 242,791
Total Income	$1,534,773	$1,560,186	Dec. $25,413
Charges	1,758,309	1,763,296	Dec. 4,987
Deficit for year	$223,536	$203,110	Inc. $20,426
Total deficit June 30	874,390	650,854	Inc. 223,536

BALANCE SHEET.

Assets.		Liabilities.	
Construction and equipment	$29,366,587	Capital stock com.	$15,995,800
Stocks & bonds of other companies	10,455,290	Funded debt	40,000,000
Bills receivable	214,309	Interest on funded debt	———
Supplies	98,942	Due and accrued	825,000
Open accounts	11,383,476	Taxes due and accrued	128,437
Cash	856,510	Accounts payable	17,117
Construction cash	3,722,128	Sundries	5,278
Profit and loss def.	874,300		
Total	$56,971,633		$56,971,633

United Railways Investment Co., San Francisco

HASKINS & SELLS REPORT.

	Year Ending Dec. 31, 1901.	Six Months Ending June 30, 1902.
Gross earnings	$5,125,882.97	*$2,541,996.43
Operating expenses and taxes	3,059,957.71	1,540,587.86
Income from operations	$2,065,925.26	$1,001,408.57
Miscellaneous income	17,230.23	8,579.41
Total net income	$2,083,155.49	$1,009,987.98

*Property completely tied up by strike April 19 to April 26, 1902.

ESTIMATE OF TALBOT J. TAYLOR & CO.

	1st Year.	2d Year.	3d Year.
Gross earnings	$5,500,000	$6,050,000	$6,655,000
Expenses of operation and taxes	3,000,000	3,025,000	3,250,000
Income from operation	$2,500,000	$3,025,000	$3,405,000
Fixed charges	1,600,000	1,600,000	1,600,000
	$900,000	$1,425,000	$1,805,000
Five per cent. dividend on preferred stock	750,000	750,000	750,000
Surplus	$150,000	$675,000	$1,055,000
Common stock will earn	1½p.c.	6¾p.c.	10.55p.c.

Jilson J. Coleman, a street railway specialist, has filed a report on the property with Brown Bros. & Co., in which he states that his investigation showed an earning capacity in January of over 29 cents per car mile, and that as 14½ cents per car mile was a high average for expenses of operation, the system could easily operate on a 50 per cent. basis. Mr. Coleman adds the estimate that the San Francisco street car system will show an annual increase of earnings of 10 per cent. at least, his calculation being that during the current year the system's earnings will reach $5,500,000.

Brooklyn Rapid Transit Co.

ANNUAL REPORT.

	1902.	1901.		
Gross Earnings—				
Passenger	$12,321,265	$11,718,929	Inc.	$602,336
Freight, Mail & Express	64,902	58,394	Inc.	6,508
Advertising	124,455	122,501	Inc.	1,954
Total Earnings from Operation	$12,510,622	$11,899,824	Inc.	$610,798
Operating Expenses—				
Maintenance of Way and Structures	$567,059	$378,800	Inc.	$188,259
Maintenance of Equipment	1,160,999	891,986	Inc.	269,013
Operation of power plant	1,262,429	1,024,979	Inc.	237,450
Operation of cars—trainmen's wages	2,605,330	2,414,062	Inc.	191,268
Operation of cars—other expenses	975,561	889,827	Inc.	85,734
Damages and legal expenses	1,094,745	1,157,593	Dec.	62,848
General expenses	543,274	458,761	Inc.	84,513
Total operating expenses	$8,209,397	$7,216,008	Inc.	$993,389
Net earnings from operation	$4,301,225	$4,683,816	Dec.	$382,591
Income from other sources—				
Rent of land and buildings	$93,248	$67,595	Inc.	$25,653
Rent of tracks and structures	99,051	100,226	Dec.	1,175
Miscellaneous	85,247	67,914	Inc.	17,333
Total income	$4,578,771	$4,919,551	Dec.	$340,780
Deductions—				
Taxes	$742,817	$754,626	Dec.	$11,809
Interest and rentals, net	3,732,633	3,587,122	Inc.	145,511
Total deductions	$4,475,450	$4,341,748	Inc.	$133,702
Net income	$103,321	$577,803	Dec.	$474,482
Special appropriations	84,428	228,678	Dec.	144,250
Surplus	$18,893	$349,125	Dec.	$330,232

Car mileage, surface	$36,840,898	$35,334,216	Inc. $1,506,682
Car mileage, elevated	15,844,082	14,821,709	Inc. 1,022,373
Total car mileage	52,684,980	50,155,925	Inc. 2,529,055

BALANCE SHEET.

Assets—			
Cost of road, equipment, etc., of properties owned in whole or in part by the B. R. T. Co			$88,299,310.18
Advances account construction for leased companies			8,161,283.36
Brooklyn City RR. Co		$5,417,706.26	
Nassau Electric RR. Co		1,783,715.40	
P. P. & C. I. RR. Co		203,991.64	
Brooklyn Union El. RR. Co		380,987.02	
Additions and betterments not yet distributed		374,883.04	
Guarantee fund—securities and cash			4,005,755.00
Total permanent investments			100,466,348.54
Current assets			3,326,458.63
Cash on hand		1,589,756.03	
Due from companies and individuals		336,605.61	
Materials and supplies on hand		536,732.51	
Prepaid Accounts		79,084.08	
Accounts Receivable		529,052.40	
Bonds and stock in treasury		255,228.00	
Accounts to be adjusted			4,374.07
Total assets			$103,797,181.24
Liabilities—			
Capital stock			$47,717,305.05
Brooklyn Rapid Transit Company		$45,000,000.00	
Outstanding capital stock underlying companies		2,717,305.05	
Bonded debt and real estate mortgages			52,666,100.00
Brooklyn Rapid Transit Company		7,000,000.00	
Bonded debt of constituent companies		45,524,000.00	
The Brooklyn Heights RR. Co	$250,000		
Sea Beach Ry. Co	650,000		
Brooklyn Q. C. & S. RR	6,624,000		
Nassau Electric RR. Co	15,000,000		
Brooklyn Union Elevated RR	23,000,000		
Real estate mortgages		142,100.00	
Total capital stock, bonded debt and real estate mortgages			100,388,405.05
Current liabilities			2,422,332.47
Audited Vouchers		376,684.27	
Due companies and individuals		28,056.54	
Taxes accrued and not due		1,070,479.63	
Interest and rentals accrued and not due		866,415.76	
Interest accrued on real estate mortgages and not due		741.14	
Sundry Charges Accrued		39,955.13	
Insurance		40,000.00	
Surplus account—balance June 30, 1902			991,443.72
Total liabilities			$103,797,181.24

President J. L. Greatsinger says: "The gross passenger earnings of the system for the fiscal year increased 5 14-100 per cent. over the same period of last year. The total receipts from all sources were $12,788,168.51, or an increase of $652,609.04. The total increase in the cost of operation for the year was $993,389, of which $457,272 was expended in maintenance of way, structure and equipment. In this item is included large amounts which were spent in extraordinary repairs, such as bringing surface and elevated equipment, roadbed, structure and tracks to a higher standard of efficiency, thereby enabling a more economical and advantageous operation of your lines." Of the $150,000,000 bond issue authorized during the year the

President has this to say: "Of the amount authorized, the mortgage provides that a sufficient amount shall be reserved to refund the bonds of the Brooklyn Rapid Transit Company and of the subsidiary railroad companies as they become due, or sooner if the exchange can be made with advantage to the company. The remainder of the bonds can be issued only for the purpose of acquiring additional securities and properties, or to provide money with which the subsidiary companies may make improvements, extensions or betterments. The issue of bonds under this mortgage will, therefore, not increase the fixed charges of the company except as the proceeds are used in improving the properties of the subsidiary companies. Such improvements will be made only as they are called for by the increase in business or are warranted by considerations of economical operation. It is confidently expected that the increase in fixed charges caused by the issue of bonds for such purposes will be more than offset by the resulting economies in operation, and by the increase in earnings rendered possible by additions and improvements to equipment and plant. The amount of bonds authorized is sufficiently large to meet all future requirements. Under the terms of the mortgage, these bonds may be issued convertible at the option of the holder into stock of the company, par for par, at any time after July 1, 1904, and before July 1, 1914."

Western Union Telegraph Company

YEAR ENDING JUNE 30

Receipts.	1901	1902	Increase.
Revenues	$26,354,150.85	$28,073,095.10	$1,718,944.25
Expenses (see statement below)	19,668,902.68	20,780,766.21	1,111,863.35
Net revenue	$6,685,249.17	$7,292,328.35	$607,080.72
Interest on bonds	926,160.00	992,580.35	36,420.35
Profits	$5,729,088.17	$6,299,748.54	$570,660.37
Appropriated for dividends	4,868,007.50	4,868,031.25	23.75
Surplus	$861,080.67	$1,431,717.29	$570,636.62
Surplus July 1st, 1901		$9,319,285.53	
Carried to surplus as above		1,431,717.29	
Surplus June 30, 1902		$10,751,002.82	

Expenses—	
Operating and general expenses	$14,727,406.92
Rentals of leased line	1,568,534.40
Maintenance and reconstruction of lines	3,591,065.17
Taxes	575,331.84
Equipment of offices and wires	318,427.88
Total expenses as above	$20,780,766.21

The capital stock outstanding is unchanged, namely, $97,370,000, of which $29,495.86 belongs to and is in the treasury of the company.

The bonded debt at the close of the year was as follows:

Funding and Real Estate Mortgage Bonds due May 1, 1950, four and one-half per cent	$13,000,000.00
Collateral Trust Bonds due January 1, 1938, against which bonds and stocks bearing the company's guarantee of interest or dividends at six per cent. per annum have been deposited with the trustee, five per cent	8,504,000.00
	$21,504,000.00

President Robert C. Clowry says: There were added to the company's system during the year 2,256 miles of poles, 57,218 miles of wires and 329 offices. Of the newly constructed wires 28,767 miles were of copper. The receipts from the transmission of regular commercial messages were increased $1,348,531.34, and from leased wires $451,749.64. The average tolls for the messages transmitted by the company were 31 cents, and the average cost was 25.7 cents.

There was expended for construction during the year $2,188,101.03.

By re-arrangements of the operating force, and through the substitution of direct-working circuits for repeating or relay offices, a reduction of $388,746 a year in the operating expenses of the company has been effected and the service greatly improved. A further improvement in the service, with an additional reduction in the expense, may be expected.

Financial Notes

Dayton, Springfield & Urbana Ry. will increase its capital to $1,500,000 for improvements.

Boston Elevated stockholders took practically the entire issue of 33,000 shares of new stock at $155.

Northampton Traction Co. has absorbed the Easton & Nazareth St. Ry. and the Easton, Tatamy & Bangor St. Ry.

United Electric Light & Power Co., St. Louis, has filed a mortgage securing $10,000,000 30-year 5 per cent. gold bonds.

Berkshire Street Railway will issue $250,000 additional capital stock to pay floating debt incurred in construction and equipment.

Suburban Gas Company, Philadelphia, is offering through Dick, Bros. & Co. $400,000 5 per cent. sinking fund first mortgage bonds at 101.50.

Lowe Coke and Gas Security Company has filed a certificate at Wilmington, Del., showing that $20,145,000 capital stock has been paid in.

Grand Rapids (Mich.) Edison Company now controls by merger all the local electric light and power properties of that city, except the municipal plant.

Staunton (Va.) Light & Power Company has given an option to J. Scott Funkhouser, Edgar M. Funkhouser and others to purchase control.

Consolidated Gas Co. of New York showed $1,342,000 more divisible surplus earned in the first eight months of 1902 than during the same period in 1901.

Georgia Ry. & Electric Co. has had listed on the Boston Stock Exchange $1,800,000 preferred stock, 5 per cent. non-cumulative, and $5,000,000 common stock.

Macon (Ga.) Consolidated Street Railway must, under an ordinance passed by the city council, expend at least $150,000 for improvements in two years.

Indianapolis & Plainfield Railway contemplate building an extension southwest to the Reform School. Henry L. Smith, of Indianapolis, is secretary and treasurer.

American Telephone & Telegraph Company, it is said, will require from 10 to 20 million per annum for several years, and it will be raised by issue of stock at par to stockholders.

California Gas and Electric Corporation will undertake to float $10,000,000 30-year 5 per cent. gold bonds by a mortgage on all property now owned or hereafter acquired.

Toronto Railway contemplates important improvements and the stock has been increased to $7,000,000 for development. Shareholders can subscribe for the new shares at par.

Chicago Elevated roads more than held their September average as to traffic, the Metropolitan gaining 25 per cent., the Northwestern 18 per cent. and the South Side 13 per cent.

Puget Sound Electric Railway charges 5 cents single fare and 25 cents for a round trip. Seattle-Tacoma Interurban Railway, a third-rail system, charges 60 cents one way and $1 the round trip.

New Directors in the persons of Howard Gould and John J. Mitchell were last month elected by the Western Union Telegraph Company to succeed Stuyvesant Fish and E. H. Perkins, resigned.

The sinking fund of the Knoxville and Kimberlin Heights Electric Railway is to reserve after 1911 $25,000 yearly to buy $1,000,000 5 per cent. bonds at a price to yield not less than 4 per cent.

Western Telephone and Telegraph Company has had listed on the Boston Stock Exchange its $10,000,000 collateral trust 5 per cent. bonds, the $16,000,000 preferred and the $16,000,000 common stock.

Manhattan Elevated Railway of New York is now operating trains by electricity on the Second, Third and Sixth avenue lines, and expects to have trains running on Ninth avenue north of Fifty-third street this month.

Union Natural Gas Corporation capital has been increased to $8,000,000 to take over stock of T. N. Barnsdall in the Reserve Gas Company, a West Virginia corporation, and the Connecting Gas Company of Ohio.

Greenboro (N. C.) Electric Co. has issued $360,000 first mortgage 30-year 5 per cent. gold bonds secured by mortgage for $400,000 to the North American Trust Co. Bonds can be called after 5 or 10 years at 105.

West Michigan Traction Co. first mortgage 30-year 5 per cent. gold bonds to the amount of $78,000, with July, 1902, coupons on, were sold last month at auction for $1,000 the lot. They had been pledged as collateral.

United States Investment Company, San Francisco, has had listed on the New York Stock Exchange $15,000,000 5 per cent. cumulative preferred and $10,000,000 common stock. They were dealt in for the first time last month.

Manufacturers' Light & Heat Company, Pittsburg, will vote November 25 to raise the stock to $10,000,000. A new line will be built to Homestead and the east end of Pittsburg. Deals are pending for taking over outside producing interests.

Rochester, Syracuse & Eastern Railway will build ninety miles of trolley, passing through Fairport, Macedon, Palmyra, Newark, Lyons, Clyde, Port Byron, Weedsport and Jordan. It is capitalized at $2,500,000 and controls the Monroe County belt. Lyman C. Smith, of Syracuse, is president.

Detroit Suburban Gas Co. has executed a first mortgage to the Dime Savings & Banking Co. of Cleveland, to secure $250,000 25-year 5 per cent. gold bonds. The company has $300,000 capital stock, and supplies the villages of Delray and Woodmere and the township of Springwells with illuminating and fuel gas.

Albany and Hudson Railway and Power Company is to be organized, and as a step in that direction George T. Blakeslee, of Kinderhook, N. Y., was last month appointed receiver on the application of the Colonial Trust Company. It is said that this company operates the largest third rail system in the United States.

Bay Shore Terminal Company, Norfolk, Va., of which John Archibald Campbell Groner is secretary, will give out $200,000 in contracts within a few months, the directors having voted to improve the power plant, extend the system and double track the line. A mortgage for $500,000 has been made to the Atlantic Trust & Deposit Company of Norfolk to secure 5 per cent. gold bonds.

Northern Ohio Traction Company stockholders are depositing stock with the Saving and Trust Company, of Cleveland, under the plan of reorganization prepared by J. R. Nutt. It provides for the formation of the Northern Ohio Railway and Light Company with $7,500,000 common stock and $7,500,000 30-year consolidation mortgage bonds, of which $1,000,000 are 5 per cent. and the balance 4 per cent.

St. Louis & Suburban Railway capital stock has been increased to $7,500,000, and $7,500,000 5 per cent. 20-year bonds will be issued, $2,300,000 to be used for retiring old bonds. About $1,000,000 will be spent for reconstruction and equipment. The Brenwood, Clayton & St. Louis and the St. Louis & Kirwood will be absorbed. The capital stock of the St. Louis and Meramec has been increased to $3,000,000.

New York and New Jersey Telephone Company's present capitalization is $9,375,000, and this will be increased by $3,125,000. Stockholders who wish to subscribe can pay cash this month at 101.50 per share, otherwise 40 per cent. now, 30 per cent. May, 1903, and 30 per cent. August next. The company will probably continue to issue new stock as required for development work.

Massachusetts Electric Companies have taken about all the $2,746,000 new stock issued by the subsidary companies, Old Colony Street Ry. and the Boston & Northern Street Ry. Co., at 110 and 130 per share respecting $5,000,000 of its own stock having been sold some months ago to meet expenditures for floating debt, rolling stock, electrical equipment, power stations, extensions, etc.

John Stanton's copper statistics show that the production in September of United States reporting mines was 23,688 tons and that the production from outside sources (estimated) was 2,100 tons, a total of 25,788 tons, or 492 tons in excess of the August output. The production of foreign reporting mines in September was 9,155 tons, or 349 tons less than in August. United States exports in September were 13,183 tons, an increase of 754 tons over August.

Auburn & Syracuse Electric Railway, which came into existence October 1, by consolidating the Auburn City and the Auburn Interurban (the latter having under construction seventeen miles from Skaneateles to Syracuse), is having a mortgage drawn, the details of which are to be announced. The company's capital is $1,300,000, of which $600,000 is 6 per cent. cumulative preferred. Directors include Hendrick S. Holden, of Syracuse, and George B. Longstreet, of Auburn.

Brooklyn Rapid Transit Co. is said to have purchased the property of the Christ Protestant Episcopal Church at Third avenue and Sixty-eighth street, Brooklyn, for $30,000 and will construct an inclined plane to connect the elevated railroad structure with the Third avenue surface line at that point. The company is planning to operate trains over the elevated road to Fort Hamilton. A through express service to Bay Ridge and the Fort Hamilton section will be established.

Corporation Counsel Rives is said to be making further plans to enforce collection of about $17,000,000 back taxes from the street car companies of New York City. Many of the claims have run for years and have been before the court. One is for 5 per cent. of the gross receipts of the Metropolitan Street Railway. Another is for license fees on cars. Claims against the Brooklyn Rapid Transit are principally for paving done between tracks. A large number of claims depend upon the contested Ford Franchise Tax law.

Augusta Street Railway & Light Company will issue $300,000 preferred and $1,500,000 common stock; also $2,000,000 5 per cent. bonds to retire outstanding securities to the amount of $1,000,000, the balance to be held for extensions and improvements. This is a consolidation of all the street railway and electric lighting properties of Augusta in the interest of the Railways & Light Company of America. J. W. Middendorf & Co., Baltimore, and John L. Williams, of Richmond, are among those who negotiated the deal.

Havana & Jaimanitas Electric Ry., of Cuba, is being financed by W. J. Hayes & Sons and Denison, Prior & Co., on a basis of $1,500,000 stock and an equal amount of 6 per cent. gold bonds, of which $800,000 have been issued and for which subscriptions were invited at 90 and interest with 50 per cent. stock as bonus. The company has four miles of franchises and right of way in Havana, the balance of 10 miles right of way being owned in fee simple. Jaimanitas is to be made a Coney Island for Havana's population of 275,-000.

Nashville Railway, in order to carry out consolidation plans and check hostile legislation, has consented to land for a park, or $125,000, to give 2 per cent. of its gross annual receipts to the city until they amount to $1,000,000, after which it will pay 3 per cent., to pay for the paving of the streets, to spend $1,000,000 for improvements and to allow the city to buy the property after twenty years at a basis which will yield stockholders the same profits as the company is then earning, computing operating expenses at 50 per cent.

Dallas Electric Corporation will be managed by Stone & Webster, of Boston, who recently bought control of the Metropolitan Electric Street Railway of Dallas, Tex., the Dallas Consolidated Electric Street Railway, Dallas Electric Company and the Dallas Electric Light & Power Company. It is estimated that first year's earnings, after improvements, will be $600,000, net $240,000, surplus, after interest, $102,500. There are issued $2,750,000 5 per cent. 20-year bonds, $1,350,000 5 per cent. non-cumulative preferred, and $1,500,000 common stock.

The Rapid Transit Railroad in New York City will be ready to open for traffic on the main line from the City Hall to 104th street on October 1, 1903, according to a statement made recently by William Barclay Parsons, chief engineer of the Rapid Transit Railroad Commission. This will be a year ahead of the contract time, but every day saved is money in the pockets of the contractors. The building of the power house is progressing, and already car manufacturers have submitted several model cars as samples, from which the rolling stock equipment may be orderd. It is said that 800 cars will be ordered in the first lot.

A Director of the New York, New Haven & Hartford Railroad says:

"The annual report was, indeed, gratifying when consideration is taken of the fact that the system is net-worked with electric car lines, more so than any railroad in the country. I maintain that the electric railway, as now operated, is a help, rather than a detriment, to the steam roads. The electric railway is bringing people to the centers of population and encouraging travel by the general public. It is possible that the through electric lines may hurt the steam roads somewhat, but until these through lines demonstrate their usefulness to the public, and their ability to earn dividends, it is impossible to say to just what extent their competition will affect the earnings of the steam roads."

Michigan Telephone bondholders' committee is not much disturbed by the plans of reorganization suggested by the so-called security holders' protective committee, of which F. W. Hill is chairman. The Michigan Telephone bondholders' committee has on deposit, which cannot be withdrawn, 85 per cent. of the total Michigan Telephone bonds outstanding and the American Telephone & Telegraph Co. owns 80 per cent. of the total capital stock; hence these two interests are in a position to negotiate for the best interests of the company. The plan of reorganization proposed by Mr. Hill, and published quite extensively in the Boston papers last month is declared by the majority interests in the company to be too preposterous for serious consideration. N. W. Harris & Co. and H. W. Poor & Co. are interested.

A London Correspondent writes: "A very strong fear widely prevails that we are about to see the construction of electric railways which will parallel many of the old existing lines, and which can not only be built but worked much more cheaply. For example, it is said that a plan is prepared for an electric railway between Liverpool and Manchester, and another plan is prepared for an electric railway between London and Brighton. Owing to all these apprehensions and bitter experiences, the British railway market is exceedingly weak. The fall, however, seems to be overdone, unless, indeed, the fears respecting electric railways are realized. It is impossible as yet to know whether Parliament will sanction the many schemes that are contemplated, and even if it does, it remains to be seen what the cost of construction and the cost of working will be."

Worcester and Connecticut Eastern Railway sold last month to Thompson, Tenny & Crawford $2,050,000 4 1-2 per cent. first mortgage sinking fund gold bonds, part of an issue of $3,100,000, $1,050,000 being held in reserve for improvements and additions. The Worcester & Connecticut Eastern Railway owns what was formerly known as the People's Tramway Company; the Thompson Tramway Company and the Danielson & Norwich Street Railway Company, and will control through leases the Worcester & Webster Street Railway. The total mileage will be about fifty-five miles and will operate between Worcester, Mass., and Moosup, Conn., with a branch line to Foster Centre, at which point connections will be made with the electric road to Providence, R. I. It is the purpose of the company to build a branch to Bayville, Attawaugan, Ballouville and Pineville and also to extend the main line of the road from Moosup to Norwich, Conn. The railway owns a valuable hydraulic plant of 2,000 horse power on the Quinebaug River, two miles south of Danielson, and eventually this plant will generate sufficient current to operate its entire system.

Incorporations and Franchises

Alabama

TALLASSEE FALLS—Water-power Electric Company.—Montgomery Water-Power Co.'s electrical plant is about completed, and after operation for thirty days will be transferred by the construction companies. It is proposed to raise the dam ten feet in the near future, so as to increase from 4,000 to 5,000 horse-power.

Arkansas

SEARCY—Electric Light and Water Works.—City will build electric light plant and construct water-works, plans and specifications for both of which are being prepared by Owen Ford, 710 Security Building, St. Louis, Mo. Municipal board of improvement, P. A. Robertson, chairman, can be addressed.

Florida

HUNTSVILLE—Electric Plant.—T. C. Du Pont of Wilmington, Del., and associates have acquired Huntsville Electric Railway, Light & Power Co. and plant. They will expend about $10,000 to improve the power plant. A. D. Hasbrouck will be local manager.

Kentucky

The Barbourville Electric Power & Heat Company of Knox County, Barboursville, Ky. Capital stock, $10,000. Incorporators: A. Gatliff, of Williamsburg, and B. L. Pope, of Barboursville.

PADUCAH—Steam Heating Plant.—Bowling Green Gaslight Co. let contract for construction of the steam heating plant mentioned last week. Plant will be engineered and built by American District Steam Co. of Lockport, N. Y. It will cost about $70,000 and have heating capacity of 150,000 square feet radiation.

Lousiana

MARKSVILLE —Electric Light Plant.—Marksville Electric Light & Power Co. has organized with Walter F. Couvillion, president; A. V. Saucier, vice-president; T. T. Fields, secretary, and L. J. Coco, treasurer. Contract has been awarded for erection of plant.

NEPOLEONVILLE—Ice Plant.—Napoleonville Ice Co. will be organized for the erection of an ice plant. Henry Delanne and August Thibault are interested.

Massachusetts

WORCESTER—The Hampshire & Worcester Street Railway Company has asked the Railroad Commissioners for approval of a stock issue of $80,000, making its total capital $155,000. This increase is desired by the company for the purpose of paying its floating indebtedness, making extensions and increasing its rolling stock.

The Worcester & Southbridge Street Railway Company has asked the Railroad Commissioners for authority to issue bonds equal to its capital stock of $500,000. These bonds are to be issued for the purpose of refunding floating debt.

Missouri

ST. LOUIS—The Schwan Reduction Co., capital, $5,000,000, has been incorporated in this State for the manufacture of aluminum and the pyro-chemical process. It is said that the plant of the company will be erected at a point near St. Louis.

The St. Louis & Suburban Railroad purposes to build a new roadbed along part of its line.

New York

ALBANY—The Bulls Head & Annadale Beach Railroad Co., capital $250,000, was incorporated here to-day to build and operate a summer travel railroad 8 miles long from Richmond Borough to the Staten Island Electric Road on the Raritan Bay. Directors are James W. Hughes, Harcourt Bull, Jordan M. Israel, Charles W. Kappes, A. E. Haskins, Hanford S. Weed, Joseph L. Doyle, H. H. Crossman and David Murphy.

After a long fight the Midland Railroad Company of Staten Island was enabled last month to land passengers under cover at the St. George Ferry house by way of the Staten Island Electric Company's tracks and terminal. Although it is understood that the controlling interest in both roads is held by H. H. Rogers of the Standard Oil Company, it was denied officially that there had been a consolidation.

Standard Technical Company, New York, electrical machinery; capital, $2,000. Directors: L. Sweet, H. L. Case, and W. V. Goldberg, New York.

Chemung County Gas Company, Elmira, (gas and electricity, Elmira Heights, Horseheads, and other places); capital, $500,000. Directors: Denman Blanchard, North Andover, Mass.; Andrew J. Miller, New York; M. H. Arnot, Elmira.

M. B. Foster Electric Company, New York; capital, $1,000. Directors: M. B. Foster, New York; T. F. Freund, Bayonne, N. J.; F. H. Corduan, Brooklyn.

Cosmopolitan Light Company, New York, gas and gasoline lighting supplies; capital, $50,000. Directors: W. S. Williams, Chicago; W. H. Batterson, Jersey City, and Leon Pistner, New York.

The London, Aylmer & North Shore Electric Railway Co. has filed articles of incorporation here with the Secretary of State, to operate fifty miles of road in Canada. Capital $500,000. The principal office of the company will be in New York city. Among the directors are James H. Hitchcock and J. Edward Howard of New York.

PLATTSBURG—It is rumored that the long talked of trolley road from Saranac Lake, in the Adirondacks, to Westport, on Lake Champlain, *via* Lake Placid, Elizabethtown and Ausable Forks, will soon be built. Surveyors are now at work near Saranac Lake locating the route, and it is expected that the road will be completed in time for next season's business. The distance from Saranac Lake to Westport by this route is sixty miles, connecting several prosperous villages.

Saugerites Light, Heat and Power Company, Saugerites; capital, $50,000. Directors: H. B. Hord and R. C. McCormick, New York; C. W. Eichells, Jr., Ridgewood, N. Y.

New Jersey

PRINCETON—Merger of the Princeton (N. J.) Electric Light Company, the Princeton Gas Company, and the Hopwell Electric Light, Heat and Power Company into a new company to be known as the Princeton Lighting Company, with a capital of $500,000.

JERSEY CITY—Eureka Automobile Co., with $400,000, to manufacture automobiles, etc. Incorporators: N. Metzenbaum, E. W. Schneider and C. J. Dorticus.

Novelty Motor & Engineering Co., with $100,000 capital, to manufacture motors, engines, etc. Incorporators: H. S. Gould, F. K. Seward and K. K. McLaren.

NEWARK—The Cleveland Automatic Machine Co., with $1,000,000 capital. Incorporators: G. H. Kelley, G. C. Whitcomb, J. G. Russell and A. L. Garford.

North Carolina

ASHEVILLE—Electric Company.—Incorporated: Piedmont Electric Co., capital $25,000, by William Farr, George L. Hackney and J. H. Weaver.

AURORA—Telephone System.—H. A. Swindell, Robt. Griffin, L. D. Bonner, M. B. Wilkerson, B. T. Bower and others have incorporated Washington-Aurora Telephone Co., with capital stock of $25,000, to establish system.

COLUMBIA—Telephone System.—Incorporated: Alligator Telephone Co., $25,000 capital, to operate telephone lines, by W. P. Jordan, Jr., of Norfolk, Va.; J. W. Sykes and Mark Aydlett of Columbia.

CONCORD—Water Works.—City is preparing to begin construction of the $70,000 water works plant recently reported. Machinery and materials will soon be wanted. Address "The Mayor."

GASTONIA—Telephone System.—Piedmont Telephone and Telegraph Co. has been incorporated, with capital stock of $11,300, and privilege of increase to $100,000, by W. T. Love, R. B. Babbington and J. W. Ware of Gastonia, and N. B. Kendrick of Cherryville, N. C.

ELIZABETH CITY—A gas and electric plant will be erected by C. M. Ferebee.

C. M. Ferebee has been granted a franchise for an electric street railway, the work of construction to begin November 1.

Pennsylvania

CONNELLSVILLE—The Connellsville Conduit Company, to construct and maintain a system of conduits in Connellsville and its suburbs for running and stringing telephone, telegraph, electric light and other wires through the system. Capital stock, $1,400. Directors: A. D. Soisson, R. Wanetta, Edwin K. Dick, Linford F. Ruth, Clair Stillwagon, J. V. Gray, of Connellsville, and William Dull, of Dunbar.

South Carolina

CHERAW—Electric Light Plant.—W. F. Stevenson, William Godfroy and N. T. Cobb have under consideration the establishment of an electric light plant.

KERSHAW—Electric Light Plant.—Kershaw Oil Mill will build an electric light plant.

SPARTANSBURG—The Spartansburg Electric and Machinery Co., capital $8,000, has been chartered by J. G. Simpson, T. W. Wright and B. M. Aull.

WINNSBORO—Electric Light Plant.—City is now asking bids on construction of its proposed electric light plant. Plans and specifications are on view; J. E. McDonald, chairman.

Tennessee

NASHVILLE—The Nashville Railway will, it is reported, extend the Jefferson street line about two miles, besides making a number of other extensions and connections. E. C. Lewis and Percy Warner are receivers.

The survey for the proposed electric line from Nashville to Lewisburg has been completed. The line begins at the corporate limits of this city, passing through Nolensville, Triune, Chapel Hill and other places in Williamson and Maury counties.

DYERSBURG—Telephone System.—It is proposed to organize company to establish a telephone exchange. W. C. Parrish can give information.

SPARTA—Contemplates putting in an electric light plant.

Texas

AUSTIN—It is stated that the Belton-Temple Electric Railroad, which recently filed its charter in the Secretary of State's office with a capital of $100,000, will be built immediately between Belton and Temple.

CROCKETT—Lighting Plant.—Incorporated: Citizens' Light Co., capital stock $10,000, by Dan McLean, Charles L. Edminston and John B. Smith.

DALLAS—Chemical Plant.—It is stated that Martin Chemical Co. of Quincy, Ill., is removing to Dallas its plant, capitalized at $15,000.

The city council has granted to A. K. Bonta a franchise for a street railway on North Harwood street.

EL PASO—Iron Furnace.—B. L. Berkey contemplates building an iron furnace.

FORT WORTH—Telephone System.—Fort Worth Telephone Co. has been organized with H. A. Fuller, president; Jos. N. Lloyd, secretary; J. L. Dunn, H. A. Fuller, F. M. Kirby and others, directors, all of Wilkesbarre, Pa. Company has capital stock of $304,000, and the organizers were named last week as to organize such a company.

CORSICANA—The Corsicana Street Railway has begun work on its proposed line.

BEAUMONT—Has about completed its electric light plant. The capacity will be from 20,000 to 25,000 lights. There are four distinct and separate circuits, so as to preclude all possibility of the city's being in darkness in case of accident.

FENTRESS—Has a new electric light plant. The new dynamo has been received and installed.

DEL RIO—The Del Rio Electric Light & Power Company, capital stock $8,000. Incorporators: Fred Mayer, Henry C. Mayer and John M. Gray.

Virginia

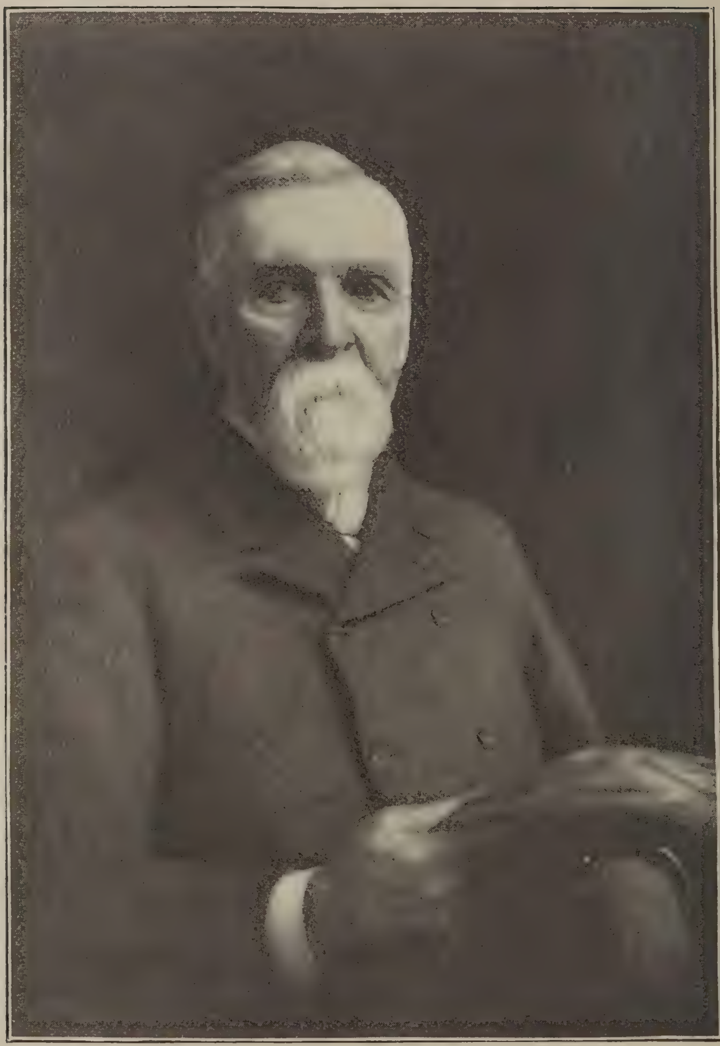
STAUNTON—The Staunton Light and Power Co., comprising the electric plant for lighting the streets, car and gas plants, has been sold by the Seventh National Bank of New York, to J. Scott Funkhouser, Edgar M. Funkhouser and others. They have also purchased the Staunton Gas Co.

RICHMOND—The Richmond Engineering Company, to do a general civil, mechanical and electrical business. Officers: James O. Spear, Jr., president; A. G. Higgins, vice-president and treasurer, and E. M. Dixon, secretary.

West Virginia

WHEELING—The Wheeling City Railway, it is said, will build from Benwood to McMechen, as well as up Caldwell's run and along the Fairmount turnpike. From Elkins it is reported that Senator S. B. Elkins will build a railway from newly-purchased coal lands to connect with the Baltimore & Ohio at Rowlesburg. At Wheeling it is said that the Panhandle Traction Co. will extend to Mahans, four miles north of Wellsburg and fifteen miles from Wheeling. The Morgantown & Kingwood Railroad will, it is stated, be extended from Reedsville to Belington, about thirty-five miles; Geo. C. Sturgiss of Morgantown is president.

MORGANTOWN—The Morgantown Electric Light & Power Co. proposes to build a street railway at a cost of $300,000 for rails and other equipment. Senator Stephen B. Elkins of Elkins, W. Va., and others are interested.



JOHN FRITZ, 1902.

Born, August 21, 1822. Aged, 80 years.

In his honor the John Fritz Medal, to be awarded for Notable Scientific or Industrial Achievements, was established at a banquet given at the Waldorf-Astoria on October 31, 1902.

A Boom for the Electrical Kitchen

By Francis F. Coleman

ELECTRICITY for household use has received a decided boom as a result of the great anthracite coal strike of 1902. Every such great industrial upheaval has its compensating effects. The Civil War of 1861, which took more than 1,000,000 men out of fields and workshops in the North, led at once to inventions and improvements which revolutionized farm work and manufacturing all over the commercial world.

The demand for men in the fields caused the invention of mowers, reapers, rakes and other implements with which horses could do the work of men, and the demand for arms brought into existence the system of manufacture by interchangeable parts, which is without doubt America's greatest gift to the world.

Deprive the people of one thing, and they soon find another to take its place.

Although the stress of the coal strike was ended before the pinch of frost was seriously felt, yet the people had already discovered that there were other ways to get heat in household and shop other than by the direct burning of coal.

The strike gave such a boom to the use of gas that manufacturers of gas cooking and heating apparatus were put to their wit's end to meet the demand, and are still behind with their orders. Before this gas had pretty nearly reached the point where it had passed out of the catalogue of luxuries into that of necessities. The great strike has assured the change. People who could not get coal began also to ask, "Why can't we cook and heat our houses with electricity?"

"You can," was the answer of the electrical companies.

"But how?" the people asked.

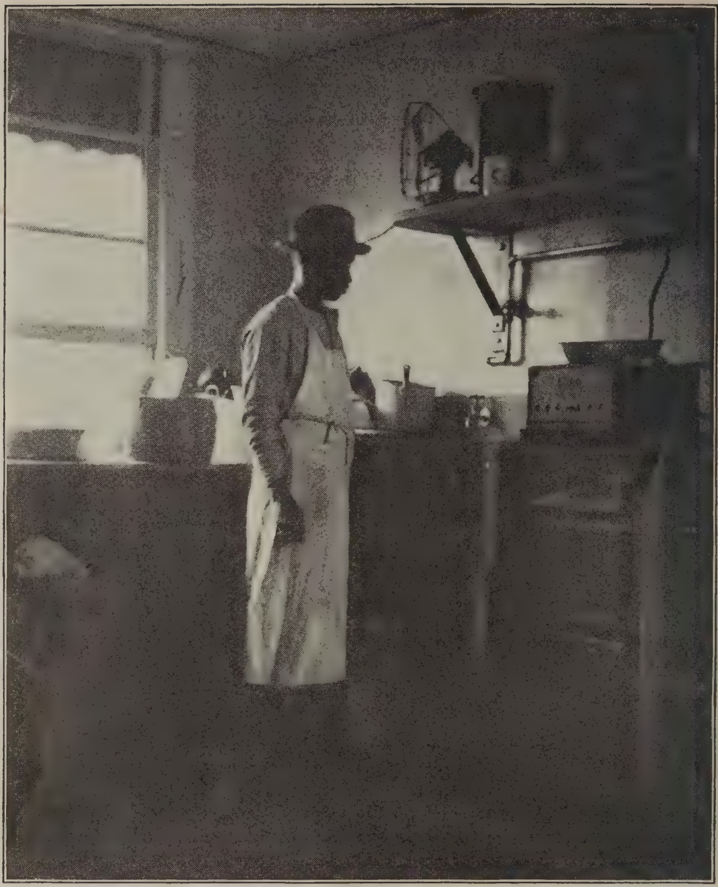
"Come and see," cried the electrical companies, leading the way to kitchens and show rooms prepared for exhibition.

It was to one of these kitchens that a party of inquisitive citizens made their way one pleasant day last month. They went to see a dinner cooked and, incidentally, to test the cookery.

The genius who presides over this kitchen is called "William." William made a reputation during the Spanish War, when, it is said, one of his dinners put down an incipient mutiny in a certain engineering corps where bad "grub" was about to cause an uprising. William never forgets that triumph. He remembers the responsibilities that go with a high reputation, even when getting up the simplest of dinners.

William's kitchen is up toward the sky. It is on top of a big building near the City Hall, whose tall twin chimneys make it known to all New Yorkers as the home of the New York Edison Company. William cooks a dinner every day for the officials of the company. He cooked a dinner for 24 persons, all told, on the day when the inquiring citizens invaded his domain.

The bill of fare showed a substantial



"The Meats In."
The Working End of William's Electrical Kitchen, Showing a Part of the Cooking Apparatus.

but not an elaborate meal. It was as follows:

MENU.

Oysters on the half shell.
Roast ribs of pork, apple sauce.
Potatoes roasted in the pan.
Egg plant, fried.
Cottage pudding.
Hard sauce. Soft sauce.
Coffee.

William cooks entirely by electricity. Nobody asks how much electricity William uses. He has such a profusion of electrical cooking apparatus that he never has to use it all at once. Besides this, he has an electric motor to grind his coffee and three or four electric fans to keep him cool in summer.

Economical persons who might contemplate using electricity for cooking should not inquire too closely into how much current William uses. It might discourage them. But they must remember that William does not have to pay for the current, and that electricity in the house where it is created is a great deal like crude oil in the oil fields. William has electricity "to burn."

William is exemplary in following the spirit of that valuable inscription which wise gas companies hang beside one's gas stove. This says, in big black type:

MATCHES ARE CHEAPER THAN GAS

"The Coffee Is On."

The Other End of William's Electrical Kitchen, Showing the Rest of the Cooking Apparatus.

He turns off the current promptly when through with its use, but he is extravagant, because many of his cooking utensils are too big for the pots or kettles in which he cooks. These should completely cover the stoves on which they are used and have a rim overhanging. This is to save all the heat. Instead of this William's stoves are three times as big as the bottoms of saucepans. The wasted heat was very apparent in the kitchen.

William's kitchen on the roof has a door at one end and a window at the other. In front of the window is a shelf on which he prepares food for cooking. Beside the door is a refrigerator. Between the door and the shelf, and running along one side of the room, stand the big variety of electric cooking apparatus provided for his use.

While William is cutting up apples for apple sauce, let us examine the kitchen. A dumb waiter and china and linen closets take up the side of the room opposite the cooking apparatus. In these we are not interested.

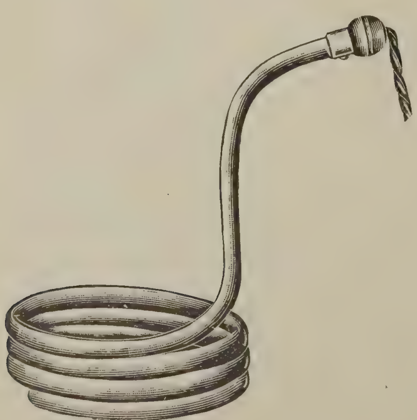
The first piece of electrical apparatus which catches our eye is the coffee grinder. It is on a high wall shelf beside the window. It is driven by a belt running from an electric fan motor. The motor was made for a 13-inch fan.

It is mounted at the end of the shelf. At William's right hand, and standing first in order of the actual kitchen apparatus, is a soap-stone sink, in which dishes are washed. Over this, on a shelf, is a brightly polished copper water urn, which used to supply the sink with hot water. An electric coil in the urn heated the water. William put the urn out of commission, and heats the water directly in the sink with the electric coil. He likes it better that way.

These electric coils are, perhaps, the handiest of all the electric cooking apparatus. They are made in forms to fit all sorts of receptacles, and are plunged right into the contents to be cooked. Every bit of heat which they produce is, therefore, utilized. The one which William uses will boil a quart of water in seven minutes.

Next to the sink is a large electric oven, with three compartments. The two lower compartments are for baking; the upper one is for plate warming. This oven is marked "No. 3." Standing upon it is an electric broiler, inclosed like a small oven.

A large square single oven, known to the trade as No. 16, comes next. It measures 13½ by 11 by 17 inches inside. It has a thermometer in the center of the door so that the cook may work



Electric Heating Coil.

with precise knowledge of what goes on within. On top of this oven stands an English electric broiler, inclosed, and made so that the top may be used also for a stove. Then come in succession three electric stoves and an open broiler. Each of these is of large size. Two of the stoves and the broiler are oblong in shape, and measure about 12 by 16 inches. The third stove is round, and measures 15 inches in diameter.

"Apple sauce put on," said William, turning the current on to the round stove.

It was 10.06 a. m. by the clock. William had begun to get dinner.

Chronology of an Electric Dinner.

Time.	
10.06	Apple sauce on round stove.
10.22½	18½ pounds pork, in two pans; set to roast in oven No. 3.
10.58	Potatoes to roast around meat.
11.05	Cottage pudding to bake in square oven.
11.11	Current on coil in sink.
11.12	Coffee grinder started.
11.15	Coffee grinder stopped.
11.16	Coffee to boil, on end stove; pot of water to heat on same stove.
11.16	Egg plant frying on next stove.
11.21	First cottage pudding done; second pudding put in oven.
11.27	Second lot of egg plant to fry.
11.33	Second cottage pudding done; one pan of meat not doing well in lower part of oven No. 3; changed to square oven, and plates put to warm in its place in oven No. 3.
11.38	Current on broiler to make toast.
11.38	Third lot of egg plant to fry.
11.51	Coffee done.
11.52	Sauce for cottage pudding put on in place of coffee.
11.52	Fourth lot of egg plant to fry.
12.02	Egg plant all done.

Time.	
12.13	Pudding sauce done; current turned off end stove.
12.13	Toast on broiler.
12.16	Toast done.
12.16	Meat done in oven No. 3, and current shut off.
12.17	Current shut off coil.
12.20	Dinner done; everything shut off.

Time that utensils were in use:

	H. M.
Oven No. 3	1.53½
Square oven	1.15
Coil	1.06
Coffee mill	.03
End stove	1.04
Round stove	2.14
Broiler	.38

The visitors, who sampled William's dinner, were fully satisfied with the gastronomic merits of electric cooking. They were, as well, satisfied, also, that there is no method of cooking which admits of such neatness and absence of heat in the kitchen. In these respects electricity is as far ahead of gas as gas is ahead of coal.

Why, then, is electricity not more generally used? The difficulty is the same as that which confronted the vendors of gas only a few years ago. At the present time both electric current and electrical cooking apparatus cost so much as to debar the great majority of persons from even trying their use. But the remedy is in sight.

"The way to resume is to resume," was the famous saying of John Sherman, when the question of resuming specie payments agitated the country after the Civil War.

The way to make gas cheap was to make a lot of it has been proven. To-day the electric companies, under the lead of progressive concerns like the New York Edison Company, are taking measures to prove that the same thing is true of electricity. Their schedules of charges are so arranged that the more current one uses the cheaper it is.

The following shows the manner in which the rates are reduced:

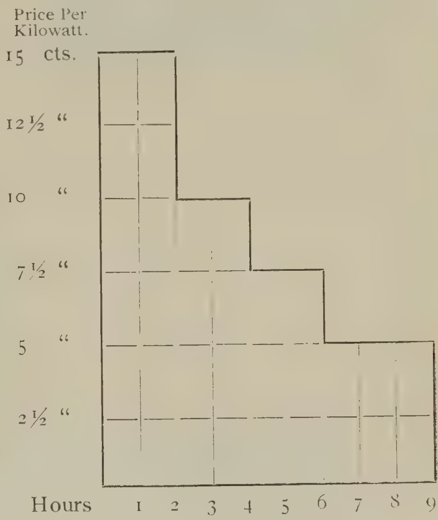
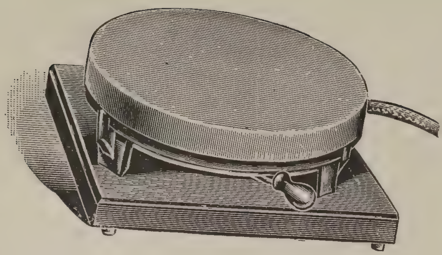


Diagram of Cost of Current.

The manner of computing the rate by this table is as follows: Taking as the unit of computation the total lighting installation in a house, the amount of current actually used is divided by what would have been used if the whole number of lights had been turned on: this gives the number of hours for the table. When this number exceeds two and is less than four, the rate drops from 15 cents a kilowatt to 10 cents. When it exceeds four hours and is less than six, the rate drops to 7 1-2 cents, and when it exceeds six hours current a day on the entire installation, the rate drops to 5 cents a kilowatt.

The heating installation is not counted as part of the unit of calculation. Whatever current is consumed therefore for heating, cooking or laundry purposes, counts toward reducing the price for all the current used. It is easy to see that this tends at once toward economy. In fact it is possible, if one assumes an ex-



Electric Stove with Heat Regulating Switch.

treme case, to almost save money by adding an electric kitchen to the household.

Let us assume that a flat contained 16 electric lamps, and that their total consumption was estimated at 800 watts an hour. Now let us also suppose that they actually consumed 47 kilowatts a month, which would be just within the two-hour-a-day limit and still subject them to the charge of 15 cents a kilowatt. The monthly bill would be $7.05.

Now assume that an electric kitchen has been added which uses 3,300 watts a day. This would be 99 kilowatts a month.

If paid for at 15 cents a kilowatt, the kitchen alone would cost $14.84, and the whole bill for current would be $21.89 for the month. As a matter of fact, however, the total consumption of current would have amounted to 146 kilowatts, or more than six times the hourly capacity of the lighting installation, and the whole bill would be at the rate of 5 cents a kilowatt. The total charge would then be $7.30, or a cost of 25 cents only a month for the cooking.

The principle of electric heating and cooking is the same as that of the incandescent lamp. Look into the lamp, and you will see a fine filament of carbon. This is so much smaller in area and conductivity than the wires which feed it that, when the current tries to pass, it chokes it back. The current turns to heat, and heats the carbon to incandescence.

In a form of heating and cooking apparatus, just being introduced here from England, known as the "Dowsing" system, the heating units are, in fact, nothing but modified incandescent lamps. The carbons are made large, so that they develop only enough resistance to bring them to a red heat, and the inclosing glass is drawn out into cylinders about a foot long each. Reflectors direct the heat where it is wanted.

Clusters of these heating units, made of ground glass and arranged in circular or fan-shaped forms of ornamental design, form the prettiest room heaters that have ever been shown. They throw out a gentle radiance of light as well as of heat.

In the ordinary electric heating apparatus coils of fine iron or german silver wire are used for the heating elements. These wires are inclosed either in a glass enamel or in packings or windings of asbestos. These inclosing substances keep them in place, and also serve to transmit and diffuse their heat. In the ordinary car heater the coil is of iron wire, and may be easily seen through the front of the heaters.

In the cooking apparatus in William's kitchen the heating material is fine german silver wire. This is only about the size of a horse hair, but yards and yards of it are disposed about the sides of the ovens or under the bottoms of the stoves,

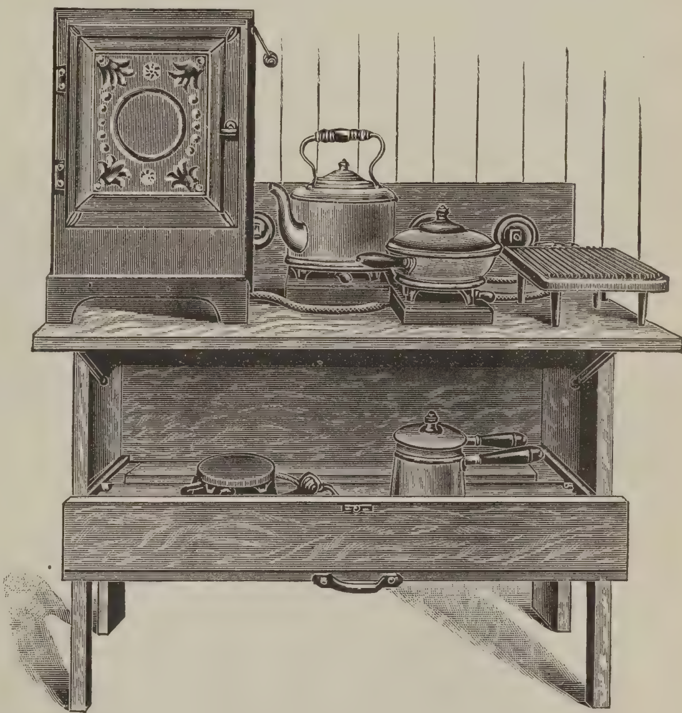
Electric Chafing Dish.

and in the coils in the stoves, ovens and broilers it is held in place by the enamel. In the heating coil the wire is covered with asbestos thread, coiled up and forced into the tube of the coil until the latter is full. Then the tube is coiled.

Another heating system which promises happy results has recently been introduced by the "Prometheus" company. Mica plates, covered with a thin coating of oxides of gold, silver, iridium, platinum or other rare metals, form the heating units in this system. A single unit, measuring but an inch wide and 4 to 12 inches in length, is sufficient to heat an ordinary cooking utensil. One mica element, the full size of the inside of a flat-iron, heats that utensil.

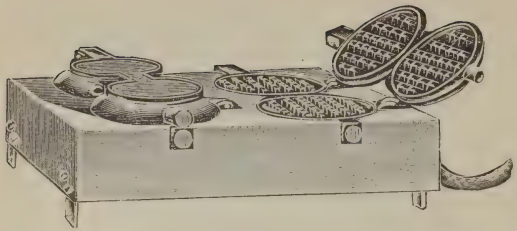
The preparation of these elements is both simple and interesting. The mica must be of the finest quality. Each piece is first rubbed hard with a silver brush on the side that is to be coated. This cleans the mica and leaves a thin coating of silver. The rare oxides, mixed into a linseed oil, are spread upon the mica with a camel's-hair brush. The amount of the coating is gauged by the color. A margin of free mica is left all around for insulation.

The plate is dried and heated over a gas jet. The oil burns away quickly, and the oxides are deposited in a metallic film. The coating resembles somewhat the silvering on a looking-glass. At either end there is added a band of silver powder, applied in the same manner as were the oxides. These form the contact points. The actual heating element is now complete, but to make it convenient to apply, more must be done. Another strip of mica, of like size but poorer quality, is taken, and thin metal bands are clipped upon its ends. On one side these hold strips of silver foil of a size to cover the silvered ends of the first strip. On the other side the metal clips are turned up to form contact points for connecting the element with the current plugs. The element is completed by placing the mica strips face to face and inclosing them in a casing of tin or sheet iron.



An Electrical Kitchen Equipment for Apartment Houses at Utica, N. Y.

When the current is passed through them the film of metal on the mica forms the resistance, and heat is rapidly generated. These elements are said to cost but about 9 or 10 cents each, and it can be easily understood that they can readily be replaced by any one in case



Electric Waffle Irons.

of accident. A part of the "Prometheus" system is the placing of heating elements in the base of each cooking utensil. This is said to result in a great economy of current.

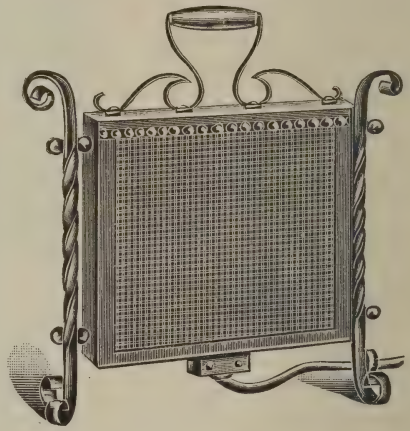
The standard electrical apparatus for the kitchen, laundry and other household uses is of the type made by the Simplex Electrical Company. Their apparatus has been installed in more than 130 kitchens—in two apartment houses at Utica, N. Y.; at the restaurant of the General Electric Company, at Schenectady; in the elaborate kitchen of the Natural Food Company, at Niagara, and many other places.

It is estimated that there are already in use in the United States more than 5,000 electric chafing dishes, 50,000 electric laundry irons and 150,000 electric street-car heaters.

What an Electrical Kitchen Costs.

A fair estimate of what an electric kitchen should consist of for a moderate sized family, and what it would cost, may be gathered from the outfits supplied in the apartment houses at Utica.

Each of these consists of an oven measuring 12 by 12 by 14 inches inside, costing $20; three stoves, two of them 6 inches each in diameter, and costing respectively $6 and $8, and one 8-inch



Portable Heater.

Electric Laundry.

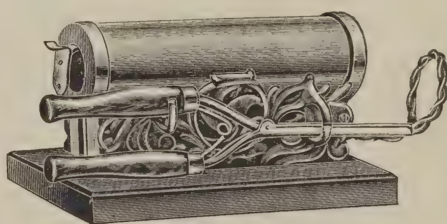
Electric Foot Warmer.

stove, costing $10; a broiler, 9 by 12 inches, costing $13.50; a blazer, costing $3.50; a double boiler, costing $3.50; a tea kettle, costing $3.25; switches costing $6; a receptacle for the oven plug, costing 90 cents, and a table for cooking. Without the table the total cost was $74.65. Tables of wood cost $10, and with slate tops $33.

The cost for wiring an ordinary house so as to put in an electric kitchen would be about $35. This would include a slate panel for the switches with four or five 15-ampere switches.

If one were fitting up an electrical kitchen they might, however, add some electrical trifles, which would make it cost more money. For the breakfast table, for instance, a griddle cake cooking plate would be desirable. One 9 by 12 inches costs $14. For the dinner table a coffee biggen is well to have. They cost from $13.50 to $20; for the tea table there are waffle irons, costing from $7.50 to $18; fancy stoves and kettles for tea making, costing $15 or so, and for all meals a plate warmer is handy, costing $20 or so. Then there are electrical frying pans, which cost from $12 to $19 each. With the addition of a chafing dish, at $10 to $30; a flat-iron or two, at $7 to $9.50; a foot warmer, at $5 to $7.50; a curling iron heater, at $3 to $6, and a portable room heater, costing $10 to $20, the figures for an electrical outfit may easily be run up toward $400 for a household.

But is this so large a sum? No. There are plenty of households where a well-supplied gas or coal kitchen of no greater capacity has cost as much or more. No one will deny, after once seeing an electrical kitchen in operation, that neither of the others can rival it for neatness or convenience.



Curling Iron Heater.

Electricity to Replace all Fuels in a Swiss Town

ELECTRIC heating has such advantages for all household purposes that it has been decided to use it, to the exclusion of all fuels, in the sanitariums of Davos-Platz and Daive-Dorf, in Switzerland. A study of the locality shows that water power sufficient for generating current can be had, according to the following estimate of the probable consumption of energy for heating, cooking and other work at these establishments. The two settlements cover a district about 2 miles long and from 900 to 1,200 feet wide. There is a fixed population of about 3,000, and, during the winter, about 2,500 patients in addition. The heaters to be used are of two types, the first being merely a resistance covered by a suitable enamel. The second type, used principally for cooking, consists of a small alternating-current transformer, which induces local currents in the base of the cooking utensil itself.

The estimates allow 185,000 horse-power hours for heating, 53,600 for cooking, 9,550 for bakeries, 15,000 for laundries and 5,000 for the baths, making a total of 268,150 horse-power hours per day in winter. Dividing this by 24 shows that the installation should have a capacity of 11,200 horse power. Mr. A. de Grandmaison asserts that the estimate of current needed for cooking is much too high. That for heating the buildings gives about 253 watt hours per cubic metre of space in the apartments, and is assumed to be correct. The results obtained at the restaurant of the Paris Exposition of 1900 show that an expenditure of about 450 watt hours per meal was sufficient. The conditions at Davos are less exacting than were those at the exposition. It is thought that 1,250 watt hours per day per person would be ample. Taking this figure for a basis the total would be reduced to 228,000 horse-power hours, and a plant of 9,500 horse power would be sufficient. This power can be obtained from two streams—the Landwasser and the Albula—situated at about 20 kilometres from Davos, and having a fall of 394 metres.

The central station will contain five sets of apparatus of 3,000 horse power each. Each turbine will be coupled directly to two three-phase alternators of 1,500 horse power each. The alternators will generate current at a potential of 8,000 volts, and, two being coupled in series, will give a pressure of 16,000 volts to be sent out over the line. The annual expense of this service, including interest, depreciation and cost of operation is estimated at 829,528 francs. The consumption of energy for the year would be 25,000,000 kilowatt hours, so that the price per kilowatt hour will be 3.3 centimes. This cost is not regarded as excessive for heating, while the advantages of its use for cooking, and the avoidance of all smoke, are considered more than sufficient to warrant the undertaking.

An Oxy-Acetylene Blowpipe

AT a recent meeting of the Societe Francaise de Physique, M. Fouche exhibited an oxy-acetylene blowpipe in which only pure oxygen and acetylene are used. In a blowpipe previously devised it was found necessary to mix ether with the acetylene in order to insure proper combustion. By using high pressures, however, it has been found possible to dispense with the ether, and, as a consequence, a much higher temperature is realized in the blowpipe flame. The proportions in which the gases are used are 1 volume of acetylene to 1.8 volumes of oxygen. The pressure used is equivalent to that of 4 metres (157.5 in.) of water, and the speed at which the gases issue from the jet is between 300 feet and 450 feet per second. At lower speeds back-firing is liable to occur. The highest temperature is found in a greenish cone at the center of the flame, the height of this cone being but 1-4 inch.

Metals fuse in this with the greatest facility, and it is easy to form autogenous welds of iron and steel, especially as the flame has neither a carbonizing nor reducing action. Silicon fuses easily, as do also lime and alumina; nor is magnesia more resistant. If the quantity of oxygen is reduced, the flame becomes luminous; and if it is then directed on a fragment of lime, calcium carbide is formed.

The Best Lubricating Oil

EVERY person who uses machinery is interested in the question of reducing friction. This is true whether the machinery used be but a sewing machine, a bicycle, an automobile or the complicated aggregating in a great power house.

From the slushing of a wooden cart-wheel to the delicate oiling of a steam cylinder the general operation is the same. But upon the character of the lubricant much depends. Every ounce of avoidable power loss means just so much more that must be provided in the coal heap. Added to that will be large increases in the bills for repairs and new machinery.

It pays to use good oil. What, then, constitutes a good lubricating oil, and how is one to tell a good oil from a bad one?

The Editor of "The Electrical Age" recently addressed to the Standard Oil Company an inquiry as to how to make a simple test of cylinder oil. Here is the reply of the Standard Oil Company's expert on that subject:

"I regret that I do not know of any simple test by which an engineer can determine whether cylinder oil is of the proper quality or not, and we do not think any simple test exists, or there would not be so many cheap and inferior oils on the market sold for cylinder lubrication. The only real test is that of service, and service takes some time to develop results. Sufficient additional friction, with wear of valves and increase of power, is not generally discoverable by a simple test; but it exists none the less, and is of sufficient consequence in its results as to make advisable a good deal of attention and effort to avoid it. If we had some simple formula that could have been published broadcast that would make these things apparent easily and quickly we would have used it long ago."

Full lubrication is got, therefore, by introducing a thin layer of oil between the moving faces of the parts of machines. One film of oil attaches itself to one face and another to the other face, thus separating them. Between these films there is a certain amount of friction in the oil itself. Friction in oil has the peculiar quality that it does not increase with the pressure. It does increase, however, with the speed of the moving parts. But to keep the films of oil from being pressed out from between the surfaces the oil must have a thickness equivalent to the pressure it must bear. The stiffer the oil the more internal friction it will develop.

All lubrication is got, therefore, by using an oil is thin as will suffice to keep journal and bearing apart. Oils, however, have many other qualities than thickness which vary their relative values as lubricators. Some wear out too rapidly; others attack the material of the machines.

The oil that best keeps down friction is the one that makes dividends, and the one that costs least by the hour, month or year is more economical than the one that is merely cheap by the gallon. For the various portions of a large machine it is often economical to use more than one kind of oil.

Coal and the Miner

A HUMAN life was lost for every 188,668 tons of coal mined in the United States in 1901, and in 18 States and Territories the total number of miners killed during the year was 1,467, and the number injured was 3,643, according to the United States Geological Survey. The number of tons of coal mined for each life lost varied from 426,094 in Maryland to 49,424 in Indian Territory. In Pennsylvania the number of tons of bituminous coal mined per life lost was a little more than double the amount mined per life lost in the anthracite mines in the same State.

The world's production of coal in 1901 was 866,165,540 short tons. The United States produced 33.86 per cent., Great Britain and her dependencies 30.86 per cent., and Germany 19.42 per cent., or, combined, 84.14 per cent. of the total production.

In the United States the bituminous coal industry in 1890, 192,204 men working 226 days produced 111,302,322 short tons, valued at $110,420,801, an average of 2.56 tons per man per day, and of 579 tons per man per year; in 1895, 239,962 men working 194 days produced 135,118,193 short tons, valued at $115,779,771, an average of 2.90 tons per man per day and of 563 tons per man per year; in 1900, 304,375 men in 234 days produced 212,314,912 short tons, valued at $220,913,513, or 2.98 tons per day and 697 tons per man per year; in 1901, 340,235 men in 225 days produced 225,826,849 short tons, valued at $236,406,449, or 2.94 tons per man per day and 664 tons per man per year. The average price of bituminous coal per short ton in 1890 was 99 cents; in 1895, 86 cents; in 1900, $1.04; in 1901, $1.05.

In the anthracite mines in 1890 the number of miners was 126,000, who in 200 days produced 46,468,641 short tons, valued at $66,383,772, the average production being 1.85 tons per man per day and 369 tons per man per year; in 1895, 142,917 men produced in 196 days 57,999,337 short tons, valued at $82,019,272, an average of 2.07 short tons per man per day and of 406 tons per man per year; in 1900, 144,206 men working 166 days produced 57,367,915 short tons, valued at $85,757,851, or 2.40 short tons per man per day and 398 tons per man per year; in 1901, 145,309 men worked 196 days and produced 67,471,667 short tons, valued at $112,504,020, an average production of 2.36 short tons per man per day and of 464 tons per man per year. The average price per short ton of anthracite coal in 1890 was $1.43; in 1895 it was $1.41; in 1900 it was $1.49, and in 1901 it was $1.67.

In the last twelve years the number of workers in the anthracite mines has increased from 126,000 in 1890 to 145,309 in 1901, or over 15 per cent. During the same period the number of men in the bituminous mines has increased from 192,204 to 340,235, or a little over 77 per cent.

Automatic Telephone System in France

The automatic telephone system, invented by a Russian engineer, which does away with the central station operator, has been adopted by the French Government. In this system the subscriber turns five disks, each numbered from 0 to 9, to form the number wanted, whereupon the correspondent is called automatically. If he is absent a sign soon appears saying: "Rang one minute; no answer," while the caller's number is registered at the other end, so that he may be called after the person sought returns. When the number desired is already "busy," a special buzz is immediately heard. In order not to dismiss all the telephone girls together, which might disturb the labor market, the new system will be introduced gradually. Three towns of moderate size are being equipped now—Limoges, Nimes and Dijon.

A 2,000,000-Mile Locomotive

THE locomotive Charles Dickens, of the London & Northwestern Railroad, England, completed its two millionth mile of running on the 5th of September, giving it a record which, it is asserted, has no equal anywhere in the world.

The history of the engine is told in the "Railway Engineer," of London, in the form of a letter, supposed to be addressed by the Charles Dickens to the press. This letter says, in part:

"I am now in the proud position to announce that, on the 5th instant, before finishing my 5,312th trip from Manchester to London and back, and when about three-eights of a mile on the north side of Bramhall Station, on the Macclesfield line, I completed, with 186 other trips, my two millionth mile of active service for the London & Northwestern Railway Company and their supporters.

"I was turned out of my owners' works at Crewe on February 6, 1882, sent to Longsight to run as often as I could between Manchester and London as the minimum work for a day, with David Pennington and Leigh Bowden as my guides.

"After a few years David's eyesight was injured, and on March 17, 1886, I lost my faithful guide, but Josiah Mills, who succeeded him, together with Leigh Bowden, who has been with me throughout my career, have been unremitting in their attentions, Leigh guiding me over quite half of the 2,000,000 miles I have traveled.

"Two millions of miles in 20 years and 181 days! How did I effect it? Well, during the time I drank 204,771 tons of water, and to develop my energies and make them equal to the duty required of me, consumed 27,486 tons of coal; but although in the interval my traveling pace was increased by degrees from 42 to 50 1-3 miles per hour, and the weight I had to haul was appreciably increased from July, 1898, to enable breakfast to be served on board, and from July, 1899, to admit of tea being served on the return journey, my consumption of fuel, including the raising of steam each day, did not exceed 32 pounds per mile.

"The cost of maintaining me in efficiency only averaged 1.28 pence per mile run. I feel now that, at my time of life, although still in excellent condition, with all the exacting provisions of the age—breakfast, luncheon, tea and dining saloons, corridor trains, reservoirs for gas for cooking, steam heating, electric lighting and generally more luxurious accommodation—I ought to give way to a more powerful comrade, and ask my owners for the indulgence of lighter duty."

A Horse Power from Six Pounds of Motor

A MOTOR which will produce a horse power for every 6¼ pounds of its weight would certainly be a remarkable piece of machinery. The Duryea Power Company, of Reading, Pa., which recently produced from its regular castings a gasolene motor which gave a horse power for every 10 pounds of its weight, is now about to undertake the building of the lighter motor.

The engine referred to was built for a flying machine man under a guarantee that it would develop 15 horse power and not exceed 170 pounds in weight. When completed it weighed 162 pounds with the sparking device and mixer attached, or 148 pounds without them.

" Our only means of testing the power of the machine," said Mr. C. E. Duryea in describing it, " was a crude prony brake on the flywheel, and, in spite of deluging this with water, it would get firey hot in a short run. We made, however, a great many tests, some of them running above 18 horse power, but the motor could not be depended upon to give more than about 13 or 14 horse power regularly.

" It was peculiarly sensitive to weather conditions, a wet day destroying fully 20 per cent. of its power because of the dilution of the charge with watery vapor. The motor is equipped with a flywheel 18 inches in diameter, and the cylinders are 4½ x 4½ inches. The crank shaft and wrist pins are hollow, the cylinder heads and piston heads being cupped to provide a spheroidal combustion space, and, of course, all unnecessary weight was cut out. The magneto is driven by a friction pulley bearing on the flywheel, the contact primary spark being used. The spark advancing device permitted the breaking of the circuit while the piston had yet five-eighths of an inch to travel before reaching the dead center.

" This engine, like all of our engines, has the crank shaft set below the center line of the cylinders, so as to produce a more nearly direct push of the connecting rod on the crank pin, an arrangement, which reduces the friction and wear and gives a more effective utilization of the power, as we believe. The crank is inclosed by a light copper case with a removable cover. An oil cup on each cylinder lubricates the piston, and the excess flows into the crank case, where it splashes upon the bearings."

An Electrical Postman.

An electrically-operated system for the collections of letters, the invention of Pigna Toeggi, is to be tested on an elaborate scale on the route between Rome and Naples, and if it proves successful is likely to come into extensive use.

The post boxes, the contents of which are collected automatically, are in the shape of poles. When a letter is posted, the stamp is automatically defaced with the imprint of the name of the town, the number of the collecting pole and the month, day, hour and minute of posting. The post box takes its contents to the top of the pole and drops the letter into a collecting box, which, automatically stopped, returns to its place at the bottom of the pole, and while doing so, releases the wheels of the collection box, which pursues its journey to the next pole or post box. The inventor hopes a speed of 250 miles an hour will be attained.

It is expected that the new invention will be exhibited on a large scale at the St. Louis World's Fair in 1904.

The Slaby-Arco System of Wireless Telegraphy

By Ernest L. Harris

United States Consul at Eibenstock, Germany

MY report to the Department on the Slaby-Arco system of wireless telegraphy has brought so many letters of inquiry to this office from all parts of the United States, that I feel called upon to treat the subject in all its details.

The Allgemeine Elektricitats Gesellschaft, in Berlin, manufactures two types of apparatus to correspond with different requirements. The first type is intended for standard stations, ships, and permanent installations, and is in three different constructions, namely: For small distances up to 25 miles, for medium distances up to 50 miles, and for long distances of over 50 miles over sea. The second type consists of a light, portable field instrument with a microphone receiver.

Transmitter of Type I. for Low-Tension Circuits.

The component parts of this apparatus comprise the following:

I. Inductor.—The inductors employed for apparatus of Type I. are different, according to the signaling distance. For small distances of 25 miles, an inductor having a spark gap of about 6 inches is used, which is placed in an inclosed wooden box and provided with an ordinary hammer interrupter. The current is supplied by a battery of from 20 to 40 dry cells, having a tension of about 16 volts. The consumption of energy is from 50 to 100 watts.

For medium distances up to 50 miles, an inductor is used, with a spark gap which is supplied direct with alternating current or with continuous current taken from a turbine interrupter.

For long distances over 50 miles, the inductors have an output of three kilovolt amperes or more, and are supplied with either alternating current direct or with continuous current converted by a Grisson direct current-alternating current converter.

II. Primary condenser.—The condenser is connected in parallel with the interrupter and is placed in a wooden box. It is usually stored in a convenient place—as a rule, in the neighborhood of the interrupter.

III. Mercury turbine interrupter.—This consists of a mercury turbine which is driven by an electric motor. The speed of this motor can be varied between 200 and 1,000 revolutions. The shaft of the turbine is arranged vertically, and dips at its lower end into a cast-iron vessel filled with three kilograms (6.6 pounds) of mercury. The turbine shaft has a small wing in its lower end which dips in the mercury, and by its rapid rotation draws the mercury up and spurts it through an opening in a horizontal plane. A metal segment ring is placed concentrically to the shaft of the turbine. The rotating stream of quicksilver strikes against this ring during a part of every revolution. As the quicksilver is connected with one pole and the current supply and the segment with the other, the current circuit is continually opened and closed.

In order to quickly extinguish the sparks caused by opening the circuit, the turbine casing is filled with alcohol. The length of the segment depends upon the extension it has—for example, with 110 volts, a length of 1 quadrant; with 65 volts, a length of 2 quadrants; and with 32 volts, 3 quadrants. The mean intensity of the primary current is, with 65 volts, about 15 amperes, with 20 interruptions.

For ship installations, the interrupter is provided with a trunnion suspension to keep it always in the same horizontal plane, which is made in different forms to suit prevailing conditions.

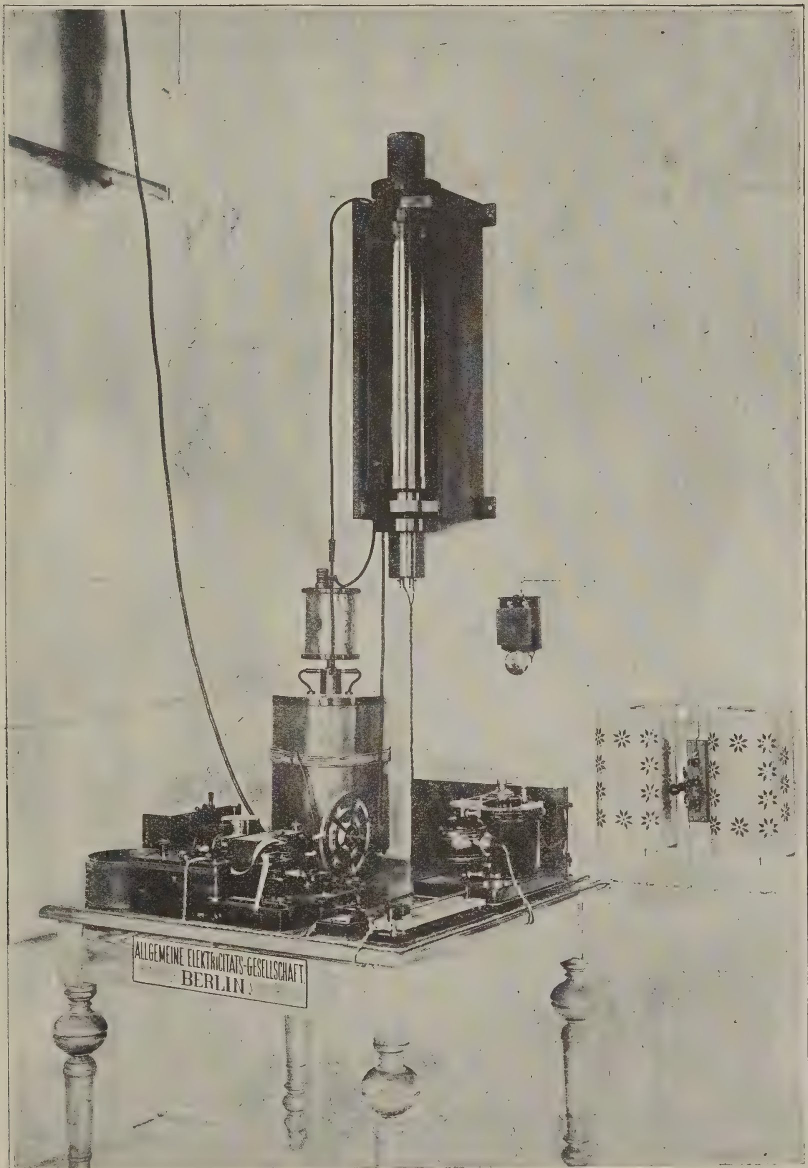
IV. The Grisson converter.—As a substitute for turbine interrupters, and in order to avoid trouble with the mercury, the Grisson direct-current, alternating converter is supplied for large electrical outputs. This converter (Grisson's patent) is used as a substitute for the direct-current interrupter. The primary winding of the inductor has, in addition to its two main terminals, a third terminal, which is connected to the metal of the winding coil. The method of operation is then as follows:

A direct current is sent into the inductive coil and is kept on until it attains a maximum value. When this is reached, the current is passed through the circuit of the second coil. The two coils have a common iron core, which they magnetize in an opposite sense, so that when the current is sent through the circuit, a counter electro-motive force is induced in the first circuit, reducing the current flowing in it nearly to zero. At this moment, the first circuit is interrupted and the current immediately rises to its maximum value. In order to perform this automatic closing of the one or the other circuit, or to effect both operations simultaneously, a contact device in the form of a commuter is provided. The device consists of two commutators insulated from one another and mounted upon a common shaft, and fitted on the one hand with two collector rings and on the other hand with a common brush, which makes contact alternately with the segments or connects them with one another.

This contact device is driven in by a small electric motor. The converter does not deliver a pulsating direct current, but a pure alternating current, whose wave form can be varied within wide limits. The frequency can easily be varied between 15 and 100 cycles per second. As the current is not interrupted when it is at its maximum value, and little, if any, sparking occurs, it is possible with the help of this converter to feed the inductor with considerable current.

V. The Morse instrument.—It has been found that the platinum contacts of the Morse instrument have either burnt or fused together when interrupting heavy currents, and thereby caused unpleasant disturbances in the working. All these troubles have been overcome by the patent Morse instrument with magnetic spark blow-out, which is delivered in two different styles, either with magnetic or electro-magnetic blow-out. The latter is so constructed that it can be added to all normal instruments without trouble.

VI. Three-step resistance regulator.—This piece of apparatus is also intended for portable field equipments. It is placed in the inductor circuit and serves to weaken the intensity of the transmitter if it is ever desired to signal to short distances. A simple, single pole three-



Complete Outfit, Type I.

throw switch, lettered "maximum," "medium," "minimum," serves to show that there is in the primary circuit of the inductor at the moment of signaling either no resistance, or one resistance, or that there are two resistances, whereby the sparks produced by the tension in the secondary winding of the inductor are reduced to different degrees.

VII. Lightning arrester.—In order to protect the dynamo generating the current from lightning, a lightning arrester is provided.

Transmitter for High-Tension Circuit.

The apparatus belonging to this circuit includes the following:

I. Electric jars.—The battery consists of three, seven, or fourteen double Leyden jars. The case consists of a cylindrical containing box, between whose upper and lower covers the jars are held firmly by layers of felt. The containing box is built by layers of micanite. The jars are double, one being placed inside the other. The upper coverings are connected by a tin-foil coating at the bottom of the jars; their inner coatings are separately connected to a good insulating plate.

II. Spark gaps.—The spark gaps are vertically arranged on the collecting plate of the battery and fitted with micanite cylinders to deaden the sound. To ventilate the interior, an ebonite leading-out tube is provided. From both terminals of the spark gap rubber-insulated wires are led to the secondary terminals of the induction coil, which is arranged on the wall. The circuit is arranged with the upper adjustable pole of the spark gaps earthed, rendering it therefore harmless. The lower pole of the spark gap, which, if touched, might produce strong physiological effects, is distinguished by being painted red, and it is scarcely accessible, owing to its concealed position.

III. The transmitting wire.—This consists of one or more rubber-insulated leads, the upper end of which is wound round into the form of a cylindrical cage.

IV. Spark gap cut-out.—This is arranged between the antenna and the outer system, and is attached to the case containing the battery of Leyden jars. It serves to automatically cut off the high-tension circuit of the transmitter from the receiver while taking messages.

V. Exciter and syntonizing coils.—The syntonizing coil consists of a few turns of wire arranged around the cylindrical box containing the battery.

VI. Storm emergency switch.—This is inserted between the antenna and the apparatus room, and is kept open during electrical storms.

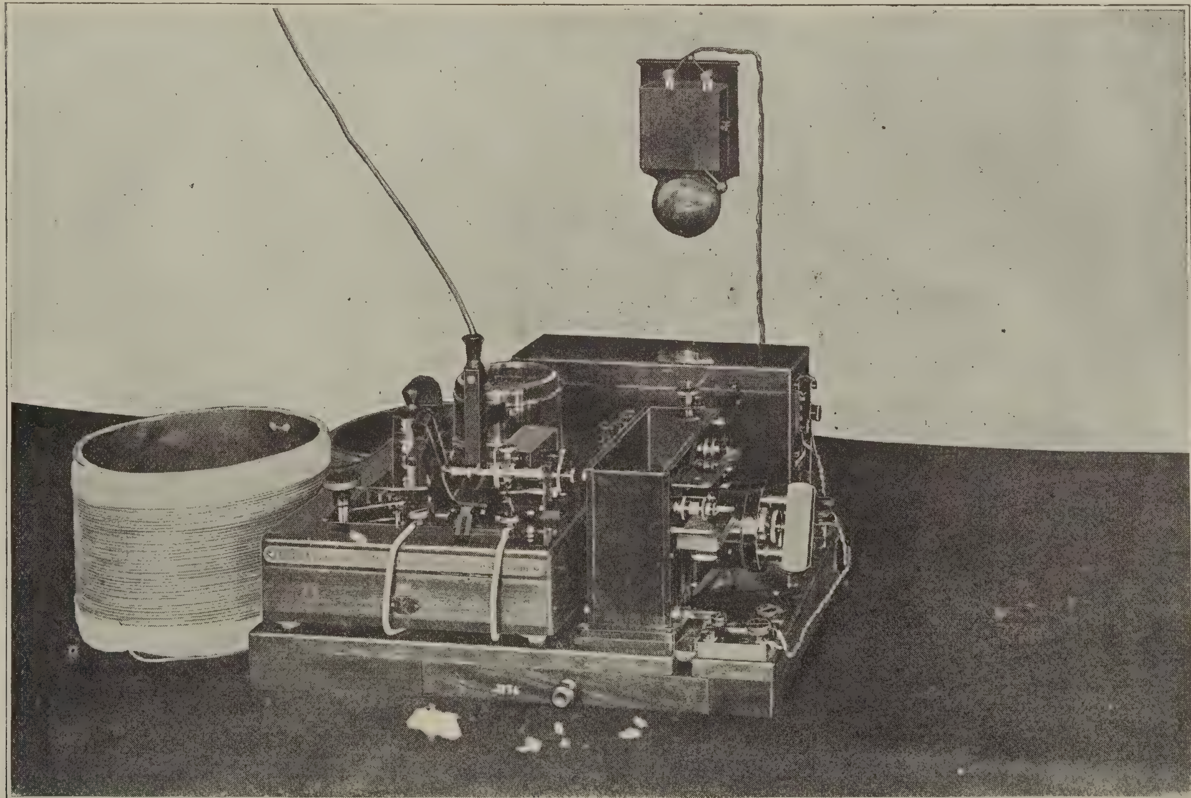
The Receiver.

The receiving apparatus consists of two separate circuits, namely, a weak-current circuit and a heavy-current circuit.

The weak-current circuit consists of—

I. The coherer.—Only vacuum fritters are used—first, in order that the filings may be protected against oxidation and the influence of the air, and, second, that the powder may remain absolutely dry and easily movable. As a result, in each stroke of the tapper the grouping of the filings is similar. The plugs of the coherer are of silver, closely fitted into a glass tube, so that between the plug and the tube no fine powder can force its way in. The connections of the coherer consist of stout platinum wires, and lead to metal caps fastened on to the coherer ends.

The construction of the plugs is patented and permits the sensitiveness to be regulated in spite of the air-tightness of the connection. The end surfaces of the plugs are not parallel, but divergent, so that the slit presents a wedge-shaped ap-



Receiving Apparatus.

pearance. If the fritter is placed with the smallest part of the slit downward, the powder fills up the greater part of this and the pressure is increased. The sensitiveness of the coherer is then at its maximum. If the widest part of the slit is placed below and the powder is divided over a large surface, the pressure is reduced and the sensitiveness of the coherer is then at its minimum value.

The fritter can be turned round its axis. It is provided with a thumb screw and arresting spring, by which it may be given any desired degree of sensitiveness. With this new arrangement of tapper and coherer, it is possible also to alter the sensitiveness of the coherer while telegraphing, if so desired.

The coherers may be changed with the greatest ease by removing them from their metal sleeves. These coherers are manufactured in all degrees of sensitiveness.

II. The interrupter.—The interrupter spring is so switched in that by a movement of the tapper lever, the weak-current circuit is opened, and the tension from the cell is cut off from the coherer. The advantage accruing from this patented arrangement is an easier and more exact interruption, at the same time prolonging the duration of the coherer, because the sparking which would result in the fritter powder at the moment when the coherer was tapped is moved to the interrupting point.

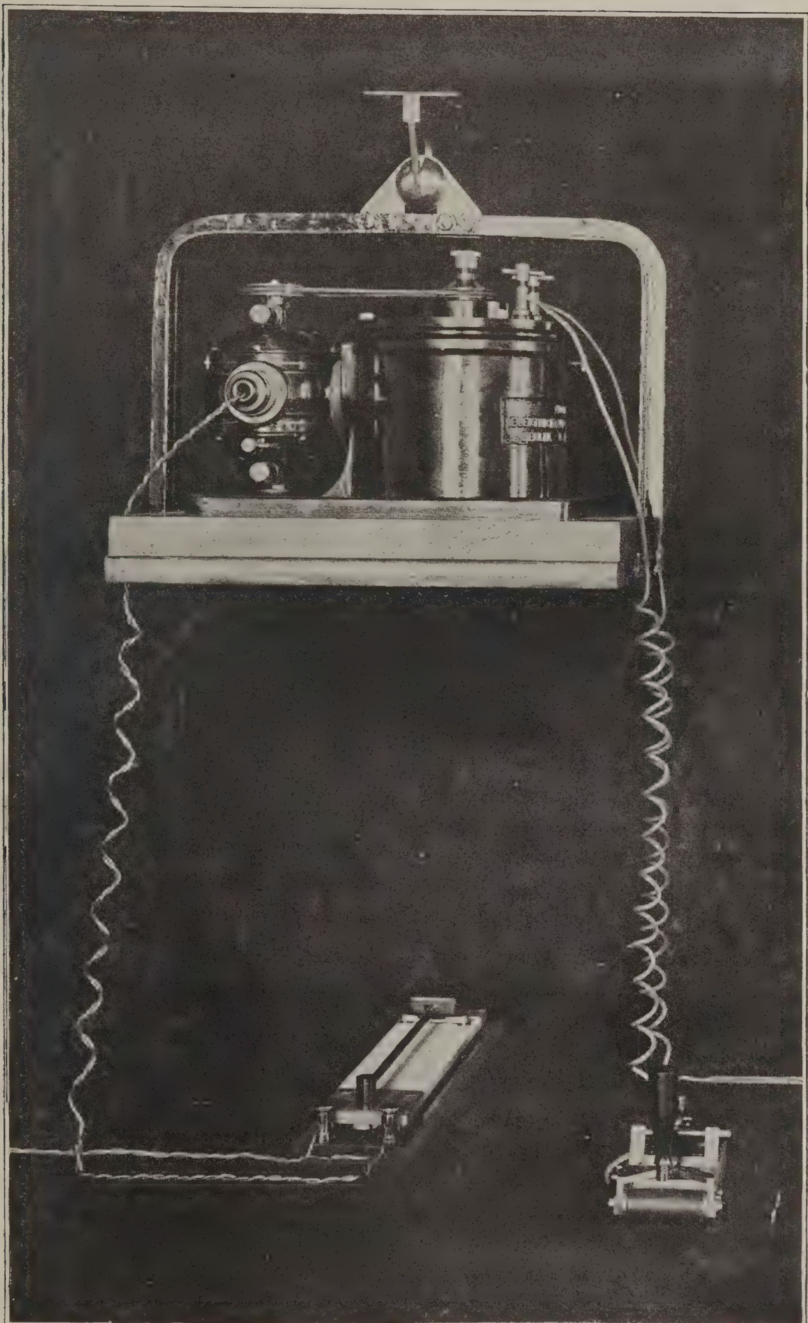
III. The coherer cell.—The coherer cell is a dry element having a tension of 1.2 to 1.5 volts. With tensions greater than 1.5 volts, the coherer does not work with sufficient precision; with tensions under 1.2 volts, the sensitiveness of the relay is not sufficiently good.

IV. Relay winding.—The resistance of the coherer is reduced with normal intensity to about 2,000 ohms; the relay coil has, therefore, a similar resistance of about 2,000 ohms. The relay is polarized and works as follows: A permanent steel magnet magnetizes the two cores of the coils so that their pole pieces become of the same magnetic polarity. The permanent magnet also magnetizes a tongue of soft iron placed between the pole pieces in the opposite magnetic polarity. This tongue is kept in a definite position by means of two contacts—that is, one stationary and one working contact.

By varying the position of these two contacts, the tongue is brought into a state of unstaple equilibrium, so that it rests against the stationary contact when there is no current passing through the relay. If a weak current is now sent through the relay winding by the coherer cell, the initial magnetism of one of its cores is increased and that of the other weakened. By this means, the equilibrium of the tongue is disturbed, and it strikes against the working contact. The relay tongue is balanced in any position by means of a counterweight, so that the relay will work satisfactorily in any position up to the vertical.

V. The condenser.—The condenser is connected in parallel with the dry cell and with the relay winding. Its capacity is 0.01 microfarad and is, by comparison with that of the coherer, extremely large. It is constructed in the usual way, with sheets of tin foil insulated from one another by means of mica. The condenser absorbs any excess of tension which would be exerted on the coherer owing to the self-induction of the relay and facilitates the release of the coherer powder. The ground connection is connected by means of the condenser and coherer through an interrupter, thus avoiding the self-induction of the relay.

VI. Resistance regulator.—The resistance regulator serves to weaken the in-



Turbine Interrupter with Trunnion Suspension.

tensity of the receiver of moving stations, in telegraphing over short distances. If the contact plate is shifted, the tuning is at the same time disturbed, and the waves which reach the coherer weaken. In order to prevent the operator from forgetting to bring his handle back into its initial position when signaling to greater distances, it is connected to, and operates simultaneously with, a cut-out placed in the turbine circuit, so that the operator is compelled before transmitting to bring the handle back into its original position.

VII. The switches.—The switches open or close the following connections: The weak-current lead to the coherer, the strong-current lead to the relay, and the high-tension and the ground leads. Thus, any influence on the transmitter is entirely avoided on the receiving apparatus, especially such as short circuits in the strong-current leads, which become evident by sparking at the relay tongue.

On the same switch are also two contact terminals, which, when the switch is open, are connected with one another, and when it is closed are open. The primary current of the induction coil is led in through these two terminals, so that if in sending a message the operator inadvertently neglects to open the coherer switch, on pressing the Morse key, no current is received by the inductor and no sparks are produced.

The heavy-current battery consists of four dry cells which in the beginning produce six volts, dropping later to four volts. The current from the battery passes through the contact placed in the plug on the receiving apparatus, through the relay tongue, the working contact, the tapper, and so through to the second contact back to the battery. As long as the relay tongue lies against the stationary contact, the polarizing elements are switched into the heavy-current circuit in series. After the polarizing coils become sufficiently charged by a current of short duration, they give an opposite electro-motive force, the battery current is reduced to zero, so that a weakening of the battery, which would arise through a permanent current, cannot take place.

When the circuit is closed by the tongue of the relay, the current is led through the winding of the tapper, whose resistance is about six ohms, and the polarizing elements, which are short-circuited by the relay, discharge simultaneously. If the contact made by the tongue is broken, the polarizing elements absorb the energy arising from the self-induction of the tapper cells and the Morse magnets, so that no ill effect can result to the coherer, as the sparking which might take place on breaking the circuit is prevented.

The Morse apparatus is connected in parallel with the tapper circuit. It has four connecting terminals connected two in parallel, one pair of which can be disconnected by means of a switch. By connecting the red covered wire with the terminals left in circuit, the Morse magnets are switched in parallel with the tapper magnets.

To the two terminals which are disconnected, an alarm is joined, which is only put into circuit if there is nobody present in the apparatus room. The spark caused by the make and break of the alarm interrupter is eliminated by the provision of polarizing elements which are placed in the woodwork of the alarm.

Transmitter of Type II.

The special inductor, with self-contained sparking gaps and Morse key, in this apparatus is designed especially for field work. Dry cells are used as the source of current. The antennae or staffs consist of single bare wires, sus-

Portable Field Apparatus at Work.

pended in the air by means of small kites or balloons.

Microphone Receiver of Type II.

The receiver consists of a tuned microphone, with telephone receiver. Starting from the fact that microphones, contrary to coherers, respond not to tensions, but to current strengths, the connections for microphone receivers have been so developed that the microphone is placed in the loop of the current waves, which are artificially strengthened. As the microphone, moreover, is not placed in the receiving system, but in a branch from this, it is possible by these connections on the one hand to eliminate all atmospheric disturbances and on the other hand to attain a pure tuning, thereby increasing the receiving intensity.

The dry cell, which is connected in series with the cored or spring microphone and with the telephone receiver through a choking coil by the double-pole switch, is contained in a wooden box. By the opening and closing of a contact push, the microphone becomes audible with a commencing resistance of 150 ohms, so that a weak but permanent current corresponding to the resistance passes through the telephone. If the waves transmitted by the antenna reach the microphone, the resistance fluctuates within small limits and produces current fluctuations from the local battery. At each spark of the transmitter, the noise may be heard in the telephone. It is advantageous to choose a primary frequency of the transmitters at least so great that 100 sparks per second pass, as the sounds are difficult to hear in the telephone with a frequency of vibration less than this.

Such a microphone receiver is tuned by being joined through a tuning coil to the tuned and earth receiving antennae, close to the earthing point, and switched into a branch circuit, which, by means of the self-induction and the condenser, earthed and made variable by means of the regulator, is therefore tuned to the special-wave form of the transmitter.

The sensitiveness of the microphone receiver is greater than that of a sensitive coherer, so that by the use of a microphone the maximum signaling distance is increased. However, on account of the variable resistance of the microphone, it is impossible to take down signals by means of a relay and a Morse printing apparatus, so that written signals cannot be received with the microphone nor can a station be called up.

The Slaby-Arco system of wireless telegraphy will, in all probability, come into general use in Germany, so far as such telegraphy may be practicable. In addition to the navy, which has already adopted this system, the merchant marine is beginning to equip many vessels with the same apparatus. Stations have been erected near Cuxhaven and Bremerhaven for the purpose of communication with vessels of the two great German steamship lines. Permanent stations have also been made at Bremerhaven and on a lightship anchored forty-three miles from the coast.

The Allgemeine Elektricitats Gesellschaft, of Berlin, has succeeded in fitting out many battleships of Austria, Sweden, Norway, Portugal, and Chile with telegraphic installations. Russia has purchased these for her postal telegraphs. Denmark has fitted up a number of lighthouses and lightships, situated on an average of nineteen miles from each other, with the same apparatus.

The following advantages are claimed for the Slaby-Arco system:

1. The long distances through which signals can be transmitted, having regard to the shortness of the transmitting and

receiving antennae, and the small consumption of energy.

2. The complete exclusion of electrostatic atmospheric disturbances at the reception of the signals.

3. The possibility of using as antennae for the transmitter and receiver, lightning conductors, iron chimneys, poles, or masts, or other earthed vertical conductors already existing.

4. The entire absence of danger from the transmitter wire.

5. The possibility, due to the use of an electric syntonizer of greater intensity, of receiving without interference messages from several transmitting stations at one and the same time.

6. The perfection of the apparatus, in the sense that when employed on board ship it is not influenced by the motion of the vessel, and it can be handled with ease by a working staff, which need not be technically instructed.

Iron and Steel at the Dusseldorf Exhibition, 1902

By Professor Hermann Wedding, Ph.D. (Berlin)

Honorary Member of the Iron and Steel Institute

THE Exhibition at Dusseldorf is limited both objectively and territorially. It does not aspire to be a world's exhibition, nor does it even represent the whole of German territory, but is confined solely to the Prussian provinces of the Rhine and Westphalia.

Of the important iron manufacturing districts, those of the provinces of Silesia and Hanover, and that of the imperial province, Lorraine, which contain besides the most celebrated iron ore deposits of Germany, are not included, the only iron-mining district of note represented being that of Siegerland. On the other hand, the most extensive coal-mining regions, apart from that of Silesia, that is, the Ruhr and Rhine, the Saar and Aix-la-Chapelle districts, fall within the scope of the exhibition.

The metallurgy of iron and machine construction in all its branches are so overwhelmingly represented, that in comparison all other objects and the industries connected therewith, appear to fall into the background. The members will, however, find that this limitation is no defect, but, on the contrary, constitutes a decided advantage. For metallursts this exhibition offers a display which, in point of completeness and imposing magnitude, has hitherto been unexcelled.

It is now the author's task, undertaken at the request of the Council of the Institute, to conduct the members through the iron-metallurgical section of the exhibition, if they will consent to intrust themselves to his personal guidance.

The division between the section devoted to the metallurgy of iron and the other parts of the exhibition is not sharply defined, since there are numerous appendages and side exhibits of the kindred industries of mining and of metals other than iron, besides the great hall of machinery.

The products of the ironworks are accommodated partly in single pavilions, and are partly assembled in one portion of the main building extending parallel to the bank of the Rhine. The most convenient course will therefore will be to take the Rheinthor as the starting point, and to conduct the members systematically thence down stream, leaving them afterwards free to view the objects of the exhibition more closely. The author proposes, therefore, to omit such data relating to dimensions, composition, etc., which may be found either in the catalogues or displayed on the exhibits themselves, since the paper concerns chiefly those who are present and not so much the absent members, and will be completed mainly by the author's explanatory comments.

Beginning then with the special exhibit of Frederick Krupp of Essen: before entering the building attention is attracted to some ponderous armor plates which were made at these works, and consist of an alloy of nickel and iron. One of these weighs 106 tons, and was manufactured from a single ingot of 130 tons. The armor plate rolling mill is driven by a reversing steam engine of 3,700 horse power, and the rolls are 4 metres (13 feet) long, and 1.2 metres (4 feet) diameter. The ballistic trials of other plates, which are placed within the building, prove their capacity for resistance. Other objects of exceptional dimensions are manufactured besides armor plate, an example of which is to be seen in the shape of a boiler plate weighing 29.15 tons, placed against the wall of the building. A boiler end plate of 3.9 metres (12 3-4 feet) diameter shows how the plates are shaped by presses.

A great degree of perfection is attained in the heavy pieces forged by the hydraulic press. A notable example of this work is afforded by the shaft for the ocean liner Kaiser William II., which has six cranks. The propeller is attached, and the total length of the shaft is 22 metres (72 feet). The material has a tensile strength of 60.5 kilogrammes per square mm. (38.4 tons per square inch), and an elongation of 21 per cent.

Not less striking to the attention is a hollow-bored shaft for a steamer, forged in a single piece, in a length of 45 metres (148 feet). The core lying near exhibits the excellent compactness of the material, as also does a glance through the hollow of the shaft while illuminated. The ingot from which the shaft was forged was formed from the contents of 1,768 crucibles, and was completed in thirty minutes, 490 workmen being required for the work of casting. Crucible steel ingots are cast at Essen up to 85 tons, and ingots of open-hearth steel are made up to 120 tons.

Shafts made of a 3.6 per cent. nickel alloy of iron are forged under hydraulic presses, the largest of which is 5,000 tons pressure. Especially noteworthy are the enormous castings of mild steel, among them the stems and sternposts for warships and the mercantile marine.

It is almost superfluous to enlarge upon the great armored turrets with electric machinery for revolving them, for serving the large guns and handling projectiles. These will be exhibited in actual motion. Every one is more or less acquainted with the renowned products of the Krupp works in respect of war material. Among these must also be reckoned the armored domes of chilled cast iron, which among other excellent productions are exhibited by the Krupp Gruson works in the apse of the building.

The next building which is entered

contains the objects placed on exhibition by the Hoerder-Bergwerks und Hutten-verein. What attracts the attention here is chiefly shipbuilding and railway material. Ship plates, reverse bars for the ship framing, deck beams, etc., of excellent finish are shown. A marine boiler end plate of 3.6 metres 11¾ feet) in diameter is formed of a single piece of plate, the material being open-hearth steel. A marine crank shaft of 550 millimetres (22 inches) diameter, also of open-hearth steel, is displayed. All the shafts are bored out through the center, partly with the object of reducing their weight and partly to obtain assurance as to the soundness of the material within. The perfection of the steel castings is particularly evidenced in the appearance of the huge sternposts with rudder and propeller. It will be noted that the surface of the machined parts of wheels, shafts, etc., are almost entirely free from blow holes.

The Hoerde works have in recent years taken a leading part in all that concerns the metallurgy of iron, and have won for themselves a well-deserved reputation owing to the public spirited manner in which they have never failed to publish the results of trials and experiments whether attended with success or otherwise.

The capabilities of the rolling mills are manifested by a rail 76 metres (250 feet) long. The large plates of extreme thinness, down to 1 millimetre for instance, afford further proof of their perfection.

The next in order is the display of the Bochumer Verein for mining and cast steel manufacture, which is also accommodated in a separate building. Finished products of extreme purity and homogeneity of composition, cast in mild steel such as portions of marine engines, shafts and articles of every description, show a high degree of perfection, as also do the heavy forgings. Here, too, is to be seen another hollow-bored shaft of great length with the core consisting of a single piece. Attention is also drawn to three steam pistons of forged mild steel, the largest of which has a diameter of 2·374 metres (about 7 feet 10 inches). In addition to these may be seen a sternpost weighing 89 tons, made of molded cast steel, a masterpiece of its kind, built up in four sections. Lastly, the Bessemer converter ring is also deserving of notice. The railway material is specially noteworthy, in particular the cast spoked wheels, on account of the exactness and cleanness of the casting.

A peculiar branch of work undertaken by this firm is that of bell founding, exemplified here by bells of large and small size, all of beautiful tone. The harmonious peal in the tower is set in motion by an electric device of special construction.

In the next building to be visited are arranged the products of the Rheinische Metallwaaren und Maschinenfabrik of Dusseldorf. Here are exhibited seamless hollow bodies in great variety of form, which have all been manufactured by the Ehrhardt process.

The method consists of the piercing by means of a mandril circular in cross-section of a hot billet of square section which is held in a hollow cylindrical die. The process is very clearly represented by means of models. The manner in which the exact evenness in the thickness of the wall is produced is particularly striking. Gun barrels for double and treble-barrelled guns, and even large gun tubes, are manufactured by this process. The initial operation in the manufacture of boiler-ring courses is performed in a similar manner, the hollow billets being afterward rolled out into cylindrical rings on a rolling mill.

Thus both riveted and welded seams are dispensed with in the finished course.

Crossing the main avenue of the exhibition the pavilion of the Gutehoffnungshutte of Oberhausen is reached. In front is presented to view a large winding engine. On turning to the right the spectator is confronted with an extensive collection of ores, pig irons and other material. The variety of the kinds of iron produced at these works is shown by the large number of rolled sections, and massive plates afford evidence of the capacity of the rolling mill. Forgings and castings of excellent quality, representing orders for the most part, are a proof of the remarkable progress which has been achieved in Germany with regard to the soundness of the castings and cleanness of execution manifest even on the rough exterior.

In making the tour of the building numerous interesting illustrations of the development of the works from small beginnings are presented. Samples of wheel bosses and pulleys, tires and bridge-building material are on view, which exhibit a remarkable degree of toughness.

The whole attention is now centered on the lage blowing engines, at present driven with producer gas, but later to be worked by blast-furnace gas. The peculiar arrangement of having the blowing cylinders placed at the side is due to the desire for economy of space lengthwise. The engine is of the two-throw type. The firm has contributed largely to the rapid development of gas engines driven direct by blast-furnace gas, and is experienced in all systems of such motors. Some idea of the serviceableness of their machines may be gained from this fact.

Four smaller pavilions are now entered, the first one being that showing the Goldschmidt process, where may be witnessed the welding of portions of iron by means of thermite, a mixture of aluminium and oxide of iron; also the reduction of carbon-free metals, more particularly manganese and chromium. Next is the Niederrheinische Hutte, containing an exhibit which is admirably elucidated by analyses. Then follows the exhibit of Dr. Otto, of Dahlhausen, where may be seen a full-size model of the most modern type of coke oven, fired from below by means of gas burners. Lastly, the pavilion of the Buderns Ironworks, at Wetzlar, which, besides exhibiting a beautiful model of a blast furnace, also illustrates the utilization of blast-furnace slag for cement making (termed iron Portland cement).

The great Hall of Industry is visited in turn, where the magnificent display of the Phoenix Company, at Laar, near Ruhrort, confronts the spectator. Among a great number of objects, material and products finished wholly or in part, is a large collection of grooved rails for tramways, which is most especially deserving of notice. The etching specimens of old and new products near the central column are highly instructive.

The central circular road leads through to a series of exhibits of tube and plate works, which are classified in such a manner as to permit of an interesting comparison of their efficiency. On the right hand is the stand of the Dusseldorfer-Rohren Walzwerk (formerly Poensgen & Co.), with welded tubes of all kinds—drawn, rolled and butt or lap-welded. Besides these are other hollow bodies, the excellence of the material of which is shown in the flanged and bent portions. On the left are placed the objects of the Schultz Knaudt Company, the special feature of which consists of boiler rings, both plain and corrugated, with welds of excellent workmanship left in the rough state, water gas having been exclusively used for heating the plates preparatory to welding. The tall columns, the highest of which is 11.26 meters (35¾ feet) in length, are evidence of the remarkable skill exercised in the manufacture of these products.

The succeeding stand is that of Messrs. Harkort, in Duisburg, distinguishable by the central revolving pedestal with the bust of Prince Bismarck. Here the chief objects of interest are the plates for the construction of burglar-proof safes, manufactured with different degrees of hardness.

Further on, on the right, is Piedboeuf & Co., with tubes and hollow articles of the most intricate kind, welded by hand. On the left again follows the Duisburger Eisen- und Stahlwerk, showing specimens of heavy work, in particular end-plates for marine boilers.

The exhibit of the German-Austrian Mannesmann tube works is the next in turn on the right. This most instructive collection displays the process of tube manufacture by the method of oblique rolling, which failed to fulfil all that had at first been expected of it, and is now only used in the preliminary stage of manufacture. The tubes are brought to their final state of perfection by the use of the so-called Pilger process.

Confronting this is the stand of the Krieger Steelworks, with beautiful specimens of the firm's products, comprising for the most part shipbuilding material.

The collective exhibition of the Siegerland is now entered. This district forms the southern part of Westphalia, and is widely celebrated on account of the great wealth of its mineral lodes, containing spathic iron ore, rich in manganese, from which are produced white pig iron and spiegeleisen. The progress achieved here in the last decades may be noted by comparing the two full-sized models of an old and a new blast furnace. Mention must also be made of the models of Burgers, of Schalke, not alluded to in the catalogue, which show how a blast furnace may be constructed entirely of iron, provided it is properly cooled on the outside.

On arriving at the end of the central passage and turning to the left an extensive exhibit is seen, consisting of chilled rolls of great superiority. These form a specialty of the Siegerland. Unfortunately, no fractures are shown of these rolls, which are manufactured in different degrees of hardness; by this means the depth to which the hardening penetrates would have been apparent.

The way now leads past several small exhibits—Soding & Halbach, the Aplerbeckerhutte, and Capito & Klein. The latter shows some thin plates made of Siegerland iron. These are followed by the Aachener Hutten Aktien Verein, at Rothe Erde, and again the Phoenix works. Then taking a passage turning off to the right the tube and plate-making section is once more passed through. Boecker & Co., of Schalke, and the stand of the Wittener Guss-Stahlwerke is reached. This section is devoted to the display of molded steel castings of mild steel, numerous and excellent specimens of which are to be seen on all sides. The extraordinary improvements which have been effected in this particular branch will be realized on examining these castings. Until quite recently it was practically an impossibility to obtain a mild-steel casting free from blow-holes, yet the material, which, in many instances, is purposely left in the rough state, shows no cavities either on the surface or in the fractures.

Before proceeding further, the collection of Felix Bischoff, in the section of the collective exhibition of the Siegerland, should on no account be passed over. This forms one of the most instructive collections with regard to the composition, and the qualities dependent thereon, of the various kinds of tool steel, more especially of the quick-cutting tool steels which are now coming into general use, and are already extensively applied for rough turning in those works equipped with sufficiently powerful lathes.

Passing on, the way leads between the Gelsenkirchener Stahlwerke, formerly Munscheid, with a large cylinder cover 2.36 meters (about 7 feet 10 inches) in diameter, and the Saarbruckener Guss-Stahlwerke, at Malstatt-Burbach, with a revolving turret cover and a ship's stern post of 25 tons weight; also a nickel-steel armor plate which has been subjected to a ballistic test, and shows in the fracture the excellent quality of the cast steel. The Oberbilker Stahlwerke follow, with a fine propeller shaft for a marine engine, and the end of Group II. of the exhibition is then reached.

The steel works appliances of Laeis at the end of the passage are worthy of attention, comprising a stamping machine for Bessemer converter bottoms, and also a casting ladle. Returning through the central avenue there may be seen on the one side the Westphalian Steelworks of Bochum, and on the other Grillo, Funke & Co. On all sides the excellency of the mild steel castings calls for admiration.

In the stand of Oeking & Co. are exhibited the interesting patent couplings of Mr. R. M. Daelen, of Dusseldorf.

On looking back toward the entrance the exhibit may be observed of the Rheinische Stahlwerke, which affords many proofs of the improvements in mild steel castings as well as in forgings and rolled pieces. The Hochfelder Walzwerke is also represented, showing chain cables for ships. Besides this there is the Emscherhutte exhibit.

Adjoining Group II. is the comparatively small Mining Section, Group I. This can be entered direct from the former, and thence the extensive sub-section of the Association for Mining Interests of the Dortmund district is reached, forming part of the same group. Here, contrary to the general rule, are represented not only the productions of the Rhineland and Westphalia, but also those of other mining districts of Germany.

The Machinery Hall is then reached, where gas engines, blowing engines and rolling-mill engines are at work, of which the thorough study would occupy many days. These are objects, however, which do not enter within the scope of the present paper, and the author will, therefore, take leave of the members at this point, in the hope that they may find a guide better qualified than himself to conduct them through this department.

Hyduret of Liquid Silicon.

Hyduret of liquid silicon inflames spontaneously upon coming into contact with the air. MM. Moissan and Smils, who discovered this hyduret, have determined the density of its vapor and found that it corresponds to the formula Si_2H_6, and also that it possesses very energetic reducing properties.

Hydro-Electrics in the Alps

By Rene de La Brosse

Electro-Chemical Works — Third Article

WE will group together in the follow description the related features of various electro-chemical power houses, because these power houses present many characteristics in common which can be better presented in this manner, without entraining useless repetitions.

In this way we will not limit our conclusions by the observation of the small number of installations that we have been able to visit. There exist in fact, in the valleys of the Arc and of the Haute-Isere, etc., other analogous establishments which the commission has not had time to inspect, but which do not offer less of interest.

Before proceeding with this description we will say that the French electro-chemical and electro-metallurgical industries have by far their principal theater of activity in the region of the Alps, where they number 25 power houses, besides the 33 which exist in France. The greater number of these derive their force from streams of moderate size. Below is reproduced M. Blondel's list ot those which existed in 1898 in Savoy and in Dauphine, with such modifications as are made necessary by changes since that time.

No.	Department.	Commune.	Name of Works.	Water Source.	Horse Power.	Products
1	Ain	Bellegarde			600	Carbide of calcium
2	Haute-Savoie	Mieussy	Pont du Risse	Le Giffre	6,000	"
3		Passy	Chèdde	L'Arve	10,000	Carbide and alkaline chlorates
4	Savoie	La Praz	La Praz	L'Arc	8,000	Carbide and aluminum
5		Saint Michel	Saint Michel	"	2,000 10,000	Aluminum Carbide and chlorates
6		Saint Jean	Saint Jean	"	8,000	Chlorates
7		Epierre	Epierre	"	1,200	Carbide
8		Montgirod	Montgirod	L'Isère	2,600	Chloride of sodium
9		N. D. de Briancon	N. D. de Briancon	"	3,000	Carbide
10		La Bathie	La Bathie	"	1,000 1,200	Carbide Carborundum
11		Chailles	Chailles	Le Guiero	1,800	Carbide
12		Saint Beron	Saint Beron	"	1,800	"
13	Isère	Chapareillan	Cernon	Le Cernon		"
14		Troges	Troges	Ruisseau de Troges	600	"
15		Livet et Gavet	Livet	La Romanche	10,000	(?)
16		"	Les Clavaux	"	5,000	Sodium, etc.
17		Séchilienne	Séchilienne	"	1,200	Carbide
		Total horse	power.	....	74,000	

Of this whole collection of works, in which 74,000 horse power is produced and utilized, the third part has been devoted, a little precipitately perhaps, to the making of carbide of calcium, an industry upon which has fallen a sharp crisis of over-production, so that the fabricants of it are compelled to share their orders pro rata and cut down the production to one-fifth of their capacity, and some have had to shut down entirely. This crisis is, without doubt, but momentary, for the demand for carbide can not but increase. Moreover, as was said by M. Blondel in 1898, "if the electrical fabrication of carbide of calcium some day disappears before more economical chemical methods there will easily be found other products to be prepared advantageously in their furnaces."

One of the most striking characteristics of electro-chemistry is, in fact, the ease with which it can be turned from one production to another.

Thus one may see in the valley of the Romanche an important power house which was put up some years since for the fabrication of soda. The corporation owning it became discouraged by difficulties met with at the beginning and closed its shops. Those who acquired the property soon rented the power house to a new society, which has now installed the manufacture of soda and its derivatives, and, far from being frightened, as was its predecessor, this society thinks of doubling its hydraulic power. In this same valley the power house of Livet, of 10,000 horse power, was actually put up without its owners having in view at the time any particular use for the power. It was designed originally for the production of carbide of calcium, but this was before the crises in that product arrived. Notwithstanding the crisis, the owners did not hesitate to advance the enormous capital needed for its completion. If they experienced a moment of hesitation, it is difficult to accuse them of imprudence, for experience has shown that the power has always found employment. In default of one product it is always easy to find another more in demand, whether it be chlorates, aluminum or some other. Finally, in default of remunerative chemical products, there remains always the vast field of employment for motrical force for lighting and of transport to a distance. Of the latter the useful radius is extended more and more with the increase of voltages.

The commission of Puy-de-Dome visited the power houses which bear the numbers 2, 3, 13, 15 and 16 in the preceding table.

Power House of Giffre

The power house of Pont du Risse utilizes the force from a fall of the river Giffre, which is 71 metres in height. During eight months of the year the flow exceeds 7,000 litres per second, and even reaches 13,000 litres; but this is beyond the actual capacity of the canal which conducts the waters to the power house. On the day of the visit of the commission, the 19th of March, the power house received about 5,000 litres, which is about the minimum drawn from the stream.

The power is obtained through eight centripetal turbines of 1,100 horse power each, each one working a monophase alternator generator of 700 kilowatts capacity, at 400 turns per minute. Turbines and generators are direct connected by means of Raffart couplings on their shafts.

The power house has in addition six

turbines of powers ranging from 12 to 200 horse power each, used for grinding, for work in the shops and for excitation. It produces carbide of calcium exclusively. Its output is restricted by reason of the general crisis already spoken of.

The works for the taking of water consist of a dam of masonry 4 metres in height, and a canal along the side of a hill of a type generally used in similar installations of the regions. The capacity of the canal seems capable of being usefully augmented, for the loss of power, though its small size is appreciable. A large overflow drain precedes the chamber of water at the end of the canal. From there depart two circular conduits made of plates of steel 1m. 80 in diameter. These are each 620 metres in length, and capable of supplying a stream of 9,000 horse power.

The power house of Pont du Risse belongs to the Electro-Chemical Company of the Giffre. It has been in operation since 1898. The energy produced is used entirely in electrical furnaces for the production of heat.

Power House of the Arve

Among the powerfully fed water courses which contain important reserves of energy, the Arve holds one of the first places.

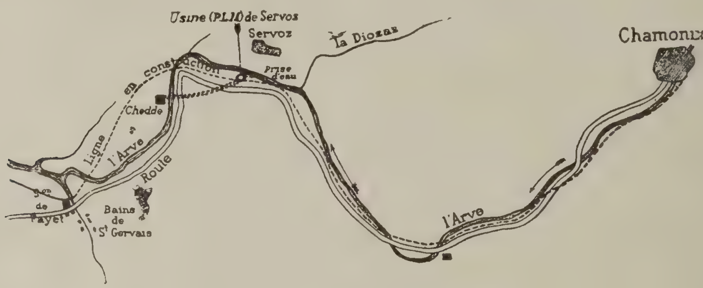
It receives its tribute from the snows of Mont Blanc, the greater part of it being from the French slope. Its flow even at low water is well sustained by an abundant melting of ice. Its slope is rapid. It is therefore the reservoir of a considerable hydraulic power which will certainly be extensively utilized before long. At present it serves the electro-chemical power house of Chedde, near Saint-Gervaise-le-Bains, and it will soon furnish to the railroad company of P. L. M. the necessary energy for the line from Fayet to Chamoni (38 kilometres in length), which is now nearly completed. This line, with a track of one metre in width, presents grades of such steepness that electrical

Intake of Water from the River Giffre.

power only would permit of its operation without the use of cog wheels and a toothed track.

The water, taken from the stream in a volume of 9 to 10 cubic metres, is carried first into a tunnel of a large section; it passes from there into a second tunnel, that of Gures, at the extremity of which is found a chamber of water from the higher fall (height 39 metres), which

After leaving the power house of the P. L. M. Company, the water crosses under the open sky over the ravine of the Chatelard to a third tunnel, that of Egrats, which is 672 metres long. At the extremity of this, at an altitude of 748 metres, is the chamber of water from the fall of Chedde. This fall, which is about 140 metres, creates 10,000 horse power.



Water Powers of the Arve.

works the four turbines of 325 horse power each, of the power house of the P. L. M. Company. This is accomplished by means of four conduits, each measuring one metre in diameter. The energy thus produced, amounting to 1,300 horse power, is furnished to the cars by a special contact rail running the length of the road. Each car is provided with motors of 100 horse power capacity.

Two steel conduits, made of plates of steel, and 1m. 40 in diameter, lead from the water chamber. They descend nearly vertically to the public highway from Fayet to Chamonix, pass in an aqueduct under this road, cross the Arve over a steel bridge, and end at the power house at an altitude of 609 metres above the sea.

The following table shows the principal features of the power house:

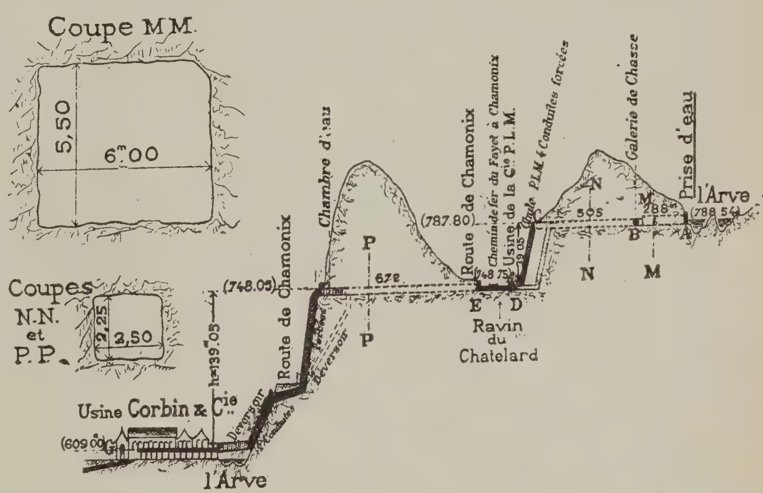
Installation at Chedde

	Turbines.	Dynamos.
No. of units	12	12
Type of apparatus	Girard, horizontal axis	
Makers	Brenier & Neyret	4. Œrlikan 4. Creusot 4. Belfort
Efficiency	75 per cent.	95 per cent.
Power, Per unit	800 horse power	560 K. W.=760 h. p.
Power, Total (with accessories)	10,000 "	9,200 electric h. p.
Cost of works, per horse power—		
At the shafts of the turbines	140 francs	.....
" dynamos	.....	210 francs
Cost of power, per year—		
At the shafts of the turbines	13 francs	.....
" dynamos	.....	22 francs

The power is employed for the making of chlorates of potash and of soda, by the electrolyses of alkaline chlorides in solution under the methods of Gall and of Montlaur, as perfected by M. Corbin; and also for the production of carbide of calcium. The power house produces annually from 2,200 to 2,500 tons of chlorates and 750 tons of carbide of calcium.

The power house of Chedde is a type of installations wherein are produced great power at a low price. A horse power is produced there under economical conditions which seem at first sight unreasonable. Elsewhere men are satisfied if they realize a horse power with an investment of 300, 500, or even 1,000 francs. We have seen, in fact, that they do not regret having paid out a much greater price at Jonage.

At Chedde the establishment costs but 150 francs for each horse power available at the shafts of the turbines. This notwithstanding that the power house of Chedde uses neither great flow of water nor a very high fall. One may say, in fact, that its resources are very modest, for it is not exceptional to find in mountainous countries falls of 140 metres or streams yielding 6 to 7 cubic metres per second. But, if each of these conditions presents nothing in itself abnormal, they are rarely found united, and it is more rare still to be able to escape from the necessity of making ruinous acquisitions of ground, or to be able at a common expense to build water works which will feed two power houses, as is here done in combination with the P. L. M. Company. This installation is therefore of the highest interest, and we know of no other which can rival for the cheapness of its power production. It is directed by MM. Corbin & Co., to whom we are obliged for these particulars.



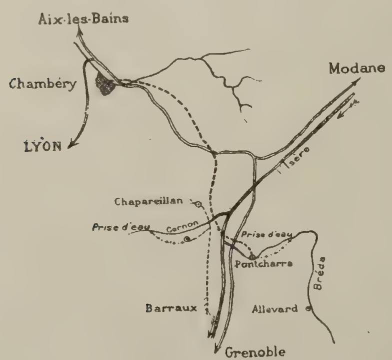
Plan of the Water Works of Chedde.

Power Houses of Chapareillan and of Pontcharra

The two installations of which we are now going to speak belong to the Societe des Forces Motrices du Haut-Graisivaudan, which was founded in 1898 with a capital of 1,000,000 francs. The establishment was for some years very expensive. Established at first with a view to lighting the city of Chambery, the power house at Cernon, at Chapareillan, soon became insufficient and was then put to a different use. This power house is remarkable for the height of its fall, which is the most elevated in the world. The fall measures 620 metres in vertical height.

The river of Cernon, which feeds it, has unfortunately but an insignificant flow during the summer. It amounts to scarcely 50 litres a second. The intake of water is built on the slopes of Mont Granier above Chapareillan. It consists of a low dam of masonry built on the bottom of the river bed, and leading thence a conduit of steel of 0.30 metres in diameter. The conduit is 3,800 metres long. It ends at the power house, after a drop of 620 metres.

The power realized at the power house varies in capacity from 300 to 1,500 horse power, according to the flow of the Cernon. The generators are four in number. Two turbines made by Brenierand Neyret drive alternators made by Labour, giving a current of 1,500 amperes under a tension of 160 volts, and two turbines of the Bouvier make drive Creusot alternators, giving 20 amperes under a tension of 5,000 volts. All of the generators make 360 turns a minute. The 160-volt current is raised to 5,000 volts by means of four Labour transformers. Thus the whole output is finally in the form of a monophase current of 5,000 volts. The current being no longer used for the lighting of Chambrey, which is assured by the power house of Pontcharra, is utilized in part on the lighting of the two communes of Barraux and Chapareillan.



Power Plants at Chapareillan and Pontcharra.

To employ its surplus energy the society erected a little electro-chemical power house, where for some years it fabricated carbide of calcium. It is well known that this product is obtained by the direct action of charcoal on lime while both are held in fusion in the electric furnace.

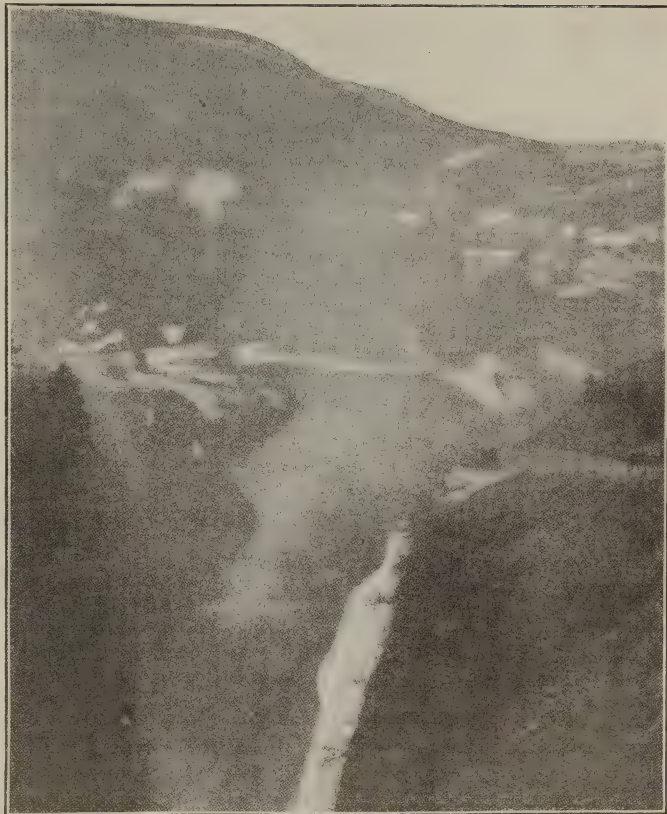
A judgment of the Court of Appeals, of Paris, of February 22, 1901, having awarded to M. Bullier the right to this invention, now prevents its fabrication by the Society of the Haut-Graisivaudan, and has closed its electro-chemical factory. This will soon be put to another use.

The power house of Chapareillan deserves special mention because of the exceptional height of its fall, which gives, with an insignificant stream, a force often exceeding 1,000 horse power. It is one of the most remarkable examples of the profit that can be drawn from a simple thread of water dashing down steep inclines and from mountain cascades.

The fall of the Cernon did not suffice for the needs of the city of Chambrey, and the Society of the Haut-Graisivaudan put into service in 1899 a new fall at Pontcharra-sur-Breda. The new water works are very simple. They consist of a dam of only three or four metres in height, covered in accordance with local usage, by pieces of wood with the bark to protect the structure from the action of gravel carried over it by the lively force of the current. From the dam proceeds an uncovered canal, 400 metres long, followed by a tunnel of 6 square metres, blasted out of the rocks on the left bank of the river. A tunnel was necessary to protect the waterway from the constant fall of rock from the walls of the ravine. This tunnel cost 120 francs per metre.

At their exit from the tunnel the waters enter a reservoir measuring 35 metres by 5 metres, whence they are taken in steel pipes 1m. 60 in diameter, placed on masonry. The fall between the water chamber and the power house is 42 metres. The conduit crosses the Breda on a metallic foot bridge and ends at the building, which is situated on the right bank. From its extremity go six branchings of 0.80 metres in diameter, serving the motors.

The flow of the Breda varies from 3 to 7 cubic metres per second, and the power of the power house varies from 1,300 to 3,000 horse power.



Cascade at the Discharge Gates of the Canal of Giffre.

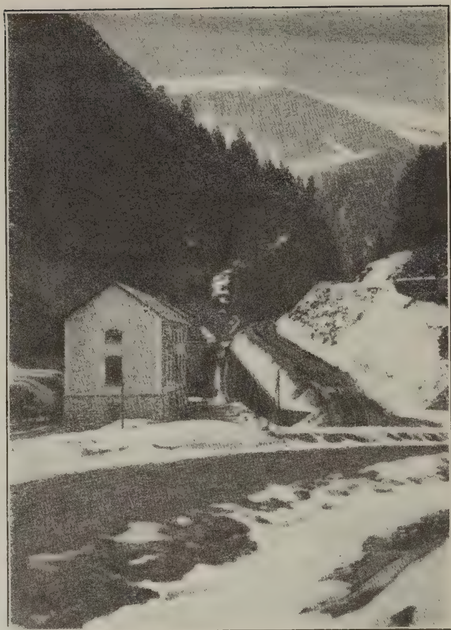
There is space in the building for six motors, but at present it contains only three, each one of 50 horse power. Each set comprises a Grenier & Negret turbine of centripetal section, with horizontal axis, an automatic speed regulator, a Baffart coupler with a fly wheel, a Nippade alternator with its exciter, and an independent switchboard with a Rheostat exciter, volmeter, ammeter, a shunt and two pilot lamps. The speed is regulated to 300 R.P.M. Each generator gives 2,400 amperes under a tension of 120 volts. They are independent, but can be coupled by aid of switches, placed under the floor of the hall, which carry the current to bus bars held to the ceiling.

The first story contains the transformers (Allioth) of 200 kilowatts capacity, with two per generator group. They receive the current of 120 volts from the bus bars and give out a current of 10,000 volts on the cables. The cables are held to the ceiling. From them go out the line wires. Three Fortis lightning arresters protect the works. The energy is delivered at Chambery at a rate of six centimes a hectowatt hour, or upon a tariff which varies from 25 francs for five-candle lamps to 40 francs, 52 francs, and 90 francs for lamps of 32-candle power. It is delivered to the villages also at 0.06 francs a hectowatt hour, or upon a tariff which varies from 10 francs to 50 francs, according to the size of the lamps and the nature of the localities lighted.

The society also furnishes electrical current for power purposes on the following terms:

First. Between 5 o'clock in the morning and 7 o'clock in the evening, at a rate of 300 francs per horse-power year, or 0.30 francs a kilowatt hour.

Second. Outside of the hours of the municipal lighting of Chambery, 150 francs a horse-power year, or 0.15 francs a kilowatt hour.



Railroad Power House in the Ravine of Chatclard.

Finally, the society installs without charge the lamps which it feeds.

A drawbridge of 10 tons, a telegraphic line and its accessory buildings, complete the installation, which presents characteristics of economy well understood and easily extendable. These precious practical qualities are the best guarantee of prosperity to which this interesting work could appeal.

An English Idea of a "Safety" Lamp

A PRIZE of 50 pounds, or $250, was offered at the Grocers' Exhibition at the Agricultural Hall in London recently, for a safe lamp for burning kerosene. The lamp was not to cost more than 1s. 3d. at wholesale. The kind of lamp which is looked upon in London as a "safety lamp" is interestingly set forth in the following abstract from the "Petroleum Industrial and Technical Review":

"The desire of directors was to produce a cheap lamp, which could be sold even in the poorest districts, and which could be used with the maximum of safety, and one which required the minimum of technical knowledge in handling. They did not require a lamp which needed the inventor sold with it in order to enable it to act; they wanted to find a lamp that would be safe when a man came home drunk at night. One of the most serious problems of London was as to how they could protect those diseased with drunkenness against themselves. Therefore, they wanted to find a lamp which if thrown by a drunken man at his wife or children would automatically put itself out, so that the man, if he unfortunately inflicted any injury on his wife, should not, at the same time, burn down his house and set fire to his children."

Tom L. Johnson as a Highwayman

TOM L. JOHNSON, the noted street railway millionaire and advocate of Henry George's single-tax theory, has repeatedly declared in public speeches that he was a robber, and held himself up as an awful example of the men who rob the people under cover of the laws; but it remained for the gathering of street railway men at the recent convention in Detroit to bring out publicly the statement that Mr. Johnson has also played the part of a common highway robber. This story is told as follows in the "Daily Street Railway Review," issued during the meeting of the association. The story is as follows:

"Mr. Johnson was delayed down town one night at a meeting, and took the 12 o'clock car for his residence in the suburbs of Detroit. The walk from the car to his house was a lonely one, and as Mr. Johnson started on his way he noticed two rather seedy-looking men lurking in the shadow of a large oak three. Buttoning up his coat and taking a firmer grasp on his gold-headed walking stick, Mr. Johnson started up the street past the two men, determined on the slightest show of hostility on their part to give a good account of himself. He found the two men quietly smoking, and evidently merely enjoying the fine evening. As he passed, one of them asked for a match. Mr. Johnson handed him one, and went on his way, harshly critcising himself for being so suspicious.

"He had gone but a block, when, placing his hand at his waistcoat pocket, he found that his handsome gold watch was missing. He began to criticise himself for being so easy. The more he thought of the matter the angrier he became, and just before reaching his house decided to go back, find the two men and force them to give up the cherished timepiece. Somewhat to his surprise he found the two men in the same position at the tree. The men noticing his foreboding attitude, started on a run for a near-by alley. Mr. Johnson raised his cane and started for the two at a lively pace. Turning into the alley he stumbled over the two men crouching in a dark corner. Seizing one of them by the throat he demanded his watch. Thoroughly cowed, one of them thrust out into the darkness something that Mr. Johnson felt was his watch. Satisfied, Mr. Johnson once more started for home, with a smile on his face.

"Reaching home, he was met by his wife.

"'Oh, Tom!' she cried, 'I have been so worried, and thought that something dreadful had happened to you.'

"Mr. Johnson asked his wife if she did not think he was old enough to take care of himself. Then he told her of his adventure. As he got to the place in the tale where he forced the robbers to give up his watch the look of acute anxiety of his wife's countenance changed to one of dismay. Before the tale was ended Mrs. Johnson was weeping hysterically.

"'Oh, Tom! Tom! what will they do with you?" his wife sobbed.

"'Do with me?' replied Tom, 'why, they won't do anything; they are only too glad to get off so easily.'

"'But, oh, Tom! you left your watch under the pillow this morning, and now they will arrest you for highway robbery.'

"Next morning a small advertisement appeared in the papers as follows: 'If the two gentlemen who were relieved of a watch on Blank street last evening will address the undersigned they can have their property back, and no questions asked or answered. Address P. D. Q., P. O. Box 24.'

"This advertisement evidently did not reach the eyes of the proper parties, and now Mr. Johnson is the possessor of two valuable watches, one of which he never wears."

Man Must Turn to Nature for New Engineering Progress

THAT man must now turn to nature as a guide for methods of utilizing the great natural forces was declared by Professor Robert H. Thurston, in an address delivered before the Philadelphia Chapter of Sigma Xi recently. Professor Thurston said, in part:

"The progress of the race and the advancement of civilization, whether in the direction of industrial improvement or of intellectual growth, depend, the first mainly, the second largely, upon the extent and the success of man's utilization of the four great natural forces, or 'energies,' as the man of science calls them —heat, light, electricity, mechanical or dynamic power.

"The engineer seems to have come very nearly to the limit of his advance in the directions which have, up to the moment, been so fruitful of result.

"The living body is a machine in which the 'law of Carnot,' which asserts the necessity of waste in every heat engine, and which shows that waste to be the greater as the range of temperature worked through by the machine is the more restricted is evaded; it produces electricity without intermediate conversions and losses; it obtains heat without high-temperature combustion, and even, in some cases, light without any sensible heat.

"In other words, in the vital system of man and of the lower animals nature shows us the practicability of directly converting one form of energy into another without those losses and unavoidable wastes characteristic of methods the invention of which has been the pride and the boast of man. Every living creature, man and worm alike, shows him that his great task is but half accomplished; that his grandest inventions are but crudest and most remote imitations; that his best work is wasteful and awkward. Every animate creature is a machine of enormously higher efficiency as a dynamic engine than his most elaborate construction, illustrated in a 10,000-horse-power engine.

"Every gymnotus living in the mud of a tropical stream puts to shame man's best efforts in the production of electricity, and the minute insect that flashes across his lawn on a summer evening, or the worm that lights his path in the garden, exhibits a system of illumination incomparably superior to his most perfect electric lights.

"Here we have a single example of the opening of a new field of research of tremendous importance to the human race yet unexplored and hardly recognized.

"It seems more than probable that it is to the mysteries and lessons of life that the chemist, the physicist, the engineer must turn in seeking the key that shall unlock the still unrevealed treasures of coming centuries. These constitute nature's challenge to the engineer.

"Nature in each of these cases converts the energy of chemical union, probably of low-temperature oxidation, into just that form of energy, whether of mechanical or of a certain exactly defined and required rate of ether vibration, that is best suited to the intended purpose and without waste in other force, utilizing even the used-up tissue of muscle and nerve for the production of the warmth required to retain the marvelous machine at the temperature of best efficiency, whatever the environment, and exhaling the rejected resultant carbonic acid gas at the same low temperature.

"Man wastes one-fourth of all the heat of his fuel as utilized in his steam boiler, and often 90 per cent. as used in his open fireplaces; nature, in the animal system, utilizes substantially all. He produces light by candle, oil lamp or electricity, but submits to a loss of from one-fifth to more than nine-tenth of all his stock of available energy as heat; she, in the glow-worm and fire-fly, produces a lovelier light without waste measurable by our most delicate instruments. He throws aside as loss nine-tenths of his potential energy when attempting to develop mechanical power; she is vastly more economical. But in all cases her methods are known to be radically different from his, though as yet obscure.

"Nature converts available forms of energy into precisely those other forms which are needed for her purposes in exactly the right quantity, and never wastes, as does invariably the engineer, a large part of the initial stock by the production of energies that she does not want and cannot utilize. She goes directly to her goal. Why should not man? He has but to imitate her processes.

"Should the day ever come when transformations of energy shall be made in nature's order, and when thermo-electric changes shall be a primary step toward electro-dynamic application to purposes now universally attained only through the unsatisfactory processes of thermo-dynamics, as illustrated in our wasteful heat engines, the engineer, following in his work the practice of nature, which has been so successful throughout the life of the animal kingdom, will find it easy to drive his ship across the ocean in three days; will readily concentrate in the space now occupied by the engines of the Majestic a quarter of a million horse power; will transfer the millions horse power of Niagara to New York, Boston, Philadelphia, to be distributed to the mills, shops, houses, for every possible use, furnishing heat, light and power wherever needed."

A New Rail for Heavy Street Car Traffic.

A new type of street car rail is being rolled for the Union Traction Company, of Philadelphia, by the Lorain Steel Company, for use particularly on streets where the traffic is of the heaviest character. The groove in the new rail is one and one-fourth inches deep, and, in order to keep the groove clean, the lip is made much lower than the head of the rail, and a considerable slope is given to the inside of the groove. A peculiarity of the rail is a sloping edge given to the outside of the tread.

This is intended to offset the wear of the rail and to retain a good form as the rail wears down. To provide for this slope the rail is made wider than usual.

Blue Print Making by Electric Light

"ELECTRICITY cheaper than daylight" is the motto of the manufacturers of the most up to date apparatus for the making of blue prints.

To have suggested such a thing a few years ago would have been considered either a wild flight of fancy or perhaps good evidence that one was a likely candidate for the lunatic asylum. There would have been reason also in this view of the subject.

The use of blue prints in the vast numbers now found necessary in the great industrial centers of the day is a growth of but a few years. A generation ago one original set of drawings and perhaps a few copies of details was ample to enable workmen to make all the parts of a machine, to get out the materials for a building, or to lay out the details of even the largest of engineering works. These copies were made by hand, and where many copies were needed, more men were put to making them.

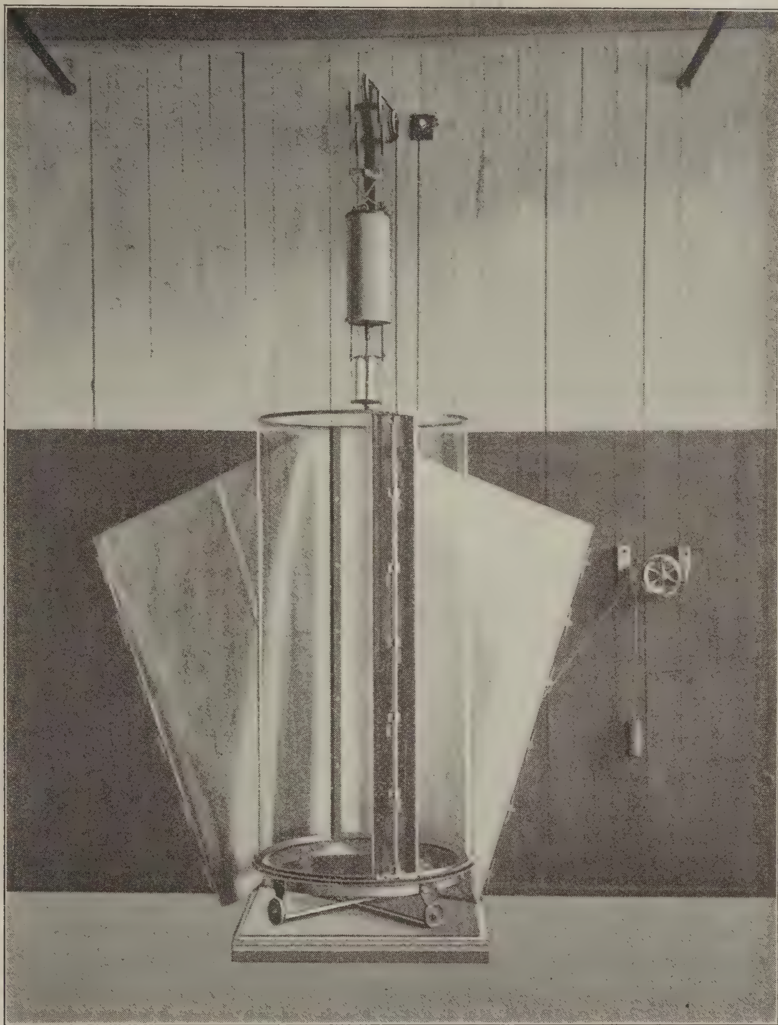
To-day, however, when contracts are made for the putting up within a year's time of such monumental buildings as that on the "Flat Iron" lot at Twenty-third street and Broadway in New York, the complete equipment of a railroad with new and novel electrical machinery within a few months, or the performance of great engineering feats such as the building of the underground rapid transit road in New York, where scores, hundreds, or perhaps even thousands, of men must be put to work simultaneously to prepare parts, such methods would be out of the question. Engineers, manufacturers and contractors begrudge even the time necessary for the production of the original set of scale drawings, let alone any time for the olden methods of copying.

With the beginning of this modern demand for many copies, the blue print process came into general use. The sun was pressed into service, and with a drawing on translucent paper or cloth for a negative, his rays were made to reproduce exact copies in reverse on the blue print paper. The printing was done under glass in flat frames exactly as photograph printing is done. Although there were many hours and even days without sunshine, yet the process proved ample for its time. Its economy over older processes was so great that no one thought seriously of its cost, while men stood waiting for the sun to shine.

Conditions changed rapidly, however. Although in the smaller establishments the sun is still depended upon to do this necessary work, in the greater ones the delay due to a dark day, or even to a few hours of overcast sky, would now make a loss of thousands of dollars. Blue prints must be turned out in almost countless numbers whether the sun shines or not. They must be had with the machine like regularity of printing press products. In fact, for the reproduction of some drawings it has been found advantageous to use the printing press itself and to make plates for use upon it.

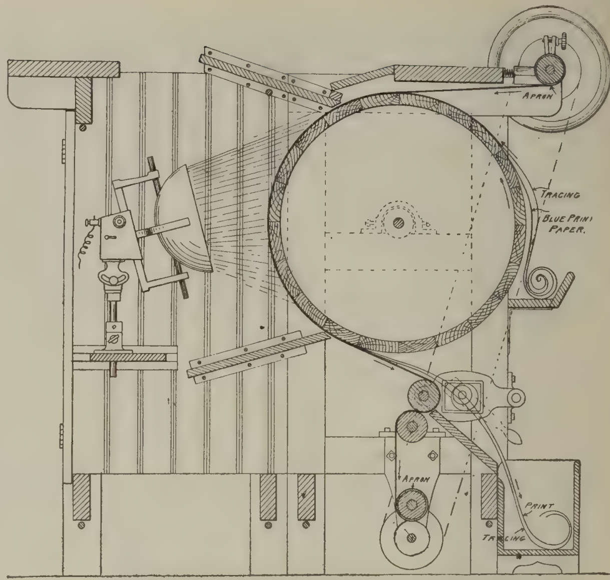
To meet this demand the electric light was pressed into service. The cost of the electric current and of the necessary equipment, though considerable, is inconsequential compared to the saving in time. The production of blue prints in this manner is found to actually cost only from one-half to two-thirds as much as with free sunshine. The results are at the same time much more even and satisfactory.

Three methods of making blue prints



Cylindrical Blue Print Machine.

by electric light are in common use. The first and simplest of these was naturally the mere substitution of electric light for sunshine. In this, known as the "flat" printing method, the frames made for solar printing are used. They are placed on tables, and above them are swung electric arc lamps, whose rays, directed downward upon the frames by means of reflectors, do the printing. These reflectors are made in parabolic form, of sheet iron, and lined with white enamel. The lamps generally used are of the standard type of the General Electric Company's make, are of about one thousand candle power, and use five amperes of current on a one hundred and ten volt circuit. To secure an even distribution of light, opal globes are used. Each lamp gives light enough to print over a surface of about 4.8 square feet. As many lamps are installed under each hood as may be required for the size of the frame. If more than one printing table is used the lamps are mounted on rails and run from table to table. The current is fed to them by trolleys. With this style of frame it takes about two and a half minutes to make a print. The cost depends upon the number of lamps needed to cover the space.



Roller Blue Print Machine—Sectional Drawing.

The cylindrical blue print machine is a type manufactured by B. J. Hall & Co., of London, and the Pittsburg Blue Print Company. It is a great improvement over the flat frame outfit. In this machine the printing is done around the outside of a cylinder of plate glass. A single arc lamp does the printing. It gives an even exposure to every part of the print, passing downward and then upward through the whole length of the cylinder while making the print. This movement is actuated and regulated by means of clock work and a pendulum.

The glass cylinder is made of plate glass. It is in two pieces. Each piece is ground and polished in the flat and then bent into form over a mold in an oven. After bending they are again polished and inspected. They must be free from all flaws or bubbles. The plates are set up with wooden strips between their edges and bound in place by brass bands at their ends. The cylinder is either mounted on a wheeled base or hung in a frame on trunnions. The latter form is used where it is desirable to make at one time large numbers of copies of small drawings. In this case the cylinder is turned to a horizontal position, to put the drawings and print paper in place over one of the glass plates and then turned over to place the drawings and paper over the other glass. The drawings and print paper are held in place by carefully fitted canvas covers secured to the wooden strips separating the pieces of glass. The lamp is hung from a bracket above the cylinder. The lamps employed for this work are of the constant-current, inclosed arc type, using a long arc and consuming fifteen amperes of current. For difficult work, such as printing through bond paper, or for making black or brown prints, an eighteen-ampere lamp is used. The fifteen-ampere lamp has a candle power of about 2,000, and uses, on a 110-volt circuit, about 1.1 kilowatts of current an hour.

The cylinder printing machines are made in sizes capable of making prints from thirty by forty-two inches to forty-two by eighty-four inches on each half of the cylinder. They cost from $300 to $500 each.

It is asserted that as many as six hundred and fifty prints, each measuring nineteen by twenty inches, have been made in a day on one of these machines whose plates were forty-two by sixty inches, and that a man and a boy made one hundred and twenty prints, each twenty-four by thirty-six inches, in two hours and a half, including the washing of the prints and hanging them up to dry.

In both the flat frame and cylinder machines it is obvious that the size of the frame or glasses is the limit of the size of each single print.

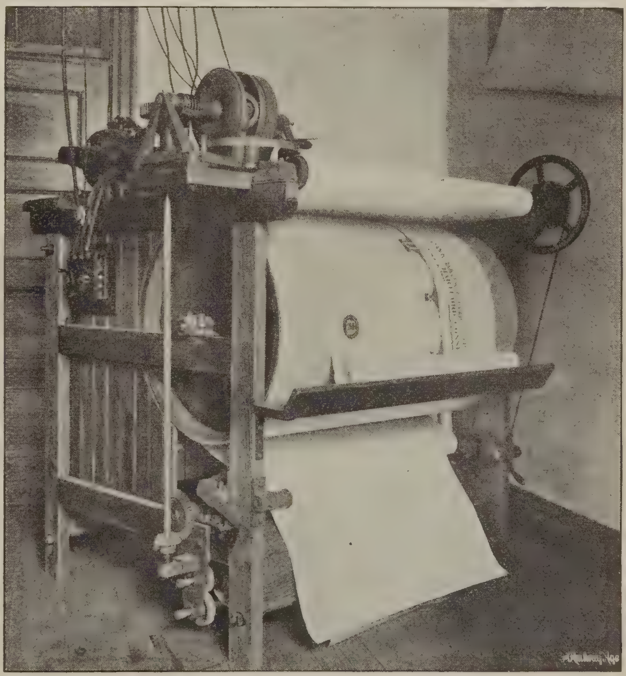
A machine in which single prints can be made of any sizes below fifty-four inches in width and one hundred and forty feet in length has been put in the market by the Spaulding Print Paper Company, of Boston. This machine can be used like the flat frame system, for printing either by sunlight or electricity. It operates practically continuously and requires no attention except to feed in the drawings and print paper between a roller and a transparent band. Prints and drawings go into separate receptacles, and can remain safely there until the one is taken out to wash and dry and the other put away.

The machine consists primarily of a roller made of any conveninet material, and this is revolved at a speed proper for the printing, by hand or by a small electric motor and belt. An apron or belt of transparent material like that used for photographic films passes partly around this roller and rests closely against its face as it passes from a reel on the upper part of the machine to one below. These belts may be of almost any length. As furnished by the makers of the machine they are either 70 or 140 feet long, as may be ordered.

The tracings and print paper are laid together edge and edge and fed into the machine between the apron and roller. As they pass to the rear they are exposed either to sunshine or to the light of electric arc lamps inclosed in a suitable chamber. These machines require from 60 to 100 amperes of current for their operation. This is divided between from three to five lamps, according to the size of the machines. The machines cost from $300 to $400 each without the lamps, motor or lighting attachment. The latter without the lamps costs from $40 to $50.

Some interesting estimates of the comparative cost of making prints by sunshine and electricity have been made. Assuming the cost of electric current to be twelve cents a kilowatt hour and that of labor to be $1 a day, this worked out as follows:

	No. of Prints Made Per Day.	Cost, Each, Cents.
Sun	41.9	2.39
Electricity—		
Flat frame machine	56.5	2.09
Cylinder machine	236	1.14



Roller Blue Print Machine—General View

Pin-Hole Spectacles

PERSONS whose eyesight is defective are often caught temporarily without their spectacles under circumstances which make their inability to see clearly particularly aggravating. It will be a piece of good news to such persons and a matter of interest to many others to know that the lack can be met and an excellent substitute for a pair of spectacles be made with nothing more than a pin and a piece of stiff paper or thin cardboard. This is the result of a discovery made recently by a German scientist.

With the pin make a hole in the cardboard or paper. Twirl the pin around a few times to make the edge of the hole smooth. Your substitute for spectacles is complete. Look through the hole, and you will find that although a great deal of light is cut off that you can see things which you could not otherwise distinguish. Fine print can be read by persons who could not ordinarily read it without spectacles, and those suffering from astigmatism can distinguish clearly outlines which would be all a blur to them without the pin-hole spectacles. The effect is improved by making two pin holes in the card, one for each eye, and looking at the objects through these.

Natural Gas Production

THE value of natural gas consumed in the United States in 1901 was $27,067,500, which, at 15 cents per 1,000 cubic feet, is equivalent to 180,450,000,000 cubic feet. If 20,000 cubic feet of natural gas be taken as equal to one ton of coal, 8,458,600 tons of coal, valued at $3.20 per ton, would be required to yield the sum of money for which the natural gas sold.

The value of the natural gas amounted to 40.7 per cent. of the value of the petroleum for the same year.

There were 10,297 wells producing natural gas at the close of 1901, of which number 74 were not turned into the gas mains, and 2,088 producing wells were drilled in the same year; there were 453 dry holes, or non-producers, and 1,084 were abandoned.

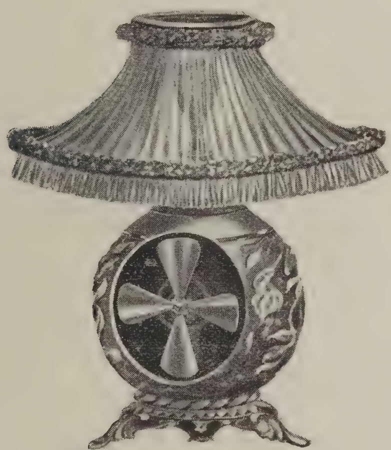
New Micrometrical Compass.

DRAUGHTSMEN will appreciate the value of two improvements to drawing compasses which have been made recently by M. Pope, a French manufacturer. The first of these improvements is intended to permit of micrometrical adjustments of the distances between points, and this is accomplished by means of a big joint, in which the adjustment is effected through a screw working against a spring. Mr. Pope's second improvement is the substitution of nuts for screws, and keeping these from getting lost by forming heads above them on the standing threaded portions.

An Artistic Jog for Electric Fan Manufacturers

By Charles A. Lieb

ART in the household is the key note of modern life. This is especially true in prosperous America, where heretofore the homes were filled with the cheap and ugly, but serviceable furnishings, that belonged to an era of pure utility.



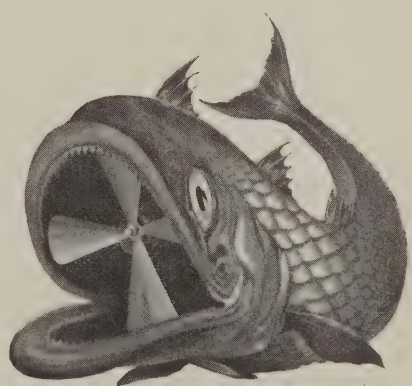
Fan and Lamp Combined.

It is still possible, however, even within the walls of our most luxurious palaces, to find some articles which for appearance are fitting only for factories, workshops or the plainest of gathering places.

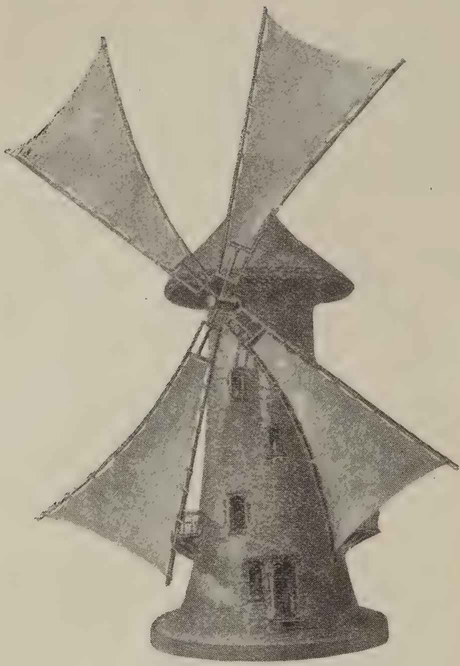
One of these is the electric fan. Never before, perhaps, was any adjunct of civilized life designed and built with a more absolute disregard of every feature of grace and beauty. "Utility" is written all over it, and no place could be found where one of these factory monstrosities would look at home except in a machine shop.

It used to be said that the most hopeless of tasks would be to make the American store ornamental, but that has been accomplished. The demand for articles of household use that should not be mere chunks of useful junk has grown with the years until manufacturers in all lines—except the electric fan makers—have called artists into their counsels and turned one article after another into things of beauty. From doorknobs to chandeliers this work has been done.

The artistic architect knows that he can find hardware ready made to comport with the noblest building of his cre-



Fan in a Dolphin's Mouth.



A Dutch Wind Mill Design.

ation, and the decorator needs but permission to spend money to find among the wealth of electroliers, lamps, fenders and other factory products, the work of artists fit to stand amid the almost priceless hangings and beautiful furniture which fill the homes of the refined.

But what of the electric fan?

Cheapness and good working qualities have dominated every maker of fans since they became commercial products.

They do their work, but woe to him who seeks for one fit to set amid the beautiful art objects which cluster about the modern hearthstone. As well might he bring the heating furnace or the kitchen range into a parlor, dining room or boudoir as one of these little monstrosities.

"To sell for $12" was the inspiration of their design. Every effort was put forth to cut down cost. Castings were designed of the simplest form, such as could be cleaned in a rumble box instead of by pickling, and every part was made in conformity with the one idea—except that they must work well.

And yet it is a fact which few will dispute that there is hardly any limit to the price the well-to-do will pay for artistic household articles which will fit in with those already installed, or which will themselves add something to the beauty of the home.

A mere suggestion of what may be done toward improving the design of the electric fan and still retain all of its usefulness, is offered in the designs shown in the illustrations to this article. These are but offhand suggestions. What would not be possible when the subject comes to be treated by such artists as those who have produced the modern electroliers and other graceful household ornaments?

There must come a parting of the ways. The twelve-dollar fan is doomed.

The five-dollar fan will supersede it on the one hand, and on the other its place will be taken by the $2,500 fan.

The five-dollar fan will perhaps be plainer and uglier than its predecessor, but fully as serviceable. It will take less current rather than more to operate it. The little effort already made by some

Fan for the Dinner Table.

manufacturers to relieve the tool-like appearance of the fan will go for naught. The new five-dollar fan will be designed with but one idea—cheapness. When it comes, instead of a total sale of 30,000 fan motors in a season in the United States, a sale of 150,000 would not be an unreasonable estimate. This would mean a great increase in the business of manufacturers of electrical machinery and supplies, a call for more generators at central stations, more feeders, conduits, and more wiring. It would mean also a welcome increase to the "day" load of the power houses. In its train would come an almost endless increase in the use of other electrical appliances. A house wired for fans would naturally become a customer sooner or later for current for lighting, cooking, or some of the many other uses to which electricity is adapted.

The other way would lead to the making of artistic fans. Not every customer would be willing to pay $2,500 for a fan, even to fit his fancy, but some would be, and thousands of others would welcome a chance to get something which would give them the wished-for breeze and yet not shock their sensibilities.

The modest designs shown herewith might meet some of these needs. For others, the work of artists of world-wide repute, such as those now called upon to design household works in gold, silver and bronze, could be depended upon as soon as it was demonstrated that wealthy patrons would buy their products.

Modern Industrial Economies

THE economics incident to modern methods of doing work are well illustrated by the comparative figures given below of the cost of handling coal by horse power and cart as contrasted with the cost of doing the same work by means of an electric hoist and automatic railway. The figures are real ones, taken from the operations of a plant on the New York harbor front. The rate paid for electric power was 5 cents a horse-power hour.

COST.

Old Plant.	
Horses and carts, blocks, fall fittings, tubs, mast and gaff	$1,750
New Plant.	
Timberwork, fencing, automatic railway car, tubs, scales, pocket valves, electric engine, blocks, fall, mast and gaff	2,800

COST OF OPERATION.

Old Plant—Capacity, 120 Tons.	Per Day.
Two shovelers, at $1.50	$3.00
Three carts, horses and drivers, at $3	9.00
One hoisting horse and driver, at $3	3.00
Two trimmers, at $1.75	3.50
Interest and taxes yearly (125 days' work), 10 per cent	1.40
Depreciation yearly (125 days' work), 10 per cent	1.40
	$21.30

Daily cost per ton in stock pile, 17¾ cents.

New Plant—Capacity, 200 Tons.	Per Day.
Three shovelers, at $1.50	$4.50
One hoister, at $2	2.00
One man to dump, weigh and tend automatic car, at $1.50	1.50
Electric power, oil, waste, etc	2.00
Interest and taxes yearly (125 days' work), 10 per cent	2.24
Depreciation yearly (125 days' work), 10 per cent	2.24
	$14.48

Daily cost per ton in stock pile, 7¼ cents

The Manufacture and Uses of Graphite

By S. A. Douglass

[From the "Power and Lighting Economist"]

THE principal form in which carbon occurs in nature is in combination with other elements. Nearly all animal and vegetable substances, as well as their fossil remains, such as coal, contain the element of carbon. In living things the carbon is always combined with other elements. Most products of plant life contain the elements carbon, hydrogen and oxygen, while most products of animal life contain the same elements with the addition of nitrogen. Uncombined carbon occurs pure in two very different forms in nature: (1) as Diamond; and (2) as Graphite or Plumbago.

Combined carbon may be set free by the application of heat, in the absence of air, resulting in the production of charcoal, lamp black, coke, or bone black, depending on the substance heated. All of these various substances are included under the name amorphous carbon. The name signifies simply that the carbon is not crystallized.

These three allotropic forms of carbon, diamond, graphite and amorphous carbon, while very different in appearance and in many of their physical properties, have some important properties in common. They are tasteless, odorless, and infusible, and are insoluble in all known liquids at ordinary temperatures. Equal weights of each of the substances, when burned in oxygen, yield equal weights of carbon dioxide gas.

One of the most conclusive proofs that they are only allotropic forms of the same element, is the fact that amorphous carbon, under suitable conditions, may be made to crystallize into the form of the diamond, or may be converted into graphite. Moissan, the eminent French chemist, has been able to produce minute diamonds, by dissolving amorphous carbon in molten cast iron and then suddenly cooling the whole mass. Under these conditions the carbon, at the moment of separation, is under great pressure, and crystallizes out in the form of diamond. Moissan has also described three processes of converting amorphous carbon into graphite.

(1) Amorphous carbon is heated to a very high temperature in the electric furnace, the conversion into graphite being effected by "simple elevation of temperature."

(2) An excess of carbon is dissolved in a metal at a high temperature. The metal is allowed to cool and the excess of carbon separates out as graphite.

(3) Carbon is dissolved in or combined with some other element, and then thrown out as graphite by the introduction of some other substance.

A great deal of interest attaches itself to the conversion of amorphous carbon into graphite, for the reasons that the world's supply of graphite, while quite widely distributed, is more or less limited in amount, and that the demand for the substance is constantly increasing.

There are only a few places in the world where graphite occurs in such quantities of sufficient purity, to permit a profitable business being made of it.

With these facts as an incentive, a successful method of converting amorphous carbon into graphite has been worked out, and is now being operated on a commercial scale at Niagara Falls. To Mr. E. G. Acheson, the discoverer of carborundum, belongs the credit of developing this new and important industry.

Very early in his experiments with the electric furnace, in the manufacture of carborundum, Mr. Acheson noticed the formation of a layer of graphite around the granular core, as well as small amounts throughout the core itself.

On opening a carborundum furnace and cutting down to the core, a curious layer is found that appears at first sight to consist of dull black carborundum crystals. On closer examination, however, it is found that, though the material has the exact form of carborundum crystals, it is nothing but pure carbon in the form of graphite. In explanation of this peculiarity, Mr. Acheson has pointed out that before the graphite has been formed, the carbon has entered into combination with some other element in the formation of a carbide; and that the compound thus formed is decomposed at a higher temperature, the volatile element being driven off, while pure carbon is left behind in the form of graphite.

The fact that graphite, which has assumed the shape of the carborundum crystal, is found next to the core, goes to prove that the silicon element of the carbide has been volatilized and driven off at the high temperature of the core, while pure carbon has been left behind.

In a paper read before the Franklin Institute in 1899, Mr. Acheson states that in addition to the formation of a layer of graphite around the carborundum furnace, he also noticed that when ordinary bituminous coal coke was used to form the core, quite a large amount of it was converted into graphite; whereas when petroleum coal coke was used, very little of it was rendered graphitic. By a careful study of these conditions, it was found that the graphite formed within the core was produced by the decomposition of carbides, formed by the chemical union of the carbon of the core with its contained impurities. This conclusion was confirmed by the fact that the larger the known percentage of impurities in the coke of the core, the greater the amount of graphite produced; also that only a part of the carbon of the core is converted into graphite, even by repeated use of the same grains in successive carborundum furnaces. These two facts go to prove that the presence of some intermediate or catalytic agent, undoubtedly carbide forming elements, is absolutely necessary for the conversion of amorphous carbon into the graphitic form. When such intermediate elements are volatilized and driven off, all further conversion ceases.

Notwithstanding the statement of so eminent an authority as Moissan that the conversion of amorphous carbon into graphite can be effected by "simple elevation of temperature," the real process seems to be the formation and decomposition of a carbide at the "elevated temperature" of the electric furnace.

The Acheson process of manufacturing graphite is identical with that previously pointed out as a secondary reaction in the manufacture of carborundum. The first step in each is the formation of the carbide, the second its destruction. The carbide may be produced by heating carbon in association with one or more oxides, and then continuing the heating process until the volatile element is driven off and the combined carbon separates in the free state. In practice a good mixture consists of 97 parts of finely divided amorphous carbon, commingled with three parts of iron oxide. This mixture, combined with a suitable bonding material, permits of being molded into any desired shape.

As the graphitizing process is progressive or catalytic, the full chemical equivalent of the metal or oxide, sufficient to graphitize the whole mass at once, is not necessary, a much smaller amount serving as well.

The molded articles are placed inside a hollow carbon cylinder through which a current is sent in a longitudinal direction, and in this way sufficient heat is generated to bring about the desired chemical changes. The molded articles themselves serve as conductors also, and thus generate heat at the exact point where it is needed.

A slightly different method is pursued where simply pure graphite is desired, without any reference to a shaped article. An oblong box, made of fire brick and lined with some refractory substance, is filled with bituminous coal, and a carbon core placed in the center. A core is necessary for the reason that when cold the coal is a very poor electrical conductor. Usually the coal itself contains a sufficient quantity of impurities to carry on the action; otherwise foreign impurities, such as the oxide of iron, are introduced into the furnace.

After the current has been running for a time, a layer of graphite is formed around the core. The increased conductivity thus produced, greatly augments the volume of current. As the graphitization proceeds the voltage is gradually lowered, although the amperage increases.

As the temperature rises higher and higher, the ring of graphite about the core increases in thickness. When the refractory walls of the furnace begin to be in danger of being melted, the current is cut off and the whole mass allowed to cool. The graphite thus produced is found to be quite pure. The impurities of the coal that would produce ash in ordinary combustion, have been completely volatilized and driven off.

Silica is one of the chief constituents of the ash of bituminous coal. If the temperature of the graphite furnace be raised to the point of vaporization of silica, this impurity can be completely removed. Coal containing 5.78 per cent. of ash before treatment, was found to contain but .033 per cent. after being graphitized.

The great purity of manufactured graphite, as compared with the natural product, is of special importance in connection with a number of its uses. For example, graphite paint, in order to give the most satisfactory results, should be made from pure graphite.

It should be borne in mind that manufactured graphite is neither an imitation of the natural substance nor a substitute for it. It is the real substance, having all the physical and chemical properties of natural graphite.

The eminent French savant, M. Barthelot, has defined graphite as being "All forms of carbon that are capable of forming graphitic oxide by oxidation." Amorphous carbon when treated with a mixture of potassium chlorate and nitric acid, is rapidly oxidized to a brown-colored body which is soluble in water; while graphite is gradually converted into a yellow insoluble substance known as "graphitic oxide." When this test is applied to Acheson graphite, it takes its place alongside the best graphite from the celebrated mines of Ceylon.

Probably the first use made of graphite was as an instrument for writing. Its employment for this purpose dates back at least to the middle of the sixteenth century. Its use for any purpose other than that of pencils is of more recent date. Probably nearly all of its modern uses have been brought out during the past fifty years.

Among the physical and chemical properties that have given to graphite an ever-enlarging field of usefulness may be mentioned its good electrical conductivity, resistance to oxidization, infusibility, insolubility and the small friction coefficient between its individual particles.

The present uses of graphite include the manufacture of pencils, stove polish, foundry facing, paint, dynamo and motor brushes, anti-friction compounds, electrodes for electrolytic and electrometallurgical work, pipe joint material, conducting surfaces in electrotyping and covering the surfaces of powder grains.

Every one is familiar with the anti-friction quality of graphite. A small amount of it rubbed between the thumb and fingers furnishes evidence on this point.

As the results of experiments conducted at Stevens Institute of Technology, Prof. R. H. Thurston showed that graphite in water is three times as effective in the reduction of friction as the best sperm oil, and that graphite in grease is six times as effective. The difficulty of feeding graphite into bearings, steam cylinders, etc., precludes its use, to a certain extent, as a substitute for oil.

One of the most successful methods of using graphite in bearings is to be found in certain artificial compounds, into which graphite enters as a constituent. The fiber graphite compound has given very good results under actual working conditions. This compound is a mixture of finely divided graphite and wood pulp. The mixture is molded under heavy pressure and air dryed. It is then soaked in oil and afterward baked. The finished product will stand an unusual amount of hammering and jarring without disintegration. When made into bearings it shows almost no wear after long use. It is not affected by water, acids, oil, alkalies or moderate heat. The bearing adjusts itself to any irregularities in the shaft, so that the shaft does not have to be so carefully made.

A saving is claimed of 25 per cent. in the power necessary to overcome running friction as compared with the best lubricating oil.

Experiments made with fiber graphite indicate its possible use as a substitute for the copper packing ring used on projectiles. The flexibility of the graphite compound enables it to fit into the grooves of the gun, so as to completely fill them. After the gun is discharged the barrel is left coated with a thin layer of graphite, which serves to protect it.

In high-pressure steam engines the matter of lubrication of the piston becomes a serious problem on account of the decomposition of the oil by the superheated steam admitted to the cylinder. Graphite, being unaffected by temperatures far beyond anything ever attained in such engines, becomes an important substitute for oil.

The good electrical conducting quality of graphite, combined with its anti-friction property, renders it a most admirable substance for dynamo and motor brushes. The Acheson process of graphitizing molded articles permits of shaping the carbon brushes before they go into the electric furnace.

In the use of the electric furnace in electro-metallurgical operations the consumption of carbon terminals or electrodes adds a considerable sum to the operating expenses. These electrodes should be of such purity as not to contaminate the contents of the furnace, and in general should oxidize as little as possible. For reduction processes a much cheaper form of carbon than that of the electrodes can be applied directly. But the oxidizing of the electrodes can not be very well avoided, or even greatly retarded, if ordinary amorphous carbon is used in their construction.

If the amorphous carbon electrode be replaced by one made of graphite a new relation is established. At the surface of the electrode the oxide or ore is in the presence of two different forms of carbon, and the oxygen liberated during reduction shows a decided preference for the easily oxidizable amorphous carbon as against the less oxidizable graphite of the electrode.

In electrolytic work graphite electrodes give the most satisfactory results. In such work one of the most important conditions to be fulfilled by the electrodes is that of low porosity. It is this characteristic more than anything else that determines their ability to withstand disintegrating action.

The amorphous carbon articles used in the manufacture of Acheson graphite electrodes are not molded articles, but are made by forcing the carbon mixture through a die under heavy pressure. This treatment gives the electrode high density and low porosity. Great efficiency and economy are claimed for such graphitized electrodes on account of their great purity, high electrical conductivity, low porosity, but especially to the fact that they are a graphite article throughout.

Although cut with the greatest ease, the tensile strength of a graphite electrode is only 20 per cent. below that of amorphous carbon. Its softer nature is simply due to a physical change in the molecule, the particles remaining bound together almost as firmly as before treatment.

Reference has already been made to the high resistance offered by graphite to oxidization. This characteristic renders it useful in the manufacture of paint to be used in covering metal roofs, iron and steel structural work, etc. Only pure graphite should be used for such purposes, as the presence of any amorphous carbon in the paint greatly lessens its lasting and protecting qualities.

Graphite mixed with clay is extensively used in the manufacture of crucibles. Its infusibility, added to its chemical inertness, renders it of special service in this connection.

A splendid pipe joint material is made from graphite. It is superior to red lead for this purpose, because the joint never sets, but may be taken apart after years as easily as the day it was put together.

While the electrical industry, especially electro-chemistry, will doubtless prove to be one of the greatest consumers of graphite, it is also to the electric furnace that we must look as a means of partially supplying the demand which it helps to create.

The Coming Paris Auto-Car Exposition.

The circular letter sent by the committee of organization of the Fifth International Automobile Exposition; to be held at the Grand Palais, Paris, from December 10 to December 25, 1902, has been so liberally replied to that Mr. Gustave Rives, the commissioner general, has some doubts about there being room enough for all the applicants for space.

The Most Ingenious Mechanical Device

The Piston

To the Editor of " The Electrical Age ":

Sir—To select from among the multitude of ingenious contrivances now in use and considered indispensable to the progress of civilzation, and even to the existence of human life, one which may truthfully be said to be superior to all the others in ingenuity or usefulness is a task which might well appall a philosopher or dismay a scientist; indeed, all of these are so mutually dependent upon each other in the complicated machinery of the present day that, if one were taken away, all would be rendered useless or nearly so.

Without detracting from the claims of any of these or withholding from any the praise which may be due it, I submit that the contrivance known as the piston is, if not superior to all, at least entitled to a high place in the list of ingenious devices which have made for the well being and advancement of mankind.

Whoever first conceived the idea of inclosing a piston within a suitable cylindrical receiver so that it should fit tightly enough to prevent the passage of fluids from one side to the other and yet loosely enough to move longitudinally without undue friction was certainly a genius, and is entitled to be reckoned one of the greatest benefactors of the human race, for he laid the foundation stone of the inventions of Watt, Stephenson and Fulton, upon which has been reared the mighty superstructure of our modern industry and commerce.

Nearly every art and manufacture of our marvelously complex civilization is dependent upon the piston in many ways, while the ponderous monster of steel and steam which whirls along at terrific speed the heavy express train of the present day or bears the burdens of commerce along the iron highways, which extend, with their vast ramifications and branches, to nearly every accessible part of this great country, is dependent upon it, not only to attain its speed, but also to render that speed possible with any degree of safety, its comparative immunity from disaster being only secured through the agency of the air brake, which in turn is dependent for its action upon a series of pistons.

Comparatively few families obtain their daily supply of water without having recourse to some form of pump, from the small, hand-driven affair in the farm house kitchen to the magnificent creation operated by means of that universal burden bearer, steam, which supplies the needs of a metropolis, pumping thousands of gallons in an hour; yet, without the piston none of these would or could be in existence.

Even that triumph of ingenuity, the artificial ice machine, makes use of the same device for performing the seeming miracle of transforming heat into cold, far outstripping nature in the purity of its product and even in economy, as ice is now manufactured, under favorable circumstances, more cheaply than the natural article can be gathered and stored.

It might be urged that electricity is now taking the place of steam to a great extent, and that, therefore, the piston is in danger of losing its supremacy as a producer, or, rather, as a means of making use of, power; but it must be considered that, without the steam engine to drive it, the field of usefulness of the dynamo would be limited to sections favorably situated as regards water power, while, with the aid of steam and piston, the subtle fluid is available in any place where fuel may be obtained.

From the clumsy but successful "Rocket" of Stephenson to the modern locomotive; from the small, noisy, inefficient, but, for that time, wonderful "Clermont" of Fulton to the mighty steel leviathan which crosses the Atlantic at nearly the speed of an express train, carrying an assemblage of humanity large enough to populate a good-sized town, and having stowed away in its lowest depths engines capable of developing thousands of horse power, all development along the lines of transportation has been attained by means of this device; indeed, if it were suddenly rendered ineffective, the population of the civilized world would be in great danger of starvation owing to the lack of facilities for transporting food. This may at first seem to be a strong statement, but when one stops to consider how few of the most common articles which appear daily upon our tables are produced within a distance which would be accessible by any other means than steam in time to be of any service to us in such a contingency, its truthfulness becomes apparent.

Even the projectiles of our modern cannon and small arms are but a modification of the same principle, so that in war as well as in the arts of peace we are dependent upon this ingenious contrivance; let us hope that in this sphere at least its sway will soon be ended and arbitration be recognized as the only method of settling differences of nations as it has long since been applied to individuals.

Ernest F. Dow.

West Newton, Mass.

Inventions and Discoveries

To the Editor of "The Electrical Age":

Sir—In the November number of "The Electrical Age" you invite communications upon the subject, "Which of man's inventions or discoveries has proved to be the greatest and most useful." I submit the following:

Nothing could be invented until something had been discovered. Therefore discovery comes before invention. True genius does not consist so much in application as in construction to application.

Inventions arise from the necessity to utilize discoveries. Hence the greatest invention of the age could not have been accomplished until the proper elements in substance became a factor of brain work.

Conduct of power—force—is the keynote of life. It enters into the first principles of every given source of things.

Force arises from natural causes. The discoverer of force has never been immortalized in history; but the genius which discovers the uses of force is constantly coming to the front.

To be precise in definition, force is a discovery of the first magnitude. No implement, of whatever name or nature, could even be constructed or made available for use without force.

The forces of the elements comprise unlimited resources and the inventions resulting from constructive energy in coercion and elimination are marvels of ways and means to the development of scientific principles adapted to the construction of an endless and awe-inspiring mechanism propelled by force.

The demand for force increases each year day by day. Force demands force. There is no end to force; it is a circle within a circle. Everything is endowed with force. Without force everything would be dead, inert, literally nothing doing on earth or in the universe. But, happily, we have force, and "The Electrical Age" forces before the public eye some of the most forceful subjects of scientific interest, which proves that force is no idle factor in the fulfilment of its natural and adapted supremacy as the greatest discovery in the course of time.

Mrs. M. E. L. Tompkins,
270 West 119th Street, New York City.

November 10, 1902.

A Long Escalator for the Rapid Transit Road.

The escalator, or moving stairway, is gradually making its way into favor notwithstanding the fear of possible accidents which, with or without reason, seemed connected with it in the minds of railroad and public officials. Nothing has ever warranted the fear, and with the public the escalator has been popular ever since it was first introduced.

The most important recent victory for the escalator is announced by the Otis Elevator Company, which has secured a contract to put in one of the moving stairways at the viaduct station of the new Rapid Transit Road in this city at the crossing of Manhattan valley at One Hundred and Twenty-fifth street. The tracks at this point are about 40 feet above the street level. Both tracks are on a level, and the escalator will carry passengers both up and down. It will have a capacity of 20,000 passengers an hour, 10,000 each way. A 35 horse-power electrical motor will operate it.

Cheap Power from Coalinga Oil.

W. C. Ralston, at a recent meeting of the executive committee of the California Miners' Association in San Francisco, made the following interesting statement:

"I recently visited the Vandalia mine and learned something that was quite a surprise to me. I found that, with an 80-horse-power engine, they were using Coalinga oil, distilling the oil and using the gas to run a gas engine, and their cost for the last five months has been from 17 to 20 cents an hour for 80 horse power. That is $1.80 a month per horse power. Free water power cannot beat that. I thought our power at the Melones mine was pretty cheap. We have the Stanilaus River, and it costs us nothing but the maintenance of the flume; but, taking the cost of the dam, the cost of the flume, the cost of maintenance and the charge off to depreciation, and we cannot provide power for $1.80 per month."

"And It Won't Be Right"

By Joseph E. Ralph

When I entered the service of the Trunk Line it was to accept the twin position of superintendent and shop clerk of the ——— Division. As division shop clerk I received instructions in regard to the motive power accounts from Mr. C———, C. C. M. P. Department, whose office was at Altitude.

Shortly after my installation, I was requested to report to Mr. C. at Altitude to get acquainted and receive some suggestions. I found Mr. C. a man rather advanced in years and very pleasant, but he had quite a pedagogical manner of setting forth his views as to his departmental work.

After giving me an outline sketch of his scheme or system of reports, he wound up by complimenting me on the exceedingly neat appearance of the reports I had already sent in; especially on the manner in which they were folded.

He said that for thirty years he had been trying to teach the division shop clerks and others under him how to fold their reports, and, taking up a blank form, proceeded to exemplify his idea by making the first fold so that the bottom edge came exactly even with the top edge, and there holding them securely so with his left hand, while he ran his right down to and along the fold to set it flat. As he proceeded to make the next fold, I quietly said, "And it won't be right."

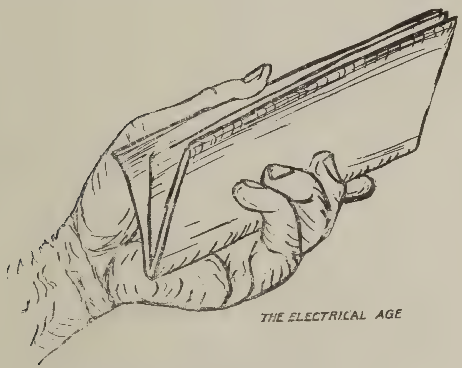
He gave me a curious sort of glance, but proceeded in his own way, and, looking at the result, was evidently dissatisfied with it, for he laid it aside and started again with a fresh form. As soon as he had made his first fold I again said, "And it won't be right."

He stopped at once, and looking at me fixedly, said, "Mr. R., will you kindly explain why you say so positively that it will not be right?"

I suggested that first he finish it and see; of course, it was as I predicted. I then explained that when he made the second fold it took an appreciable additional length of the paper and the outer sheet to go around the fold in the inner sheet, and having arbitrarily equally divided the length of paper in making the first fold, the edge of the outer sheet must fall just so much short of the edge of the inner sheet when the second fold was completed.

Taking a new sheet I started by folding it so that the bottom edge was somewhat short of the top edge. I meant it to be rather more than an eighth of an inch short, but as it proved to be less than an eighth I laid it aside and started again with another, taking pains to get this as far short as I desired. Finishing the second fold I handed it to Mr. C. He was delighted with it. "That was just how he liked to see reports folded," and, he said, "had tried to get his men to fold them so, but had not known how to do it himself; no wonder he had failed to teach others."

From the stress which he laid upon the beauty of having the edges come so evenly and neatly together, I ventured in the face of his compliments to suggest that I did not believe that he quite understood the real points of a good fold yet. Taking up the sheet I had discarded and finishing it, I called his attention to the fact that the two cut edges and the folds were all more even than in the sample he had so greatly admired. "Yes," he said, "it is even better than the other; why did you discard it?"



How a Properly Folded Paper Opens.

"The proof of the pudding is in the eating," I said, and taking the report in my left hand with the thumb on the cut edge and springing it open with a thumb motion, I showed him that the thumb held both the edges.

When he tried this he found it so also, and when he used his right hand to complete the opening of the report he had considerable difficulty in getting the two cut edges apart.

When he tried the sheet I had finished first he found that his thumb only retained the outer sheet—the other single sheet standing apart both from the outside sheet and the folded portion, as is shown in the drawing, and making it very easy to take hold with the right hand and pull the report fully open, ready to place on the desk or to read.

To make a neat appearance when the folding is completed, without really going to much trouble, all that is necessary is to make the first fold so that the inner edge will be certainly short enough to offset the "creeping"—if the paper is very heavy or the form is so long as to require folding more than twice more allowance should be made. When the final fold is made, care should be taken to have the outer edges come even—they will hide the intentional shortness of the bottom edges and of any errors of judgment.

If it is necessary to roll a report of paper it will be found advantageous to roll it with the face—or the side that will be used most, outside—the weight of the sheet will then aid in keeping it from rolling up when on the desk.

Gift of $5,000 to Prof. Slaby.

The curators of the Jubilee Foundation of German Industry have awarded Prof. Slaby $5,000 for the purpose of enabling him to prosecute his studies in connection with wireless telegraphy on the Slaby-Arco system of wireless telegraphy, which has been introduced into the German Navy.

Carbon Has Been Melted.

Dr. Ludwig has succeeded in melting carbon in the electric furnace, at a pressure of 22,000 pounds to the square inch, and keeping it in a liquid form for a time. When the liquid was suddenly cooled the carbon became a light grey powder, in which minute diamonds were present.

Cable Messages On Which Fortunes Hang

By A. G. Williams

EXACTLY at 10 o'clock on every week-day morning, as the gavel falls in the Stock Exchange and the roar and rush of the day's business begins, the special cables to Europe set apart for the stock business are simultaneously set to vibrating. Before the sound of the gavel has died away its echo has reached London over wires 4,000 miles in length, and within a few seconds the sound reverberates to New York.

From 10 a. m. until 1 p. m. these messages are kept flying back and forth. At that hour they cease, but only because the difference of time between the two countries has forced a cessation of transactions on the other side of the Atlantic.

That which keeps the Stock Exchange cables so busy during these hours is principally what is called arbitage business—brokers and operators trading for a profit upon the differences between the markets in New York and London.

It is a remarkable business, and requires for its successful carrying out both expedition and absolute accuracy on the part of the cable companies. A mistake of a word in a code message might involve the loss of thousands of dollars.

During flurries in the market it is not unusual for as many as 400 messages an hour to be sent from New York to London and as many more to be received in reply by a single company.

It has happened that a message has been sent and the reply to it been received in one minute, and it is quite an ordinary thing for messages to be sent and the reply to be in hand within two or three minutes.

To insure such celerity of operation the lines are divided into three sections, and each section is connected by a human relay. The first section of the cable lines ends at the American end of the cables. From the Stock Exchange the message goes direct to the man at the head of the cable. He catches the message letter by letter, and his agile fingers repeat it on the cable key almost as quickly as his eye catches the significance of dots and dashes.

At the other end of the cable another man is going through a like operation, transmitting the message over land lines to London. The complete message will be finished in London within two or three seconds of the time the last tick of the instrument is heard in New York, and sent on its way to the person addressed.

It is found that three working sections are more reliable than one stretch would be, and, consequently, much quicker also in operating. Moreover, a break in any one section can be immediately filled up with an alternate section held in reserve.

The strenuous life and excitement of the two great commercial cities has a powerful effect upon the human links in this cable chain. Remote from the outside world, and living in the small villages where most of the cables are landed, are these operators. As the messages pass through their hands there occurs a state of intense excitement. The operators strain every nerve in response to the lightning flashes coming over the wires. Yet, withal, the business is manipulated with extraordinary accuracy.

Operators become so accustomed to the code words used that, on many occasions, errors made by the brokers themselves are corrected, repetitions asked for and the messages delivered many minutes before the corrected words have come back from the senders.

The cablegrams are usually short and composed of Latin combinations. To facilitate despatch all superfluous words are omitted.

A typical message might read like this:

"Mr. 359 4 T usiturus plusorium."

Translated, this might mean Mr. 359, New York, four words. Leon, London, buy 1,000 Union Pacific preferred at 90⅝.

The signature of the sender is never sent, as the letter T covers the name of sender and receiver.

Firm designations and codes become so well known that even if the single letters are wrongly sent the particular code used is likely to be recognizable, and the name corrected at the terminal station, and often at the intermediate.

There are five cable companies, and each competes for and obtains a share of the business from the Stock Exchange, the Cotton, Produce and other exchanges.

How to Construct a Perfect Track

By J. C. Brackenridge

Chief Engineer Brooklyn Rapid Transit Company

A PERFECT track is one that will always keep its alignment and surface and never wear out. Unfortunately, I cannot tell you how to build one or tell you where you can find out.

Large sums of money have been wasted upon poor designs of rail, of special work and on poor installation. The conditions existing upon our city streets are distinct from steam railway practice. The track, once laid, should last the life of the rail head without attention. This is important, as the cost of track work is largely that necessitated by disturbance of pavement. The secret of securing the best results is due more than half to the care and skill in laying. In preparing the road bed to receive the ties care should be taken to excavate as little as possible below the finished grade line of the bottom of the tie. When the holes are dug carelessly, some deeper than others, it is impossible to tamp up the track in such a manner that it will retain a perfect surface and line. After the tie holes have been dug and ties laid the rail should be distributed, then driven up tight to the abutting rail and spiked, no allowance being made for expansion. The ends of the rails being in close contact, the friction between the faces of the ends will help support the joint, prevent work and the consequent loosening of the electric bonds. Before tightening up the joints the rail ends should be in surface and line. This latter is a matter that track foremen are very apt to be careless about, and, when this is the case, a kink will result which it is difficult to get out. The rail is then buried within the pavement, which restrains movement of the rail laterally, and protects it from sudden temperature variations.

The most expensive, as well as vexatious, question in track work is that of maintaining joints, especially in paved streets. This is due to the poor design of nearly all makes of joints or fish-plates. In designing a fish-plate advantage should be taken of every square inch of bearing area that a rail affords for a distance of 10 inches from its end. The Weber joint is the only one that has come under my observation that takes advantage of the horizontal area offered by the base of the rail. It stands to reason that a rail can be better supported by using the 50 or 60 square inches of bearing area offered by the base of the rail than by the angular bearing obtained by most fish-plates under the rail head and on the flange of the rail. I have found that, by using a sole plate similar to the old stringer joint plate in connection with the regular fish-plate or Weber joints, placing ties 5 inches between faces at the joints—making a suspended joint—and driving the rails up tight together, tightening the joints, then paving the street with as light longitudinal joints between the stone as possible from the head of the rail toward the curb, being careful to see that the stone next the rail is fitted up close to it, in order to prevent the rail from getting out of line, due to expansion, that, in a track laid in this manner, there will be no necessity for repairs until the head of the rail is worn out.

I am a believer in wooden tie construction, having used the longitudinal concrete beam with steel tie rods, and found that the rigid foundation shortened the life of the rail more than 25 per cent.

One of the difficulties I have found with the 9-inch girder rail track under heavy traffic was that it always became wide gauge, no matter how carefully the track was laid. After giving this subject considerable thought I came to the conclusion that this was due to the fact of the web being in a perpendicular line with the gauge, which throw the weight outside the center of gravity, resulting in the tipping out of the rail and the consequent widening of the gauge of the track. This difficulty I overcame by designing two rail sections, known as the Standard B. H. R. R. Section or the Pennsylvania Steel Company Section 224, which is a tram rail, and 241, which is a grooved rail. In these sections the web was moved back from the gauge line about one-half inch, and no more difficulty was experienced.

[Abstract from a paper read before the Railroad Club.]

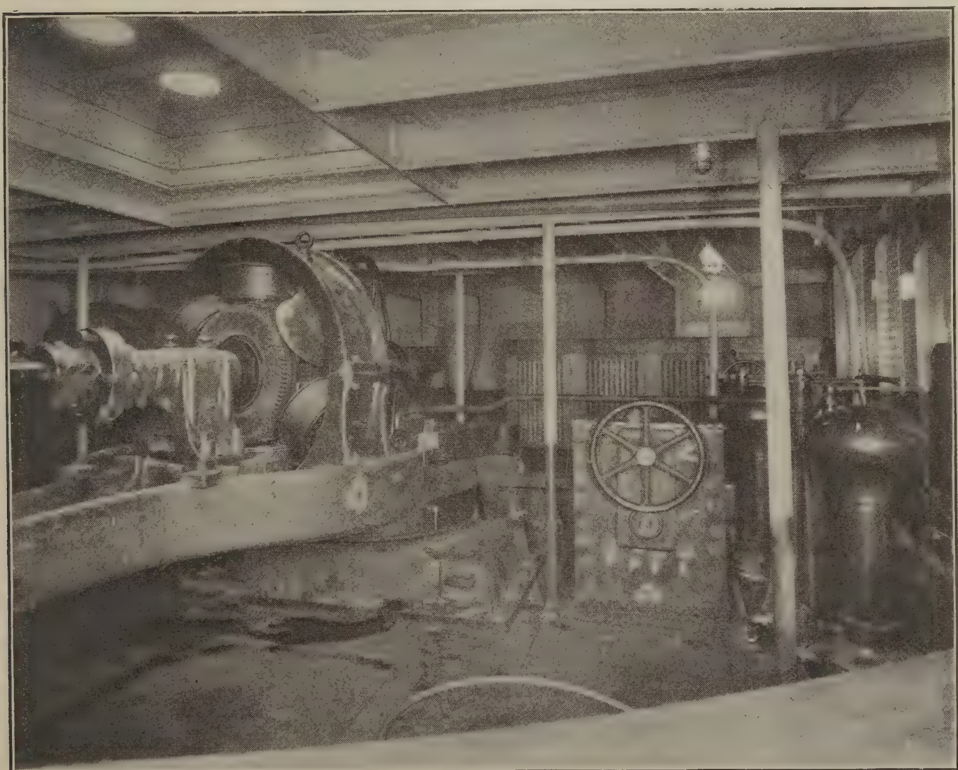
Electricity Steers the Ship

FOR generations no harder work has been known than that of steering a ship in a storm. Long years ago the simple tiller was abandoned except upon the smaller vessels sailing in quiet inland waters, and the powerful "wheel" was resorted to for resisting the sweep of angry seas against the broad blade of the rudder.

But as ships and rudders grew larger, the "wheel" proved inadequate.

Indeed, it was no uncommon thing, even with two stout seamen on each side of the wheel, to have its spokes torn from their grasp, and one or more of them to suffer broken bones in the struggle for supremacy against the waves.

To-day, with steamships 700 feet long and weighing 20,000 tons or more, the problem of steering would be almost beyond solution if the very power that drives them had not been called upon to handle the rudders.



Electric Steering Gear at the Rudder Head on the "Finland."

The mighty force which sweeps against the rudder of these leviathans of the deep may be judged by the fact that not infrequently rudder and stern-post are torn completely away, although these are among the marvels of modern steel production, and represent some of the heaviest of forgings.

Yet it is now possible to control every movement of one of these mighty rudders with a touch almost as light as that which sways my lady's fan. This is done by electricity.

The development from the rude tiller to the wonderfully made electric steering gear of to-day has been through three distinct eras.

First was the era of the "wheel." Sometimes the "wheel" was placed forward and sometimes it was kept aft. In any case it was but the simple wheel, and axle. Sometimes the two steering ropes ran to a tiller and sometimes they ran direct to the rudder, but in all cases they were coiled on the axle in opposite directions. The one wound up while the other unwound, and so they kept the rudder in control in both directions while it was being moved or held still. The "wheel" is still the most in use of any steering gear.

Modifications of this gear are made in which the ropes are replaced by a gear wheel on the rudder head and an endless screw on the axle, but it is still mechanically the wheel and axle.

The "wheel" soon became so popular with seafaring men that no steering apparatus could be successfully put into use even to-day unless it worked with a similar device. The principle of electrical steering lends itself to this adaptation in a most happy way, as will be explained later.

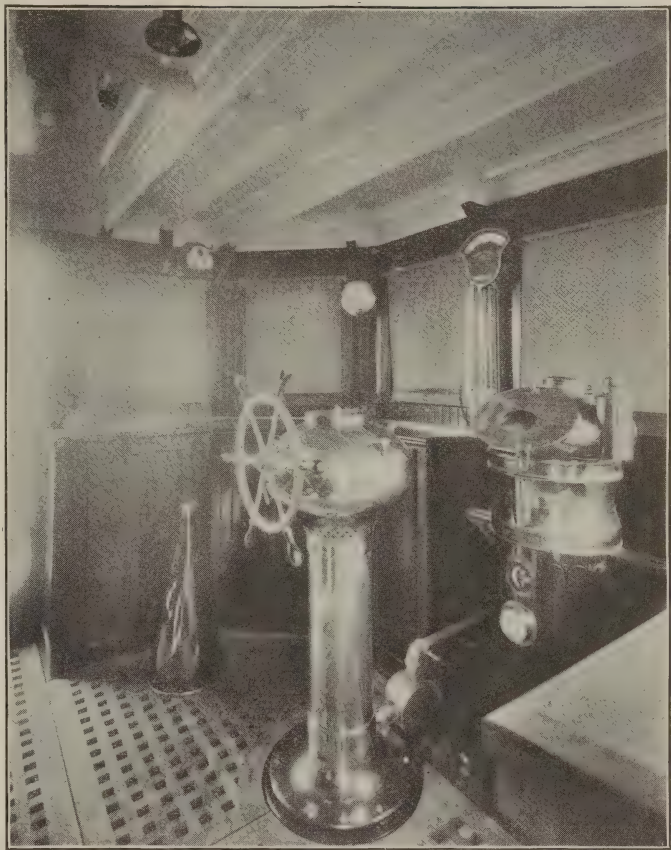
The second era of steering development was that of the use of steam apparatus. This was so great an advance that at the present time almost every steam vessel afloat of any great size is provided with such gear; and this is also true of many of the larger sailing vessels. To-day, even, steam yachts of 100 feet in length or less often have steam steering gear.

That steam steering gear is effective there is no doubt, but steam does not lend itself readily to this work, nor is it economical in its application. In fact, steam steering gear is very expensive in operation. The engine which controls the rudder must be large and powerful and must be ready at the instant to exert its full power. A delay of a few seconds might decide the fate of the ship and the thousands of men and women aboard of her. To keep the engine ready for work live steam must be kept passing through it all the time. This is to keep the cylinders warm and free from condensation. The valves work at full stroke, or nearly so, and the consumption of steam for the power produced is enormous.

If the wheelman had to open and close the throttle of the main steering engine every time he wished to shift his rudder he would have about as hard work as it was to steer in a storm with the old-time "wheel." To relieve him of this labor a small secondary valve is operated by his wheel. This works a "pilot" valve which in turn moves the larger valve by steam power. This makes the steering easy, but it involves carrying steam pipes long distances, to the pilot house and steering engines. Steam pipes are not easy to keep in condition, and live steam leaking out is neither pleasant nor safe. To do away with the latter difficulty some systems use compressed air or liquids to connect the "wheel" with the steering engines and to work the "pilot" valve.

Others use electricity for this purpose.

The use of electricity entirely for steering is, however, the ideal system. Simple wires, easily protected, are all that are needed to carry this power, and the power, which can be controlled by the touch of a finger, may be multiplied in simple ways to any degree needed.



Electric Steering Gear in Wheelhouse of the "Finland."

The Pfatischer electric steering gear, built by the Electro-Dynamic Company of Philadelphia, is the first system of this kind fully and practically developed. This gear has been installed upon eight ships of the Russian Navy, including the formidable "Variag," and it is also installed on the new Red Star liner "Finland," built by the Cramps, which has just completed her maiden trip across the Atlantic. Two liners now being built for the Pacific trade by the Eastern Shipbuilding Company at New London, Conn., are to have similar steering gear.

The principle of the electric steering gear is that of the Wheatstone bridge.

If two rheostats of exactly equal resistance are connected in parallel to a source of electric current, the potential of any point on one of them is the same as that of the corresponding point on the other, and no current will flow through a wire joining them together. If, however, two non-corresponding points are joined by a wire, then their potential being different, current will flow in one direction or the other according to the relative position of the two points.

In applying this principle to the steering of a ship, one rheostat is placed in the pilot house, or others similarly connected may be placed at other steering stations, and the second or balance rheostat, is placed in the steering gear

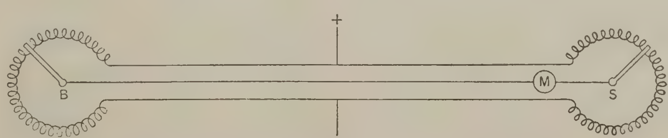


Diagram Illustrating the Principles of Electrical Steering.

room. Each rheostat has a sweep so arranged as to move over an arc of contacts, and the two sweeps are connected by the "balance wire."

Through the "balance wire" runs a small electric current taken from any handy source which is always in operation. This is the only electrical energy which is constantly needed to operate the steering gear. Somewhere on the ship, in a convenient place, there is kept constantly running a big dynamo capable of furnishing current enough to operate the steering gear. Connected with this is a smaller dynamo, capable of furnishing current enough to excite the magnetic field of the big one. The magnetic fields of both dynamos are "dead," and the only power required to run them is the small amount which they consume in friction on their well oiled bearings.

Mounted on the rudder head and tiller is a big electric motor. All it needs to enable it to turn the rudder is a current from the big dynamo. Its field is separately excited.

The big dynamo is ready to produce current as soon as the little one supplies current to magnetize its field. The little one is waiting for current from the "balance" wire to pass into its own field magnets to give it life.

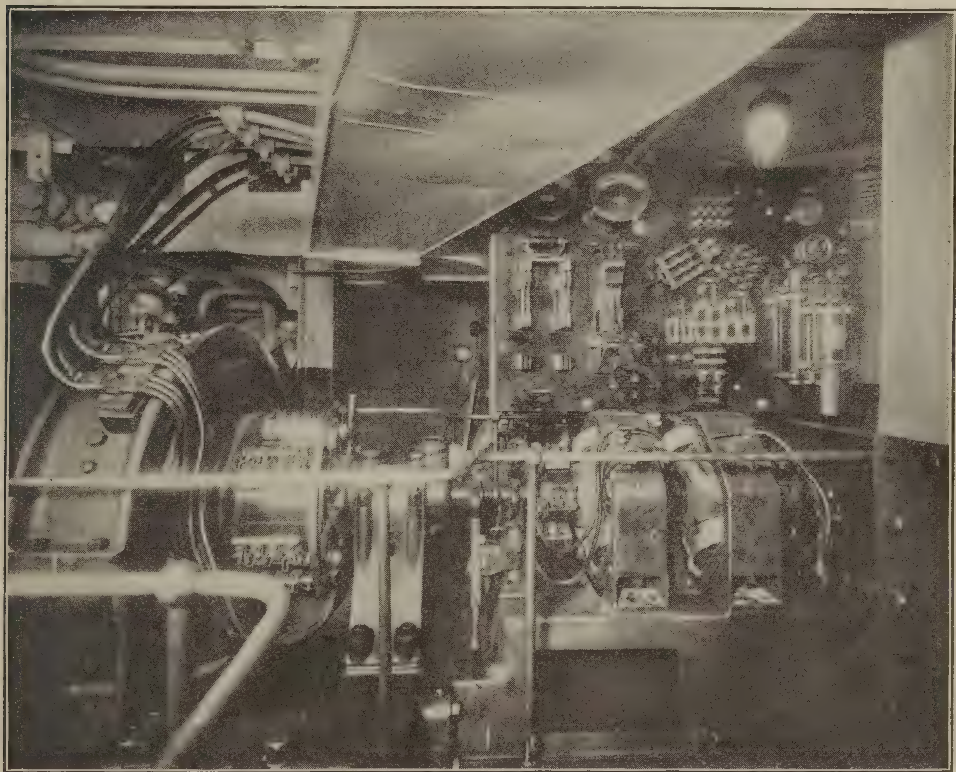
The field of the small dynamo is part of the balance wire circuit. The exciter armature is connected to the field of the main generator, and its armature is connected to the armature of the rudder motor. The characteristics of the current in the balance wire determine the characteristics of the current supplied to the rudder motor, and so determine the speed and direction of its rotation. The following is a technical description of the plant on the "Finland."

In the pilot house is placed the steering rheostat encased in a brass column. It has a hand wheel and gears to move the sweep, and also a Pfatischer electrical rudder indicator. From here a five-wire cable is run to the steering gear switchboard in the main dynamo room. Two wires are required for the indicator, two to supply the rheostat and the fifth is the balance wire.

In the steering gear room is a 60 horse power 110-volt rudder motor mounted on a Brown tiller, the balance rheostat placed in an iron column with a lever and gears to move the sweep, and a spare balance column which is also provided with a hand wheel so that it can be used as a steering column when desired; and also a third column, similar in external appearance to the other two, but containing a higher resistance rheostat, which is the transmitter for a rudder indicator in the pilot house. This rheostat is supplied with current from the ship's lighting circuit. One of the two wires leading to the indicator, which is a voltmeter suitably calibrated, is taken from the middle point of the rheostat and the other from the sweep which moves over the contacts, so that the position of the rudder is indicated at all times. The sweeps in all three columns are connected by links to the rudder post, so that they are all moved in unison with the rudder. The wires from these are taken to the steering gear switchboard in two five-wire cables. The motor connections are taken separately. The wiring is in iron pipes.

In the dynamo room are installed the main generator of 60 kilowatts capacity at 110 volts, the exciter, a small shunt generator of 4.5 kilowatts at 110 volts, and the steering gear switchboard. The main generator, shunt generator and exciter are all mounted on one bed plate and are driven by a direct connected 9 by 5 1-2 inch double-cylinder Sturtevant engine running at 375 revolutions per minute. The armatures of the shunt generator and exciter are rigidly coupled together, and also coupled to the main generator shaft by means of a clutch, which can be easily thrown in or out.

The steering gear switchboard is entirely separate from the main switchboard, and is mounted over the field yokes of the shunt generator and the exciter. On this board are mounted all the necessary switches, instruments and field rheostats connected with the steering gear. A four pole, triple throw switch controls the connections between the different columns. In one position connections are made so as to steer from the pilot house, using the regular balance column; in a second position connections are made so as to steer from the pilot house, using the reserve balance column, and in the third position when steering from aft the reserve balance column is used as a steering column in connection with the regular balance column. All the other switches, excepting the rudder indicator switch, which is single throw, are double pole, double throw. When in their upward position the whole steering gear is entirely independent of the ship's lighting or power circuits, the small shunt generator supplying the current for the rheostats and rudder motor field. In their downward position the regular engine and main generator may be stopped, current for the rheostats and motor field and to run the shunt generator as a motor to drive the exciter being taken from the ship's lighting circuit, while any one of the four lighting generators may be used to sup-



Exciter and Generator of Electric Steering Gear on the "Finland."

ply power to the rudder motor. On each of the lighting generators is mounted a small board with the required switches to connect the machine to the main bus bars or to the steering gear system.

Ordinarily in steering the switches on the steering gear board are in their upward positions, the main generator, shunt generator and exciter are continuously driven, the shunt generator supplying current to the columns and motor field, while the main generator and exciter only generate current when it is required, and at a voltage determined by the difference of potential at the ends of the balance wire. Therefore since the speed of a motor depends on the voltage at its terminals, the speed of turning the rudder depends on the rate of moving the sweep in the steering column. If in the steering column the wheel is put hard over quickly there will be a maximum difference of potential between the ends of the balance wire and the maximum voltage will be generated, causing the motor to rotate rapidly, while if the wheel is put over slowly the motor has a chance to follow up, keeping down the difference of potential between the ends of the balance wire and therefore keeping a low voltage at the motor terminals, causing it to run slowly. The voltage does not reach a maximum immediately on starting nor does it fall to a minimum instantly when stopping. There is a time element in both cases which is beneficial in saving the machinery from mechanical strain.

In the whole system there is no sparking at any point, no circuit being opened or closed in the operation of the gear. The time required to shift the rudder from "hard over" to "hard over" is less than thirty seconds. The power required ranges from one to sixty kilowatts.

Cheapest Gas in the World

[From Progressive Age]

THAT is the title under which the municipal gas works at Widnes, in Lancashire, Eng., announces its product, with the additional information that it costs them at present only 12.2 cents per 1,000 to make and distribute 20-candle gas, or 23 cents, including fixed charges. The price at which this gas was sold in 1901 was 34 cents up to, and 30 cents over, 3,000,000 cubic feet consumed per year. Gas engines were charged 26 cents and slot meters 52 cents. These figures are, to say the least, interesting, and show pre-eminently a wise and economical management, for, in 1881, the cost of distribution and manufacture was 29 cents; in 1895 17 cents, and in 1901 it was 12.2 cents, while the number of consumers is now tenfold and the output about fourfold. To Mr. Isaac Carr, the engineer, is due the credit for this excellent showing.

The population supplied is about 35,000; the works is owned by the city, and is represented by $276,320 in outstanding bonds, which bear 2.75 and 3.5 per cent. interest; the cost of coal is $2.90 per long ton, and oil or benzol 16 cents per gallon, there being 24,600 tons of coal and 10,084 gallons of oil used in 1901, from which 244,520,000 cubic feet of gas was made, or 244,151,000 cubic feet sold; the candle-power prescribed was 14, and that supplied was 19.4; there were 6,231 consumers—1,069 stoves, 3,891 slot meters and 894 free public lamps; coke was sold for $3.40 per ton: there are 38 miles of mains, and seven outlying towns are supplied.

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TO ADVERTISERS

Changes for advertisements and new advertisements **must** be in this office by the **20th** of the month to be included in the issue in the month following. The advertising pages carry printed matter measuring five and a half by eight inches. Cuts intended for use on these pages should be made to accord with these measurements.

Correspondence and semi-technical articles, with suitable photographs for reproduction, or cuts, are invited. Accepted matter will be promptly paid for. We cannot be responsible for any unsolicited manuscripts, but when stamps are enclosed all unavailable matter will be returned. Postage must always be fully prepaid. Cuts to be available for illustrating articles must conform to the column or page measurements. The columns are 2½ inches wide. Cuts for single column use should not exceed that width. Cuts to go across the page should not be more than five inches wide, and full page cuts may not exceed 4½ x 8 inches.

Publisher's Notice.

With this number of "The Electrical Age" Volume XXIX ends, although it is only No. 10 of the year's series. This action is considered advisable, as it will make it more convenient for such of our subscribers as intend having the numbers bound. The seven numbers issued since the adoption of the new form for the magazine will make one convenient sized volume, and hereafter and beginning with the January number, there will be six numbers to a volume, and the monthly issues will be numbered in accordance with this arrangement.

Book Reviews

Annual Report of the Smithsonian Institution.

Washington Government Printing Office, 1902. Pp., 6 x 9 inches, 782. Cloth.

The fifty articles making up the appendix to the report of the Board of Regents of the Smithsonian Institution for 1901, which fill more than 600 pages of the volume, just issued, cover a wide range of interesting topics, each treated in a manner to make them understandable and valuable to the non-technical reader. Many of the articles are original, while others have been reprinted by permission from magazines and other publications. They began with an article upon " Some Recent Astronomical Events," by C. G. Abbott, and range through many subjects, including among them wireless telegraphy, color photography, the telephonograph, a description of the palace of Minos, with its famous labyrinth, traps of the American Indians, Santos Dumont and his flying machine, and the fire walk ceremony in Tahiti.

"Work Done, No. 1," is a 100-page illustrated pamphlet issued free by Westinghouse, Church, Kerr & Co., in which, as is frankly stated for purposes of their own, they tell of some of their important achievements in engineering. The particular works described are the Grand Rapids, Grand Haven & Muskegon Railroad; the Detroit & Port Huron Railway; the Detroit, Ypsilanti, Ann Arbor & Jackson Railway; the Toledo, Fremont & Norwalk Railway, and the American Car and Foundry Company. These descriptions are interesting and valuable to everybody who has engineering or financial interests in like works; but the pamphlet has some valuable points apart from this. One of these is the declaration of principles.

"This organization of workers," the preface says, "has thus continued to grow, and, withal, by care and industry, to thrive, having always had the courage of its convictions in many things, not the least of which is that engineering is a means to a commercial end, and not an end in itself, and that engineering, if good, cannot far depart from the dictates of sound business."

In treating of "The Railway Situation," the authors say:

"While the present steam service is relied upon entirely for cross-country work, the rapidly expanding electric systems are more and more encroaching upon this heretofore exclusive field, and a few years of further progress will serve to connect not only the largest of the Michigan cities by interurban electric systems, but also these industrial centers with similar centers situated in neighboring States. It may also not be improper to predict long-distance work for the immediate future. Already one system is closing the gaps in the cross-State line from Detroit to Grand Rapids and the eastern shore of Lake Michigan. There will shortly exist an uninterrupted electric service from Port Huron to Toledo, a distance of approximately 100 miles. Another system extends to Cleveland—140 miles further from Toledo. A fourth system now forms the major part of a cross-State line, from Toledo to Cincinnati, a distance of 215 miles, the remainder of which is now under projection, and, when constructed, will complete a through service from Cleveland to Port Huron, aggregating approximately 355 miles.

"The majority of these roads are equipped with permanent way material worthy of any steam road, with cars superbly appointed where conditions of service require these refinements, and with power distributing systems commensurate with the requirements of high schedule speed, frequent stops, heavy grades and other local characteristics. Each new undertaking has surpassed its predecessor in the completeness of its equipment and the character of the service rendered, all of which is made possible by the embodiment of the most advanced engineering ideas and talent in the design, construction and operation of the road.

"Time was when an electric road might be, as it were, thrown toegther by some railroad man experienced in all but that invaluable knowledge of the successful application of electricity, but who, by relying upon standard apparatus and the hard-earned experience of others, had succeeded in operating his cars when conditions were favorable, trusting to Providence and his engineer to 'keep the old thing going,' when unfavorable. It is needless to say that such service would not now be tolerated by any progressive community; and, in addition to low fares and handsomely appointed cars, an interurban road must be prepared to render a service of great frequency, high schedule speed and reliability during all conditions, both of climate and patronage. Mail, express and freight service are also required in many localities."

"The Distribution of Light from the Nernst Lamp" is the title of folder No. N4,002, issued by the Nernst Lamp Company, of Pittsburg. In this booklet it is argued that the human eye is not accustomed in nature to light projected horizontally, and that the arc lamp, generally used for street lighting, is objectionable for this reason. In the Nernst lamp, it is asserted, this trouble has been overcome, with the result that, instead of its projecting blinding rays of light into the eyes of pedestrians, teamsters and others, it casts a soft, white light downward upon the street, evenly distributing the illumination over the surface.

"Facts About the Scu h," by Richard H. Edmonds, editor of the "Manufacturers' Record," of Baltimore, Md., is a timely pamphlet of 37 pages, in which the author sets forth the progress which has been made in the South during recent years in agriculture, mining, manufacturing and commerce, with statistical statements, and also pointing out something of the future possibilities of that section of the country.

Catalogues.

"The Mechanical Cashier" is the title of a very handsome production of Bartlett & Co. and the Orr Press, in which is described and illustrated a new machine which does the combined work of a cash register, change making and the registration of sales. It is issued free by the American Mechanical Cashier Company, of 40 Wall street, New York.

The Fort Wayne Electric Works' bulletins Nos. 1,035 and 1,036, recently issued, deal respectively with "Electrostatic Ground Detectors" and "Small Direct-Current Motors," and describe new products of that factory which have lately been placed on the market.

The Garvin Machine Company's latest catalogue deals with the subject of "A Modern Machine Shop Outfit," and contains 56 pages of descriptive and illustrative matter upon that important subject.

Personal

Mr. J. L. Greatsinger, president of the Brooklyn Rapid Transit Company, has returned from his vacation.

Mr. M. H. Sherman, vice-president of the Los Angeles Pacific Railway Company, of Los Angeles, Cal., has returned to California after a visit to New York, Washington, Niagara Falls, Quebec and the home of his boyhood at Lake George.

Mr. O. W. Brain, is the new electrical engineer of the New South Wales Railways & Tramways department, having succeeded the late Mr. P. B. Elwell.

Mr. E. C. Mills, of E. W. Mills & Co., Ltd., Wellington, New Zealand, is in this country on a business trip. His address while in New York is care of the Livingston Nail Company, 104 Reade street.

Mr. James T. Rood, formerly electrical engineer of the Natural Food Company, of Niagara Falls, N. Y., has accepted a position with the Worcester Consolidated Street Railway Company in the department of motive power and machinery.

Mr. Thomas E. Mitten, General Manager of the International Traction Company, of Buffalo, N. Y., is considering a proposition which may place him at the head of the Metropolitan Railway Company of New York, under President Vreeland.

Mr. Robert K. Howard, of Knoxville, Tenn., has been appointed superintendent of the Dayton, Springfield and Urbana Electric Railway Company.

Mr. Will S. Cook has resigned as superintendent of the electric-light and waterworks plant at Petoskey, Mich., to become superintendent of the Petoskey, Bay View and Northern Gas Company.

Mr. Edward Plaisted has been appointed manager of the Kenton Gas and Electric Company, Kenton, Ohio. He was formerly superintendent of the Columbus Electric Light and Power Company.

Mr. W. C. Ward, mayor of the town of Warren, Ohio, has tendered his resignation to become manager of the Peerless Electric Company of that city.

MR. G. R. NEWCOMER, an experienced electrical salesman, has formed a connection with the Columbia Incandescent Lamp Company of St. Louis, and will have charge of the territory served from Memphis, Tenn., with headquarters in that city.

COL. JOHN JACOB ASTOR dedicates to the public all his patents on marine turbines in the hope that thereby the development of the ideal turbine may be hastened.

MR. CHARLES M. SCHWAB is enjoying his holiday and has chartered A. J. Drexel's steam yacht Margarita, and is likely to cruise in her in the Mediterranean for several months.

MR. MARCONI has been visiting his wireless telegraph station in Novo Scotia in the Italian warship Carlo Alberto.

MAJOR WALTER K. ROSSITER, who has been assistant secretary of the Brooklyn Union Gas Company since the formation of that company, has been made secretary of the company to succeed Edwin Ludlam.

SECRETARY J. W. YOUNG of the Allis-Chalmers Co., will become manager of the company's London offices. He will be succeeded here by Third Vice-President Seaman.

GEO. H. BARBOUR has left the C, W. Hunt Co., of New York, to take a place as engineer with the DeForest Wireless Telegraph Co.

MR. ARTHUR HUGHES, Youngstown, O., has accepted the place of assistant superintendent of the Helinbacher Forge & Rolling Mill Company, St. Louis, Mo.

MR. JOHN H. SWINERTON, formerly president and manager of the Staten Island Electric Railway Company, has sailed for Europe for a prolonged visit.

MR. C. BROOKE JOHNSON, of the Norfolk Railway & Light Coompany, will take charge of construction work for the Railways & Light Company, of America.

MR. E. E. STODDARD, representing Charles C. Moore & Co., engineers of San Francisco, is making an eastern business trip.

MR. J. G. GAINES, of Canso, N. S., it is understood, will be the superintendent of the new Pacific cable line, with headquarters at Hawaii.

MR. E. H. BEACHMAN, of Messrs. Sanderson & Poster, has accepted an engineering position with the Levering & Garrigues Company, New York.

MR. JILSON J. COLEMAN resigned as president of the New Jersey & Pennsylvania Traction Company, of Trenton, N. J. Mr. J. A. Barry, formerly connected with the Johnson interests, succeeds Mr. Coleman.

MR. W. H. STOCKS, master mechanic of the Chicago, Rock Island & Pacific Railroad, has resigned, to accept an appointment as representative of the Gold Car Heating & Lighting Company, of New York, Chicago and London.

MR. ALBION E. LANG, of the street railway and lighting interests of Toledo, has retired, and his place of president of the Toledo Railways & Light Company will be filled by Mr. Henry A. Everett, of Cleveland.

MR. L. G. MARTIN, the cable-laying expert of the Okonite Company, has gone to California, to superintend the laying of the land lines for the Pacific Cable Company at San Francisco. He will also lay the land cables at Honolulu. This cable is expected to be in working order between Hawaii and United States in about thirty days.

MR. CHARLES CUTTRISS, chief electrician of the Commercial Cable Company, has also gone to San Francisco to superintend the technical details of the opening of the new cable between the United States and Hawaii.

MR. KELSEY SCHOEPF, president of the Cincinnati Traction Co., has become a director of the Cincinnati, Dayton & Toledo Traction Co., and has been appointed chairman of the executive committee.

J. J. BELLMAN AND HENRY SANFORD, 2ND., have opened offices at 14 Church street, New York, to transact a general engineering and contracting business. Mr. Bellman is a graduate electrical engineer of Columbia University, and has been connected with the N. Y. Edison Co., the Crocker-Wheeler Co., and Westinghouse, Church, Kerr & Co. Mr. Sanford has been connected with the General Electric Co., and the Metropolitan Street Railway Company. They will make a specialty of power plant work, and take complete contracts for the entire equipment of central stations and isolated plants.

AUTOMOBILE CLUB OF SPRINGFIELD, MASS., on November 5th, elected the following officers: President, Harry G. Fisk; vice-presidents, W. R. Weiser, A. O. Squier, A. P. Smith, I. H. Page; secretary, F. A. Hubbard; treasurer, F. S. Carr.

Current Engineering and Scientific Notes

Abstracts from the Foreign Papers

A Portable Electric Lamp.

[*La Nature.*]

FOR a long time the need of a simple electrical lamp, portable and suitable for miners' use, has been felt. A lamp which would give under a weak volume of current and with a restricted weight an intensity sufficiently luminous and lasting from eight to ten hours.

This result has been approximated in a special lamp made for the coal mines of Bruay, in the Pas-de-Calais. La Societe anonyme d'eclaerage et d'applications electricques of Arras, of which the administering director is M. H. Catrice, has installed in the mines an electrical lampistery, where the electrical lamps, to the number of about 500, are delivered to the miners ready to use and are returned to be recharged.

The lamp consists of a rectangular box made of leaded iron plate, and this contains two ebonite demi-flexible cells, which contain each one an accumulator of a special model known as the Estampe. This accumulator uses grills 118mm. in height by 68mm. in width. They are made in the following manner:

The metal, consisting of an alloy of lead and antimony, with but very little of the antimony, is cast into ingots. These ingots are then passed under a powerful press, which transforms them into plates of 2mm. in thickness. These plates are then cut up into strips 120mm. in width, and a press cuts from these blank plates with ears. A stamping press with a twenty-ton blow then transforms this plate into a sort of honeycomb by passing it under a punch furnished with 128 points; each compartment is left separated from the next by a cross of 1mm. in thickness. The operations to which the grill is subjected render the metal homogenous, elastic and resistant.

The grill is at the same time solid and light; it can receive a weight of active matter double its own weight. The active matter consists of chemically pure lead, which is compressed into the openings. This spongy lead is then transformed into the oxide by a series of successive electric charges and discharges. The plate entire weighs after formation 310 grammes. It has a capacity of 7.5 ampere hours when discharged in an hour, a capacity of 15 ampere hours when discharged in two hours.

The lamp uses two accumulating elements, each formed of a positive plate between two negative plates. This battery, with a potential difference of 3.9 volts, furnishes a flow of 0.8 ampere for twelve hours with a liquid electrolite.

On the lid of the lamp is fixed a base of ebonite which supports a thick glass globe protector, which is fastened by a steel crossbar to the cover of the box by three rods. It bears on another part a hook which serves as a handle for the lamp.

On the ebonite base are placed supports to hold the bottoms of the little lamps; these use a straight filament and give a luminous intensity of 1.5 candle power with a consumption of 0.75

ampere. One-half of the globe is covered with a varnished reflector, but this allows a certain quantity of light to be diffused at the back.

On the ebonite base is a turn button for lighting and extinguishing the lamp. There is also an opening for introducing the charging wires.

These parts are so arranged that the charging can be done when the current is turned off from the lamps.

The recharging is done with a current of 1 ampere, lasting for ten hours. Special tables are provided as a guide for recharging in case the current is of 110 or 220 volts. All the apparatus in caring for the lamps is already installed.

This lamp is equally useful for mines, distilleries and gas houses.

Insulating Wire With Cellulose.

[*Electricity, London.*]

By the use of cellulose as an insulation for wire it is claimed that the objections which have heretofore applied to this type of insulation are obviated. It has been found that if finely divided sulphur, such as flour of sulphur, is intermixed with dissolved cellulose and then subjected to heat, preferably with the aid of pressure, the resistance value of the material insulated is more than double, and any degree of flexibility may be reached. Moreover, the degree of flexibility can be regulated in accordance with the percentage of sulphur added, and the sulphur adds the valuable property of a greater degree of resistance to the action of acids or of moisture.

Lights and Lighting.

[*Electrical World and Engineer, London.*]

Osmium Lamp.—Ziegenberg.—A review of recent progress made with the Nernst lamp and the osmium lamp. A number of patents for the Nernst lamp were described, and it is pointed out that for practical purposes a compromise must be made between the requirement of cutting the heating body out of the circuit when the lamp is lighted, on the one hand, and the requirement to avoid complicated construction on the other hand. The trouble with the osmium lamp is that osmium is rare and expensive and is very difficult to work economically. The osmium lamp will be rented only, and not sold, by the Welsbach Company for some time, so that the company retains possession of the osmium and can use it again. The following method of Deville and Debray for making the osmium wire is described. It is based upon the observation that if osmium vapors are sent through a tube of clay, the inner side of which is coated with an adherent layer of carbon, the tube being heated to incandescence, then osmium is deposited and replaces the the carbon, i. e., the carbon layer is changed into an osmium layer. By this method there is only a very small loss of osmium. For making osmium wires, carbon threads are placed in a case of clay; the air is driven out by means of nitrogen, and $Os\ O_4$ is introduced either in solid form or by means of a current of inert gas (nitrogen); the case is then heated to a high temperature, causing the carbon threads to change gradually into osmium threads, the change taking place in the direction from the outside to the center. Very thin osmium threads can be made in this way, which is of importance, as it facilitates making lamps for the higher voltage. Another trouble is that the osmium filament has a relatively great length and must be supported. Mixtures of certain refractory oxides are recommended for the supports. Another solution of the problem of making osmium filaments for normal voltage and of such a rigidity that the incandescent filament does not change its form, is due to Auer von Welsbach. He uses the osmium wire in the form of a spiral of fine wire. This spiral must consist of windings of very small diameters, only a few millimeters. This spiral is supported and held in its form by means of a thread of mixtures of refractory oxides. The osmium wire is made by preparing a paste of osmium and certain other materials, and forcing it through a die. Single windings of this spiral of fine osmium wire may be in direct contact, without diminishing the incandescence of this winding, i. e., the contact does not represent a serious shunt.

The Fagoel Oil Burner.

[*Petroleum Review.*]

A test was recently made with the Fagoel oil fuel burner by a committee of experts, in Canton, Ohio. The results of this test are stated to have been as follows:—

The boilers were fired first with coal, and the coal ashes, etc., carefully weighed, as was also the water evaporated. It was found that 681 pounds of coal evaporated 3,994 pounds of water, or that each pound of coal evaporated 5.85 pounds of water. In the same time with the Fagoel burner 353 pounds of high grade oil of the quality of kerosene evaporated 2,295 pounds of water, an average of 6.5 pounds of water for each pound of oil.

With 143 pounds of heavy or crude oil, obtained from the Beaumont fields, 1,222 pounds of water were evaporated, an average of 8.55 pounds of water to a pound of oil.

Reduced to gallons, 20 3/7 gallons of Beaumont oil converted 1,222 pounds of water into steam, while it required over a third of a ton of coal to perform the task.

It is difficult to arrive at a financial comparison because of the difference in cost of coal in various portions of the country. In Canton, coal costs $1.75 a ton for steam purposes when delivered under contract, and in large quantities, while crude oil for fuel purposes costs 25 cents a barrel for a barrel containing 50 gallons or 350 pounds. The average cost of oil, as nearly as we can arrive at it, is 7 cents per 100 pounds. With the Fagoel burner, this would indicate that an expenditure for oil at this price will convert just twice as much water into steam as will a like expenditure for coal.

To Prevent the Freezing of Gas Pipes.

[*Illustrated Zeitung fuer Blechindustrie.*]

A simple but effective device for preventing the freezing of gas pipes consisting merely in the insertion of a wider piece of pipe just where the conduit issues from the ground or wall. For a conduit of a diameter from three-eighth to one-half inch, a length of from 20 centimeters to 30 centimeters of a pipe 1 inch in diameter suffices. The deposition of the water particles contained in the gas, which on leaving the works have a temperature of about 10 degrees C., naturally takes place just where the gas is subjected to the most abrupt change of temperature—i. e., on its issue from the ground. If the external temperature is sufficiently low, the deposited water immediately congeals, and clogs the conduit. As soon as the gas has acquired the temperature of the conduit, the deposition of water and congealing cease; and this is said to be the case a short distance beyond the first cooling point. Therefore there should be no congealing beyond the inserted wider piece, and this piece is wide enough to accommodate a thick ice-crust and to still leave a free passage for the gas.

Digest

Engineering Literature of the Month

A Tramway Parcel Service.

IN many of our provincial towns the question of establishing goods carriage by tramways has been under consideration for some time. In the Potteries a tramways parcel service has been introduced. The scheme was started in the early days of December last in a small way. Two hundred parcels was the weekly average for the first month. Now, less than six months afterwards, the express receives and delivers as many as 3,000 parcels per week, and at the present moment that total is being increased at the rate of 400 per week. A better proof of growing popular confidence could not be desired. For a new departure, the management is wonderfully thorough and masterful. Not only has the mere carriage and delivery of parcels been brought to a condition bordering on the ideal, but other large schemes not usually associated with a carrying company are issuing from the chrysalis state, and before long, and after a brief trial, no doubt will be as much appreciated as the carriage of parcels itself. Indeed, such a Titanic and all-comprehensive scheme has been thought out as almost to suggest American origin, a country which owes much to the boldness and insight of its business men. Parcels are collected and distributed in a considerably less period than has hitherto been possible. The machinery at the service of the officials is unique. The frequent service of trams throughout the district places at the disposal of the officials a rapid and safe means of carriage. Only quite recently the Board of Trade gave consent to the company to have baggage wagons attached to the cars for the special purpose of carrying goods from one part of the district to another. The Board has been fully alive to the need of preventing inconvenience to the travelling public, and have edged the consent round with safeguards in the interests of the governing authorities. The company will not be allowed to attach more than one trailer to each car, and other requirements will prevent the company, if they were foolish enough to run in the face of their own interests, incommoding or inconveniencing the users of cars. This will also be an innovation on electric traction systems, which are not also light railways, and the progress of the scheme will be watched with very general interest. The vans will be much in keeping with a railway guard's van, but they will be much more lightly constructed. People can hand goods to the man in charge at any portion of the route, but distribution will only take place from arranged centers. Each parcel office of the company is also a cloakroom, and can be utilized in the same way and for the same purposes as the ordinary cloakrooms at the railway stations. Goods will be collected and delivered within a couple of miles of the tramway lines by a corps of youths and men who have been engaged for the purpose. Heavy parcels, which it would be unsafe to send on the lines, will be moved in the ordinary way, the management having at its service a large number of horses and vans. Rapidity of collection and delivery is not, however, the only merit claimed for the system. It is also the cheapest way of satisfactorily dealing with parcels. The company accepts a parcel not exceeding 1 lb. in weight, and delivers it to any part of London for 2d., while the charge for same by parcels post would be 3d., or by rail 4d. All parcels are collected and delivered at the same relatively cheap rate, whether in and for London, or any part of the country. The P. E. T. is not exclusively, or even principally, local in its operations. It is prepared to collect and forward light and heavy luggage, with equal indifference, for or from any part of the world, and at rates which must commend themselves to the trading community. There is no parcel post to America, but, in spite of this fact, the company will collect and deliver in New York, Boston, or Philadelphia, parcels not exceeding 5 lbs. for 1s. 6d.; 7 lbs., 2s.; 10 lbs., 2s. 6d.; 15 lbs., 3s. 9d.; 20 lbs. 5s. To and from Paris the charge is 2s. 6d. for 10 lbs., and so on; to and from Germany the carriage is even cheaper, and no declaration of value demanded or required. The "P.E.T." vans and handcarts of the company are already familiar in the district. They are met in all parts, and may be said to be already among the institutions of North Staffordshire.—*The Tramway & Railway World.*

Electric Heating Device.

A system of heating houses and cars which combines the hot water and electrical systems has been devised by a New Haven inventor. It is claimed to represent high efficiency and to give a uniform and most pleasant heat. The heater itself is made up of but few parts and is yet durable and inexpensive. It is composed of castings which form the connecting heads and circulating flue or water chambers, around which are placed the electric coils of high resistance. The latter are perfectly insulated by lava and specially prepared cement. The heads of the casting are made to receive iron plates, which are held in place by screws, and form a casting around the cells. The heat is controlled by a switch made to use in connection with the heater, and with its use the current is reduced without the aid of any external resistance, thereby keeping all the heat within the heating apparatus. In the application of this system the electric water-heater is placed in the cellar in place of the regular coal burner, the rest of the plant being the same as with the ordinary water-heating installation. The controlling switch may be located in any part of the house that may be desired, from which point the temperature of the entire structure may be regulated. The convenience of such a system will be apparent to anyone. There is no handling of fuel or ashes, and there is also the advantage of instant adjustment. The principle has been applied to the radiator with an expansion tank and pig and circulating pipes, thus forming a portable electric-heating system with a flexible cord connection with the electric light.—*Engineering Review.*

The P. R. R. Not to Build Engines.

The Pennsylvania Railroad has changed its plan for building its locomotives next year. The Baldwin Locomotive Works has received what is probably the largest order for engines ever given to a single concern by a railroad company. The order is for 250 high-class freight locomotives, the total cost of which will be about $3,250,000. All these engines are to be delivered within the first six months of 1903.—*The Iron Age.*

New Methods in Coal Mines—Powder Blasts Discontinued and Water Power Substituted.

An ingenious invention which has been successfully experimented with in several collieries in Lancashire, England, bids fair to add greatly to the simplification of coal mining. Under existing conditions the coal after it has been undercut, is "brought down" by an explosion of gunpowder. The new device brings down the coal by water power exercised through a hydraulic cartridge and obviates the wasteful shattering of the fuel.

Made of steel, the cartridge is twenty inches in length. Along its sides are orifices, each of which admits of a pressure of three tons per square inch, the total pressure being over sixty tons. When inserted into the hole bored into the coal to be operated upon, the cartridge is connected with a small hand pump. In a few minutes after the apparatus has been at work the coal breaks up and comes down in great blocks. There are no clouds of dust such as are caused by the gun-powder method, and the entire operation is carried out without the slightest danger to the workers. About one and a half pints of water are used in the operation, and as the liquid returns to a tank it can be repeatedly used.

Although the initial expenditure is greater the cartridge method is much more economical than the system now in vogue. It reduces the cost of labor, prevents waste, and secures rounder coal. One colliery proprietor who has adopted the invention for use in three mines computes that each cartridge saves $75 per week.—*New York Times.*

Forestry in the Hawaiian Islands.

A press bulletin of the Bureau of Forestry says that the Hawaiian Islands are in need of foresters, and eager to secure them. Governor Dole, who sees the immediate necessity of caring for the island forests, has applied to the Bureau of Forestry for expert men, to be sent as soon as they can be spared. The mountains are overrun by both wild and tame cattle, which graze and trample on young trees and destroy the ferns that protect the ground. When this ground cover is removed the soil rapidly loses its moisture and the forest dies. Great areas of Hawaiian forest have been utterly destroyed in this way. The disappearance of so much forest on the island of Hawaii has caused remarkable changes in the flow of the streams. There are freshets and floods now, followed by long, dry seasons when the water does not run. Since much of the sugar crop depends entirely on irrigation, and since the irrigating ditches must draw their water from the mountain streams, the damage done the forest affects the prosperity of the whole island. Forestry in Hawaii has never been attempted by the government, and the field will be an entirely new one. It will have the support and confidence of the people, who are eager for relief from the harm done them by the failure of their irrigating ditches to supply the sugar crops.

On the island of Molokai—the leper island—still more remarkable conditions prevail in the forest. There the timber is grazed and trampled to death not by wild cattle alone but by herds of red deer, descended from a few that were imported from England to stock parks. The deer imported propagated beyond the calculations of the inhabitants, escaped to the woods, and, since there are no animals to prey upon them, have increased to many thousands. The American forester who undertakes the care of the timber of Molokai will have a problem entirely novel to his experience—the protection of forests from wild animals.—*Science.*

With Our Foreign Consuls

Electric Lighting for Saxon Railroad Trains.—Richard Guenther, Consul General at Frankfort-on-the-Main, says: German papers state that the management of the Royal Saxon Railroads is adopting electric lighting for trains, and has just given an order for an electric light outfit to the Accumulator works of the firm "Pollak," at Frankfort-on-the-Main, for a conductor's coach and seven passenger coaches of the first, second, and third classes.

Decrease of Gold Output in the Klondike.—Consul Brush writes from Niagara Falls that the report of G. H. Hees, who was recently sent to Dawson by the Canadian Manufacturers' Association to make a thorough examination into the business prospects of the Yukon territory, states that the total yield of gold last year in the Klondike was $24,000,000. The production of the coming year, according to the Government estimates, will not exceed $14,000,000, a falling off of nearly one-half.

German Electrical Manufacturers.—Frank H. Mason, Consul-General, Berlin, sends the following report:

What is called in headlines by the German press "The catastrophe in the Schuckert Electrical Company" has during the past week recalled public attention sharply to the conditions under which some of the great electrical corporations of Germany were promoted, and the embarrassments which some of the methods employed have more or less inevitably entailed. The event alluded to was a meeting on the 26th instant of the stockholders of the Schuckert Electrical Company at Nuremberg, at which the managers announced that, through depreciation of plant and material, insolvent accounts, and necessary appropriations for a reserve fund to meet further depreciations, the company had suffered losses aggregating 15,500,000 marks, or something more than $3,500,000. As the Schuckert Company is one of the foremost corporations of its class in Europe, with an up-to-date plant and all the accompaniments of a large business, some surprises have been expressed that its affairs should make such a bad showing for its shareholders. The explanation leads back to the fact, now well known here, that the sudden rise of some of the German electrical companies into corporations of vast resources and activities was, in some cases at least, the result of skillful and artificial creation of markets for products, rather than the supply of an actual and legitimate demand. Concisely stated, some of these companies bought their orders for electrical installations and materials by financial operations that left them shareholders in many enterprises which have since proven less promptly lucrative than had been hoped, and have thus drawn more or less heavily upon the capital of the parent companies. To understand how all this came about, it should be remembered that German progress in electrical science was for a long time far in advance of popular appreciation of its advantages. The companies organized and equipped for the manufacture of lighting and power plants could not wait for the slow growth of public demand for such improvements, and they therefore undertook to finance and erect such installations themselves, confident that, once established and in use, the public would not fail to appreciate them and invest in their securities. This went very well for a time. It created a large and ready market for electrical machinery and materials at high prices, and supplied hesitating municipalities with electric tramways and lighting plants which their citizens greatly enjoyed, but which were built and for a time managed by the electrical manufacturing companies at their own expense. Inevitably, this process of consuming their own capital necessitated heavy loans and frequent increases in the stock of such corporations, together with a steady expansion of their manufacturing capacity. Some of the companies, especially the Schuckert corporation, made enormous investments in electric installations of the manufacture of calcium carbide, putting in the machinery at their own prices but receiving for it little or nothing except stock in the carbide plants. Thus the supply of acetylene material was soon far beyond all legitimate requirements, prices collapsed, and the carbide industry suffered a serious and permanent reverse.

Another heavy blow for some of the German electrical manufacturing companies has been the failure of the storage-battery traction system for tramways, which is now conceded to be practically hopeless. When electric traction was introduced into this country, municipal governments were timid and hesitating. They objected to the overhead conductor because it was considered unsightly and dangerous, and in order to obtain any franchise at all the tramway companies and the electrical manufacturers who were behind them had to agree to furnish cars that would dispense with a visible trolley. This meant either the underground-conduit system—which is so expensive to construct as to be justified only by an enormous traffic—or a reliance upon storage batteries, and the companies generally had recourse to the latter. The extent to which this has been done may be inferred from the fact that one company in Hanover has at present 274 accumulator cars in service. There, as at Halle, Hagen, and many other places they have been found so heavy, costly, and subject to explosions as to be unremunerative. At Berlin, where many hundreds of them have been in service, all are to be abandoned and recourse had to underground conductors for centrally located streets and overhead wires for the less crowded and suburban sections.

The net result of all these conditions was that some of the electrical manufacturing companies of Germany which had gone on organizing and supplying power, lighting, carbide, and other plants, not only at home but in Russia, Scandinavia, Austria-Hungary, and other European countries, were caught with all sail spread by the turning tide and adverse gale that set in during the summer of 1900. In the stormy weather that ensued, most industrial stocks declined sharply, the investing public became alarmed and timid, the failures of the Leipziger and other banks followed a few months later, and led on to the situation of which the meeting of last week at Nuremberg has been the ultimate result.

The encouraging features of the present conditions are the fact that the credit of several of the oldest and strongest of the electrical companies remains unshaken, the general feeling that the bottom has been reached, that the obligations entailed by a system of forced development have been mostly liquidated.

Massachusetts Franchise Laws and Conditions

When the promoters of a corporation desire to secure a charter in Massachusetts they are required to prepare a certificate showing the amount of capital stock, the names of the incorporators and the organization of the company. Having done that, before the corporation is entitled to do business in the State, they have to prove to the State Commissioner of Corporations that the capital stock has actually been paid in, either in cash or by property which, when given a fair and reasonable value, will satsify the Commissioner that the conditions of the law have been observed. Should the incorporators fail to do this they render themselves liable as partners in a firm.

The Railroad Commissioners of Massachusetts have issued the following statement of the conditions under which street railway locations will be approved:

In acting under the provisions of Chapter 399 of the Acts of 1902, the Board of Railroad Commissioners will make the following requirements a condition of approval of locations granted to street railway companies:

Every location must be accompanied by a plan showing the place in the highway to be occupied by the railway (including turnouts) and by trolley poles. The plan should also give grades and street lines, and such other information as may be practicable.

The following conditions should be attached to grants of location:

1. T-rails to be not less than 60 lbs. per yard in weight.

2. Ties to be of suitable timber, not less than 7 ft. in length, 6 ins. wide, with 6-in. face, and spaced not more than 2 ft. on centers.

3. The roadbed to be constructed with at least 18 ins. of suitable ballast below base of rails and properly drained.

4. When practicable the railway to be continuously either on one side or in the center of the driveway, and separated from the driveway, with a clearance from any obstruction of at least 4½ ft. on tangents and more in proportion on curves.

5. The roadway independent of the railway to be of sufficient width to properly accommodate other travel.

6. Crossings of railway from one side to the other of the highway to be avoided; but if permitted, only with provision for proper regulation respecting the operation of cars and restriction of speed.

These requirements are not to exclude other suitable conditions and restrictio s by local boards or by this board, as the circumstances in particular cases may require.

Trade Notes.

The Phoenix Glass Company has removed its Chicago office to 206 Wabash avenue, at the southeast corner of Adams street. Mr. E. H. Fox is the Western agent.

The United States Coal Company is about to equip its soft coal mines at Dillonvale, Jefferson County, Ohio, with electrical machinery, and has purchased from the Westinghouse Electric and Manufacturing Co. two 150-kilowatt, 530-volt, direct-current generators and two 10-ton electric mining locomotives.

The C. W. Hunt Company received a gold medal, the highest award of merit at the Dusseldorf Exhibition, which has just closed, for its exhibit of the "Hunt" Conveyor.

The Metropolitan Switch Board Company, through President T. J. Murphy, says that the report widely published to the effect that this company was controlled and operated by the American Union Electric Company, which is in financial difficulties, is not true.

Sargent, Conant & Co., of Boston, Mass., have purchased the construction business of the Hawks Electric Co. of that city, together with the good will, stock and tools, and will complete its outstanding contracts.

The Alabama Steel & Wire Co., which has been seeking a location for a large furnace and steel plant to supplement its wire plant at Ensley, announces that it has settled on Gadsden, Ala.

The Stanley Electric Manufacturing Company has gained a decision before Judge Lascombe, of the United States Circuit Court, to the effect that its "AO" and "G" transformers do not infringe the Stanley patent No. 469,809. The decision was given in a suit brought by the Westinghouse Electric Manufacturing Company against the Orange County Gas and Electric Company.

Street railway companies, electric lighting companies and gas companies which desire their reports to appear in the Financial Bureau of THE ELECTRICAL AGE are requested to forward the information so that it may reach us by the 20th of each month. Monthly reports are requested showing gross receipts and when possible operating expenses. Companies are also requested to furnish the highest and lowest prices for which their stock has sold in the market for the previous month.

Street Railway and Other Statements

	Gross Earnings.		Net Earnings.	
Companies. Date.	1902.	1901.	1902.	1901.
Albany & Hudson Ry. & P.				
July 1 to Sept. 30	61,782	59,588	26,227	17,677
Athens Electric Ry.............Oct.	4,756	4,038	3,363	2,797
Jan. 1 to Oct. 31.............	38,091	31,781	23,976	19,217
Bennington & Hoosick Val.				
July 1 to Sept. 30	11,919	12,947	5,069	5,822
Binghamton Railway.......Sept. qtr.	64,865	61,882	30,883	30,858
Brooklyn Heights R. R.....Sept. qtr.	3,216,894	3,053,801	1,455,577	1,122,804
Catskill Electric Ry........Sept. qtr.	3,728	3,865	1,286	1,355
Central Crosstown, N. Y....Sept. qtr.	98,342	118,567	31,334	36,703
Cincin., Dayton & Tol..........Oct.	41,747	......	19,099	......
June 1 to Oct. 31............	226,249	......	112,395	......
Cleveland, Elyria & West.......Oct.	28,242	22,735	12,212	10,124
Jan 1 to Oct. 31.............	245,177	211,760	109,749	95,711
Coney Island & Brooklyn...Sept. qtr.	489,066	525,551	227,519	243,442
Coney Island & G. End.				
July 1 to Sept. 30	25,037	24,752	2,718	1,862
Dry Dock, E. B, & B., N. Y. .Sept. qtr.	150,106	153,742	39,468	40,080
East Ohio Traction..............Oct.	17,366	14,645	7,224	6,963
Elgin, Aurora & Southern......Oct.	33,648	28,577	12,607	11,613
June 1 to Oct. 31............	189,307	169,109	84,519	84,085
Elmira, W. L. & Ry.........Sept. qtr.	$53,563	47,612	17,220	12,176
Forty-second St., M. & St. N. Ave.				
Sept. qtr.	200,136	189,230	91,942	82,335
Galveston City Ry.............Sept.	17,486	11,580	8,240	3,834
Jan. 1 to Sept. 30............	127,700	92,078	39,125	28,003
Hamburg, N. Y., Ry.				
July 1 to Sept. 30	19,663	2,852	8,191	951

Companies.	Date.	Gross Earnings. 1902.	Gross Earnings. 1901.	Net Earnings. 1902.	Net Earnings. 1901.
Harrisburgh Traction	Oct.	37,447	32,163	15,092	9,592
Jan. 1 to Oct. 31		382,573	325,145	166,527	128,818
Houston Electric Co.	Sept.	32,282	27,537	14,478	12,707
Hudson Valley Ry. July 1 to Sept. 30		103,841	107,743	20,658	44,843
Manhattan Railway	Sept. qtr.	2,495,112	2,093,277	1,156,171	781,147
Mexican Telephone	Sept.	20,907	18,119	9,548	8,168
For seven months		139,937	122,659	63,131	54,125
Minneapolis Gen. Electric	Sept.	41,625	35,998	18,760	20,280
Olean Street Ry.	July 1 to Sept. 30	18,401	16,372	10,266	9,485
Jan. 1 to Sept. 30		43,927	40,124	20,635	20,111
Richmond Light & R. R., N. Y. July 1 to Sept. 1		20,085	......	8,903	......
Rochester Railway	Oct.	91,552	79,972	45,107	34,821
Rochester Street Railway	Sept. qtr.	338,108	259,073	162,740	115,583
Rochester & Suburban	July 1 to Sept. 30	23,358	23,790	10,290	11,901
Savannah Electric Co.	Sept.	42,882	38,402	20,080	16,538
Schenectady Ry.	July 1 to Sept. 30	123,998	47,492	47,697	23,605
Seattle Electric	Sept.	163,685	127,425	55,796	43,795
Southfield Beach, N. Y.	Sept. qtr.	3,209	1,938	1,501	338
Southern Boulevard	Sept. qtr.	17,533	18,272	5,734	7,162
Staten Island Electric Ry.	July to Sept. 1	52,064	79,908	19,297	37,805
Staten Island Midland	Sept. qtr.	58,681	56,157	33,557	24,345
St. Louis Transit Co.	Oct.	603,402	531,509	......	......
Syracuse Rapid Transit	July to Sept 30	182,741	166,796	81,517	75,271
Tarrytown-W. Plains & M'k.	Sept. qtr.	23,962	22,891	7,162	6,075
Terre Haute Electric	Sept.	32,716	32,156	12,773	9,377
Third Ave., N. Y.	Sept. qtr.	595,973	599,406	293,818	275,768
Thirty-fourth St., N. Y.	Sept. qtr.	121,765	117,765	47,146	44,011
Toledo Railways & Light	Oct.	124,487	114,666	64,004	60,050
Twenty-eighth and 29th St., N. Y.	Sept. qtr.	48,627	44,808	21,200	21,148
Twin City Rapid Tr.	Sept.	339,669	308,393	209,058	185,262
Jan. 1 to Sept. 30		2,667,095	2,340,165	1,475,775	1,271,318
2d week in Nov		71,126	61,093		
Jan. 1 to Nov. 14		3,094,850	2,713,159		
Union Railway, N. Y.	Sept. qtr.	298,874	271,961	100,379	109,170
United Traction, Albany	Oct.	133,305	......	19,715	......
Jan. 1 to Oct. 31		1,243,794	......	365,615	......

Companies.	Date.	Gross Earnings. 1902.	1901.	Net Earnings. 1902.	1901.
United States Telephone Co.	6 months to Aug. 31	144,595	......	64,401	......
Westchester Electric	July 1 to Sept. 30	75,687	72,810	13,264	3,726
Westchester Electric	Sept. qtr.	75,686	72,809	9,537	13,263
Yonkers Electric Ry	Sept. qtr.	74,195	63,088	20,320	20,987
Youngstown-Sharon Ry. & L.	Sept.	39,618	......	17,217	......
	Jan. 1 to Sept. 30	312,572	......	139,141	......

Stated Reports of Companies

Manhattan Railway Co.

OPERATIONS FOR YEARS ENDING SEPT. 30, 1902 AND 1901.

Year ending September 30.	1902.	1901.	Increase.	Decrease.
Earnings from operation	$11,067,746.33	$9,620,563.98	$1,447,182.35	
Operating expenses	5,545,395.2	5,328.649.04	216,746.20	
Net earnings	$5,522,351.09	$4,291,914.94	$1,230,436.15	
Other income	515,800.00	835,308.32		$319,508.32
Gross income	$6,038,151.09	$5,127,223.26	$910,927.83	
Interest on bonds	1,809.680.92	1,809,680.92		
Taxes	902,408.14	873,451.23	28,956.91	
Total interest and taxes	$2,712,089.06	$2,683,132.15	$28,956.91	
Net income	3,326,062.03	2,444,091.11	881,970.92	
Dividends, 4 per cent. on $48,000,000.	1,920,000.00	1,920,000.00		
Surplus for the year	1,406,062.03	524,091.11	881,970.92	
Surplus balance, profit and loss, September 30, 1900		4,442,265.41		
Surplus balance, profit and loss, September 30, 1901	4,966,356.52			
Surplus balance, profit and loss acct.	$6,372,418.55	$4,966,356.52	$1,406,062.03	
Operating per cent. (incl. all taxes)	50.10	55.38		5.28
Operating per cent. (excl. all taxes)	58.25	64.46		6.21
Passengers carried	223,427,283	194,152,316	29,274,967	

BALANCE SHEET, SEPT. 30, 1902.

Assets—		Liabilities—	
Cost of road and equipment	$80,082,272	Consolidated capital stock	$47,999,700
Cost of leases	14,014,000	Subscriptions to increased capital.	300
Other permanent investments: real estate	3,237,448	Funded debt (including $4,000 N. Y. Electric 1st mortgage 7's called for redemption)	39,545,000
Central Trust Co. of New York, trustee, etc.	4,593	Taxes in litigation	3,336,440
Supplies on hand	222,756	Interest due and accrued	186,414
Due by agents	906	Sundries	292,362
Due by others	7,871	Dividends unpaid	12,358
Open accounts	41,243	Coupons due, not presented	60
Cash on hand	270,743	Due for wages	122,221
Loaned on collateral	1,122,250	Due for supplies and taxes	1,049,609
Prepaid insurance	13,926	Open accounts	86,545
Sundries	27,454	Profit and loss, surplus	6,372,418
		Convertible bond certificates	42,035
Total	$99,045,463	Total	$99,045,463

In the absence of President Gould, Vice-President Skitt read the following report:

The statement of operations for past year, showing an increase of over 29,000,000 in the number of passengers carried and a decrease in the operating ratio, is an encouraging indication that the results which were predicted when the stockholders decided to equip the system with electricity will be more than realized, particularly as only one-half of the line had been under full operation since September 15 last, and that the high cost of fuel has materially increased expenses. Since the last annual meeting substantial progress has been made with the new equipment. The Second and Third avenue lines have been completed, with 608 cars in operation. The Sixth and Eighth avenue lines, on which 80 cars are now running, should be finished not later than April 1, 1903. The electric apparatus, method of generating and transmitting power, and the equipment of cars, has proved highly satisfactory, having met our expectations, and generally exceeding them. Among other improvements the new extensions and station in Bronx Park, the stations and elevators at 110th street, new yard and shop facilities are being pushed as fast as material can be secured and another year should see their completion.

Third Avenue Railroad, N. Y.

BALANCE, ETC., SEPT. 30, 1902.

Assets.		Liabilities.	
Cost of road and equipment	$29,366,587	Capital stock	$15,995,800
Stocks and bonds of other companies	10,455,290	Funded debt	$40,000,000
Supplies on hand	83,261	Interest on funded debt, accrued,	412,500
Due by open accounts	12,035,720	Due on open accounts	650,385
Cash on hand	3,071,561	Taxes accrued	76,762
Prepaid insurance	11,968		
Bills receivable	214,309		
New construction to be distributed	1,143,387		
Profit and loss, deficiency	753,364		
Total	$57,135,447	Total	$57,135,447

Union Railway, New York.

BALANCE SHEET, SEPT. 30, 1902.

Assets.		Liabilities.	
Cost of road and equipment	$6,447,365	Capital stock	$2,000,000
Supplies on hand	225,245	Funded debt	2,000,000
Open accounts	1,836,039	Interest	6,660
Cash on hand	126,427	Open accounts	4,087,339
		Profit and loss surplus	531,071
Total	$8,635,077	Total	$8,635,077

42d St., Manhattanville & St. Nicholas Ave., N. Y.

BALANCE SHEET, SEPT. 30, 1902.

Assets.		Liabilities.	
Cost of road and equipment	$11,062,475	Capital stock common	$2,500,000
Stocks and bonds of other companies	1,500	Real estate mortgage	100,000
Construction cost express	10,589	Funded debt	2,700,000
Supplies on hand	10,500	Loans and bills payable	214,310
Due by agents on account of traffic	438	Interest on funded debt, due and accrued	6,000
Cash on hand	48,496	Other interest due and accrued	17,179
Open account	2,890	Taxes due and accrued	55,894
Prepaid insurance	2,374	Due for supplies	92,365
Profit and loss (deficiency)	473,159	Due companies and individuals	5,926,673
Total	$11,612,421	Total	$11,612,421

Sixth Avenue Railway, New York.

BALANCE SHEEET, SEPT. 30, 1902.

Assets—		Liabilities—	
Cost of road and equipment......	$2,373,822	Capital stock....................	$2,000,000
Stocks and bonds of other companies	4,800	Due companies and individuals...	18,734
Cash on hand..................	74,051	Profit and loss surplus...........	433,939
Total........................	$2,452,673	Total........................	$2,452,673

Coney Island & Brooklyn.

BALANCE SHEET, SEPT. 30, 1902.

Assets.		Liabilities.	
Cost of road and equipment......	$3,409,751	Capital stock common..........	$2,000,000
Stocks and bonds of other companies......................	$1,000,000	Funded debt...................	2,000,000
Other permanent investments....	57,683	Loans and bills payable.........	95,628
Supplies on hand................	57,589	Interest on funded debt, due and accrued......................	46,750
Accrued interest................	46,750	Due for wages..................	3,034
Due by open accounts..........	64,586	Due for open accounts..........	63,603
Cash on hand..................	114,277	Rentals due and accrued.........	146,209
Prepaid insurance..............	15,347	Due for supplies...............	43,031
		Accrued taxes..................	76,948
		Profit and loss, surplus.........	290,780
Total........................	$4,765,983	Total........................	$4,765,983

Hudson Valley Railway.

BALANCE SHEET, SEPT. 30, 1902.

Assets.		Liabilities.	
Cost of road and equipment......	$5,640,544	Capital stock, com...............	$3,000,000
Stocks and bonds................	960	Funded debt....................	2,985,500
Accrued interest cash reserve.....	51,706	Loans and bills payable..........	895,062
Other permanent investments.....	106,136	Interest due and accrued on funded debt........................	24,023
Supplies on hand................	26,363	Interest due and accrued (other than debt).....................	13,022
Treasury stock..................	277,600	Allowances for taxes............	580
Consolidated first mortgage bonds	844,000	Surplus account.................	61,600
Open accounts..................	38,248	Open accounts..................	67,484
Cash on hand...................	31,640	Allowances for insurance.........	75
Prepaid taxes...................	2,631		
Prepaid insurance...............	3,389		
Cash reserve accident fund.......	4,849		
Profit and loss deficiency.........	13,867		
Damage suspense account........	5,410		
Total........................	$7,047,346	Total........................	$7,047,346

Syracuse Rapid Transit.

BALANCE SHEET, SEPT. 30, 1902.

Assets.		Liabilities.	
Cost of road and equipment......	$7,782,464	Capital stock com................	$2,750,000
Stocks and bonds................	34,916	Capital stock pref................	1,250,000
Other permanent investments.....	82,869	Funded debt....................	3,250,000
Paying assessments..............	66,213	Second mortgage bonds..........	586,000
Supplies on hand................	16,215	Loans and bills payable..........	25,000
Open accounts..................	15,782	Interest due and accrued..........	31,915
Cash on hand...................	26,089	Tax reserve.....................	22,721
Injuries and damages reserve.....	26,319	Open accounts..................	14,094
Prepaid insurance...............	1,018	Profit and loss surplus...........	125,934
Construction Valley Theatre......	3,775		
Total........................	$8,055,664	Total........................	$8,055,664

Montreal Street Railway.

REPORT YEAR ENDING SEPT. 30.

Assets—	1902.	1901.
Construction, etc.	$3,539,823	$3,239,814
Equipment, etc.	3,063,068	2,839,764
Real estate and buildings	1,616,925	1,588,739
Mon. P. & I. Ry. stock and bonds	1,159,297	1,105,485
Stores	76,086	76,620
Accounts receivable	57,277	61,789
Cash in bank and on hand	95,382	325,958
Cash on deposit with city of Montreal	25,000	25,000
Cash fire ins. fund	100,000	......
M. P. & I. Ry. Co. cur. account	122,501	......
Balance new stock call unpaid	.....	57,194
Total assets	$9,855,360	$9,320,383

Liabilities—		
Stock paid up	$6,000,000	$6,000,000
Bonds	2,473,333	973,333
Mortgages	6,035	6,035
Bank of Mon. loan	......	1,100,000
Accts. and wages	100,808	103,916
Int. on bonds	33,275	5,150
Tax on earnings	101,748	93,006
Employes' securities	8,490	7,627
Unclaimed dividends	1,957	1,957
Unredeemed tickets	20,401	18,338
Suspense accounts	62,490	63,608
Mon. P. & I. Ry.	......	9,267
Div. Nov. 1st	150,000	139,200
Contingent account	183,766	191,056
Fire insurance fund	204,222	......
Surplus	508,836	607,870
Total liabilities	$9,855,360	$9,320,363

	1901-2.	1900-01.
Passengers carried	49,947,467	46,741,660
Transfers	15,077,511	14,215,784
Gross receipts	$2,046,209	$1,900,680
Operating expenses	1,135,176	1,105,267
P. c. of operating expenses to car earnings	(56.39)	(58.52)
Net earnings	$911,033	$795,413
Fixed charges	$210,066	$146,162
Dividends	600,000	551,700
Contingent fund	......	50,000
Fire insurance fund	100,000	......
Total	$910,066	$747,862
Surplus	$967	$47,551

President L. J. Forget says: The earnings continue to increase in a satisfactory manner, and the ratio of operating expenses to gross earnings shows a substantial decrease. Owing to the heavy expenditure required to place the Park & Island System in thorough repair, its total revenue has been absorbed and no interest has been received by us on our holdings of its stock and bonds. During the year $1,500,000 of 4 1-2 p. c. debenture bonds were sold at par to shareholders to pay off the loan incurred by the purchase of the Montreal Park & Island Railway Co. and other purposes of that railway. Owing to delay in the delivery of electrical machinery, the whole of the water power contracted for will not be in use till the 1st of November.

Consumers' Gas Co., of Toronto.

The annual statement shows the receipts for the year, from gas sales to be $771,982.40; from coke, $50,868.31; tar, $8,445.20; ammoniacal liquor, $10,282.03; office and house rents, $1,847.21; interest on debentures, $4,285.13, making a total of $847,730.28. The expenses amounted to $509,800.39; dividends, $175,000; interest, $9,672.92; the total disbursements being $694,473.31, leaving a balance of $153,246.97. Deducting the cost of repairs and renewals for the year, $117,196.36, the net profits amounted to $36,050.61.

Manager Pearson referred to the recent large increase in the consumption of gas, owing to the large number of people using gas for fuel on account of the scarcity of anthracite coal, this increase amounting for the month of October to about 37 per cent. over the corresponding period of last year, and which increase the company had been able to meet having recently put in a number of additional retort benches and their other benches being in first-class condition.

Financial Notes

Consolidated Telephone Co., of Buffalo, is arranging details for a bond issue.

Bell Telephone Co., of Buffalo, will increase its capital stock from $5,000,000 to $10,000,000.

Stock Quotation Telegraph Co. has called a block of 1888 bonds, to be redeemed next February.

Bay Cities Water Co., of California, will issue $10,000,000 bonds, it being capitalized for that amount.

Syracuse Rapid Transit directors have decided to build to Oswego, the estimated cost being $1,000,000.

Westborough & Hopkinton Street Ry., of Massachusetts, has issued $40,000 5 per cent. bonds for funding the floating debt.

American Telegraph & Telephone Co. had outstanding October 20 3,042,697 instruments, against 2,406,979 the same date in 1901.

North Jersey Street Ry. has had its Newark property assessment reduced from $2,075,000 to $1,240,979 by decision of the Supreme Court.

People's Gas & Electric Co., of Xenia, O., offer through T. B. Potter, at par and interest, $135,000 first mortgage 5 per cent. $1,000 gold bonds.

Lake Street Elevated Ry., of Chicago, sold last month a block of $130,000 5 per cent. car trusts to the Illinois Trust and Savings Bank and Blair & Co.

People's Tramway Co., of Killingly, Conn., has called for redemption all its $600,000 5 per cent. mortgage bonds dated October 2, 1899, at 105 and interest.

High Electric Speed experiments on the Fossen-Berlin military railway have shown that 75 miles an hour can be maintained without serious wear of motors or roadbed.

Consolidated Gas Co., of Baltimore, has secured A. S. Miller for general manager, and this is regarded as a concession to the opposition. Mr. Miller ranks high as an engineer.

Hudson River Electric Co., through E. H. Gay & Co., offer at 101 and interest $560,000 of the first mortgage 30-year gold 5 per cent. bonds, of which $1,500,000 are outstanding.

An Interurban Electric Line is being built from Quincy, Ill., to Bearstown, and from Quincy to Niota. Bracey, Howard & Co., of Chicago, have the contract, which amounts to $3,000,000.

Sterling Gas & Electric Light Co., of Illinois has executed a mortgage to the Federal Trust and Savings Bank, of Chicago, to secure $250,000 first mortgage 5 per cent. bonds, due June 1, 1927.

Citizens' Gas Light & Coke Co., of Finley, O. are offering, through MacDonald, McCoy & Co., at 101 and interest, $200,000 first mortgage $500 gold 5's, due August 1, 1920, but subject to call until August 1, 1910, at 100 and interest.

Metropolitan West Side Elevated Ry. of Chicago will build the proposed down-town terminal at Jackson boulevard and Fifth avenue, and the necessary space and the cost, $1,300,000, will be met from the proceeds of extensions 4's of 1901.

Virginia Passenger & Power Co., of Richmond, took formal possession of the Richmond & Petersburg Electric line November 14. It connects the city with Manchester and Petersburg and is the longest electric line in the State.

A Berlin Subway Electric railroad is planned, the details now being under consideration by the Municipal Council. It is designed to extend seven miles through the city to Hallisches Gate and Schoenberg, and the estimated cost is $14,000,000.

Stone & Webster, of Boston, have incorporated the Metropolitan Street Railway, of Dallas, Tex., with $4,500,000 capital, to operate the Dallas Electric Corporation, which owns the stock and bonds of all the railway and electric lighting plants of the city.

Boston Elevated shares to the number of 1220 were offered at auction by R. L. Day & Co.

in Boston last month, and bought in one lot by Estabrook & Co. for 155⅛. This block represents what the stockholders did not take of the 33,000 shares at 155.

Interborough Rapid Transit Co. is now at work on the Brooklyn tunnels, contracts having been awarded by the Rapid Transit Subway Construction Company. The Manhattan excavation was begun November 8th, at State and Pearl streets, opposite Battery Park.

Helena Light & Traction Co., of Montana, has executed a mortgage to the Federal Trust and Savings Bank, of Chicago, to secure $500,000 6 per cent. $1,000 gold bonds, due July 1, 1922, but subject to call in any amounts after July 1, 1904, at 105 and interest.

Edison Electric Co., of Los Angeles, California, is offering, through N. W. Harris & Co., E. H. Rollins & Sons and Perry, Coffin & Barr, $1,000,000 first and refunding mortgage 5 per cent. gold bonds at 102 and interest. The bonds are due September 1, 1922, but after September 1, 1907, can be redeemed at 110 and interest.

Oklahoma Gas & Electric Co., of Oklahoma City, authorized an issue of $300,000 5 per cent, $1,000 first mortgage sinking fund gold bonds, due March 1, 1922, but subjeect to call, in whole or part, on any interest day at 105 and interest. These bonds were ofered by Baker, Ayling & Co., of Boston, at 101 and interest.

Chicago Union Traction Co.'s finances have come in for a good deal of comment during the past month, and some of the statements are misleading. The company has a floating debt, and so had the subsidiary companies when they were taken over. The notes of the West and North Side companies, however, do not now exceed the floating indebtedness at the date of the leases.

Electric Storage Battery Co. has secured control of the Chloride Electrical Storage Syndicate, Ltd., of England. This company has been in existence several years, and only recently reached a dividend-paying basis. The Storage Battery Co. and the Stanley Electric Co. propose to enter the field all over the world in competition with the Westinghouse, Thomson-Houston and General Electric companies.

Western Union Telegraph Co. got a favorable decision last month in the United States Circuit Court of Appeals at St. Paul, the case being that of the Great Northern Railway Co., brought 10 years ago to oust the telegraph company from 825 miles of lines, worth $2,500,000. The Western Union has taken over the lines of the Alabama Midland Telegraph Co. The Western Union has suits pending against the Pennsylvania.

Staten Island Electric Lines, now merged and controlled by H. H. Rogers and associates, are to be extended and improved by an expenditure of $1,500,000, with new terminals at West New Brighton and Tompkinsville connecting with a fast ferry service by new double-deck boats to Whitehall street, Manhattan. Application has been made to the Dock Commissioners for a 25-year franchise. Engineers are now working on details.

Erie to Buffalo by trolley is the plan being worked out by J. H. Latimer and F. Halcomb, of Cleveland, their negotiations the past month having to do with controlling the Lake Shore Traction Company. They mean to build from Dunkirk to Buffalo under the charter of the Dunkirk & Point Gratriot Company, and connect with that road in Sheridan from Westfield under the charter of the Lake Shore Traction Company.

Denver Gas & Electric Co. security holders, who are looking for more satisfactory results, have appointed a protective committee, composed of Ashbel P. Fitch, Warren W. Foster, Anton G. Hodenpyle, Philip Lehman, Claude Meeker, E. W. Rollins, Dennis Sullivan, George P. Sheldon, Junius M. Stevens and W. B. Mahony. They ask that deposits be made with the Trust Company of America, the Michigan Trust Company and the Ohio Trust Company.

Michigan Telephone Co. appears to have new internal troubles, and a protective committee has been appointed, of which Samuel T. Douglas, 85 Moffat Building, Detroit, is chairman. This committee represents about $200,000 stock. Since the beginning of the year the company has been controlled by the American Telephone & Telegraph Co., and a suit to foreclose the mortgage is pending. Expectations are that the case will be reached for trial in February next.

Texas Oil Companies will probably make use of a part of the United States Geological Survey report issued last month, notably that section estimating the average daily flow of 162 wells operating at Spindletop at 10,000 to 12,000 barrels, and the statement that the total production of crude oil in the Beaumont-Spindletop field, including oil wasted, local consumption and oil held in tanks or shipped from the beginning of 1901 to May 31, 1902, is estimated at 11,688,000 barrels.

North Shore Gas Co., of Illinois, has authorized an issue of $700,000 first mortgage 5 per cent. $1,000 gold bonds, due January 1, 1931, and subject to call at 105 after January 1, 1906. The Thompson, Tenney & Crawford Co. offered $150,000 of the outstanding $459,000 during the month. The gas company has long franchises in Chicago suburbs, where 1,700 meters are installed and 1,200 gas stoves in use. It is believed this company will be absorbed by the People's Gas & Coke Co., of Chicago.

International Telephone Co., of America, with headquarters at 719 Thirteenth street, N. W., Washington, D. C., has a capital of $200,-

000,000, of which $50,000,000 is 6 per cent. cumulative preferred, the present issues being $120,000,000 common besides the preferred. The company recently executed to the Trust Company of the Republic a mortgage securing $100,000,000 5 per cent. gold bonds, due July 1, 1952, without option of redemption earlier. The immediate issue will be $20,000,000.

Copper Statistics compiled by John Stanton show that the production by United States reporting mines for October were 584 tons less than that for September. It amounted to 24,152 tons. The output of the outside sources equaled that of the previous month, namely, 2,100 tons. Foreign mines produced 9,707 tons, as against 9,156 tons in September. The exports decreased 608 tons, totaling 12,515 tons. Foreign copper production in October was 9,707 tons as compared with 8,960 for the same month last year.

St. Joseph Ry., Light, Heat & Power Co., of Missouri, the management of which is under the direct supervision of E. W. Clark & Co., of Philadelphia, have sold to Redmond, Kerr & Co. $3,500,000 first mortgage 5 per cent. 35-year $1,000 gold bonds, due November 1, 1937, without option of earlier redemption. The mortgage is limited to $5,000,000, the remaining bonds being issuable only for future betterments, additions, etc., after the completion of the same at 85 per cent. of the actual cost thereof. Net earnings of the company in 1901 were $222,439; in 1902, $250,725.

General Electric Company, of Tacoma, represented by Stone & Webster, of Boston, has obtained control of all the street railway systems of Tacoma, Seattle and Everett. They have just let contracts for the development of 25,000 horse power by diverting the flow of Puyallup river inter-canal ten miles long, giving a fall of 800 feet. This power will operate the Tacoma and Seattle street railways. They are also negotiating for the purchase of the Bellingham Bay Electric Light Company, together with a power plant which the company is installing at the falls of the Nooksack River.

Interurban Ry. & Terminal Co., of Cincinnati, was formed last month by consolidating the Cincinnati & Eastern, the Suburban Traction and the Rapid Railway, with an authorized capital stock of $2,500,000. A bond issue will be made for the same amount. The new Interurban Terminal Company will be taken over. It cost $150,000 in stock to make the merger. An equal amount, with $55,250 in bonds, are set aside for new terminals. Constituent company bond and shareholders got bond for bond and share for share of their holdings and sufficient new bonds to pay accrued interest on the present bonds.

An Important Decision was handed down by Justice Dean, of the Pennsylvania Supreme Court, last month. It declares unconstitutional various acts of the Assembly permitting rival passenger railroads to use 2,500 feet of an existing road for a connection in Pittsburg. The decision is in the case of the Philadelphia, Morton & Swarthmore Street Railway against the Chester, Darby & Philadelphia Railway, the Union Railway, of Chester, and the Chester Traction Co. The result of the decision will be to give the Pittsburg Railway Co. an absolute monopoly of the down-town streets of Pittsburg, and give the Philadelphia Co. a practical traction monopoly in two cities.

Bell Telephone Company, of Buffalo, has voted to increase its capital stock from $5,000,000 to $10,000,000. Vice-President Carlton said: "The purpose of the increase is to enable the company to issue new stock from time to time as its necessities require. We are constantly requiring more capital to meet our increasing business. We are establishing new exchanges and new toll lines, and extending the service throughout every part of the seven counties within our jurisdiction. All this requires more capital. The increase voted in the capital stock will enable us to issue more stock. It is not proposed to issue $5,000,000 worth at one time. It will be issued in small quantities at intervals whenever the money is needed. We have over 900 people on our pay rolls and we need money."

Railways Company General passed last month from the Investment Company, of Philadelphia, to a syndicate of New York and Philadelphia capitalists, who propose to develop and extend the properties controlled. Railways Company General has a capital of $1,200,000, the par value of the shares being $10. The company was formed in 1899 by W. W. Gibbs and others in opposition to the American Railways Company. Control passed to a Philadelphia banking house, and eventually to the Investment Company of Philadelphia. The capital stock was reduced last year from $1,500,000 to $1,200,000 on the basis of a revolution of assets. The company owns the following stocks and bonds of electric corporations:

	Total issue.	Owned.
Elmira & Sen. L. Ry. (stk)..	$300,000	$153,000
Elmira & Seneca Lake 5s...	300,000	230,000
Lewisburg, M. & W. (stk)..	150,000	150,000
Lewisburg, M. & W. 5s.....	150,000	150,000
Michigan Traction (stk)....	500,000	330,000
Milton Elec. L. & P. (stk)..	27,750	27,750
Montoursville Elec. Lt. Co..	75,000	75,000
Montoursville El. St. Ry. 5s.	75,000	75,000
Montoursville Pas. Ry. (stk).	75,000	75,000
Newtown Elec. St. Ry. 5s...	300,000	200,000

City Inspector Shelton, of the light department of the city of Richmond, Va., has submitted to the Committee on Light of the City Council a table showing the annual receipts of the gas works since the year 1890. The figures are interesting because they show that the department is just beginning to recover from the cut in the price of gas made in 1892 and 1893, in which years there were cuts of 25 cents per 100 feet. In 1891 the receipts were $224,945.75, and the following year, with the price 25 cents less, when it was argued that the receipts of the department would be larger, they fell to $213,147.05. The next year the council ordered another cut of 25 cents, making the price of gas $1, the present rate, and the revenues from gas dropped again, this time falling to $180,853.43. The next year the hard times came on and the receipts fell to $146,717.22, more than $70,000 less than in 1891. In 1895 the receipts were larger, and they have been increasing year by year since. With two months yet in this year the department is only $42,572.91 behind the receipts for the last year. It is expected that the receipts will be in excess this year of 1901. Mr. Shelton's statement is as follows: 1890, $216,505.50; 1891, $224,045.75; 1892, $213,147.05; 1893, $180,853.43; 1894, $146,717.22; 1895, $163,387.78; 1896, $173,717.95; 1897, $188,925.07; 1898, $195,388.50; 1899, $204,544.11; 1900, $213,195.27; 1901, $221,682.63; 1902 (10 months), $172,299.73. Mr. Shelton's report as to small gas consumers is as follows: Meters showing less than $3 in a year, 292; cost to the city, $1,916.85; amount of gas consumed, $292.50; profit on gas consumed, $88.05; interest on cost of meter, per cent. in profit, 4.6 cents.

Incorporations and Franchises

Alabama.

MONTGOMERY—Electric Plant.—Merchants' Light & Power Co., will immediately build a light and power plant to cost about $100,000. No architect, engineer or builder has been engaged as yet. Charles G. Abercrombie is president.

OPELIKA—A syndicate is being organized by Frank D. Sweeten, of Philadelphia, Pa., to buy the Alabama Light and Power Company at Opelika, Ala., and also to build an electric line to Auburn, 7½ miles. The new company will be capitalized at $200,000. An option has been secured by the new company.

Arkansas.

LAKE VILLAGE—Electric and Ice Plants.—Thomas Neely, Frank Strong and James G. Yerger have received lighting franchise. They will organize a company to take over the franchise, erect electric-light plant, and to establish an ice factory.

Delaware.

WILMINGTON—The charter of the Delaware Suburban Railway Company, with a capital of $100,000, has been filed. The company proposes to construct a road connecting with that of the Wilmington City Railway's extension at Stanton. The road will extend from there to Chesapeake City, through Newark, Elkton and other towns.

Florida.

MIAMI—Electric-light Plant.—It is proposed to build an electric-light plant, and John B. Reilly is said to be interested.

PENSACOLA—Telephone Conduits.—Southern Bell Telephone & Telegraph Co., will expend about $20,000 to construct underground conduits for its wires and otherwise make improvements to telephone system.

Georgia.

MACON—The consolidation of the Macon Consolidated Street Railroad Co. and the Macon Electric Light & Railway Co. has just been consummated. The deal involves about $1,000,000. The directors have authorized an expenditure of $164,000 for new equipment.

GRIFFIN—Water-works.—City contemplates improving its water-works, and is reported to have engaged Nisbet Wingfield of Augusta, Ga., to investigate plans, Address "The Mayor."

Indiana.

INDIANAPOLIS—President McCullough of the Union Traction Co., a Widener-Elkins property, says that the Indianapolis & Shelbyville line will be extended to Cincinnati.

Kentucky.

BENTON—Telephone System.—W. M. Oliver, L. C. Starks and Cecil Read have incorporated the Marshall County Telephone Co. Capital stock $5,000.

GEORGETOWN — Telephone Plant. — Georgetown Telephone Co. will expend about $25,-000 for improvements to its exchange and plant.

Louisiana.

BATON ROUGE—The officials of the city, announce their desire for proposals for lighting streets and public buildings of the city electrically. Details may be ascertained from Mr. Edward Wax, secretary of the lighting committee.

NEW ORLEANS—Trolley Attachment Manufacturing.—Incorporated: Burke Perfection Single Wire Trolley Co., Ltd., capitalized at $100,000, for manufacturing and introducing patented trolley-wire devices, etc. Patrick J. O'Keefe is president; Thomas J. Burke, vice-president, and George W. Butler, secretary.

ATLANTA—The electric plant being built by an Atlanta company on the Chattahoochee River will cost $1,500,000. The concrete dam will be 1,100 feet long from shore to shore, and will be 65 feet wide at the base. About 20,000 horsepower will be developed.

The Atlanta Railway and Electric Company will, in December, inaugurate an increased scale of wages on an average of one cent per hour. Extra pay is also promised men who serve a stated term of years.

Maryland,

CUMBERLAND—Telephone System.—George W. Randall and Urner G. Carl, of Cumberland, and B. F. Madore, of Bedford, Pa., have incorporated the Western Maryland & Hyndman Telephone Co., with capital stock of $20,-000.

Massachusetts.

BOSTON—The Watertown and Litchfield Tramway Company has completed the surveys for an electric railway between Watertown and Litchfield, Conn., and will soon award the contract for its construction. The proposed line will pass through a section of Litchfield County that is not reached by an electric railway. At Watertown it will connect with the Connecticut Railway and Lighting Co.'s system.

Michigan.

DETROIT—The Edison Illuminating Company of this city has passed into the hands of a syndicate of New York and Boston capitalists that proposes to make extensive changes, more than doubling the capacity of the plant. The deal is being managed by W. F. White and C. W. Wetmore of the North American Company of Boston. The new syndicate offers to take all the stock of the Edison company, the par value of which is $25 per share, at $60 per share, and, it is said, has already obtained over 90 per cent. of it.

Mississippi.

LAUREL—Woodworking Plant, Etc.—Standard Arm & Pin Co., incorporated with a capital of $75,000, will establish a plant for manufacturing handles, cross-arm pins, etc.

Missouri.

NEWTONIA—Telephone Company.—Uneeder Telephone Co., capital $3,500, by J. A. Hundson, D. P. Weems, G. W. Harrison and others.

ST. JOSEPH—Electric Plant.—St. Joseph Railway, Light, Heat & Power Co. will increase capital stock from $3,500,000 to $6,000,-000.

New Jersey.

MOUNT HOLLY—A trolley is projected from here seven miles to Burlington.

GRANTWOOD—The Grantwood Steel and Iron Manufacturing Company; capital, $125,000. Incorporators—E. F. Smith, M. W. Baldwin and A. G. Brown.

New York.

ALBANY—The Brockport, Niagara & Rochester Railway Company has been incorporated with a capital of $500,000, to construct and operate an electric road forty-four miles long in Monroe and Orleans counties. The incorporators are: Frederick Beck, of Brockport; William Shields, of Waterville; S. J. Spencer, J. L. Bock and Stephen J. O'Gorman, of Buffalo; John Helling, of Rochester; Samuel W. Smith, of Holley; G. L. Smith, of Glade Run, Pa. The terminal of the road will be Rochester and Medina.

ELMIRA—The contract for the construction of the Elmira-Waverly trolley has been signed, and work, it is stated, will begin before cold weather. The construction company takes over the issue of $400,000 in bonds in payment for its work, and the road will, with ten large cars, cost about $350,000.

UTICA—Initial steps have been taken for the construction of a trolley line from Rome to Boonville. Beginning at Rome, the proposed line would run to Westernville, North Western, Dunn Brook, Boonville, Talcottville, Martinsburg and Lowville. There is a possibility that engineers may be placed on the route this winter.

ONEIDA—The authorities of Kirkland have granted a franchise to the Oneida Railway Company for the construction of its lines through that town.

ITHACA—The projectors of the new trolley line which will extend from Ithaca to Auburn held a meeting recently at Auburn, and it was decided to begin the work of surveying the route at once. The road will be forty miles in length.

NIAGARA FALLS—Niagara Traction Automobile Company, capital, $25,000. Directors—W. R. Campbell and F. A. Dudley, Niagara Falls; F. A. Babcock, Buffalo.

SALAMANCA—Berney Traction Company, to operate a four-and-a-half-mile electric road; capital, $10,000. Directors—S. A. Holbrook and A. J. Edgett, Bradford, Penn.; W. K. Harrison, Salamanca.

PATCHOGUE—The Patchogue Gas Co., capital $150,000. Its object is to operate a lighting plant in the town of Brookhaven, and within a radius of five miles thereof. The directors are: Troy Meyers and Samuel P. Barnes, of North Paterson, N. J.; John Richmond and James S. Black, of New York.

North Carolina.

SALISBURY—Electric Plant.—Salisbury Light & Power Co., has been organized with capital of $50,000 to build electric-light and power plant (also a railway). N. B. McCanless is president; A. H. Boyden, vice-president; J. M. Maupin, secretary, and J. S. McCubbins, treasurer.

GASTONIA—Telephone Systems.—Piedmont Telephone & Telegraph Co. has been incorporated, with capital stock of $30,000, and privilege of increasing to $100,000. It combines the telephone system of Gastonia, Kings Mountain and others towns, and improvements will be made. W. T. Love is president, and R. B. Babbington, superintendent.

CHARLOTTE.—A new power house will be erected and 18 cars will be purchased by the Electric Railway Company of Rome, Ga. The improvements, including a six-mile extension to Lindale, will cost $250,000. Seymour Cunningham of Washington, D. C., is president of the company.

Ohio.

CINCINNATI—The Norwood, Oakley, Madisonville & Red Bank Traction Company has been organized with a capital of $100,000, to construct a line from Norwood to connect with the Cincinnati & Norwood and the rapid transit route at Oakley, and with the Cincinnati & Oakley route. It is designed to cross the Madisonville line, and at Red Bank will connect with the East End route and the several Milford lines being projected. The incorporators are: David Davis, Peter Eichels, L. M. Strafer, Benjamin W. Harrison and A. E. Carr.

CINCINNATI—The Terminal Traction Co., capital, $100,000. The purpose of the company is to build a central depot for the electric lines from different parts of the State and to provide suitable terminals.

COLUMBUS—The Southern Fast Line Railway Company has been incorporated by the following: C. G. Grant, Thomas L. Childs, Charles H. Wheeler, George W. Sieber and Robert Herzer. The proposed route is from Cleveland to Akron and Massillon, with the right to construct a branch to some point between Akron and Massillon to Canton.

The Galion Gas Light Company has increased its capital from $35,000 to $100,000. S. N. Blake is president.

Pennsylvania.

YORK—The charter for extensions of the York County Traction Company's electric railway lines which will connect York with Harrisburg, has been filed with the county recorder. The extension will take in Rossville, Newberrytown, Gildsboro, York Haven, Dillsburg and Bowmansdale.

South Carolina.

SPARTANBURG—Water-power Development. Whitney Manufacturing Co., of Whitney, S. C., has purchased Griffin Shoals, on Pacolet river, capable of being developed to furnish 800 horse-power.

Tennessee.

CLEVELAND — Electric-power Plant.—Cleveland & Ducktown Electric Railway Co., just chartered with capital stock of $5,000, will develop water-power and erect electric plant for transmitting the power. W. B. Eckhardt, M. C. King, A. A. Campbell and others are interested.

CHATTANOOGA—The Chattanooga Light and Power Company has beeu awarded a contract for lighting the city during a period of two years.

COLUMBIA — Electric-lightPlant.—City contemplates building an electric-light plant, and has appointed a committee to investigate the advisability of taking definite action. Address "The Mayor."

Texas.

BEAUMONT—Electric-power Plants.—Beaumont, Sour Lake & Houston Electric Railway, Edward Kennedy, promoter, contemplates building three electric-power stations, one at Beaumont, one at Houston, and one midway between the two cities.

DENISON—The Lehigh Traction Company, which intends to build an electric road from Atoka to Coalgate, I. T., has floated its bonds and now has all its funds ready to commence work. The line will be fifteen miles long, and will be completed within twelve months.

Vermont.

BARRE—The People's Lighting, Heating and Power Company, has been incorporated. Frank Howland, Frank McWhorter, H. K. Bush are incorporators. The board of aldermen of Barre has granted a franchise.

Virginia.

HAMPTON—The Hampton Telephone Company has been reorganized. Most of the company's stock recently changed hands. The new company's officers are as follows: President, W. T. Gentry, of Atlanta, Ga.; vice-president, Col. Hunt Chipley; secretary and treasurer, S. Gordon Cummings.

STAUNTON—The plant of the Staunton Light and Power Coompany, now in the hands of the receiver, will be purchased by Edward M. Funkhouser and associates.

RICHMOND—The Amalgamated Association of Street Railway Employes of Richmond has begun a number of meetings for the schooling of members regarding their obligations to the public, their employers and the union. L.

Washington.

TACOMA—Charles H. Baker and his associates have secured control of the White River Power Company, which was incorporated several years ago as a New Jersey corporation. This company proposes to drain part of the flow of the White River into Lake Taps, whence the water will be carried over the high bluff near Sumner. This water power will generate electricity to the amount of 12,500 horse power. The project has been consolidated with Snoqualmie Falls power plant, and to accomplisn this purpose the Snoqualmie Falls and White River Company incorporated with $2,000,000 capital. The company will transmit power to cities and towns scattered the entire distance from the British line to Portland, Ore. Power for Tacoma, Portland, and intermediate towns will be furnished by the White River plant, while the Snoqualmie Power will serve Seattle, Everett and towns in the northwestern part of the State.

West Virginia.

MORGANTOWN—Orders have been placed by the Morgantown Electric and Traction Company for the machinery and rails for the road, and plans will be prepared at once for a $100,000 power plant. The road must be in operation by March 24.

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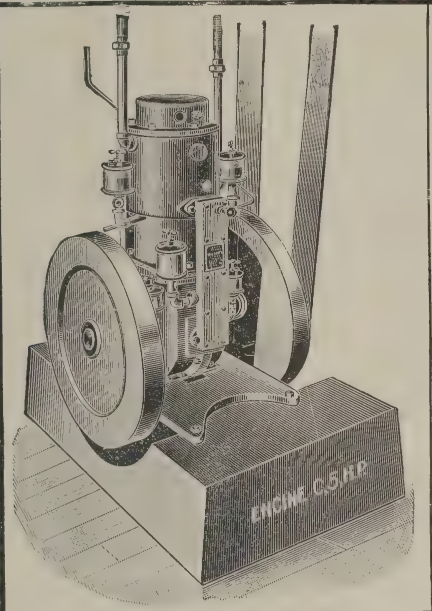

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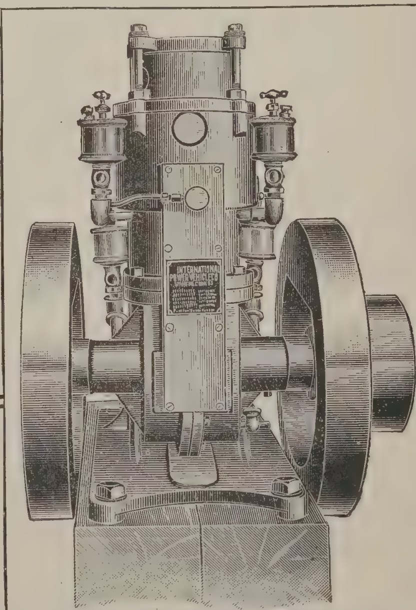

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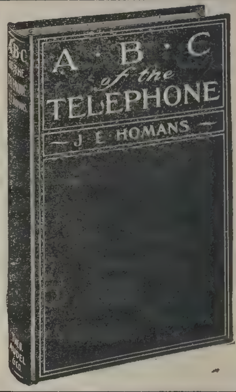

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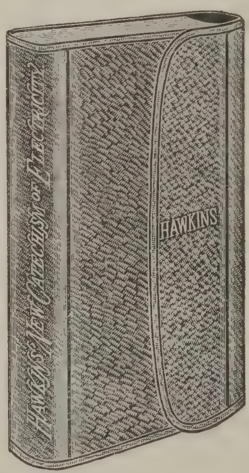

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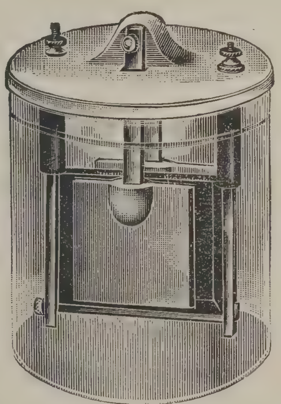

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