SCIENTIFIC AMERICAN

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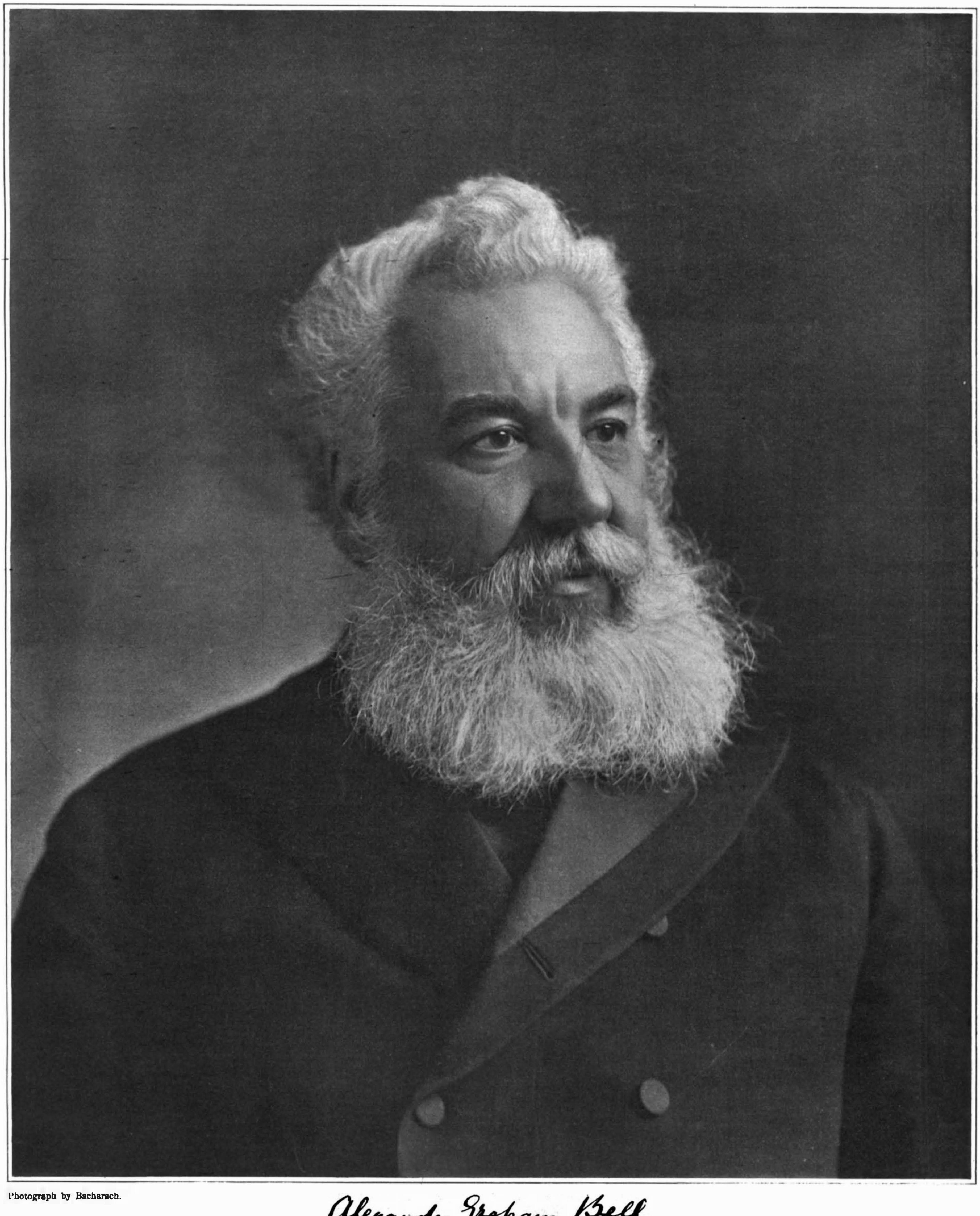

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Alexander Graham Bell

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, MAY 2, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SUBWAY CONTRACTOR AND THE SUFFERING PUBLIC.

The contractors of the New York Subway are rapidly losing the public good-will which they had unquestionably secured by the expedition with which they carried out the work of excavating and building the new tunnel. They are losing it because of the inexcusable indifference to the convenience of the public which they have shown, and are showing to-day, by making no attempt to clean up the streets as soon as they are through with their work.

We are not sure that the engineers of the Rapid Transit Subway are not also somewhat to blame for this discomfort; for in order to protect the public there was a special clause inserted in the first general contract and specifications of the Subway covering this very point—a clause which, as we know to our cost, is "more honored in the breach than in the observance." It was stipulated in the first contract that any given stretch of the cut-and-cover work was to be open for only a limited period of time, sufficient presumably for putting in the steel work and concrete; and it is expressly directed that "at his own expense, and as directed from time to time by the Engineer, the Contractor is to *clear the work, streets, and all public places occupied by it from all refuse and rubbish, and leave them in a neat condition.*" Now, when we consider that some stretches of the work, such for instance as that through 42d Street, will have been "open" and encumbered for between two and three years, it is evident either that the contractor has been willfully obstreperous, or that the engineers have not fully exercised the authority conferred upon them under the contract. We are inclined to think that the fault lies with the contractor more than with anyone else for in spite of the storm of public indignation which has found its expression of late through the press, and despite the fact that the Chief Engineer of the Commission has recently called special attention to the shocking condition of the streets, there are scores of blocks along the route of the line which, although the Subway beneath them has been completed for many months, are to-day in a disgraceful state of disrepair and disorder.

Nothing could be more admirable than the patience with which the merchants and property owners, to say nothing of the pedestrians of New York city, have endured the enormous inconvenience arising from the construction of the Subway; and they have certainly deserved something better than the total disregard of their interests and convenience which has been shown during the progress of this great work. We commend this subject to the special and immediate attention of Messrs. Parsons and McDonald, respectively the Chief Engineer of the Rapid Transit Commission and the Chief Contractor for the Subway.

FAILURE OF THE "IOWA'S" 12-INCH GUN.

When the deplorable accident to one of the 12-inch guns of the "Iowa" occurred, it was generally credited to the bursting of a shell in the bore of the gun. Although the official report of the Board of Investigation has not yet been made, there is now a general belief that the failure of the gun was not due to a defective shell, but either to the inherent weakness of the gun itself, or to abnormal pressures set up in the chase of the gun by the smokeless powder employed. The gun was one of the pieces with which the "Iowa" was originally supplied, and as this vessel went into commission in the summer of 1897, it has seen nearly six years of service. During this time the gun has had to do duty in the regular courses of target practice each year, and it also endured the severe test of the Spanish war, during which the "Iowa" was engaged in the bombardment of San Juan, the blockade at Santiago, and the naval battle which ended in the destruction of Cervera's fleet. In all these years the 12-inch gun that failed has been fired between two hundred and three hundred times; and if there were anything in the theory that the life of a modern built-up gun of large caliber is restricted to between one hundred and fifty and two hundred rounds, there might be some truth in the suggestion that the strength of the gun was exhausted. For our part we do not believe that there is anything in the suggestion, provided, of course, that during its six years of service the gun has not been subjected to powder pressures exceeding the limit which it was designed to stand.

Now, it is just here, in connection with the question of powder pressures, that the probable cause of the explosion will be found; for although the most modern smokeless powder is stable and reliable in its results, some of the earlier powders, especially if they have been for any considerable time in storage, are liable to a more rapid combustion with consequent higher pressures than they were intended to give. The "Iowa's" 12-inch gun was designed for the old brown powder, which was relatively quick-burning, and did not give such high pressures during the latter part of the travel of the projectile down the bore as the later smokeless powders. Hence it was not necessary to give so much tangential strength to the chase of the gun as would be the custom in designing a modern, high-velocity gun using slow-burning smokeless powder. Hence the smokeless powder employed would be somewhat more trying for the gun than the brown powder, and if there were any sudden combustion of the remaining unburnt powder shortly before the shell left the gun, the chase might readily have proved unequal to the extra duty put upon it.

TESTS OF OIL FUEL ON LOCOMOTIVES.

At the time that the preliminary report of the elaborate tests of oil fuel now being carried out by the Naval Department was made last year, we gave a brief account of the findings reached at that time. During the intervening months a series of tests has been carried out to ascertain the value of oil fuel for use on locomotives, the trials being made on the Florida East Coast and the Boston & Maine Railroads. Particular value attaches to the results, from the fact that the work of the locomotive was tested when it was hauling its regular load, and the results represented, not merely a single trip, but the work of a whole month. On the first-named railroad, on level track the engine consumed 6¾ gallons of oil per mile run, the oil weighing 7.55 pounds per gallon. The same engine in doing the same work burned 2,000 pounds of Tennessee coal for every 19.6 miles that was covered; the result showing that under those particular conditions 132.3 gallons of oil did the work of one ton of coal. When the same locomotive was tested on freight service, where the speed was lower and the loads greater, the consumption was 10.6 gallons per mile on oil, and 2,000 pounds of coal per each 13 miles, thus giving a ratio of 131.8 gallons of oil to 2,000 pounds of coal. The test on the Boston & Maine Railroad was made on a helper used in assisting trains in the Hoosac tunnel. The work was done by the engine on an upgrade of 42 feet per mile, the engine returning without any load. On this test the oil weighed 7.75 pounds per gallon, and 11.45 gallons were used per mile. When burning coal, this engine ran 12.25 miles for every 2,240 pounds used, thus showing a ratio of 140.26 gallons of oil to 1 ton of coal. An important fact developed in these tests was that the engine could be urged to a greater capacity with oil fuel than with coal, and that this could be done with a smokeless fire. It is considered that there is no reason why equal results should not be obtained in marine service.

ENGLISH REPORT ON THE AMERICAN RAILWAYS.

The Board of Trade, London, recently authorized Col. Yorke, its Chief Inspecting Officer of Railways, to visit the United States and make an extended tour over our railroad systems. The report of his investigations has recently been published in pamphlet form, and taken altogether it may be regarded as one of the most fair-minded and valuable documents of its kind that has ever appeared.

It is pointed out under the head of steam railways, that there is a fundamental difference between English and American track in the fact that in England the bullhead rail, laid on cast-iron chairs, is in almost universal use, whereas in the United States the T-rail is almost exclusively used, the latter being laid either directly on the ties or upon tie-plates, and the rail secured by ordinary rail spikes. The weight of the rails on first-class track is about the same in both countries, varying from 80 to 100 pounds in the United States, and from 85 to 103 pounds in England. Although American roads use from 14 to 16 ties to a 30-foot rail, as against only 12 ties to the same length of rail in England, the larger dimensions of the English ties give a slightly larger total bearing surface, there being 85.3 square feet of such surface with 16 ties on American track, and 90 square feet for the 12 ties used on an English rail. The bearing surface of the rails on the ties is 768 square inches in American practice, as against 1,260 square inches bearing surface of the cast-iron chairs in English practice. Attention is drawn to the fact, however, that on the best eastern roads in America, the ties are of hard wood, which has better wearing qualities than the Baltic timber ties used in Great Britain. The report speaks favorably of the American practice of breaking joints when laying the track, that is to say, bringing the joint in one rail opposite the center of the adjoining rail. In discussing the advisability of abolishing the chairs and using hard-wood ties, Col. Yorke considers that the extra cost of the ties would be greater than any saving gained by discontinuing the use of the chairs.

Perhaps the most interesting portion of the report is that which deals with the question of signaling. This was found to be in a more or less experimental condition, no uniform practice having as yet been adopted throughout the country. The remarks on this subject are particularly timely just now, because of the attention that has been directed to our signaling system by the many and fatal collisions that have occurred, either through faulty signaling, or through disregard of correct signals. Moreover, as the Board of Trade has oversight of all matters relating to the safety of the traveling public, and has the authority to investigate and report on all railway accidents, the opinion of its expert necessarily will carry very great weight. His severest criticism is of the fast-and-loose method by which the interpretation of block signals is in many cases left to the judgment of the engineer; by which more than one train is frequently allowed to be in the same block section at the same time; and by which trains are permitted, under special conditions, to run against the traffic, that is to say, a down train is permitted to run on an up line, and *vice versa.*

On the question of automatic signaling, the report considers that it does not necessarily produce greater safety of operation, that it is after all merely a labor-saving device, and that while it gets rid of errors due to the human element, it opens the way for other errors due to inaccurate operation or breakdown of the mechanism, which may be equally disastrous. It is pointed out that since the chief object of such a system is to increase the density of the traffic by enabling trains to be run under shorter headway, this very density must of itself increase the chances of accident. We must confess that we can hardly see the force of this argument. It is evidently desirable that as many trains as are consistent with safety should be run over any given stretch of track. Automatic signaling increases the number, and if the apparatus be properly made and carefully maintained, this increased traffic can be worked with the same immunity from disaster as a less frequent traffic under a non-automatic system. The fault is not in the automatic system, but in the human element that operates and takes care of it. The system being good in itself, the obvious thing to do is to teach signalmen and maintenance-of-way engineers to exercise redoubled care and vigilance in keeping the automatic plant at all times in first-class condition. Automatic signaling has come to stay. With increased experience in its use, and with a more rigid observance of the first principles which underlie its successful operation, our railroads will learn to operate their trains without incurring the frightful loss of life that has occurred during the past few months.

ELECTRIFICATION OF THE LONDON "UNDERGROUND" RAILWAY.

BY OUR LONDON CORRESPONDENT.

By permission of Mr. James R. Chapman, general manager and chief engineer of the "Underground Electric Railway Company of London, Ltd.," the writer was enabled a few days ago to inspect the two new electric trains for the District Railway which have just arrived at the carsheds at South Harrow, and to make a trip in one of these over the new electrified line between Ealing and South Harrow, which will shortly be open for public service.

Each of the new trains is made up of seven cars, three of which are motor cars and four trailer cars.

They are to be regarded at present as experimental only, and on their working will depend the nature of the cars, not only for the electrified Metropolitan District Railway, but also for the three tube railways controlled by the Underground Electric Railway Company via the Baker Street and Waterloo, Charing Cross, Euston and Hampstead, and Great Northern, Brompton, and Piccadilly Circus lines.

In a few weeks' time electric trains will be running on the new line which the Metropolitan District Railway Company has constructed from Ealing to South Harrow, a distance of six miles. This line has been finished for more than eighteen months, but it has not as yet been opened for traffic. It has been chosen as the first section to be operated by electricity, and a temporary power station has been installed at Alperton which supplies current to the rails at 550 volts direct.

The new Ealing-South Harrow Railway, which consists of six miles of double track, is completely in the open. During the past few months the work of electrifying this portion has been steadily pushed forward, and the Brush Electrical Engineering Company have just delivered the two "sample" trains referred to. The system which has been adopted may be described as the "third-rail multiple unit."

As a matter of fact, two new conductor rails, one the positive and the other the negative conductor, have been laid; there are therefore four rails in all. This system differs from that found on the Central London Railway, where only one conductor rail is laid, and also from the British Thomson-Houston system to be adopted on the North-Eastern Railway, where the third-rail will be used on the positive side of the circuit. All the existing track rails will be bonded for the entire current.

It is quite true that on the Ealing-South Harrow line the track rails are bonded also, but this is done for the purpose of carrying the small currents necessary for working the electric signaling system to be employed. The conductor rails weigh 100 pounds per yard and are very soft and of high conducting power, their electrical resistance being only from six and one-half to seven times that of pure copper, whereas the resistance of the ordinary steel rail is about twelve times that of copper.

These conductors have been supplied by the Rheinische Works, Germany, and another German firm has since obtained the contract for 3,000 tons more of these conductor rails.

The two sample trains are very similar to those employed on the Boston Elevated Railway. Each train will be made up of seven cars, of which three will be "motor cars" and four "trailers." One of the motor-cars will be at the front, another at the rear, and the third at the center. The total length of the train will be 352 feet, and the seating capacity, 330; each motor-car will seat 38, and each trailer 52 persons. Each car is 12 feet 4 inches high, 8 feet 4 inches wide, and 50 feet long. The two end motor-coaches have a luggage compartment as well as longitudinal seats; the other coaches have part longitudinal and part transverse seating, except the middle motor-car, which has only longitudinal seats. Each train, therefore, contains three different types of cars. The Brush Company are also supplying the bogie trucks, which are of two types, motor-trucks and trailer trucks; they are made entirely of cast steel. Each motor-car will be fitted with two motors mounted on one of the four-wheel trucks, the truck at the other end of the car being free; the motors are each of 175 horse power and will be geared by single-reduction gear to the two axles of the truck. This will give 350 horse power per motor car, or 1,050 horse power per train. The driving wheels of the motor cars are 36 inches in diameter, while the carrying wheels, as well as those of the trailers, are 30 inches in diameter. One train is to be fitted with electrical apparatus manufactured by the British Thomson-Houston Company, and the other with apparatus made by the British Westinghouse Electric and Manufacturing Company. Each firm will apply its own particular system of train control.

The framework of the cars is of the best English oak and ash. The paneling is of whitewood run in two courses, the inside being horizontal and outside vertical. The exterior woodwork will be entirely in wainscot oak, with natural wood finish. The seats will be of rattan on spring frames. There will be no upholstering in the interiors of the cars; all the wood has been treated to render it uninflammable, so that there is but little danger of cars catching fire.

A motorman's cab is provided at each end of the train, and at either end of the center motor-car is a similar cab, which is capable of being folded up when not in use. It is practically settled that there will be no distinction of class on the Electrified Underground, and a uniform fare of probably 2½d. will be instituted for any distance. The rumor that as a concession to British custom some cars will be labeled "reserved," and that for these an extra fare will be charged, is generally believed to be incorrect.

The motors will be capable of very high powers of acceleration. A speed of twenty miles an hour will be attained in less than half a minute, and midway between stations as high a speed as sixty miles an hour will probably be reached. The stop at each station will not be more than 20 seconds.

Until the great new power house in Lots Road, Chelsea, is ready to supply the current, the temporary power house at Alperton will be relied upon for the short Ealing-South Harrow section. The Underground Electric Railway Company have purchased the plant which was used for the experiments on the Earl's Court-Kensington High Street section, and have installed it at Alperton.

The Lots Road generating station has been commenced, and it is expected that the steel framework will be erected in June next. It will be the largest electric traction station in the world, and it will be first to employ steam turbines exclusively instead of reciprocating engines for driving the dynamos; the steam turbines to be installed will be the largest ever built. There will be ten turbines, each of 7,500 horse power, giving 75,000 horse power in all. The overload capacity of these machines will, however, allow them to work continuously at 11,000 horse power each, or in all 110,000 horse power, the largest power of any one station in the world. They are to be supplied by the British Westinghouse Company, and will be of the Parsons type with Westinghouse modifications. The speed will be 1,000 revolutions per minute and mounted on the same shafts will be ten three-phase generators of 5,500 kilowatts each. The current will be supplied at a voltage of 11,000, the highest pressure yet employed for traction purposes in this country. Substations will be erected, among other places, at the Mansion House and South Kensington, where the alternating current will be converted into continuous current and transmitted to the rail at 600 volts.

THE HEAVENS IN MAY.

BY HENRY NORRIS RUSSELL, PH.D.

Though the winter constellations have ere now disappeared from our view, and the duller skies of spring taken their place, there is yet much of interest for the star-gazer, even apart from the presence of two of the brightest planets in the evening sky.

We may well choose as one point of departure, for this month's survey of the heavens, the constellation of the Great Bear, more familiarly known as the Great Dipper, which is nearly overhead at nine in the evening. Prolonging the curve of the dipper-handle southward for rather more than its own length, we come upon Arcturus, the brightest star of Bootes, which includes also most of the stars we have passed on our way. Below Bootes, and to the right, lies Virgo, marked by one bright star, Spica, and, for the present, by the brighter presence of Mars.

Farther to the right, and a little higher up, is Leo. It requires but little imagination to see the head and mane of a couchant lion in the curve of the "sickle," while Regulus marks his fore-paws, and the triangle of stars some distance to the left forms his hind-quarters.

Cancer, which comes next along the ecliptic, is distinguished only by the little nebulous group of the Præsepe—a star cluster whose components can be seen with any field-glass. Gemini is still lower in the west, and is the last zodiacal constellation in sight. Rather lower than the twin stars, Castor and Pollux, and more to the southward, is Procyon, while Capella, with the rest of Auriga, is low in the northwest.

The long irregular line of stars below Leo and Virgo forms the constellation Hydra Its head is marked by a little group below Cancer, while its tail extends far beyond Spica. The little group of brightest stars below and to the left of the latter is known as Corvus, the Raven, who appears to be perched on Hydra's back. From the extreme southern portions of the United States, south of latitude 27 deg., the Southern Cross is visible at this season, directly below Corvus, its brightest star, at the foot of the Cross, almost touching the horizon.

A line of three second-magnitude stars in the southeast, followed by a brighter red one, shows that Scorpio is reappearing. The large and formless group of Ophiuchus and Serpens lies to the left and above. Farther on in this direction is Hercules, with the pretty circlet of the Northern Crown between it and Arcturus and with Lyra below in the northeast.

The Little Bear is on the right of the pole—east of it by ordinary reckoning, but south in the astronomical sense; for "south" in astronomical parlance always means away from the pole-star, or, more accurately, from the invisible pole which lies near it. Between the Great and Little Bears, separating them completely, is the long line of Draco.

By far the most interesting piece of astronomical news at the present writing is the discovery of a new star in Gemini, just announced by Prof. Turner, of Oxford.

The new object is faint—only of the eighth magnitude—and it seems improbable that it will become visible to the naked eye. With the telescope—as seen by the writer at Cambridge, England, March 28—it is conspicuous by reason of its strong orange color, which is strikingly like that of Nova Persei just after its maximum—and its peculiar spectrum, which, like that of other novæ, is full of bright lines, some of which are probably due to hydrogen.

THE PLANETS.

Mercury is evening star throughout May, and is visible under remarkably favorable circumstances. On the 10th he is at his greatest elongation, 21½ degs. east of the sun, and as he is also very far north, he does not set until the unusually late hour of 8:30 P. M. He is in Taurus, north of Aldebaran, at about one-quarter the distance of Capella, and moves rapidly eastward. As he is about as bright as Capella, he should be easy to see, at least during the first half of the month. After the 20th he approaches the sun and rapidly becomes invisible.

Venus is likewise evening star, and is exceedingly conspicuous in the west. She moves eastward through Taurus and Gemini during the month, and increases in brightness and remains in sight till nearly 10 o'clock each evening. The only difficulty about seeing her in broad daylight is that it is hard to find out just where to look for her. On the 29th she is in conjunction with the moon, but she is so far from the latter—7½ degs. north of her—that the conjunction will not be much help in finding the planet.

Mars is conspicuous in the evening sky. He is in Virgo, about two-fifths of the way from Spica toward Regulus, and is still very bright, though he loses half his light during the month, as he recedes from us. His apparent motion among the stars is westward until the 10th, when he begins to retrace his path.

Jupiter is in Aquarius, and Saturn in Capricornus. The latter rises at midnight in the middle of the month, and the former about 2 A. M.

Uranus is in Ophiuchus, and is approaching his opposition, which occurs next month. Neptune is in Gemini, and is getting too near the sun to be observed.

THE MOON.

First quarter occurs at 2 A. M. on the 4th, full moon at 8 A. M. on the 11th, last quarter at 10 A. M. on the 19th, and new moon at 5 P. M. on the 26th. The moon is nearest us on the 28th, and farthest away on the 16th. She is in conjunction with Neptune on the 1st, Mars on the 7th, Uranus on the 14th, Saturn on the 18th, Jupiter on the 21st, Mercury on the 27th, Neptune on the 28th, and Venus on the 29th. None of these conjunctions is at all close.

London, England.

SCIENCE NOTES.

In the course of a lecture at the Conference of Musicians in Dublin, Ireland, some interesting particulars and some astonishing statistics were given relatively to the amount of work accomplished by the brain and nerves in piano playing. A pianist in view of the present state of piano-forte playing has to cultivate the eye to see about 1,500 signs in one minute, the fingers to make about 2,000 movements, and the brain to receive and understand separately the 1,500 signs while it issues 2,000 orders. In playing Weber's "Moto perpetuo," a pianist has to read 4,541 notes in a little under four minutes. This is about 19 per second; but the eye can receive only about ten consecutive impressions per second, so that it is evident that in very rapid music a player does not see every note singly, but in groups, probably a bar or more at one vision. In Chopin's "Etude in E Minor" (in the second set) the speed of reading is still greater, since it is necessary to read 3,950 signs in two minutes and a half, which is equivalent to about 26 notes per second.

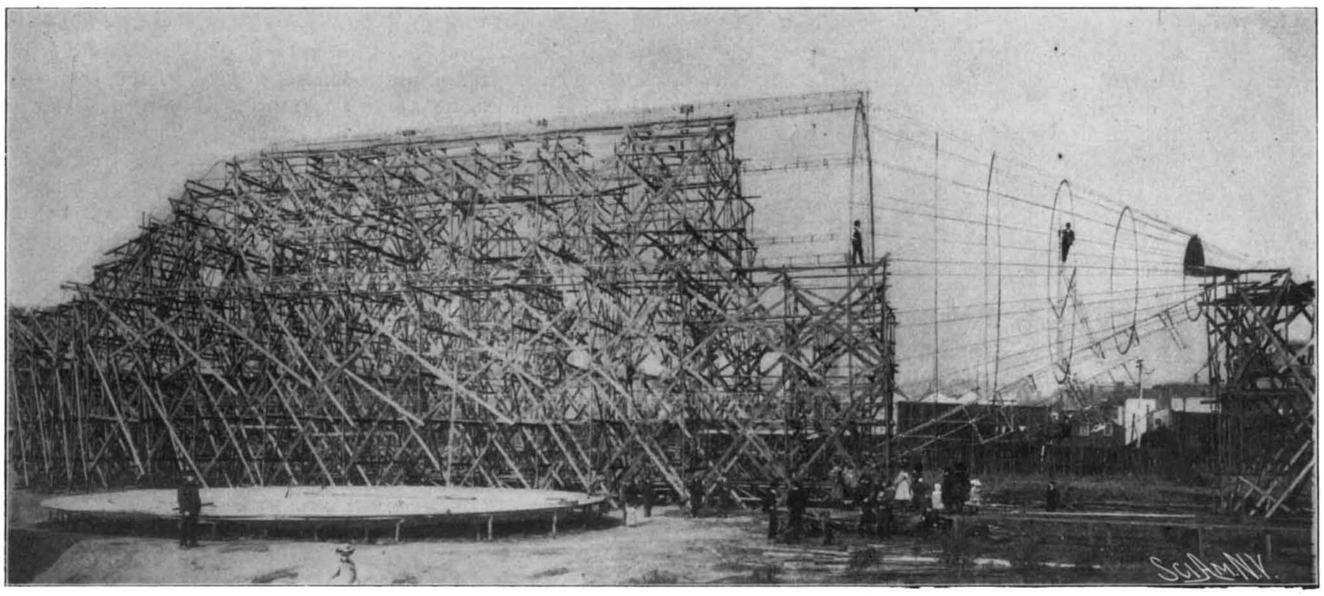
The manufacture of pure artificial camphor upon a commercial basis has been discovered by Mr. E. Callenberg, of Germany, technically known as chlorhydrate of terebinth. This substance possesses many peculiar properties, which will render it of great value for many commercial purposes, the most important of which is that it is soluble in nitro-glycerine; and as it reduces the maximum temperature of this dangerous substance during explosion, it is considered that it will do much to render considerably more safe the manufacture of high explosives such as nitro-glycerine. Not only does it reduce the temperature of explosion, but it lowers the freezing point of the substance to a very marked extent as well. Pure nitro-glycerine freezes at +8 deg. Centigrade, but when a 3 to 5 per cent solution of the chlorhydrate of terebinth is added, the freezing point drops from —10 deg. to —15 deg. Cent. Furthermore, guncotton and many other soluble explosives can be easily dissolved at a cold temperature in a solution of chlorhydrate of terebinth and nitro-glycerine, the resulting substance being a highly improved quality of gelatine-dynamite.

It has been reported to the Academy of Sciences by Henri Dufour that a comparison of the solar observations made with the Crova actinometer during the first three months of the present year with the results of preceding years, shows a distinct falling off in the sun's radiation in the lower layers of atmosphere. The suggestion that the solar radiation is perceptibly absorbed by the volcanic dust now diffused through much of the earth's atmosphere is to say the least plausible. But so far as international reports of the season indicate, the earth's loss of solar heat has not recently been traceable in the meteorological observations. March was, on the contrary, marked by abnormally high temperatures in portions of Europe and America, and few records for excessively intense cold have been reported this year. If the dust from the volcanoes of tropical America has now been spread through the upper atmosphere within the middle latitudes of America and Europe, it will be conducive in some slight degree to the formation of rain clouds in unusual quantities for several months. But the precipitation of summer will mainly depend on much more influential causes.

THE STANLEY AIRSHIP.

One of the competing aerostats for the airship prize offered by the St. Louis Louisiana Purchase Exposition will be the Stanley airship. Although not the largest vessel of its kind ever built, the airship will, nevertheless, be noteworthy for its size.

The contrivance will have a total length of 228 feet and will consist of a cylinder 116 feet long, tapering at either end in a cone 56 feet long. The diameter of cylinder is likewise 56 feet. The entire machine will weigh 13,000 pounds, but the lifting capacity of the hydrogen gas with which it will be filled will be 21,000 pounds. Accommodations for thirty passengers with their baggage have been provided. Besides passengers, allowance has also been made for mail matter weighing 1,000 pounds and 1,000 pounds of ballast. The inventor hopes to attain rather fabulous speeds. His best time he thinks will be 130 miles an hour; his worst he places at 70 miles an hour. These speeds are to be obtained with propellers 10 feet in diameter moving at the rate of 800 revolutions per minute. Besides rudders, side planes are to be used for the purpose of keeping the ship in proper longitudinal trim.



THE FRAME OF THE STANLEY AIRSHIP

The novel features of the airship, according to its inventor, are the manner of propulsion, control over elevation, ability to descend at will, and adjustable propeller blades.

The airship is divided longitudinally into two parts by a partition running the full length of the ship 12 feet above the keel. The lower of the two parts thus formed will contain the motive power, machinery, passengers, and freight. The upper part is to be divided into six compartments to contain the hydrogen gas. Each compartment will be provided with an inner skin of silk to prevent leakage of the gas.

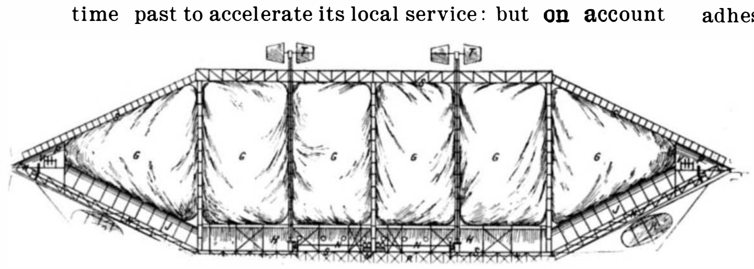
The propellers are placed at the apex of each cone. A rudder beneath each cone will guide the ship horizontally; while a series of side planes or side rudders will control the vertical movement. Top propellers are provided for the purpose of controlling the ship in rising and for the purpose of forcing it down when a landing is to be made.

It is said that a model has been built which works satisfactorily. The information which we are able to give is meager, but it is all that can at present be obtained. It remains to be seen whether the inventor's claims will be fulfilled when the airship is completed.

J. M. B.

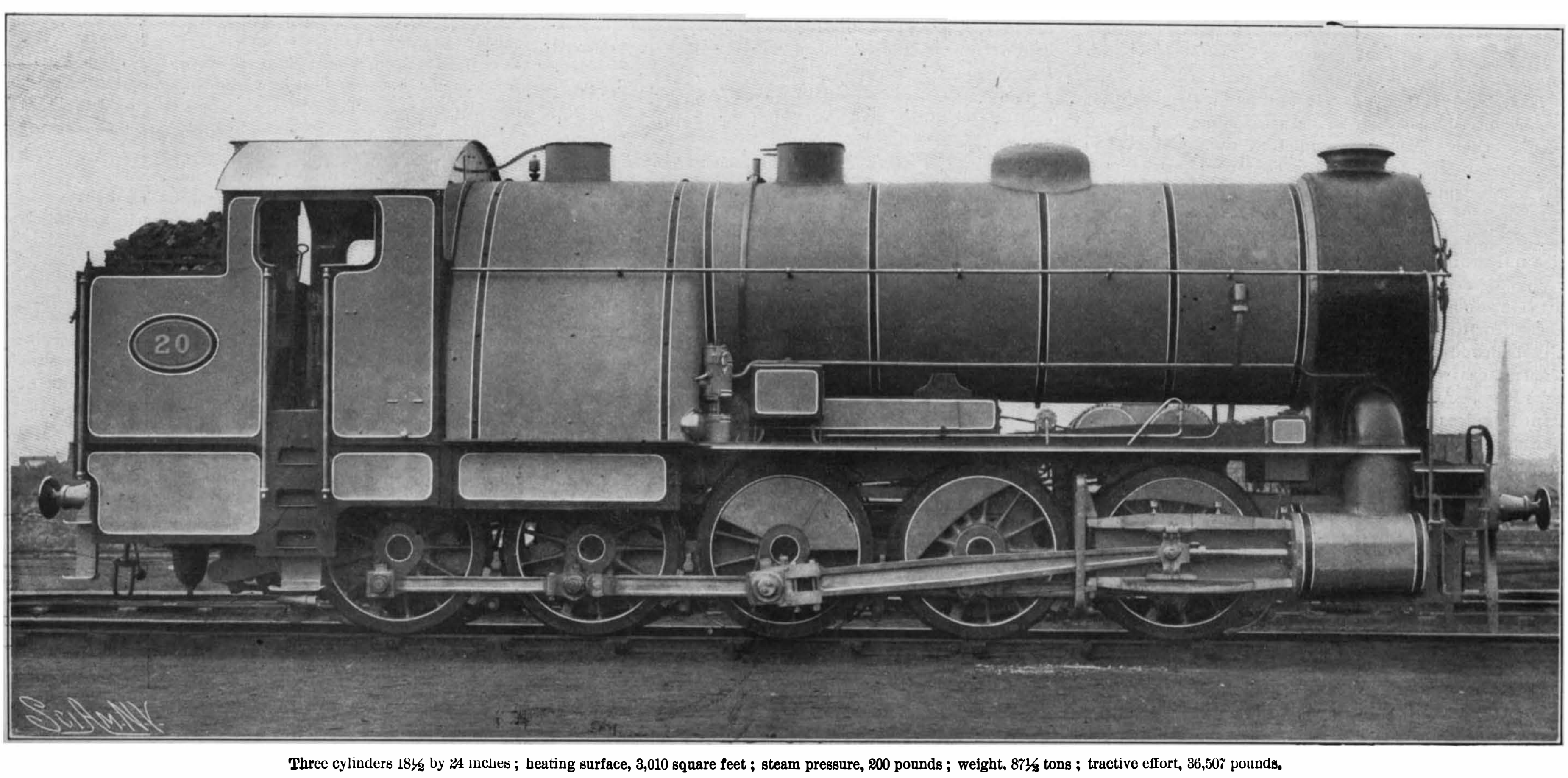
POWERFUL ENGLISH ENGINE FOR SUBURBAN TRAFFIC.

The locomotive that is herewith illustrated is certainly the most striking departure that has been made from standard English locomotive practice for many a decade. It was designed by Mr. James Holden, Chief Mechanical Engineer of the Great Eastern Railway, to handle the extremely heavy travel on the suburban lines of the Great Eastern Railway, England. This traffic centers at Liverpool Street and Fenchurch Street stations, London, and the annual travel over the suburban lines served from these stations amounts to 111,000,000 people. Although the Great Eastern Railway has a good record for the number and punctuality of its trains, it has been endeavoring for some time past to accelerate its local service: but on account of the great number of stations on each of the suburban lines, this has been a matter of much difficulty. Thus, on the line running to Enfield there are sixteen stations in a distance of 10 miles, and the inability to make rapid starts with the long and heavy suburban trains has prevented the trains from maintaining a high average speed. The steady increase of the past few years in the number of passengers and in the weight of the trains showed that to cope with the situation some special type of locomotive was necessary, and Mr. Holden broke away from all precedent by designing and building a locomotive which is not only by far the most powerful in Great Britain, but as a matter of fact, has a greater hauling power than the biggest passenger locomotive built in this country, not even excepting the great engine recently turned out by the Baldwin Company for the Chicago & Alton Railway. A fair test of the power of a locomotive is its tractive effort; this in the case of the Baldwin engines is 31,600 pounds, and for the Great Eastern Railway "Decapod," 36,507 pounds. The best acceleration that has hitherto been possible on this suburban service is the attaining of a speed of 20 miles an hour in 30 seconds from the start with a train of fifteen cars weighing 225 long tons. Some years ago the cars were widened, with the result that each train had an increased carrying capacity of nearly 21 per cent. The new "Decapod" is expected to pull a 50 per cent heavier load and attain a speed of 30 miles an hour in 30 seconds from starting, with a train carrying 1,200 people, making a saving of about 10 minutes on the 10½-mile journey and thereby allowing of a more frequent service of trains. The engine is carried on ten wheels, all of which are coupled, the whole weight therefore being available for adhesion. The practical absence of any smokestack is due to the fact that the loading gage in England is between 1 and 2 feet lower than that in this country, and consequently, as the center of the boiler is lifted, the top of the boiler encroaches on the smokestack until, as in the present case, the latter is entirely sunk within the smokebox. The boiler is 5 feet, 3 inches in internal, diameter, and the barrel measures 15 feet, 10⅞ inches in length between the two tube plates. The firebox shell measures 7 feet, 9½ inches in width by 6 feet, 9½ inches in length on the outside. The inside firebox, which is of ⅝-inch copper plate, is 6 feet long by 7 feet wide on the inside. It is stayed by bronze stays 1 inch in diameter. There are 395 steel tubes with a total heating surface of 2,878.3 square feet, and there are 131.7 square feet in the firebox, making a total for the whole boiler of 3,010 square feet, or about double that of the average English locomotive of the present day, and about three times as great as that of the English passenger locomotive of fifteen years ago. The working pressure is 200



SECTIONAL VIEW OF STANLEY AIRSHIP.

S, shell; *G*, gas bags; *E*, end propellers; *T*, top propellers; *M*, engines; *N*, shafting from engines to propellers; *H*, main hall; *J*, inclined passages to pilot houses; *P*, pilot houses; *R*, rudders; *B*, lower bridge; *V*, steering gear.



Three cylinders 18½ by 24 inches; heating surface, 3,010 square feet; steam pressure, 200 pounds; weight, 87½ tons; tractive effort, 36,507 pounds.

POWERFUL ENGLISH LOCOMOTIVE FOR SUBURBAN TRAFFIC.

pounds to the square inch and the steam is expanded in three high-pressure cylinders, two being outside the frames and one between the frames on the center line of the engine. Each cylinder is 18½ inches in diameter by 24 inches stroke. To avoid having to incline the middle cylinder, a divided connecting rod is used, the leading axle passing through the connecting rod and being slightly bent to enable it to clear. The ten driving wheels, all coupled, are 4 feet 6 inches in diameter, and the rigid wheel-base, which is equally divided, measures 19 feet 8 inches. The length of the engine over all is 37 feet 9 inches, and its total weight is 87½ tons.

This new departure in locomotive practice will be watched with great interest by engineers on both sides of the water. Mr. Holden claims that the fight between steam and electricity as the motive power for suburban traction is not by any means decided, as yet, in favor of electricity. Although we do not agree with him in this, we have no doubt that this engine will show marked power and economy as compared with the lighter engines hauling smaller trains, which it is intended to displace.

ORE FINDING BY ELECTRICITY.

BY HERBERT C. FYFE, LONDON.

The writer has recently been afforded an opportunity of witnessing the new Draft-Williams method of electrical ore finding in operation on actual mineral lodes at the Telacre Mine, Prestatyn, North Wales.

The inventors, Mr. Leo Draft and Mr. Alfred Williams, claim to be able to detect the presence of certain mineral ores invisible to the eye, and during the course of the last few months to have located, traced, and mapped out metalliferous deposits of various natures which were quite invisible to the prospector and undiscoverable by mining engineering.

In many cases mine prospectors have made borings and opened up lodes solely on the strength of the inventors' predictions, and have discovered new and unsuspected sources of mineral ores, which are now being worked at a profit.

It is claimed that by the Draft-Williams method not only can deposits be located, but that the extent and depth of the lode can be determined with an accuracy that is quite impossible with any existing system of prospecting.

Before giving an account of what the system has already accomplished, mention must be made of the instruments employed.

There are two stations, the transmitting and the receiving. At the former there is a battery of 12 volts, giving 4 amperes and 50 watts; a special form of break works in methylated spirits, and is driven by a motor, which is supplied with current by a special local battery and a primary condenser. The current is next led through the primary by an inductor, a special form of induction coil having a large core and very heavy winding on the secondary circuit. The current now passes through a secondary condenser to adjustable series and parallel spark gaps. The electric waves generated by this arrangement are taken to earth by means of two iron spikes driven two to three inches into the ground. At the Telacre Mine there were two circuits, one vertical, the other horizontal. In the former case the wire was taken down the mine shaft close at hand and along the tunnel as far as the fore-breast, a distance of 200 yards; and in the other it was placed some yards away in a line with the tent in which the transmitting set was placed. In both cases one spike was driven into the ground close by the transmitter.

The receiving set comprises two similar iron spikes, driven into the ground to a depth of an inch or two, and connected up to a tripod on which are placed a series parallel and with a transformer and two delicate receivers or resonators. The interrupter breaks contact 700 tines a minute.

By adjusting his earth connections the operator can focus the waves on any field that he may wish to explore; the lines of force travel outward and onward until they reach the iron spikes in the receiving set. When this occurs, the observer can by means of the resonators detect their presence by hearing the noise of the break, or by the sparking across the gaps.

ORE PROSPECTING BY MEANS OF ELECTRICITY.

Now, in a normal condition, i. e., if the ground be of a homogeneous character, the prospector should hear the noises loudest when exactly opposite the center of the base line of the transmitting station.

The existence, however, of a vein or reef containing metal has the tendency of throwing the waves out of normal course, by reason of the fact that it has a different conductivity from the material by which it is surrounded. The prospector must therefore make his earth connections in different places, and shift his position until he can detect the presence of the waves. When directly over the lode, the noise in the resonators will be loudest.

Condenser-discharges from lodes manifest themselves as overtones in the receivers, and at certain spots or nodal points the noise will cease altogether, owing to the influence of the waves.

The condenser discharges can be heard over some lodes when the distance from the inductor is so great that the noise of the break or of the spark gap cannot be heard; thus they form a great assistance to prospecting, helping to determine, not only the position and depth of a mineral deposit, but also, to a great extent, its nature and characteristics.

The area to be energized by the electric waves may be as small as 300 square feet and as large as 30 square miles, and the terminals may be placed hundreds of yards apart.

It is interesting to note that so far back as the year 1830 Fox made some experiments with a galvanometer with a view of attempting to determine the continuation of ore bodies. This method has since been tried on many occasions, but in nearly every case unsuccessfully. Recent variations of this consisted in connecting a current to earth and to watch the swinging of the galvanometer's needle or some equivalent. The idea was that the presence of a mineral lode would decrease the local resistance of the earth, thereby allowing more current to flow through the galvanometer, which would thus indicate the presence of the lode.

Mr. Alfred Williams informed the writer that he had measured over a hundred lodes in Alaska, British Columbia, the United States, Wales, and Cumberland, and had been unable to detect the slightest variation in resistance on the surface.

More delicate instruments than the old galvanometer have been employed in the measurement of earth resistance, and mining engineers and prospectors know only too well the numerous instruments and processes that have been brought before their notice.

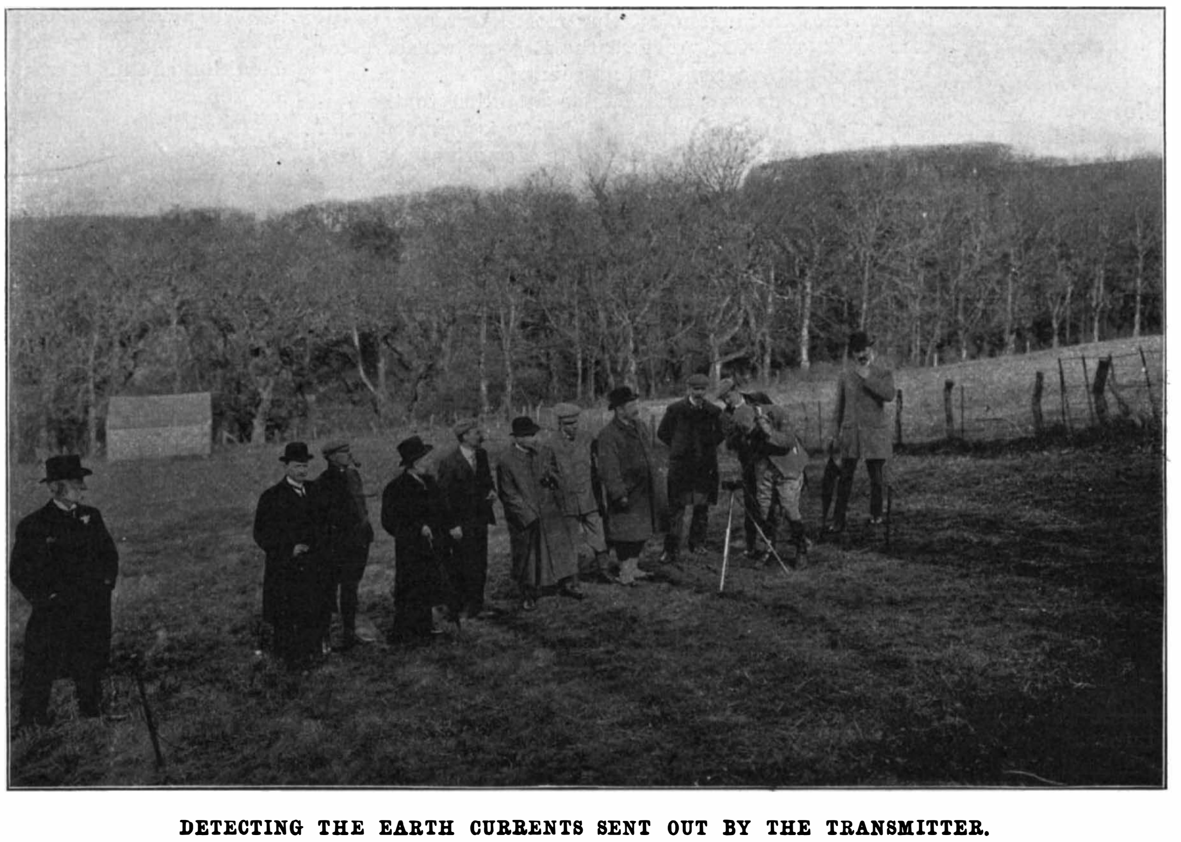
With the exception of the dip needle, which is used in prospecting for magnetic ores, no instruments are used by the modern prospector, who trusts to his geological knowledge, his past experience, his maps, and his knowledge of the country.

Prospecting is, of course, a very inexact science, and the mining world, it need hardly be stated, would welcome with open arms a system of ore finding which could be depended upon and which would do something toward lessening the yearly loss entailed in making borings which prove unsuccessful, and in opening up lodes which turn out to be not sufficiently promising to encourage the mine proprietors to continue their working.

In 1899 the inventors commenced experimenting with electrical methods of ore finding, and in 1899 Mr. Williams, in place of a galvanometer or potentiometer, used his body by passing quickly pulsated induced currents from a dry cell and a small coil in series with the earth. By this method the slightest increased intensity in the current flowing by virtue of the decreased resistance of the earth was instantly noticed.

He, however, soon abandoned this method as useless, for reasons characteristic of all earth measurements.

Messrs. Draft and Williams made their first practical experiment with their present system in Seattle, Wash., and San Francisco, Cal. These met with success, and the next trials were made in the southeastern Alaskan archipelago. Coming to England, they have achieved considerable success in prospecting for



DETECTING THE EARTH CURRENTS SENT OUT BY THE TRANSMITTER.

lead and zinc ores in Wales and for nemalite in Cumberland. The following is an instance of successful prospecting with this method.

The lead and zinc mines at Cwmstwth, Devil's Bridge, Cardiganshire, Wales, owned by Mr. H. Gamman, have been worked for the past 1,700 years, and a good-paying lode was found to cease suddenly in one direction. After costly and numerous attempts to discover this lode beyond this fault, the attempt was abandoned.

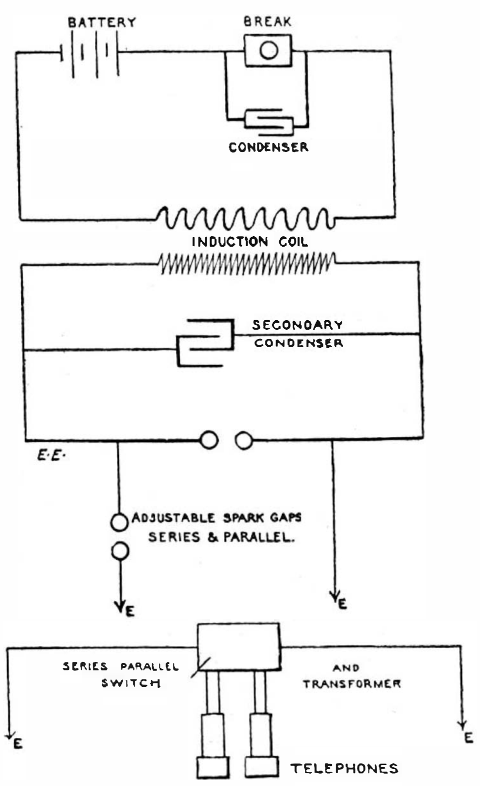
Mr. Williams, being called in, placed the two electrodes at a considerable distance from the broken lode on unmined ground, and in such a position that a perpendicular through the center of the line joining the two electrodes would coincide with the run of the lode as worked out.

The current streams from the one electrode to the other would thus, under normal conditions of homogeneity, pass at right angles through the extension of the lode if it existed beyond the fault.

Exploring with the resonators, Mr. Williams found on the hillside that the line of normal current flow was in several places rotated through a very considerable angle. After careful mapping out of the results obtained, the direction of the lode was finally predicted.

A tunnel was at once commenced by Mr. Gamman's instructions, with the result that a good lode of lead and blend was discovered after a drivage of less than three fathoms. Mr. Gamman told Mr. Williams that in proof of his belief in his *modus operandi*, he had ordered a third drivage to be started, to reach the rich ore detected by the instruments at a lower level.

Transmitting Apparatus.



Receiving Apparatus.

DIAGRAM OF THE DRAFT-WILLIAMS SYSTEM OF ORE PROSPECTING.

"Had your instruments," writes Mr. Gamman, "been discovered years ago, it is my opinion that tens of thousands of pounds would have been saved in these mines alone."

It will, of course, be necessary to train mining engineers and prospectors in the use of the instruments and in the detection of the presence of the waves. The whole outfit is, however, simple and easy to work with. Its development during the next few years will be watched with interest by all interested in mining operations.

[While this method of finding ore enables the prospector to detect and locate a body which is a good conductor of electricity, it, on the other hand, offers him no guarantee that this conductor is valuable ore; for any metal substance, such as iron piping or a piece of wire, or better still a stratum of moist earth or a subterranean stream, would affect the detecting instrument and indicate a vein of ore. Nevertheless, though this be so, the Draft-Williams system should be of valuable assistance to the prospector, because it reduces greatly his chances of failure by assuring him of the location of some good conducting medium, which can be further investigated by boring or some other test.—Ed.]

It is announced in Berlin that Count Zeppelin's airship shed on Lake Constance, together with his apparatus, will be sold at auction. The count is a poor man. He sank over one million marks in the enterprise.

In Sweden books are placed in third-class railway cars for the free use of passengers. A similar plan is about to be adopted in Denmark.

ALEXANDER GRAHAM BELL.

BY MARCUS BENJAMIN, PH.D

The World's Fair held in Philadelphia in 1876 had for its principal object the celebration of the one hundredth anniversary of our national independence, but of greater importance was the demonstration of the wonderful mechanical genius of our people, that has since given to the United States the industrial supremacy of the world. An event of that exhibition that is now historical is characteristic. Men of science had come from various countries to examine and study the numerous inventions that were to be seen. A demonstration of the transmission of sound by electricity was announced, and a special wire connecting widely separated parts of the grounds was installed. There were those who were incredulous of the possibility of sending the human voice over so great a distance, and they did not hesitate to express that opinion, but the youthful physicist with a boldness begotten of knowledge insisted that the instrument would do what he claimed for it, and it did. Distinct and clear came the tones of the voice at the other end of the line, forcing conviction upon those who were doubtful, and a new invention—the telephone—was given to humanity.

A few words will suffice to give an outline of the inventor's career. Alexander Graham Bell was born in Edinburgh, Scotland, in 1847, and in 1872 settled in Boston, where he was called to the chair of Vocal Physiology in Boston University, and there introduced the system of visible speech invented by his father, the venerable Alexander Melville Bell. The success of the telephone brought him fame and ample means, and having married the daughter of the late Gardiner G. Hubbard, he settled in Washington, residing there during the winter months, and spending the summers at his country place at Cape Breton.

While he is a man of leisure, as the phrase goes, Mr. Bell finds much to occupy his attention, and he has but little spare time. During the season that he spends in Washington, which is frequently interrupted, however, by trips to Florida or California, and to Europe, as is shown by the many interesting objects that he has gathered from various parts of the world, with which his house on Connecticut Avenue is filled, he nevertheless finds much to do with several institutions in which he is interested, for he makes the pursuit of knowledge his principal pleasure.

It will be remembered that for his invention of the telephone, the French Academy bestowed upon him its valuable Volta Prize of 50,000 francs, and with this sum, together with important additions, he founded in 1883 the Volta Bureau. A building was erected in Georgetown in which a library is installed and facilities are afforded for the study of problems by the solution of which the condition of deaf mutes may be improved. He frequently visits this Bureau, and exercises toward it almost a paternal interest.

Another institution in which Mr. Bell takes great interest is the Smithsonian Institution. He has followed most closely the experiments made by Secretary Langley in aerodynamics, and in 1891 presented him with the sum of $5,000 for the further prosecution of his investigations. Mr. Bell was an eye-witness of the successful ascensions of Dr. Langley's aerodrome in 1896, and communicated a description of those flights to the French Academy of Sciences. Mr. Bell was appointed in 1898 to the vacancy on the Board of Regents caused by the death of Mr. Gardiner G. Hubbard, and he also succeeded to Mr. Hubbard's place on the Executive Committee. He has recently advocated with much earnestness the bringing of Smithson's remains from Genoa to Washington, offering most generously to defray the expenses, provided the Regents will care for them on their arrival in this country.

Mr. Bell devotes considerable attention to the National Geographic Society, of which he is president, and the erection of the new building, a memorial to the late Mr. Hubbard, its former president, now rapidly approaching completion, is carefully watched by him. Whenever questions concerning the policy of the Society come up for consideration, or indeed other important matters pertaining to the development of geographic science, he gathers the Board of Managers around him at his home, and the subject is then thoroughly discussed. Two topics of more than common importance are now receiving much careful consideration. The first of these has to do with the Geographic Congress which is to assemble in Washington a year hence, and for which plans are now being matured; and the other is the selection of a suitable representative to accompany the Ziegler Expedition to the North Pole.

As a host Mr. Bell is most delightful. For several years his Wednesday evenings have been noteworthy, for to his home are invited men who know things, and who have something to say that is worth listening to. Distinguished visitors to the capital are invited to meet the men of science whose regular duties make them part of the official life of Washington; and Simon Newcomb, most eminent of American astronomers, S. P. Langley, the distinguished Secretary of the Smithsonian Institution, Carroll D. Wright, first among political economists and statisticians, Harvey W. Wiley, the genial chief of the chemical division of the Department of Agriculture, Willis L. Moore, the able head of the Weather Bureau, O. H. Tittman, of the Coast Survey, and the many younger men whose names need not be mentioned here, for they fill the pages of the most recent scientific journals, announce their latest discoveries, which are pleasantly discussed and commented on. It should be mentioned that as president of the National Geographic Society he frequently entertains distinguished explorers and travelers. The splendid reception that was tendered to Nansen a few years since was an event that will be long remembered, and this winter De Windt was made the guest of honor at a reception given by Mr. Bell after his recent lecture "From New York to London by Rail via Bering Strait." It is by such means that he finds his greatest enjoyment.

At his summer home in Cape Breton Mr. Bell finds it possible to devote even more time than ever to his hobbies, and these, as I have tried to show, form his chief enjoyment. His kite experiments, concerning which so much has been written without authority, have occupied much of his time; and it may be said that at one of his Wednesday evenings during the past winter he was prevailed upon to describe these experiments, the results of which will shortly be prepared for publication; it may be now said that after many trials with various forms of kites it became apparent that certain forms possessed greater force than others, and showed a power quite capable of carrying several hundred pounds. Another interesting investigation which he has carried on at his summer home has been the improving of the breed of sheep on his farm. He found curiously enough that the amount of food given to the animals seemed to have a direct relation to the sex of their young. His results of this investigation were presented before the National Academy of Sciences at the spring meeting in 1901, and referred to in the Scientific American for April 27 of that year.

Naturally Mr. Bell has received many honors. The French government, ever quick to recognize science, has conferred upon him the decoration of the Legion of Honor in one of the higher classes. The Society of Arts in London in 1902 gave him its Albert medal, which is awarded only to those who by their writings, researches, inventions, or investigations have done something that will forever be of lasting benefit to humanity. Eads and Edison are the only Americans who have previously received this medal. In 1883 he was chosen a member of the National Academy of Sciences in our country.

Universities at home and abroad have conferred honorary doctorates upon him. The National Deaf Mute College of Washington and the University of Würzburg, Bavaria, have given him the degree of Ph. D. The exceedingly ingenious electrical device, by means of which the exact location of the bullet in President Garfield's body was detected, was invented by him and gained for him the honorary conferment of the degree of M. D. from the University of Heidelberg at the time of the celebration of its fifth centenary. Amherst (1901), Harvard (1896), and St. Andrews (1902) have conferred upon him the degree of LL. D., and that from Harvard was in special recognition of his method of improving the condition of deaf mutes.

PROF. BELL'S KITE EXPERIMENTS.

The final paper read before the last meeting of the Academy of Sciences was "On the Tetrahedral Principle in Kite Structure," by Alexander Graham Bell. At the outset he said that in the old Hargrave box kite, and all subsequent kites and flying machines of the same order, there were two important defects, which he described as follows: The box kite is braced in a horizontal and vertical direction, but not otherwise, so that cross supports have to be introduced in the frame, which increase the weight without adding to the flying power, and at the same time operate as an obstacle to the wind. The chief defect of the box kite, of which Dr. Langley's aerodrome is an elaboration, is that the weight increases with the cube as rapidly as the lifting power does with the square, so that the larger the kite, the less it will lift in proportion. In view of these facts, he had been led, he said, to construct a kite, the frame of which would present the form of a triangle no matter from what side one viewed it. In other words, the frame was a perfect tetrahedron; and in experimenting with the same, he found, as he had expected, that it was self-braced in every direction, and moreover, that the lifting power increased at a greater ratio than the increase in weight. He was, furthermore, surprised at the facility with which such a kite could be managed. By combining a great number of these kite terahedrons he had recently built up an immense kite, with which he successfully lifted not only a man, but a weight of 200 pounds, showing the vast improvement of this over all previous machines of the same order.

Correspondence.

European Fire Engines.

To the Editor of the SCIENTIFIC AMERICAN:

In your article on European Fire Engines, published in the SCIENTIFIC AMERICAN for January 17, 1903, certain mis-statements are made in a note, which we feel called upon to correct. The system of supplying the hose with water directly from the hydrant by means of a snort connecting hose under the pressure in mains has long been known and applied in German cities where street hydrants have been installed. In village communities, where there is no system of supply pipes, but where the head of the water is considerable, iron pipes are driven into the soil, by which pipes the subsoil water is directly fed to the hose.

Every hand pump and likewise our own motor-driven fire engine is provided with a device, whereby it is possible, without uncoupling the section-hose, to draw water from without or from the tank on the engine. This device is merely a three-way valve, the application of which in this connection seems to have escaped the notice of the author of your article.

The provision of a water-tank on the engine is advantageous for the reason that it renders it unnecessary to carry a separate water receptacle. A water receptacle in a fire engine is never unnecessary, since in some cases it may be very serviceable, for example, if a water pipe should burst.

It is true that in Vienna water casks of 1,000 liters capacity are used; but if the city had the water-supply system referred to in the article, it would be unnecessary to employ these casks.

Freiburg i. B., April 8, 1903. GRETHER & Co.

[Our correspondents acknowledge that the incorporation in their machine of a water-tank obviates the necessity of carrying one along. Why is one at all necessary if the engine is directly connected with the hydrant by the three-way valve? It is said that such a tank is "never superfluous." Why not? If a hydrant break, water can be taken from another. Of what use is a tank on the truck unless there be other trucks with tanks at hand to keep it filled? Clearly, the tank must be used for something; and if the hydrant be used, the need of a tank is not very apparent. What the conditions may be in Vienna now, we do not know; but we were careful to state in the footnote to the article criticised that the conditions described prevailed in Vienna several years ago. And that statement was made on the strength of actual observation. —ED.]

The Duodecimal System Again.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the article of N. Y. Hubbard, on page 299 of SCIENTIFIC AMERICAN of April 18, allow me to say: All of Mr. Hubbard's objections to duodecimals fade away, *provided* the arithmetic is brought to that change along with all tables. Duodecimals would then have all the advantages claimed for decimals, and many that decimals never can have.

Try to teach a child fractions by means of a decimal numeral frame, and see how poorly you will succeed compared to the same effort with the aid of a duodecimal frame. Seek to pack a hundred different articles each by tens in boxes, and see how great a proportion of them will be utterly unmanageable, and then see how readily they will nearly all conform to the necessity of the situation by packing in dozens. When you have them in boxes, try your hand at packing the boxes by tens in cases, and see how soon your troubles begin, and how difficult they will be to get rid of. But try packing them in dozens, and see how readily you will solve the problem in almost every case.

The great superiority of duodecimals in the practical, everyday affairs of trade, commerce, and ordinary business is so great, that no laws in any manufacturing or commercial country can be made that can compel the use of decimals to the displacing of dozens and grosses.

James Watt, Thomas Jefferson, John Quincy Adams, Abbe Gabriel Mouton, and N. Y. Hubbard may have spoken favorably of decimals, but it would have been impossible for either of them to show that eight, nine, twelve, or sixteen was in any way inferior to ten as a base number for the practical affairs of life, while as a matter of fact either one is superior, and twelve is almost infinitely superior to ten. You can divide ten by two and five without a remainder, and that is the limit; but you can divide twelve by two, three, four, and six.

We believe every reader of the SCIENTIFIC AMERICAN would be interested in the editorial opinion of the paper as to whether, in the practical business affairs of the world, twelve would or would not be superior to ten as a base number, and given a system of numbers based thereon, whether duodecimals would not be superior to any system that can be devised from the use of decimals. R. C. ELDRIDGE.

Niagara Falls, N. Y., April 17, 1903.

Automobile News.

It has been definitely decided that the Gordon-Bennett race will be held on July 2. The race will be followed by a fortnight devoted to tours, hill-climbing contests, motor-boat races, etc., in Ireland. It is expected that many English and American motorists will attend and participate in these events.

As a result of the so-called eliminating trials for contestants to represent America in the Gordon-Bennett Cup race, it has been decided to send, in addition to Alexander Winton, Louis P. Mooers with his Peerless racer, and Percy Owen with his Winton. The latter succeeded in covering 5 miles in 5 minutes, 25 seconds, but Mooers' machine was not in very good shape and did not make any startling bursts of speed. H. S. Harkness was present at the trials, but the new racer he is having specially built was not ready. He will probably go to Ireland as a substitute, however, after running his racer in the Paris-Madrid race the last of May.

In the Nice-La Turbie hill-climbing contest on April 1, which was brought to an abrupt end by the fatal accident to Count Zborowski, one of the first three contestants who preceded him and were also mounted on Mercedes machines, came within one-fifth of a second of equaling Gabriel's record of 15 minutes, 45 seconds, made last year, while another, Hieronymus by name, made 1 minute, 18 1-5 seconds better time than Gabriel, and established a new record of 14 minutes, 26 4-5 seconds.

At the annual speed trials held at Nice on April 7, Leon Serpollet on his steam racer covered a kilometer from a flying start in 29 1-5 seconds. This was 3-5 of a second better time than he made last year, and, it being the third time he has won the Rothschild cup, according to the rules he is now the owner of it. No less than eight contestants broke the mile record from a standing start of 1 minute, 9 seconds, until then held by Augieres. The best time made in this event was that of Mr. Alfred Harmsworth in a 60 horse power Mercedes car. This was 1 minute, 3.72 seconds.

Two other interesting events that occurred during the Nice automobile week were the brake and consumption tests. The former test consisted in running the cars down a hill in a minimum and a maximum time, and having them make four stops during the descent. A maximum distance of 65 feet was allowed in which to make a stop. The best showing was made by three Rochet-Schneider cars, which made stops in 19.68, 39.37, and 55.77 feet respectively, the times taken in descending the hill being 19 and 20 minutes. In a test made running down hill backward, stops were made in 6.06, 8.43, and 10.49 feet.

Each contestant in the fuel consumption test was allowed 100 grammes (3.53 ounces) of gasoline per 50 kilogrammes (110.23 pounds) of gross weight of his machine. A 6 horse power Renault voiturette and two 6 horse power de Dion "Populaire" machines made the best records. The fuel consumed, distances covered, and times were as follows:

Cars	Gasoline Consumed	Distance Traversed	Time
6 h. p. Renault Voiturette............	1 890 kgs. 4.166 lbs. .666gals.	33.702 kms 20.928 miles	h. m. s. 1 27 24
6 h. p. de Dion Bouton "Populaire"	1.880 kgs 2.380 lbs. .380gals.	31.483 kms. 19.550 miles	h. m. s. 1 33 39
6 h. p. de Dion-Bouton "Populaire"	1.066 kgs. 2.350 lbs. .376gals.	31.050 kms 19.282 miles	h. m. s. 1 33 30

The Automobile Club of America will hold a commercial vehicle test on May 20 and 21. There are six classifications of vehicles according to the load carried, the loads ranging from 750 to 20,000 pounds. According to the rules, a vehicle may carry 300 pounds more or less than specified in the class in which it is placed, provided the dead load carried, exclusive of driver and observer, be at least 50 per cent of the weight of the vehicle. Electric vehicles will be allowed one stop for charging, but the current used will count against them. Stops made by gasoline or steam trucks or delivery wagons for fuel or water will also be penalized. A 40 mile route around the city will be covered each day, the first day without stops and the second with a certain number according to the size and weight of the vehicle. An accurate account of fuel consumption will be kept, so that the cost per ton-mile with the different kinds of power can be figured. The contest will doubtless throw some light on the cheapness of automobile transportation when wear and tear and depreciation of machinery and batteries are left unconsidered.

The Bailey automobile bill, which was passed by the New York State Legislature on April 22, has some peculiar clauses in which its originator evidently attempted to make automobiling impossible. One of them is to the effect that no automobile shall pass a person walking, or driving a horse on the highway, at a greater speed than 8 miles an hour. As most horses are capable of slightly exceeding this speed for some distance if urged, an automobilist overtaking a horse-drawn vehicle may be compelled to take its dust for several miles before it will come within the limit at which he is allowed to pass. Another clause forbids a faster speed than 10 miles an hour when passing a school house on week days or a church on Sunday. The only feature of the bill that is to be commended is the clause making it impossible for the authorities of any city or town to pass an ordinance compelling a slower speed than 8 miles an hour in the built-up part of the city, 15 miles an hour where the houses are 100 feet apart, and 20 miles an hour in all other places.

Engineering Notes.

Some interesting and valuable particulars regarding turbine air compressors have been announced in a lecture by the Hon. C. L. Parsons, the inventor of the steam marine turbine. The Parsons Company is now making a specialty of this apparatus, and some very remarkable results in contrast with air compressing plants have been attained. In one case a compressor driven by an electric motor, supplying air at a pressure of 2 pounds per square inch, delivered 3,500 cubic feet per minute, and the efficiency of the plant as measured by the ratio of air horse power to electric horse power was 61 per cent. With the Roots blower, which was previously used, the efficiency measured was only 41 per cent. In another similar plant in work at a foundry near Leeds, 11,300 cubic feet of free air is supplied per minute at 3 pounds pressure. In this instance the air turbine is driven by a steam turbine running at 5,200 revolutions per minute, and the air horse power is 61 per cent of that theoretically obtainable from the steam used.

Dr. Robert H. Thurston, of Cornell University, says that two controlling tendencies mark the improvement in the efficiency for commercial purposes of every product of the engineer's labor; their resultant varies as the one or the other is in the ascendant. These are increasing costs with increasing efficiencies, and advancing expenditures with diminishing gain. As the outgo for increments of efficiency and economy continues, the gain by increased efficiency is partly, or wholly, or more than wholly, compensated by the simultaneous increment of cost. With the crude apparatus of the earlier stages of uneconomical and incomplete industrial systems, there usually exist great opportunities for improvement by refinement of the apparatus and by systematizing the industry at, often necessarily, increased cost in the form of invested capital. Later, the possibility of further improvement lessens, and the costs to secure any given gain increase, until it ultimately becomes a fact that more must be paid for a given gain than it is worth, and the net outgo on the improved apparatus or system becomes, interest and sinking fund included, more than that on a less perfected machine or system. What may be called a "golden mean" is thus always found at that stage at which the cost of additional economies will exceed the necessary cost of securing them and where the result of securing them is loss rather than gain. The resultant of the two tendencies takes a direction which thus tends toward the unprofitable, and a limit may thus always be expected to be found, beyond which further refinement is financially undesirable.—Cassier's Magazine.

Of late years the size of gas engines has much increased. Many makers are now building machines of 2,500 horse power, and are ready to double this efficiency. The development of large gas engines is closely connected with the evolution of the fuel-gas processes, and it is noteworthy that the first gas engines in England above 400 horse power were operated with producer gas, while many of the large gas engines in Europe have been built for use with blast furnace gas. In August, 1902, two English firms had under construction over fifty gas engines varying in size from 200 to 1,000 horse power. A classified list of engines made or making shows 327 such with an aggregate horse power of 182,000, or about 560 horse power per machine. The last volume of the United States census reports 18,500 combustion engines in the country, with a total capacity of 165,000 horse power, or only about 9 horse power on the average. This state of things is not likely to last long. One American firm has already sold over 40,000 horse power of large engines, most of them of 2,000 and several of 1,000 horse power. Another has recently built two 4,000 horse power gas compressors and a number of 1,000 horse power gas engines. The gas engines of the larger sizes are extensively used for generating electric light and power, but there is a decided tendency to employ the smaller sizes direct as motors. Cheap fuel gas processes will bring the gas engine to replace the electric motor for very many purposes, and we may look for development along these lines in the near future.

EXPERIMENTS IN FOOD PRESERVATIVES CONDUCTED BY THE DEPARTMENT OF AGRICULTURE.

BY OUR WASHINGTON CORRESPONDENT.

That the public is entitled to an exact knowledge of the things that it purchases, is becoming more and more a recognized fact, and especially so in regard to food. The addition of an ingredient to a standard food product may or may not have a deleterious effect, depending, for instance, among other things, on the constitution of the individual, and experts have frequently testified, both in published volumes and before courts, to opposite opinions. It was in consequence of this condition of affairs that by Act of Congress, approved on June 3, 1902, funds were provided "to enable the Secretary of Agriculture to investigate the character of proposed food preservatives and coloring matters, to determine their relation to digestion and to health, and to establish the principles which should govern their use." This work was naturally assigned to the Bureau of Chemistry, in the Department of Agriculture, and is now being actively carried on under the direction of its chief, Dr. Harvey W. Wiley.

Early in December of last year a kitchen and dining room were fitted up in the basement of the building occupied by the Bureau of Chemistry, after which application was made to the Civil Service Commission for a cook, and an expert was obtained, whose skill and knowledge were certified to by several of the *bon vivants* of Washington. The selection of young men on whom to experiment was not so easy, for the all-powerful Civil Service Commission was for once impotent, and in consequence volunteers were called for. In time Dr. Wiley succeeded in obtaining a dozen or more young men, chiefly from his own Bureau, who were willing for the cause of science to submit themselves to the experiments.

In order to secure the desired results, it became necessary to determine a series of facts concerning the subjects. Accordingly they were at the outset critically examined by a physician from the Bureau of Public Health and Marine Hospital Service, and then for a period of time were fed on pure food, so as to determine exactly what quantity of food was necessary for their normal diet. That is to say, each man throughout the entire course of the experiments is allowed only the same amount of food, which, however, may vary with the individual, but which amount is determined after experimentation to be just enough to maintain the individual in a normal condition. Charts were prepared for each person, on which the weight is daily recorded, and also a record made each day of the temperature taken before and after dinner. The number of heart beats and the respiration are determined twice daily, the blood corpuscles are counted, and the amount of hemoglobin in the blood measured. Of course it is understood that the subjects were pledged to eat only the food given to them by Dr. Wiley, and to refrain from the use of stimulants, although tobacco is allowed during the experiments in the regular manner in which it had been used.

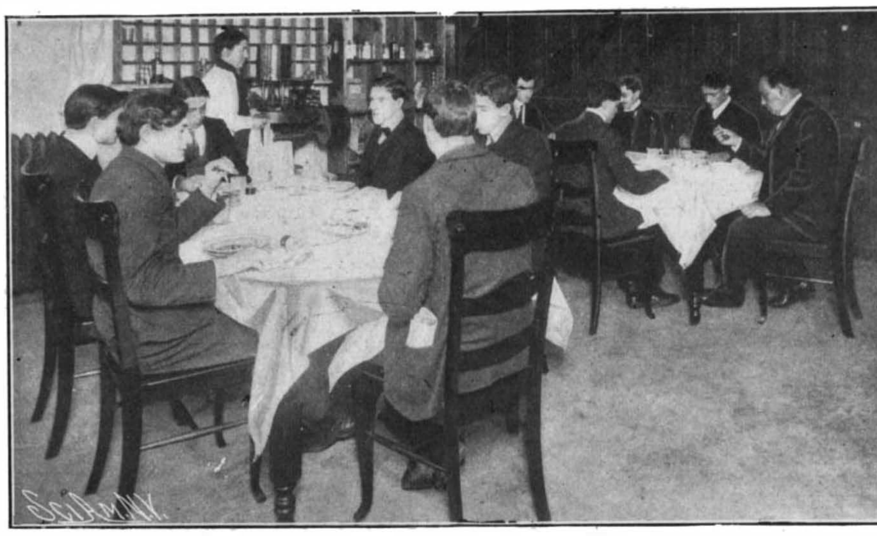


Fig. 1.—Prof. Wiley at Table With His Guests.

The selection of the first substance to be experimented with was considered, and borax was chosen, concerning which it is generally admitted that it is a most excellent preservative, especially for meats and dairy products. A small quantity of borax will act as a preservative just as well as a large quantity of salt. Therefore admitting, for the sake of argument, that borax taken in certain quantities does derange the physiological functions, it is probable that it does not do so to such an extent as does the larger quantity of salt which must be used as its substitute. In the case of meats, if preservatives are really injurious, the injury is a necessary evil, unless the meats are preserved solely by the canning process. In some instances, such as with hams and breakfast bacon, this method would practically destroy the qualities of those meats which are most desired.

The young men having reached a normal condition, that is, possessing a constant weight, and the proper amount of food for each having been determined, they were divided into two sets of six each, and the experiment began. One set was fed with pure food only, and the other set with food to which borax, in increasing amounts, was added, and the effects on metabolism noted. These experiments continued for about four weeks, when the young men changed. That is to say, those who had been eating the food to which borax was added were now fed only on pure food. There was also a special set, consisting of two young men, who were fed continuously on food containing borax. It is understood, of course, that the object of the investigation is to ascertain the changes that occur in the subject, in consequence of the use of the special preservative employed, which in this instance was borax. Therefore, the exact quantity of food required normally by the individual being known, he is given exactly that amount, with the addition of varying proportions of borax. The food is carefully analyzed, so that it may be known exactly how much of each ingredient is given to him, and all that is excreted, both solid and liquid, is carefully weighed and analyzed. By striking a balance, the precise amount assimilated is deter-

Fig. 2.—Dr. Bigelow Examining the Cooked Food in the Hygienic Kitchen

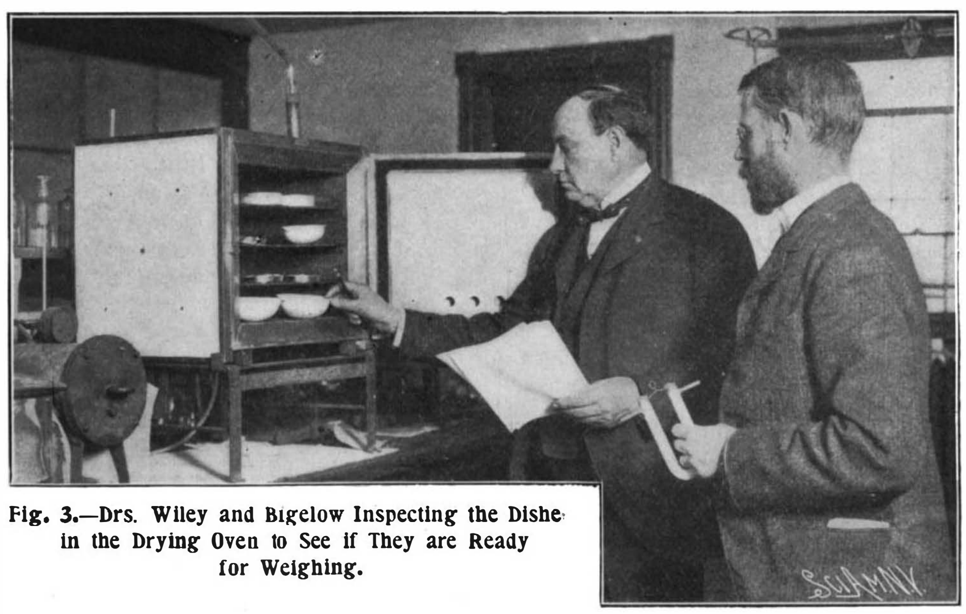


Fig. 3.—Drs. Wiley and Bigelow Inspecting the Dishes in the Drying Oven to See if They are Ready for Weighing.

Fig. 4.—Drs. Wiley and Bigelow Examining the Capsules in Which the Preservative is Administered.

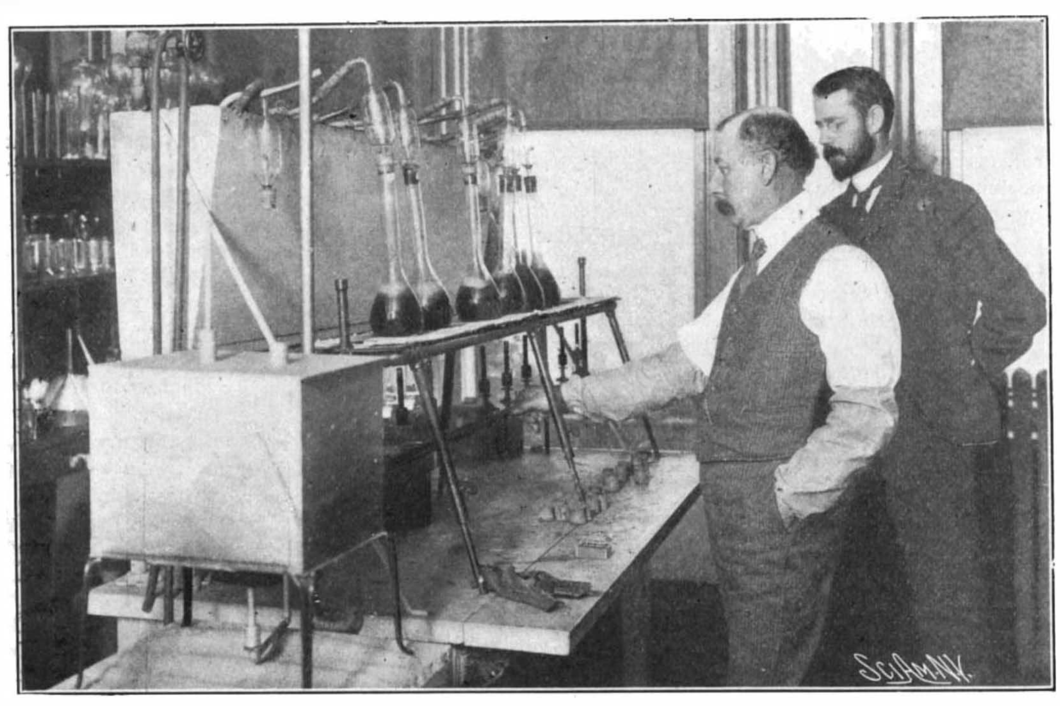
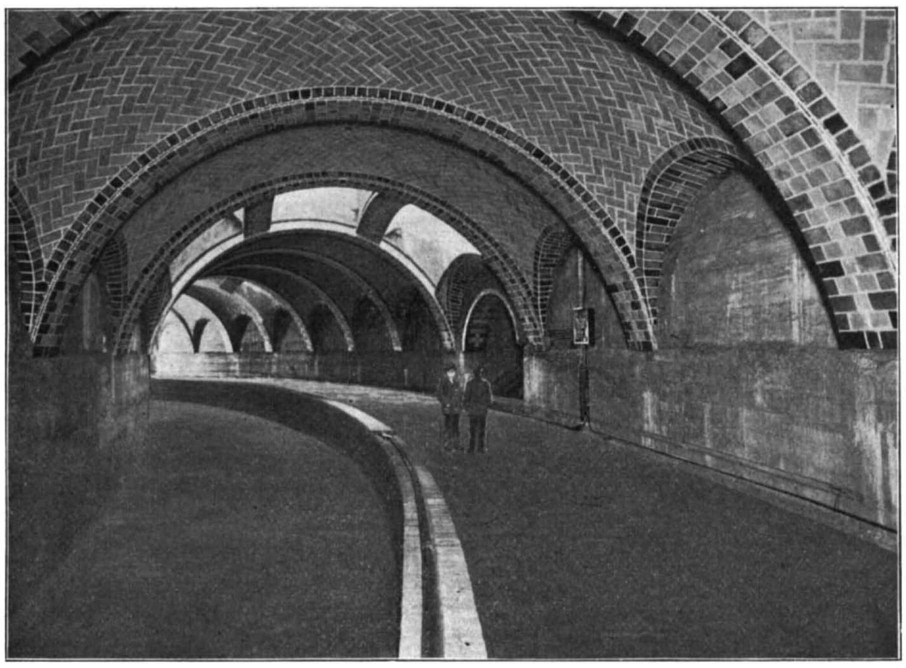
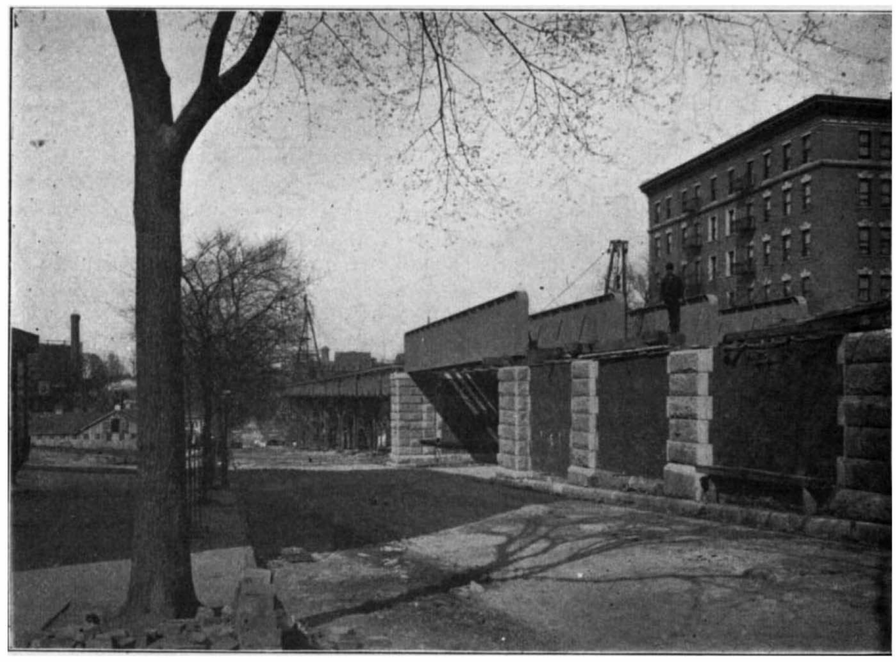


Fig. 5.—The Apparatus Used for the Determination of Nitrogen.

EXPERIMENTS IN FOOD PRESERVATIVES CONDUCTED BY THE DEPARTMENT OF AGRICULTURE.

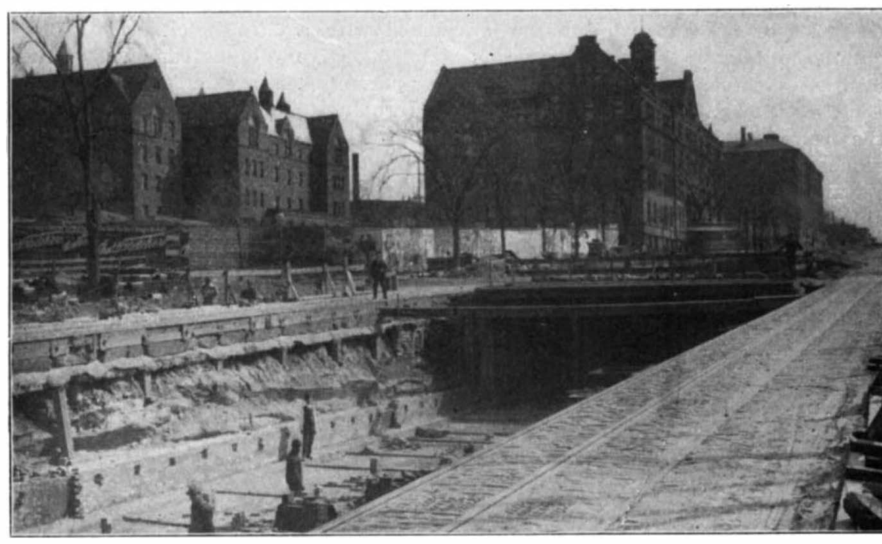


City Hall Loop Station; Concrete Roof, Tile-faced.

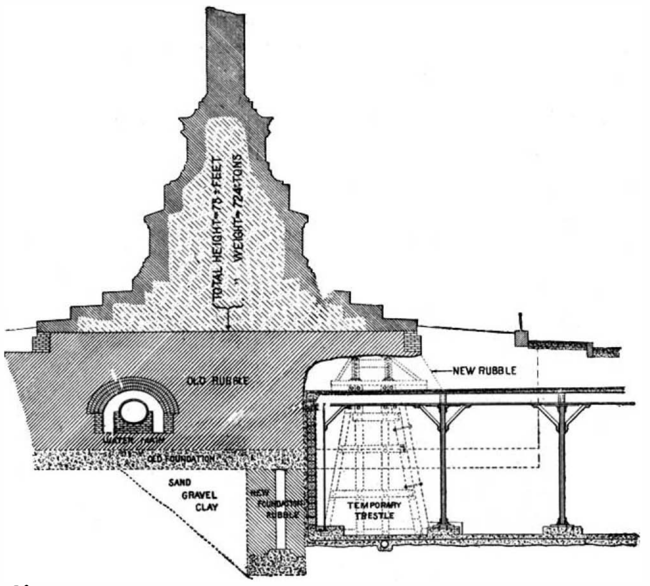


Masonry of North Approach to Manhattan Valley Viaduct.

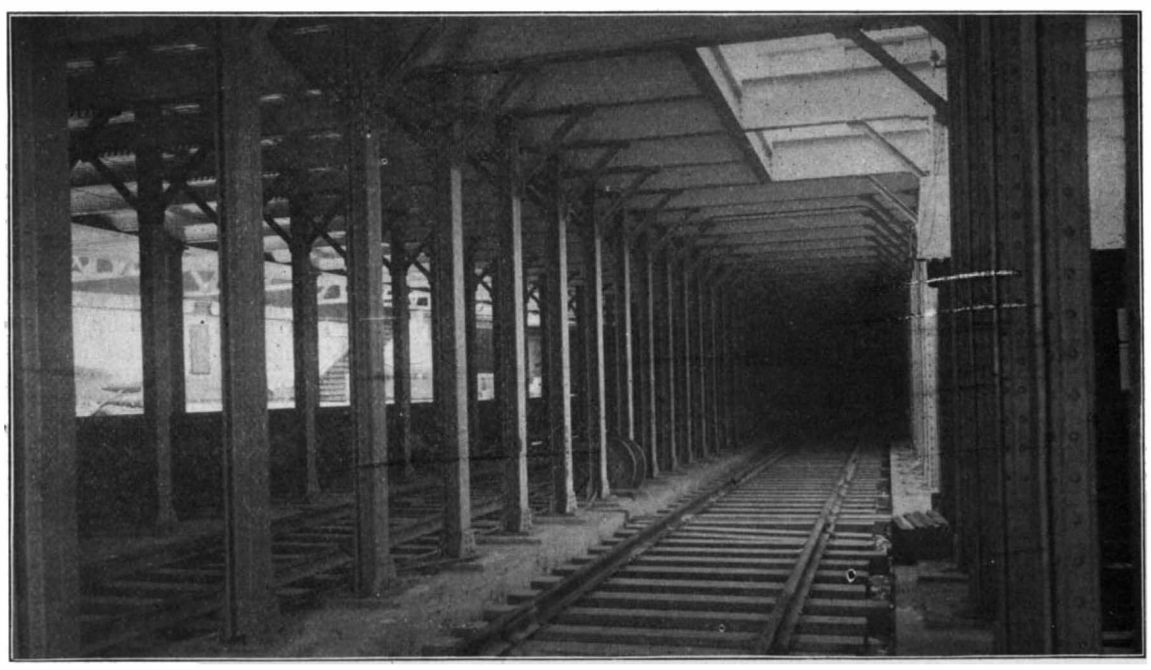
Manhattan Valley Viaduct, Showing Skewbacks for Arch.



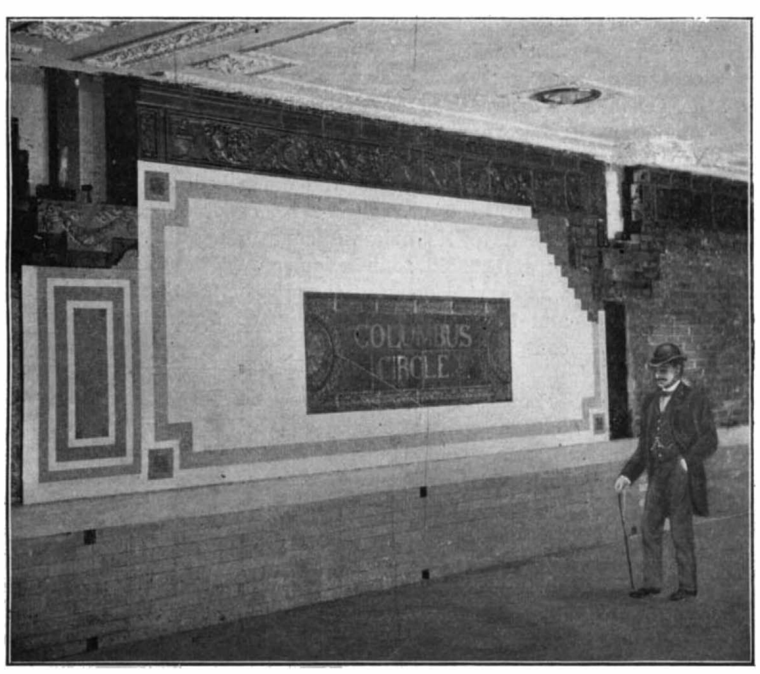
Entrance to Subway from Viaduct Looking South.



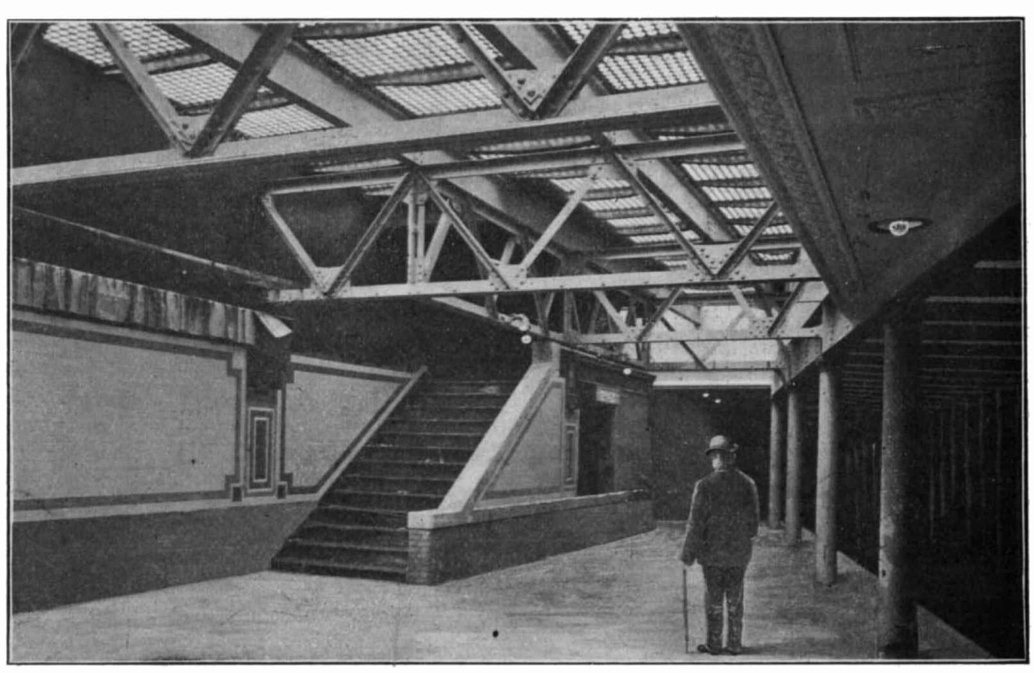
Showing Method of Supporting Columbus Statue During and After Building Subway



View Looking Up One of the Express Tracks at Columbus Circle Station.



Interior Tile Decoration of Station.



Stairway, Platform, and Vault-lighting of the Columbus Circle Station.

Photographs made especially for the Scientific American.

CONDITION OF THE WORK ON THE RAPID TRANSIT SUBWAY.

mined, and the changes in weight or metabolism show the results of the value of the food on the individual. It may be added that the services of some twenty chemists and assistants are required for the various analyses that are essential in this investigation.

A few words about the food may be of interest. The meals are simple, but the best food obtainable is provided, including fruits and vegetables of the season. For breakfast, which is served at 8 o'clock, a cereal, meat with mashed potatoes, bread and butter, and coffee and milk, are furnished. At 12, a luncheon is provided, consisting of soup, bread and butter, fruit and milk. The dinner is more elaborate, and occurs at 5:30 in the afternoon, and a typical meal is the following: Roast beef, mashed potatoes, string beans, bread and butter, milk and sugar, with boiled rice as a dessert, and coffee. In order that the proportion of meat may be constant in its value, and so that a fair sample may be secured for analysis, it is ground up before it is served. The bread is specially prepared on a constant formula. Condiments, such as salt, pepper, and certain spices, are permitted, but the quantity taken by each individual is determined.

Unfortunately, at the beginning of the investigation there was a disposition on the part of some of the newspapers to treat the experiments in a spirit of levity, and stories were told of how, for instance, the coffee of one of the subjects was sweetened with a quinine pill, and the occurrence of slight digestive disorders was magnified into cases of serious poisoning. But these, it is almost unnecessary to say, were due to the desire of the reporter to make "copy." But in consequence of these stories Secretary Wilson, of the Department of Agriculture, than whom no one is more able and progressive, wisely issued an order that no further information should be given to the public. This regulation has also the additional merit of preventing the publication of undigested periodical returns.

It is generally assumed that the experiments with borax will be continued until June, when a further selection from substances, such as benzoic acid, formaldehyde, salicylic acid, sodium benzoate, and sulphurous acid, will probably be made. It is expected that several years will elapse before the entire series of experiments will be completed.

As to the ultimate value of the result to be obtained, it may be said that the information will be of service in shaping intelligent legislation, regulating commerce in food products, securing the removal of unnecessary and unjust restrictions, and making effective those that are necessary and just. It will serve as a basis for international agreement in regard to the composition of preserved foods. At present different nations have widely different laws to protect and regulate the importation and exportation of food products. The experiments will serve also as a basis for rational advice on the part of hygienists and physicians in regard to the foods that should be or should not be used by persons in ordinary health, and they will be especially valuable in the treatment of invalids. The investigation will produce results which will tend to conserve the public health and guard the invalid and the weak person from injurious substances.

The illustrations show the various phases of the work.

In Fig. 1 will be seen the arrangement of the two tables, with Dr. Wiley at the head of the table to the right. Fig. 2 represents Dr. Bigelow examining the cooked food in the hygienic kitchen. Fig. 3 represents the method of conducting the chemical test with the analyses of foods and excretions. Drs. Wiley and Bigelow are inspecting the dishes in the drying oven to see if they are ready for weighing. Fig. 4 shows Drs. Wiley and Bigelow examining the capsules in which the preservative is administered. The nitrogen balance is the most important of the factors determined in controlling metabolism; Fig. 5 shows the apparatus used for the final determination of the nitrogen in the foods and excreta. Dr. Bigelow and Mr. Trescott, the nitrogen expert of the Bureau of Chemistry, are conducting the determination.

CONDITION OF THE WORK ON THE SUBWAY.

In agreement with a practice which we have followed each year since the opening of work on the Rapid Transit Subway, a representative of the Scientific American recently made his annual inspection of the work from the Bronx to City Hall Park. The result was on the whole encouraging, and seems to bear out the statement of the contractor that he will have trains running as far north as 145th Street by the close of the present year. At the same time, it is evident that if this promise is to be fulfilled, the finishing up of those portions of the line that are at present in the most backward state will have to be rushed through with much greater expedition than has been shown during the past year in finishing up some other portions of the work, which twelve months ago were in a very advanced condition. Even if the Subway is completed and the steel laid ready for the trains, there is still the important question to be considered of the erection of the power house and the installation of sufficient plant to operate this portion of the line. Fortunately, the strike on the power house, which threatened to delay the whole Subway, has been amicably settled, and construction is being pushed along at full speed.

Although the prospect of an early completion of the Subway tunnel and tracks is good, and the contractors and engineers are to be congratulated on the fact that they are from six to nine months ahead of the contract, so far as the actual running of trains is concerned, it is impossible to shut one's eyes to the fact that so far as the most important question of restoring the street surfaces along the route of the Subway to their proper uses is concerned, the contractors have been grossly negligent, and have shown an indifference to the rights of the public which cannot be too strongly censured.

The total length of the Subway, including the deep-level tunnels and elevated structure, is about 20 miles, of which about 11 miles have involved the opening up of the streets; about 3½ miles is deep tunnel work that has been carried on without any considerable obstruction of the surface; and about 5½ miles consists of elevated structure. Dealing first with that portion of the Subway that has been built by the cut-and-cover method, in which it must have seemed to the citizens of New York that there was a great deal of cut and very little cover, it may be said that the greater part of it is to be found in Manhattan, between City Hall Park and 145th Street, and on the easterly branch of the road from 104th Street to the Harlem River. As this is the section of the road for which there is the most pressing demand, and because the cut-and-cover system involves the most complete disorganization of city traffic, the public is doubly desirous of seeing it cleaned up, and the street surface restored to its original condition. At the present writing, out of 10.8 miles of the Subway constructed by this method, 6.35 miles have been completed, that is to say, the tunnel has been excavated, the steel framework erected, the concrete roof and brick or terra cotta sidewalls built, the excavation filled in, and the street surface paved or asphalted as the case may be.

There are 1½ miles of the Subway on which the steel work has been erected and the concreting is now going on. The excavation over this portion of the line is, of course, still open and the streets encumbered, but the work is in such an advanced stage that another month or six weeks should see it completed and the street surface restored.

There are other portions of the Subway, aggregating altogether 1.35 miles in length, where the steel structure is only partially completed; but in this case the work of concreting is following close upon the heels of the steel work. Then there are various stretches of the work, making a total of 1.6 miles, on which the work of excavating is still in progress, and as the excavation is mainly in rock, it must necessarily proceed rather slowly. In this case also the work of putting in steel and concreting is following closely upon the excavation.

Of the deep-level tunnels that are being excavated entirely through rock, there are three principal sections. The first of these is the notorious double tunnel, with two tracks in each, extending from 34th Street to 42d Street; notorious because of the unfortunate accidents due to the faulty quality of the rock, which resulted in the collapse of several houses on Park Avenue. This important stretch of tunnel work is completed. The next section of deep tunnel is that which runs under Washington Heights between 145th Street and the station at 160th Street; and here the heading has been cut through and the men are now on bench work, that is to say, they are blasting out the lower half of the tunnel, and some of the concreting has been completed. Between 161st Street and 181st Street the heading has been driven, the bench is being excavated, and some concreting is completed. The most backward portion of the tunnel is from 181st Street to 196th Street, where the heading has not yet been driven through, and the work will not be completed for twelve months or more.

The first portion of the line to be opened will be that from City Hall Park to the great underground storage yards at 145th Street, and on this part of the work there is a stretch of elevated viaduct which carries the tracks across the Manhattan Valley. The viaduct consists of a single-arched span over 125th Street measuring 172 feet between the skewbacks and a trestle approach on either side of it. This approach, of which we present some views, is practically all completed, there being a gap of only about 400 feet to be closed, and of this 172 feet will be taken up by the arched bridge. The connection between the tunnel and the trestle at either end will consist of an open cut and a masonry embankment. The embankment will be faced with stone and brick, and finished with a massive stone parapet of pleasing design, the character of which can be seen from the accompanying illustration. On the rest of the elevated structure, namely, the stretch from 196th Street to Kingsbridge and that which extends from about Third Avenue in the Bronx to Bronx Park, but little work has been accomplished, that which has been done consisting mainly of the foundations for the piers.

The east side branch of the Subway diverges from the main line at 104th Street and Broadway. It includes a tunnel beneath the northwest corner of Central Park, which is practically completed, and can easily be made ready for the passage of trains by the end of the year. The Subway below Lenox Avenue is completed; but the work below the Harlem River and the approaches thereto is still in a backward condition, and there is no possibility of its being ready as early as the main line to 145th Street. Most of the tunnel in the Bronx from the Harlem to Third Avenue is being excavated by the open process, and is in a very incomplete condition, the streets below which it runs being, for much of the distance, in a practically impassable condition.

The question of the opening of the main line at the end of the year is a question of the completion of the work at certain points, where it has been delayed either by legal obstructions or the backwardness of contractors, but chiefly by the former cause. The first break occurs between Worth and Canal Streets, where for some blocks only the easterly half of the tunnel has been completed and the westerly half still remains to be done. The next serious break is at Astor Place, where the work has been held up for a year and a half by the obstruction offered by Wanamaker's store; and if there is any delay in the opening of the line, it looks as though it will be chargeable to this obstruction more than to any other. The building is now being torn down, and the work of constructing a station at this point is being rushed as fast as men can be crowded upon it. The stations at 14th Street, 18th Street, and 23d Street are nearing completion, but the station at 42d Street is still in a very backward condition, quite a large section of the rock excavation opposite the Grand Central Station being still uncompleted. At 42d Street and Broadway also there is an enormous amount of work to be done. Excavation is being carried down at this point for considerable distance below the Subway tracks which here pass through the site which will be occupied by the new Times building. If trains are to be running at the end of the year around this curve, there will have to be some extraordinarily rapid work done both in excavation and steel work.

We present illustrations of two of the most important Subway stations on the whole line, namely, the loop station situated below City Hall Park and just in front of City Hall, and what is known as the Columbus Circle Station at 60th Street. They are representative of two different types of construction, the City Hall Park station being formed of arched concrete construction, while the roof of the Circle station is carried on steel columns and girders with concrete roofing turned in between the girders. In both cases it will be seen that the stations are well lighted by overhead sidewalk vault lights, assisted by a liberal use of incandescent electric lights. The finish of the walls will be in glazed tiling, the colors being chiefly white, green, and Venetian red. The names of the stations will be shown in large glazed tile letters set in the panels of the wall, and they will be clearly distinguishable by the passengers. The loop tunnel will contain a single track, and the station platform, and the whole station indeed, is on a curve of somewhat sharp radius. The Circle station being on the main line will contain four tracks. One of our views of this station shows the platform and one of the stairways, and the other is taken looking up one of the tracks where the line runs on a tangent. An interesting feature of the Circle station is the fact that the structure cuts in underneath the Columbus statue, which is over 75 feet in height and weighs about 724 tons. During excavation a pair of heavy steel girders was placed beneath the corner of the heavy base of the statue and carried on two temporary timber bents. The steel work was then built in place and concreted up, the temporary girders and bents were removed, and the surface restored to its original condition. To prevent sliding in of the old foundation, a new foundation of rubble was carried down at the side of the Subway excavation and left permanently in place when the Subway was completed.

Lord Rayleigh for some time past has been carrying out experiments relative to the surface tension of liquids. This tension is at the maximum in pure water, but by the application of the smallest drop of oil or grease, the tension is reduced considerably. This fact may be easily demonstrated by dropping a small piece of camphor into pure water, and it will rotate very rapidly. But apply a drop of oil to the water, and the rotatory motion ceases immediately. According to Lord Rayleigh, a film of oil on water may be so thin that its thickness is no more than one twenty-five-millionth of an inch—which is computed to be in all probability the size of a molecule of the oil.

MOTORS FOR THE NEW YORK CITY SUBWAY.

The Interborough Rapid Transit Company, more popularly known as the New York Subway, will operate two classes of train service. The first will consist of five-car local trains, composed of three motor cars and two trailers, making an average speed of approximately 16 miles per hour. The second will be eight-car express trains, comprising five motor cars and three trailers, making an average speed of 25 miles or more per hour. The same motors and gearing will be used for both classes of service. The motors, which are to be supplied by the Westinghouse Electric and Manufacturing Company, were designed especially for this purpose, and were made to fit the particular conditions and requirements involved. One of these requirements, and perhaps the most difficult, made necessary the designing of a motor of large capacity to fit into a limited space. As a result, the present motors are probably of smaller size for their output than any built heretofore.

The nominal capacity of the motor is 300 amperes at 570 volts, or 200 horse-power, for one hour. With this current and voltage, a tractive effort of 4,150 pounds is developed at the periphery of a 33-inch wheel, at a speed of 19 miles per hour. Although designed for an average voltage of 570, the motor will operate satisfactorily with voltages up to 625. It will carry loads up to 500 amperes without injurious sparking.

The motor has a field frame of cast steel, divided into halves on the line of the centers of armature and axle, and completely surrounding the axle. There are thus no separate axle bearing caps, and the number of pieces is consequently reduced to the least number possible for an easily accessible motor. The top half of the field can be readily lifted off, and access gained to the interior for inspection and repairs.

The four pole-pieces are made of laminated steel punchings held between heavy end plates and secured by rivets. The field coils are made of copper strap wound on edge. The insulation between turns consists of asbestos and mica, held in place by shellac and baked at a high temperature under heavy pressure, so that the coil and insulation make a solid mass. The completed coil is sealed in a curved metal case, from which it is insulated by molded mica made like the V-rings of a commutator. This construction gives a coil which is absolutely fireproof, moisture-proof, and practically indestructible.

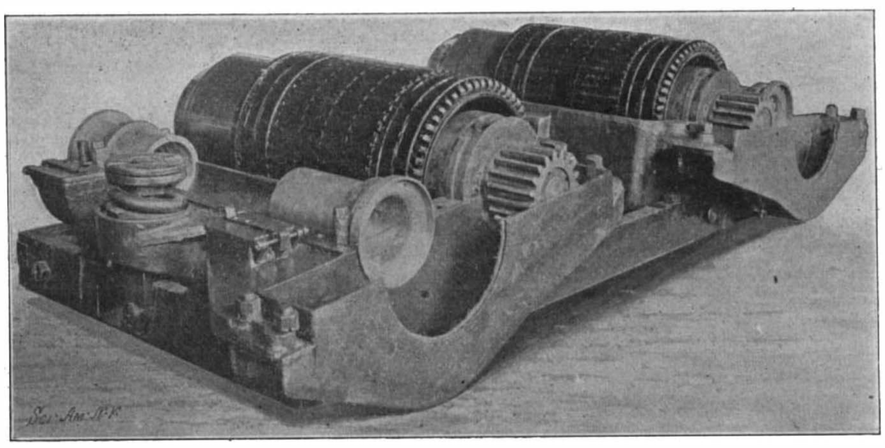
The armature is 20 inches in diameter and weighs 1,930 pounds. It is of the slotted drum type, and is composed of sheet-steel punchings assembled on a cast-iron spider. The commutator is also carried on the same spider, and the shaft may thus be removed and replaced, should this ever become necessary, without disturbing the armature winding or its connection to the commutator. The winding itself is of the two-circuit type, and is of ventilated construction. There are 53 slots and 159 coils, i. e., three coils per slot. Each coil consists of a single turn of copper strap. The coils are held in the slots by wedges of special unshrinkable material, which will withstand a high degree of heat without injury. This is a valuable feature, and gives a construction which is stronger and safer than the use of bands. It also greatly facilitates the removal and replacing of the armature coils. The armature insulation consists essentially of mica, which extends between turns at all points. The mica is protected by a sufficient amount of fibrous material to insure against deterioration due to mechanical vibration. This fibrous material is treated with a moisture and oil proof compound, forming an insulation capable of withstanding very high temperature without injury. The commutator is composed of 159 rolled and hard-drawn copper bars, held in place by two steel V-shape rings, one of which serves as an oil guard to thoroughly protect the mica from oil or grease. A low voltage between the commutator bars is secured, decreasing the liability of flashing from any cause. The bars are insulated from each other by sheets of mica of a hardness that insures its wearing at the same rate as copper. The mica separating the bars from the rings is 1-16 inch thick, and the mica ring also separates the bars from the commutator spider. The wearing surface of the commutator is 16⅞ inches in diameter and 9⅞ inches long. The bars are of a depth which allows a reduction in diameter of 2 inches.

The brush holders consist of two cast-brass arms, each carrying three carbon brushes ⅝-inch by 3 inches in section. The brushes slide over finished surfaces, and each is pressed on the commutator by a spring finger. The tension of these fingers is readily adjustable, and the brush holder arm is arranged for radial adjustment to allow for wear of the commutator. Copper clips are bolted to the carbon, and these clips are connected by flexible shunts, of ample capacity, to the body of the brush holder, thus relieving the springs from carrying the current.

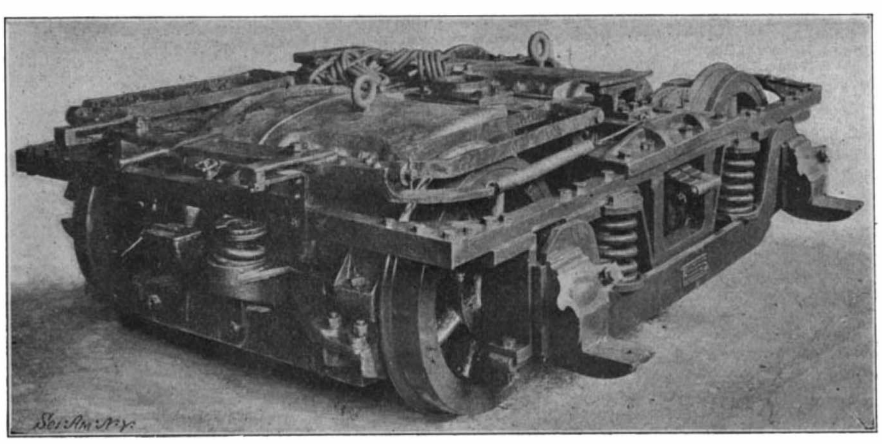
The completed motor will stand an insulation test between winding and motor frame of 4,500 volts alternating momentarily, or a test of 3,000 volts for one minute.

The armature bearings are contained in housings which are securely held between the halves of the field frame. These and the axle bearings are lubricated by oil fed to the journals by waste, in accordance with standard railway practice. The oil boxes are formed so that the waste will pack itself against the journals.

The gears are solid, of cast steel, with cut teeth. The pinions are forged steel with cut teeth. The gear case is made of malleable iron planed to a tight joint, with a suitable opening at top having a hinged cover. It is supported at the ends by horns cast on the motor frame and so shaped that they support the gear case without side strain, the weight being carried in its own place. The whole motor can be dismantled with great ease and dispatch without the use of any special tools. Its total weight including gear, gear case, etc., is about 6,600 pounds.



MOTORS FOR NEW YORK SUBWAY. UPPER HALF FIELDS REMOVED.



NEW YORK SUBWAY MOTORS MOUNTED ON TRUCK.

The Current Supplement.

The current SUPPLEMENT, No. 1426, opens with an instructive article on the great viaduct at Fort Dodge, Iowa. Several excellent illustrations accompany the article. Our Consul-General at Berlin gives a very valuable account of lignite, peat, and coal-dust fuel in Germany. Another technological article on a somewhat allied subject treats of the value of rational methods in coke production. Emile Guarini continues his lucid exposition of the development of the Marconi system of wireless telegraphy. Prof. W. Smart discusses industrial trusts. A readable description of Japanese lacquer and of its preparation and application is presented by Randolph I. Geare. Among the many things taught by the Correspondence Schools at Scranton is the method of instructing railroad men in the use of the air-brake. An article on the instruction given is published, together with some helpful pictures. Prof. A. W. Bickerton, whose letters on Star Explosions published in the SCIENTIFIC AMERICAN are doubtless remembered by our readers, outlines an original theory of cosmic evolution. Prof. John H. Poynting, well known to physicists the world over, tells of some recent studies in gravitation.

A Proposed Alliance of Astronomers.

In a pamphlet entitled "The Endowment of Astronomical Research," Prof. Pickering, of the Harvard Astronomical Observatory, proposes a combination of the world's observatories on a trust basis. He believes that by such a combination it will be possible to utilize existing astronomical stations to the utmost capacity.

Prof. Pickering shows that the astronomical industry is by no means as unimportant as one might suppose. The observatories of the world represent an investment of more than ten million dollars. Their expenditures, moreover, are large. The money spent varies from a few thousands to $85,000 per year.

The great observatories have so far shown a singular incapacity for concentrated effort. In 1891 fifty observatories agreed to watch the opposition of the planet Eros. But so far as is known, only two or three of them have made the reductions needful to give value to their observations. Sometimes it has happened that a great observatory has not been adequately equipped with a telescope; sometimes a great telescope stood ready for use, but no astronomer was at hand to use it; sometimes the collected observations of a famous astronomer have lain unpublished for years for want of a few hundred dollars.

Prof. Pickering has suggested the appointment of an advisory board of leading astronomers of the United States, who would meet at regular intervals for the purpose of considering how resources may be expended in order to receive the maximum scientific return. Details of organization are also outlined.

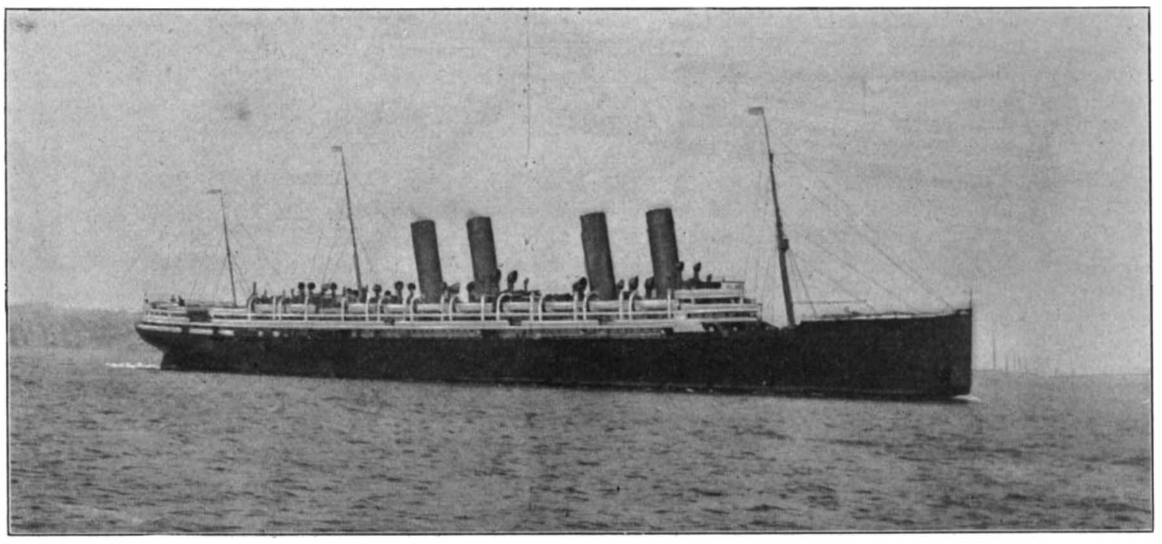
THE LATEST ATLANTIC LINER, "KAISER WILHELM II."

If we consider her great size, unprecedented power, and the exceptional beauty of the boat, both within and without, it must be admitted that there was never a great transatlantic liner slipped into the port of New York at the close of her maiden voyage so modestly, or made fast at her dock so quietly as the new "Kaiser Wilhelm II." Ships that are notable are put afloat in these days in such rapid succession, that it takes a very big or a very fast boat to be entitled to special notice. Of the recent great liners there have been the "Oceanic," 705 feet over all, the longest ship afloat since the "Great Eastern;" the "Deutschland," with her average Sandy Hook-Plymouth speed of 23.5 knots an hour, the fastest of the great liners; the "Celtic" and "Cedric," each 700 feet long and 75 feet beam, and over 37,000 tons maximum displacement, dimensions which entitle them to be called the widest and largest ships afloat. Then a couple of weeks ago we chronicled the launch of the "Minnesota," which, with her molded depth of 56 feet, is the deepest ship in the world, her displacement being somewhat less than that of the "Cedric" and "Celtic."

The "Kaiser Wilhelm II.," the latest of these big liners, 706.5 feet in length over all, is remarkable as being the longest ship in the world, and also the ship having the greatest horse power, the contract requirement being that she should indicate 40,000 horse power, which is 7,000 more than the stipulated horse power of the "Deutschland." The complete dimensions of the new boat are, length 706 feet, 6 inches; beam, 72 feet; molded depth, 52 feet, 6 inches; load draft, 29 feet; and displacement, about 26,000 tons. The double bottom, which extends the full length of the ship, is divided into twenty-six compartments, while the hull itself is divided into nineteen watertight compartments. There are seven decks, known respectively as the orlop, lower, main, upper, lower promenade deck, upper promenade deck, and awning or boat deck. The vessel thus carries one more deck than is common in large passenger ships of her type, her predecessors having only one instead of two promenade decks; and by the way, these two decks are truly magnificent in their clear, unobstructed sweep from the bridge to within a short distance of the taffrail. To those passengers who spend most of their time on deck, and much of it in a steamer chair, the doubling of the promenade deck accommodation will be a positive boon. In her general appearance the new ship shows the characteristic features of the German boats that have come from the Stettin yard. She has the same pronounced sheer and perceptible lift of the sheer line toward the stern, and she carries the usual four funn ls, although there is an innovation in the fact that she has three masts, placed somewhat the same as in the "Oceanic." As a result of the great height of the upper works of the "Kaiser Wilhelm," she does not look to be as long as she actually is. The best impression of her size is gained when standing on the captain's bridge or on the second bridge astern at a height of between 60 and 70 feet above the water, and letting the eye range up and down the full 706 feet length of the vessel.

The passenger accommodation includes 290 first-class cabins and 107 second-class, and one of the "show" features of the ship is her two imperial suites, each of which includes a dining-room, drawing-room, bedroom, and bathroom, all most daintily and tastefully decorated. There are also eight suites that include sitting-room, bedroom, and bathroom, and also eight state cabins with bathroom adjoining. The most spacious room in the ship is the first-class saloon, a magnificent room, 69 feet broad and 108 feet long, which provides sitting accommodations for 554 passengers. The second-class saloon accommodates 190 passengers. Special features are a children's saloon, a typewriting room, and a safe deposit department. The four kitchens, the largest of which is about 55 feet by 30, can cater to about 800 first-class passengers, 400 second-class, and 1,100 third-class. The crew alone amounts to a complement of 600 individuals, and of these the engine-room staff requires 237.

The chief interest of this remarkable boat centers in the engine room, which is arranged on a principle entirely novel in transatlantic travel, although it has been adopted in some warships. The engine room is made up of four separate compartments, with a complete engine in each. There are two propeller shafts, and two engines are arranged in tandem on each, a stuffing-box arrangement being used on the crankshaft where it passes through the transverse watertight bulkhead separating each pair of engines. The engine in each compartment is a complete quadruple-expansion, four-cylinder unit, and its contract indicated horse power, as given out by the company, is 10,000, although it will undoubtedly prove to be nearer 11,500 when the engines have sweetened out and found themselves. This is shown by a comparison between the engines of the "Kaiser Wilhelm" and those of the "Deutschland." The engine on each shaft of the "Deutschland" consists of two 36.6 high-pressure cylinders, one 73.6 first intermediate, one 103.9 second intermediate, and two low-pressure cylinders 106.3 inches in diameter, the common stroke being 72.8 inches. On each shaft of the "Kaiser Wilhelm II." there are two 37.5-inch high-pressure cylinders, two 50-inch first intermediates, two 75-inch second intermediates, and two 112.2 low-pressure cylinders, their common stroke being 70.8 inches. The steam pressure in both cases is the same, 213 pounds to the square inch. Now the engines of the "Deutschland" have always indicated much more than contract power, the greatest average for the whole trip being 37,500 or 4,500 more than the contract. The contract calls for 40,000 horse power in the "Kaiser Wilhelm," and probably toward the close of the season she will be averaging over 45,000 horse power for the eastward passage and her average speed will probably be between 23.75 and 24 knots an hour.



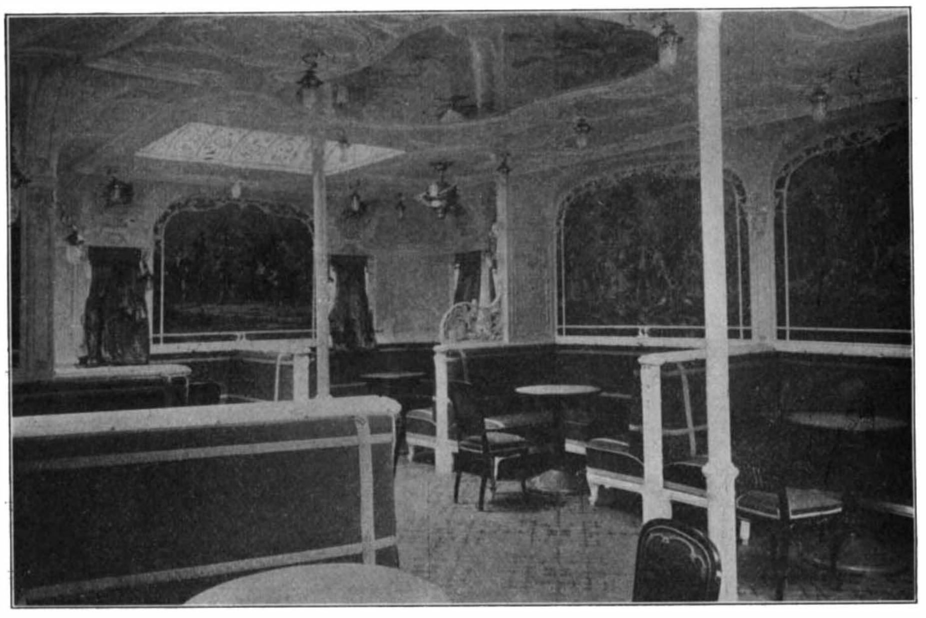
THE LATEST ATLANTIC LINER, "KAISER WILHELM II."

Length, 706½ feet. Beam, 72 feet. Depth, 52½ feet. Horse power, 40,000. Speed (expected), 23½ knots.

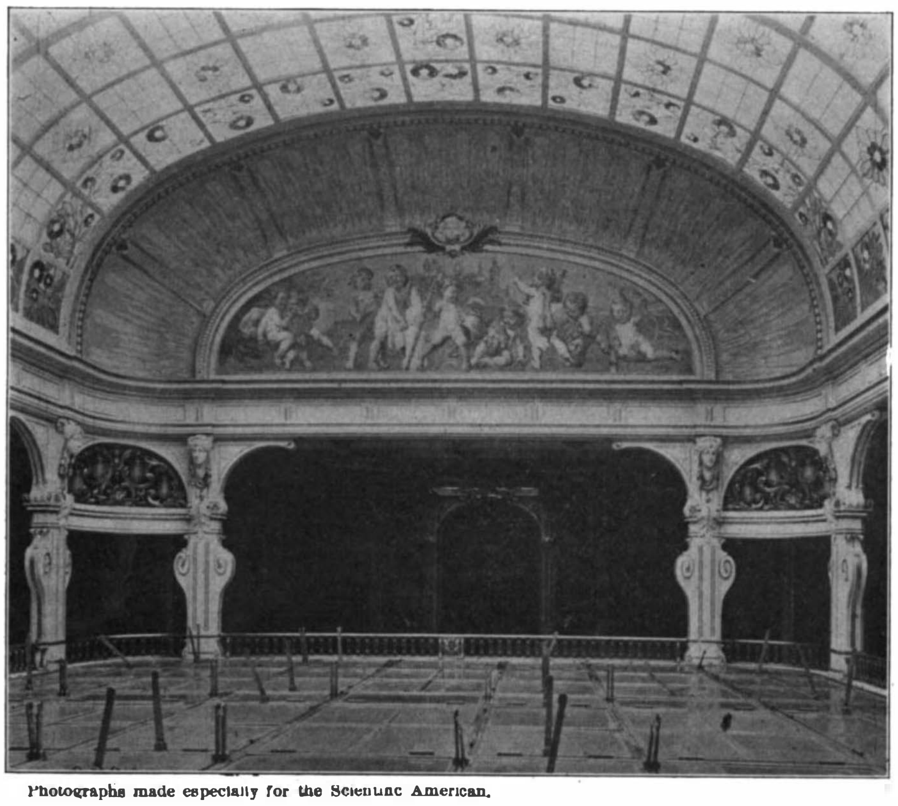
The following particulars of the motive power will be of interest: There are two propellers, each 22 feet 10 inches in diameter. The driving shaft is 230 feet long and weighs 253 tons. the weight of the crankshaft alone being 108 tons 15 hundredweight. To condense the huge volumes of steam that are delivered, hour by hour, to the condensers requires 46½ miles of condenser tubes. The vessel has nineteen boilers, twelve of which are double ended and weigh when empty, 114 tons apiece. The total heating surface of these boilers is over 2½ acres. The coal bunkers have a maximum capacity of 5,239 long tons of coal, and the coal consumption is expected to be about 650 tons per day. On the run over the ship was not pushed, as the engines and plant were entirely new; but nevertheless, she averaged 22.1 knots an hour, and there was no trouble whatever with the engines; the pumps, etc., working to perfection and the bearings remaining cool.

A section of the submarine cable between Cienfuegos and Santiago, in the Caribbean Sea, has recently been raised, with some very interesting results. The cable was manufactured in 1873, and laid off Cienfuegos, Cuba, in 1881. Some few months ago a question arose as to the durability of cables covered with India rubber, as in this case, and it was decided to raise the Cienfuegos cable and subject it to tests. The line was picked up in 1,350 fathoms of water in April last, and received at the works of Messrs. Hoopers, at Millwall, in June. The tests of the core showed that after twenty years' submersion it was still in perfect electrical condition. An examination of a foot specimen proved that the insulation was in good mechanical condition, and that the copper conductor had not suffered from the attacks of any sulphur in the rubber.

MAIN SMOKING ROOM.

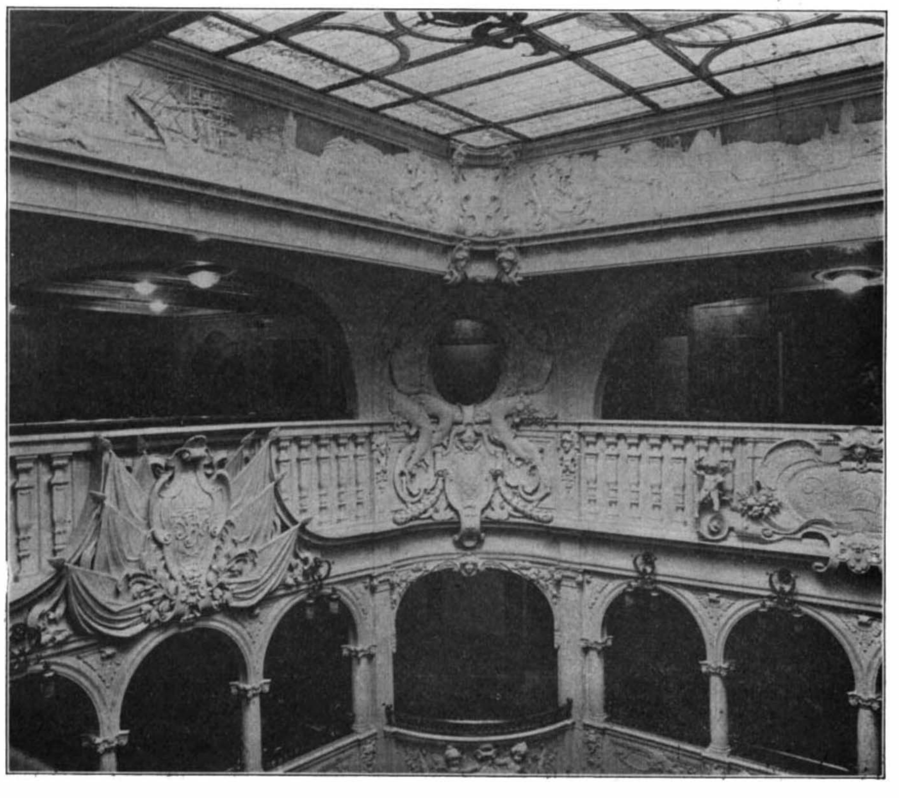


VIEW IN LADIES' PARLOR, SHOWING COSTLY WALL TAPESTRIES



Photographs made especially for the Scientific American.

THE HANDSOME DOME ABOVE THE MUSIC ROOM.



SKYLIGHT AND GALLERIES OVER THE DINING SALOON.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CULTIVATOR.—A. A. THOGERSEN, Brookings, S. D. The disks of this cultivator may be so adjusted relative to the main frame or to the rows of plants that the soil may be thrown toward or away from the plants, when needed. The ground-wheels and the bars or beams supporting them may be shifted laterally to permit the passage of large plants or bushes.

Electrical Devices.

ELECTRICAL SMELTING APPARATUS.—R. L. BARNHART, Charleroi, Penn. This mechanism is adapted for smelting minerals by the use of the electric arc, the minerals being suitably fluxed and prepared in the form of paste, which is then formed into bars, so that when electrically charged and brought in contact an arc is formed and the mineral is thereby smelted.

VOLTAMETER FOR THE ELECTROLYSIS OF WATER.—P. GARUTI and R. POMPILI, 11 Via Vesta, Tivoli, Italy. The inventors in this case make a new and radical improvement in their voltameters of a former patent, for electrolysis of water; and it consists, chiefly, in a modified form of the metallic diaphragm used in connection therewith. The present invention eliminates certain inconveniences by an improved construction of diaphram which will permit the use of larger electrodes without increasing the internal resistance.

ELECTRIC CONTROLLER.—C. T. J. OPPERMANN, 2 Wynyatt Street, London, England. This invention relates to a controller-switch for electrically-driven vehicles, and has for its object to enable, by means of one controller having comparatively few contact-pieces, four different speeds in the forward direction of running, to be obtained without the use of a separate reversing-switch.

Engineering Improvements.

DEVICE FOR REMOVING IMPURITIES FROM BOILER FEED-WATER.—G. T. CONKLING and C. C. MITCHELL, Plainfield, N. J. The purpose of this invention is to construct a filter which comprises a suitable hollow body having a removable cap and inlets and outlets in the body-section, together with straining cloths carried by supports of perforated metal, which supports and cloths are fitted in grooves in the body of the cap and are readily removable. The inlet is formed to deliver the incoming material to filtering members, the outlet placed to take the filtered liquid from the body. The invention provides a packing, to be used when a great body of filtering material is required.

CONVERTIBLE ENGINE FOR DERRICKS AND CABLEWAYS.—A. LAMBERT, Newark, N. J. In practice the endless traversing rope of a cableway is given a few turns around its drum, and the drum is therefore concave. In derrick-engines, the drums are cylindrical, the ropes being wound up or allowed to unwind, as desired. Again, the Lambert cableway system enables a drum of large diameter to be used for the haul-rope to obtain high speed for the carriage, while a drum in a corresponding position in a derrick must be of small diameter to obtain power. The invention provides means for readily converting a cableway-engine into a derrick-engine and vice versa.

SLIDE VALVE GEAR FOR STEAM ENGINES.—S. S. YOUNGHUSBAND, Granville Terrace, Darlington, England. Two patents have been granted to Mr. Younghusband for slide-valve gears for steam engines. His inventions relate to slide-valve reversing and expansion gear of the kind wherein motion is transmitted from the expansion and reversing link to the slide-valve through an intermediate lever, which is pivoted to the die-block of the link and connected by its shorter arm or arms to the valve rod, while its other and longer arm is pivoted to an arm or arms on the weigh-shaft, the expansion and reversing link vibrating as a whole about a fixed axis, to which it is connected by a pair of swing carrier-links, and the reversal of the engine being effected by moving the die-block along the slot of the link. This type of valve-gears gives a fixed amount of lead with all degrees of linking up, a quick port-opening for the admission of steam, a quick opening at the commencement of the exhaust, and a much larger steamport opening and more sudden cut-off than usual for all degrees of linking up, thus enabling the engine to be always readily started.

Heating and Lighting Apparatus.

HEATER.—O. JAHELKA, New York, N. Y. The object in view in this improvement is to provide a heater so arranged as to give out a high and practically constant degree of heat with a small amount of fuel consumed, and further, to provide means whereby obnoxious gases rising from a fresh supply of coal are prevented from entering the room in which the heater is placed.

GAS-BURNER AND REGULATOR FOR SAME.—A. A. PRATT, New York, N. Y. The present invention of Mr. Pratt relates to incandescent gas-burners as described in a former patent of his. The object is to provide a new and improved gas-burner and regulator arranged to allow minute regulation of the amount of gas passing into the mixing-chamber of the burner to insure a proper mixture and burning of the gas and air for producing a very bright light without waste of gas and irrespective of the prevailing pressure of the gas-supply.

GAS-BRACKET.—D. CAVANAGH, New York, N. Y. In this arrangement of a gas-bracket the user is permitted to burn the gas with a flame ranging from the maximum to the minimum power without turning the key ordinarily employed for turning the gas on or off, the bracket being very simple and durable in construction and easily manipulated to obtain a flame of the desired power.

HEATER.—M. BARMAN, Brooklyn, N. Y. This apparatus is of that order of heater particularly adapted for boiling water for laundry use; and the aim is to provide a heater comprising a fire-box and boiler so arranged that the box will occupy a comparatively small space of the boiler-bottom, thus increasing the area of water directly acted upon by the heat.

FEED-WATER HEATER FOR BOILERS.—C. G. TAYLOR, Farmington, Wash. This heater for boilers is so constructed that it is utilized as the sides and grate of a furnace except where a rocker-grate is required, when the device is used as the sides of the furnace only, and the sides are connected at a point beneath the rocker-grate. There is a double series of tubing, the inside pipe feeding water to the boiler, and the outside pipe giving free circulation of water from and to the boiler, whereby the heater is exposed to great heat, thus heating the feed-water to a high degree by what would otherwise be waste heat.

Mechanical Devices.

BALL-BEARING.—E. J. FARR, Boston, Mass. The object in view in this invention is to provide an improved ball-bearing which is simple and durable in construction and arranged to prevent the balls from rubbing one against the other, to reduce the friction to a minimum, and to allow of convenient and quick adjustment of the parts to compensate for wear.

SAW-FILER.—D. L. KELCHNER, Brooklyn, New York. This invention relates to improvements in machines for filing saws, the purpose being to provide a machine of this character and by means of which a saw may be quickly and uniformly filed. The file is connected with the carrier or rotary part by means of screws. Therefore when a file becomes worn out it is readily replaced by a new one.

POWER-TRANSMITTING MECHANISM.—F. SEDIVY, Globe, Arizona Ter. The mechanism in this case is in the nature of an improved construction of duplex screw gear or shaft and a traveler co-operatively connected therewith for converting a continuous rotary motion into a reciprocal motion; and the invention provides a mechanism simple, economical, and stable in construction, in which the operation of converting the motion is automatic and positive.

APPARATUS FOR WATERING COKE-OVENS.—D. B. STAUFT, Scottdale, Penn. Comprised in this invention is a novel sprinkling apparatus introduced through the oven-door into the oven, so as to lie over the bed of coke, and so constructed that it will automatically turn over the coke thoroughly for sprinkling. The sprinkler may be manually turned. The arrangement of the sprinkling pipe is such that the water is confined to the bed of coke and does not spray the oven walls, since the sudden cooling would tend to destroy them.

CARD-CONTROLLING ATTACHMENT FOR TYPE-WRITING MACHINES.—R. K. SLAUGHTER, Brooklyn, N. Y. This attachment includes an interchangeable line-spacer that sets the machine to print upon lines any desired distance apart. The attachment is adapted for rapidly feeding postal-cards, index and other cards, envelopes, etc., in position on the platen, where they may be printed upon and carried over the platen and deposited in a receptacle. The attachment will not require the machine to be raised after cards have been placed in a supply-receptacle and fed to guide devices, since by action of the machine, the cards may be printed and conducted to and deposited wherever desired.

TYPE-WRITER.—J. ALEXANDER, New York, N. Y. The invention relates particularly to improvements in carriage mechanism for type-writing machines. It comprises adjustable means for preventing upward movements of the carriage during operation; novel means for causing the step-by-step movements of the carriage; novel means for causing vertical movements of the roll-carrying frame; and means for stopping the carriage and locking the several finger levers at the end of the line.

TYPE-WRITER-BAR MOVEMENT. — J. ALEXANDER, New York. This invention relates particularly to improvements in the construction of the type-carrying bars and the mechanism for operating the bars, the object being to simplify the construction of the parts, and to so arrange them that they may be readily adjusted, assembled, or separated when required. This application is a division of an application for a patent formerly filed by Mr. Alexander.

MECHANICAL POWER.—S. HAYES, Macon, Neb. The object of the inventor's claim is the provision of a simple device employing a series of rolling weights for actuating pumping devices, air compressors, or similar machinery. A very small engine or like power will operate the device. The heavy weights serve by gravity as a means for increasing the power, as upon once starting its momentum will aid in carrying the rollers around the track.

METHOD OF EMPTYING BEATING-ENGINES.—E. A. JONES, Pittsfield, Mass. A new and improved method of emptying from beating-engines the finished pulp in a thorough, quick and economical manner without requiring manually-wielded rakes for moving the pulp to the discharge-pipe of the vat, is the claim of this invention. The method consists in subjecting the pulp in the vat of the beating-engine to the action of a forceful undercurrent to set the pulp in motion and direct it to the discharge-pipe of the vat.

CHEESE-CUTTER AND SLICE DISCHARGER.—H. ROSE, Shreveport, La. This machine is supported on a rotatable table, which is divided into sections. A knife mounted above may be depressed to sever sections from the cheese. By means of a gage-plate one may determine accurately the size of slice necessary for a desired weight of cheese. The severed slice may be slid into a receptacle by tilting the section of table on which it is resting.

Railway Improvements.

SWITCH-OPERATING MECHANISM.—J. M. WILBUR, Colorado Springs, Col. The invention in this case is an improvement in switch-operating mechanism and especially in the class of such mechanism described in Mr. Wilbur's former application for patent, in 1902. The present invention relates particularly to the means for supporting and operating the mechanism constituting the switching devices.

BRIDLE RODS FOR RAILROAD-RAILS.—J. R. JOHNSON, El Paso, Texas. The present invention provides a device for temporarily bridling or bracing the rails laid down by a track-laying machine, until they can be properly secured by the spikers. The bridle-rod will also be found useful for preventing lateral displacement of rails on curves or switches. The construction permits rapid attachment or removal of the device, so that it is particularly adapted for laying a temporary side-track around a wreck, etc. The bridle-rod consists of a stationary rod and two gage-bars mounted to slide thereon. The base flanges of the two rails to be bridled are securely held between the ends of the stationary rod and the movable gage bars which are held in position by spring catches.

Vehicles and Their Accessories.

PROPELLER-WHEEL FOR VEHICLES.—C. H. O. HAMANN, Bergedorf, Germany. This is a traction-wheel adapted to engage the ground for propelling vehicles and like service. It is mainly intended for use on bicycles, and automobiles, for propelling them over ice, although it should be understood that Mr. Hamann's invention is not limited to this use, but is also applicable for the purpose of propelling other vehicles and for analogous purposes.

WHEEL.—W. H. LASSWELL, San Angelo, Texas. In this wheel the frame is rigid, it being composed in part of hollow radial spokes, which are permanently connected with the central annular portion in which the hub proper is adapted to move radially. The hub is connected with the felly by spiral or coil springs and devices in the form of turn-buckles, these parts being arranged in the hollow spokes and annulus, and thus protected.

TRACE-DETACHER. — J. D. BLAKEMAN, Smith's Grove, Ky. This detacher is adapted for use on singletrees, and is an improvement in that class of trace-detachers represented by a former patent to J. D. Blakeman in 1890; and the present invention consists in certain novel constructions and combination of parts which provide means to free a horse in a moment, and in case he should run away, damage to the vehicle and injury to occupants will be avoided.

Miscellaneous.

FURNACE-GRATE.—C. P. ROBERTS and G. P. ROBERTS, Toledo, Ohio. In accomplishing these improvements relating to steam-boiler furnaces, the inventors are enabled to provide a grate of hollow bars through which atmospheric air may pass and become heated before it meets with the products of combustion.

TOY GUN.—MALINDA C. ANTHONY, Oakland, Cal. By means of certain improvements in toy-guns, this inventor provides a gun so arranged as to first discharge a target and then to discharge a projectile, thus not only providing amusement but offering a simple and harmless means for acquiring skill in marksmanship.

STEREOTYPE.—A. L. ANDERSON, Grundy Center, Iowa. This improvement relates to devices for locking stereotype plates and the base together in such manner as to lock the plate to the base securely when the foot-slug is placed in position, thus dispensing with brass strips at the top of the column or at the sides of the column and avoiding accidents by neglect in placing these strips in place to prevent the plate from slipping and damaging the press or other machinery.

FASTENING FOR BASKETS, ETC.—A. A. BENEDICT, Riverton Township, Mich. Several objectionable features in fastenings, particularly for fruit-baskets, are overcome in this invention in which the cleat of the cover of the basket is formed with a slot, and the nail after being driven through the parts is then returnbent, and its point is extended upward and passed into this slot which locks the point securely and prevents it from projecting out to tear the clothing or cut the skin of handlers of baskets.

OIL-TANK ATTACHMENT.—C. MOLLER and M. SALISBURY, Pensacola, Florida. In this attachment the inventors furnish means for guarding against explosions in tanks containing volatile hydrocarbons and like substances. As is well known, such explosions are due to vapors in the tank, these vapors being continually given off from the oils. The invention involves an improved means for disposing of these vapors.

BOOKKEEPING.—J. C. MACNAMARA, New York, N. Y. The design in this process of keeping accounts by single or double entry, is to provide, first, internal proofs of the accuracy of the records without taking off trial balances; and, second, a means for obtaining results more expeditious and certain than by the double entry now used. A summarized double-entry record serves as a check on accounts kept in detail by single entry and provides means for obtaining a balance-sheet and profit and loss statement in a very quick and accurate way.

GAME APPARATUS.—H. J. FRYSINGER, Baltimore, Md. This improvement belongs especially to that class of game apparatus illustrated in a former patent of Mr. Frysinger's, designed for playing what is termed "royal pinball," and the present invention relates to the means for securing the canvas or netting to the end posts which support either of these materials.

DRAFT DEVICE.—T. V. ELLIOTT, Columbia, Penn. Mr. Elliott's invention is an improved draft device for furnace-stacks. By use of the construction a strong upward draft is caused in the stack of the furnace which is regulated by proper adjustment of a pin-valve, and where desired a valve may be provided to throttle or control the discharge of steam through the steam pipe leading from the dome of the boiler to the stack.

BALL-CATCHER.—S. A. COHEN, New York, N. Y. The aim in this invention is to furnish a ball-catcher more especially designed to enable the user to conveniently and quickly pick up a ping-pong ball from the floor, from under the furniture, and other places under which the ball may have strayed during the playing of the game. The device is easily handled, and arranged to allow picking up the ball without stooping down.

WATER-COOLER.—Z. F. BOWMAN, Washington, D. C. The inventor claims an improvement in coolers particularly designed for use in connection with railway cars, the object being to produce a cooler so arranged as to use circulated air in lieu of ice as the cooling medium, thus reducing the cost of labor in providing cool water in passenger-coaches or the like.

STAIR STRUCTURE.—N. BOIS, New York, N. Y. In this improvement in the construction of stairways, the object is to provide a stairway having a plurality of steps and risers formed of a continuous strip of sheet metal attached to sheet-metal string-pieces, thus not only making a fireproof stair, but materially reducing the labor and cost of stair building and placing.

KILN.—H. STEHMANN, Whitecliffs, Ark. This invention relates to cement-kilns, lime-kilns, and the like, such as shown in a patent granted in 1901 to Mr. Stehmann. The intention of the present invention is to provide a new and improved kiln arranged for continuous operation to produce Portland cement, lime, and the like of very high quality and at a low cost.

BANJO.—W. B. FARMER, New York, N. Y. This musical invention relates to banjos and like instruments in which strings extend over a stretched membrane. The object in view is to provide a new and improved banjo or similar musical instrument arranged to produce an exceedingly fine melodious tone when the instrument is played.

HEN'S NEST.—W. J. DILLARD, Santa Rosa, Cal. When eggs have been laid, this improvement will cause them to pass downward into one of a series of pockets in the receptacle below, thus obviating the danger of being damaged through remaining in the nest. When the egg passes through the passage between the nest and receptacle, it operates certain mechanism to revolve the receptacle, thus presenting an empty pocket beneath the chute. The receptacle is prevented from revolving until the egg is safely placed in its pocket. The nest is made so that all chaff, dust, straw or dirt will pass through.

BIFURCATED GARMENT. — E. ARPIN, Springfield, Mass. The object in view in this improvement is the provision of means by which chafing at the crotch is prevented, thus increasing the comfort of the wearer of men's under-garments, chiefly in warm weather. The improvement tends to separate the organs from contact with the thighs, and it not only insures comfort, but reduces perspiration, and thereby conduces to cleanliness.

FIRE-LADDER.—J. C. SCHALLER, Hastings-upon-Hudson, N. Y. One object of the inventor is the provision of a metallic non-destructible ladder arranged to provide for the circulation of water through it, so as to stiffen the device by the water-pressure and to keep it cool. Another is to equip the ladder with means for distributing water toward a door, window, or other place, so as to quench the flames and enable the fireman to carry on the work of rescue.

SOLDERING IRON—C. R. GUTNER, Croton Falls, N. Y. The purpose of the invention is to so construct the iron that its body, which is in the form of an electric coil, will have an aluminum core, to make the body light, and to provide means whereby the sealing tip is detachably connected to the core of the coil. This enables a short piece of copper to be used and the soldering tips cheaply replaced. The core for the coil is so constructed that acid from the sealing tip cannot reach it to scale off the metal and short-circuit the wire wound adjacent to the core. A mica insulation is furnished between the layers of the coil.

WATER COOLER OR HEATER.—J. H. Rose, Shreveport, La. The inventor claims in this device an improvement in apparatus for cooling and heating water and the like, and the invention relates particularly to coolers and heaters in which the heating or cooling medium is placed within an air-tight can and the can immersed in the liquid to be heated or cooled.

SHUTTER-WORKER.—J. H. Rose, Shreveport, La. Mr. Rose in this case makes an improvement in that class of shutter-workers which are adapted to be operated from the inside of a building. The apparatus is very easily operated for opening or closing the shutter and it consists of few parts, which are not liable to get out of order. It may be easily applied to window-frames and shutters by boring through the window-sill and then applying the several parts.

PACKING-BOX.—J. H. Rose, Shreveport, La. The purpose of this invention is to complete an improvement in the covers and cover-fastenings of packing or shipping boxes. The covers are preferably constructed of sheet metal for the sake of economy in manufacture and of space in the box and also reduction of weight, and the invention relates in particular to the construction of the cover proper, whereby the fastening is formed.

BOTTLE CLOSURE.—C. W. Scott and H. Hughes, Saratoga, Wyo., and C. E. Shipley, Denver, Col. The closure consists of a plug having an interior chamber with outlet at the bottom. A ball-valve operates in the chamber and normally closes this outlet; but when the bottle is tipped the valve opens, permitting the contents of the bottle to flow into the chamber, whence they pass out of the bottle through a discharge passage in the plug.

SUSPENDERS.—M. Gluckauf, New York, N. Y. In these shoulder straps the web is in one piece. A specially constructed back-piece holds the web so that a strap will be in position over each shoulder. When the strap or web passes over the plate the suspenders will be flat and comfortable. Means are provided which serve the dual purpose of a buckle for the web when used as a belt, and for connecting the front suspender-ends with the webs. These means are concealed in the button loops through which the ends pass and have play. The suspenders may be readily converted into a belt.

SILK-HOLDER.—S. V. Luallen, Alva, Oklahoma Ter. The purpose in the present improvement is to provide means especially adapted to be attached to tooth-brushes and by which silk or the like may be held taut, so as to be useful in cleaning the teeth. The invention comprises means for carrying the silk in or on the handle of the brush or other supporting part and a bow for holding a part of the cord extended in position to be used.

SHADE-HOLDER.—C. J. Kusche, Oshkosh, Wis. Comprised in this invention is a certain specially-formed gripper for engaging a lamp. The gripper carries an adjustable arm, which in turn supports a frame or holder for the shade. This shade may consist of a cardboard or material of any degree of opacity. It may be either plain or ornamented, and owing to the construction provided, the shade may be made to occupy exactly the position desired.

PERPETUAL CALENDAR.—W. M. Finch, Willow, Cal. By a novel construction and combination of parts, Mr. W. M. Finch is to provide a simple formation of a perpetual calendar which can be easily read and operated and which can be adapted to a pen holder, a pencil, or other cylindrical support or which can be used flat, as desired.

CANVAS-STRETCHER.—W. J. Dorgan, Chicago, Ill. The object in view in this invention is to provide a canvas-stretcher perfectly true, not liable to get out of shape, requiring no truing up before or after mounting the canvas thereon, and maintaining the canvas after the painting is finished, in the proper shape, thus requiring no remounting previous to securing the painting and its stretcher in a suitable frame.

BOTTLE.—H. De Rocco, Buenos Aires, Argentina. In this construction of a bottle certain novel valve devices render refilling impracticable after the orginal contents have been extracted. A sectional plug is employed in which a tortuous passage is formed, this passage constituting the outlet for the liquid. In such passage are placed valves which open outward, so that the liquid may be withdrawn, but which will seat to prevent any introduction. This plug is held in place by a cap fastened by cement in the extreme mouth of the bottle.

SCENIC APPARATUS.—F. W. Thompson, New York, N. Y. In this invention the underlying aim is to provide a device comprising a rocking platform having wings to represent an aerial ship, in connection with scenic effects so arranged as to give passengers the illusion of gradually ascending and descending through the air.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 4084.—For dealers in gun metal.

Inquiry No. 4085.—For makers of nose and mouth protectors to keep out dust.

Inquiry No. 4086.—For a reversible marine clutch for explosive engines.

Inquiry No. 4087.—For makers of steam turbines of 11 to 20 or 30 h. p.

Inquiry No. 4088.—For makers of metal grille for fly screens.

Inquiry No. 4089.—For makers of kilns for burning lime from limestone.

Inquiry No. 4090.—For makers of traction engines or road locomotives.

Inquiry No. 4091.—For manufacturers of machines for making paper tubes.

Inquiry No. 4092.—For blue prints of one horse power stationary engines.

Inquiry No. 4093.—For a large gasoline stove for heating a one horse power boiler.

Inquiry No. 4094.—For makers of collapsible metal tubes for holding polish, etc.

Inquiry No. 4095.—For a rotary fan run by clock work.

Inquiry No. 4096.—For parties engaged in difficult chilled casting work.

Inquiry No. 4097.—For makers of machinery for making potato starch.

Inquiry No. 4098.—For makers of self-cleaning curry combs.

Inquiry No. 4099.—For advertising novelties suitable to advertise medicines.

Inquiry No. 4100.—For makers of gas fixtures, chandelier hangings, etc.

Inquiry No. 4101.—For machinery for cutting gloves.

Inquiry No. 4102.—For makers of table tennis supplies, such as balls, rackets, etc.

Inquiry No. 4103.—For dealers in glassware to make a special bottle.

Inquiry No. 4104.—For a machine for ripping stitches in seams and hems of bags.

Inquiry No. 4105.—For full information of motor cars, wagons and busses, as to size, capacity, weight, power, speed, cost, etc.

Inquiry No. 4106.—For makers of benzine-cleaning machines.

Inquiry No. 4107.—For a bicycle, getting power from a dynamo driven by the sprocket wheel.

Inquiry No. 4108.—For makers of celluloid.

Inquiry No. 4109.—For manufacturers of tents.

Inquiry No. 4110.—For dealers in compressed paper buckets, pails, also of compressed paper in sheets.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8964) F. R. asks: I have a small battery motor which runs perfectly on one or a number of dry cells, or a sulphuric acid battery, and I put four gravity cells on, so it would be on closed circuit, and it would not move it. What is the trouble? A. We do not know why your motor would not run with four gravity cells when one dry cell will run it. The fault would naturally be sought in the gravity battery. 2. Can you give me a formula for making a good battery that would drive this motor for three or four hours or on closed circuit, other than bluestone? A. For a good battery to drive a motor see Supplement, No. 792, in which plans and drawings are given for such a battery. 3. How long will a Mesco dry battery last closed? A. A dry cell does not last long on closed circuit.

(8965) H. P. D. asks: Could you, or any of your readers, please explain the following results, obtained with an electric light with a broken filament, and an induction coil giving one-fourth-inch sparks? When the current was too weak to produce any light in the globe, the approach of a strong horseshoe magnet caused a light in the tube, varying in intensity with the position and strength of the magnetic field. When only one terminal was connected to the coil, a faint light was produced. On touching the globe with my hand, the light greatly increased, and the place touched was surrounded by a bright spot, a dark band, and then a brighter band. A slight spark could be obtained from my finger to the glass if the other hand touched the other terminal of the coil. A. The experiments you describe are due to the fact that an electric light bulb is a vacuum tube, either a Geissler or a Crookes tube, according to the perfectness of the exhaustion. When brought into the field of a electro-magnetic coil, the tube fills with light, as you have observed. All lamps will not act in this manner. In the early days of the use of X-rays, some lamps were found which could be used for taking photographs by X-rays. These had a very high vacuum.

(8966) W. D. A. says: Can you give me any information concerning a water telescope? A. A water telescope consists of a tube of wood or of metal, closed at one end water-tight by a plate of glass. Plate or good window glass will answer the purpose. This is placed in the water, open end down, and by looking through the glass top of the box, one can see very distinctly to quite a depth; hence the name, water telescope. The apparent opacity of water is largely due to the ripples upon its surface, which break up the waves of light and prevent their accurate transmission from below. The surface of the water within the box is smooth and the glass top is smooth; for both reasons the light comes up through the box to the eye undisturbed. Such a box to be held over the side of a boat may be three or four feet long and six inches square in section, so that both eyes can look into it at once with ease.

(8967) F. I. G. says: Do heat rays other than those from the sun pass through glass? It is admitted that the heat from the sun does pass through glass, but "A" contends that the rays of heat from an oil lamp or an open wood fire will not pass through glass. If sun heat only passes through glass, why? I do not wish to know if glass conducts or radiates heat, but whether glass is transparent to artificial heat, and in what degree. A. Heat rays of all wave lengths may pass through glass, but not equally. The longer wave lengths are cut off by glass much more than are the shorter wave lengths. Heat from any luminous source passes easily through glass. The contention of "A" that heat from an oil lamp cannot pass through glass is not well taken. He cannot say that he never felt heat which had passed through a lamp chimney, or that a thermometer would not rise if held near the glass chimney of an oil lamp. A window pane in the same way cannot cut off all the heat of a wood fire.

F. I. G. writes further: Your kind favor of the 13th is at hand and the answer is as I supposed. "A," however, is not satisfied. He says the heat from a lamp chimney is radiated. He also states that you do not dare publish the answer and query in the Scientific American.

Your friend "A" is certainly very poorly informed upon the literature of this subject, if he supposes that our answer to your inquiry so differed from the text books and commonly received opinion of scientific men that we *dared not print* it in our columns. A very small portion of the hundreds of letters received and answered each week can be printed. The Scientific American would be filled with letters, should all be inserted. Only those are published which seem to have general interest. However, for the satisfaction of "A" we publish both inquiries. He will find in Ganot's Physics, 15th edition, price $5, page 425, the power of heat to pass through bodies "differs greatly with the radiation from different sources. Rock salt is here stated to transmit all kinds of heat with equal facility, and is the only substance which does so. Fluor spar transmits 78 per cent of the rays from a lamp, but only 33 of those from a blackened surface at the boiling point of water. A piece of plate glass one-tenth of an inch thick, and perfectly transparent to light, is opaque to all radiation from boiling water, transmits only 6 per cent of the heat of copper at 850 deg. Fahr. and 39 per cent of that from an oil lamp without a chimney." These results were attained by Melloni, who died in 1854. They have never been disproved nor doubted by scientific men. With higher degrees of temperature than can be given by a lamp, Tyndall carried the subject much farther. These researches may be found in his book "Heat as a Mode of Motion," price $2.50. The general subject is "diathermancy." We have many times lighted a match by heat rays which had passed through several lenses of the stereopticon and through iodine dissolved in carbon bisulphide, none of which were made hot by the heat rays. They were brought to a focus by the lenses and the heat without light was able to set the match on fire. This beautiful experiment we owe to Prof. Tyndall. It is not true that these heat rays were absorbed by the lenses and radiated on their farther side.

(8968) E. G. A. gives the following recipe for removing indelible ink stains: If the base of the ink is nitrate of silver, which is generally the case, the following is certain and easy. Paint the ink stains with tincture of iodine, and after a minute or two wash out the stain, iodine and all, with stronger ammonia or a strong solution of hyposulphite of soda. The iodine simply creates iodide of silver, which is easily soluble in either of the above solutions. It works especially well in nitrate of silver stains upon the flesh.

(8969) H. D. H. writes: 1. Please inform me how to make a liquid glue suitable for mounting photographs which have a "glace" finish. The directions say: "Brush the backs with a very thin solution of pure white glue." I would like to know how to prepare such a solution that would remain liquid. A. The mountants for photographs which do not affect the gloss of the front are usually made of gelatine or of white glue. They do not remain fluid, but are placed in a dish of warm water and melted before use. The warm glue is applied rapidly with a brush, and the print must be in its place before the glue sets. 2. Is Sirius, the great dog star, variable? I notice this winter it does not appear nearly so large and bright as it did last year. A. Sirius is not a variable star in the sense that one can with the eye tell that it is dimmer this year than it was last. It has a dark companion. The system revolves once in 52 years. This companion was first seen by the late Alvan Clark, Jr., since which time it has not been classed as a dark star, though it gives less than one ten-thousandth as much light as is given by Sirius.

(8970) E. A. W. asks: Is there any extra wear on either rail of a double track, if the trains run respectively due north and south? If so, on which rail? Should trains travel north or south on a single track, would there be more wear on one rail than on the other, and why? A. On a railroad track laid due north and south, the car wheels bear against the east rail when running north and against the west rail when running south on a single-track railway. On a double-track road the wheel thrust is constantly on the outer rails of the double track. This effect is greatest at very high speed, and at 50 to 60 degrees north and south latitude, gradually decreasing to nothing at the equator. This is caused by the differential velocity of the earth's surface, which a train meets and which bears the track against the wheels on the west side when running south; on the contrary, when running north, the train is running toward a decreasing velocity of the earth's surface, and is borne against the east rail.

(8971) C. M. E. asks: 1. How can I make a good, strong baking powder that will not cake in tins? A. For baking powder, mix 80 parts dry bicarbonate of soda and 180 parts of cream of tartar. To the mixture add about 20 per cent to 25 per cent of starch; the object of the starch is solely to prevent caking and deterioration. 2. What is the formula for a strong liquid bluing? A. For liquid bluing: a. Dissolve indigo sulphate in cold water and filter. b. Dissolve Prussian blue by digesting with one-eighth its weight of oxalic acid in water solution. c. Dissolve 1½ parts of indigo carmine in 15 parts of water; add ¾ part gum arabic.

(8972) C. S. asks: 1. Which is the most desirable current for any electro-magnet —one of great intensity, with less quantity, or one the reverse? A. The current through an electro-magnet should not be strong enough to heat the wire more than 40 deg. above the air, and is usually less than this. If the current is small the number of turns must be large in order to obtain the magnetic flux necessary to saturate the iron. If no other consideration existed, it would be better to have a large number of amperes rather than a high voltage. 2. Is the amperage of a dynamo measured by dividing its voltage by its internal resistance alone, or is there an external resistance included? I refer to the current a dynamo is said to generate, as in the case of one for sale, when no external resistance is mentioned. A. A dynamo machine will give its largest current when the external and internal resistances are equal. This is not desirable except for uses in which the heat produced is desirable. The dynamo is calculated for a definite voltage or for a constant current as the case may be. Incandescent lamps in multiple call for a constant voltage, arc lamps in series call for a constant current. The output of a dynamo is better expressed in watts than in amperes, at a certain speed or turns per minute. 3. Is there more resistance between two separated electrodes in a vacuum than in dry air, being the same distance apart in both cases. A. There is an enormous resistance between two points in a vacuum. A tube can be exhausted so completely that current cannot pass between points a small fraction of an inch apart.

(8973) W. A. S., Jr., asks: Can gas (natural or illuminating) be ignited without a spark? A. A red heat will ignite any of the hydrocarbon gases, when mixed with the proper proportion of air to make them explosive. A spark is not necessary. The hot tube of gas and gasoline engines shows this principle.

(8974) J. L. P. asks: Can you inform me as to whether a bipolar dynamo having its yoke, cores and poles connected by common steel rod running through center will work all right, or should be of iron? A. Steel bolts may be used to fasten the yokes, cores, and pole pieces of a dynamo together. So, too, steel may be used for all these parts of a dynamo. But brass must be used as a bridge across from the positive to the negative pole s piece, if there is need of anything to prevent the vibration of the pole pieces.

(8975) J. H. B. asks: 1. Does a given amount of gas give off, in combustion, the *same amount* of heat, whether said gas be burnt as an illuminating flame in an ordinary gas jet, as a blue flame, in a Bunsen burner, or for heating purposes, in a stove furnished with asbestos lining. A. The *complete* combustion of a given quantity of coal gas produces the same number of heat units without reference to the manner in which it is burned; but if burned with a luminous flame, as in an ordinary burner, the combustion is not complete. The Bunsen flame or blast lamp gives the most complete combustion, the most concentrated flame, and hence the highest temperature. The hottest part of a Bunsen flame is 3,137 deg. F. The hottest blast furnace gives 3,272 deg. F. A white gas flame may be between 2,300 degs. and 2,700 degs. F. 2. If so, what is the advantage of the last two methods for heating? A. An asbestos lining or fire-brick acts as a non-conductor to retain the heat within the firebox and prevent to an extent its radiation through the walls of the stove. In this way more heat remains to be applied to the articles to be heated.

(8976) H. L. T. says: I have at my disposal one pound of No. 36 double silk-covered wire. With this I wish to construct a jump-spark coil for my motor bicycle. Will you inform me what amount of wire and what size should be used for the primary coil, how thick the core should be, and what the dimensions of the coil should be, whether short and thick or long and narrow? Also whether the vibrator can be omitted or not? A. For a primary winding for your coil use No. 16 wire and wind two layers upon the core. The core should be 8 inches long and 1 inch thick. The condenser requires 100 sheets of tinfoil 5 x 7 inches. A vibrator will not be required if the circuit is broken by the motor in its revolution. A valuable article on the winding of coils may be found in our SUPPLEMENT, No. 1402, price 10 cents.

(8977) S. R. asks how to make a stereopticon lantern large enough to throw an image about 20 x 15 inches, using regular slides. A. The ordinary condenser for a stereopticon is made with two plano-convex lenses placed with their convex surfaces nearly in contact. The combination should have a focal length of about 9 inches. It is not desirable to use lenses smaller than 4 inches in diameter, since the clear opening will then be smaller than a slide. For a projecting lens a Darlot quarter-plate lens of about 9 inches focus is commonly used. The size of the picture upon the screen is determined by the distance of the screen from the lantern. If the hall is long and the lantern must stand far back, it is desirable to have a projecting lens of 12-inch focus. If the lantern must stand near the screen, a lens of 6-inch focus should be had. One who uses a lantern in all sorts of halls should have a set of lenses, so as to adapt himself to the hall and produce his pictures of about the same size in all places.

NEW BOOKS, ETC.

ELECTRICAL PROBLEMS. By William L. Hooper, Professor of Electrical Engineering, Tufts College, Boston, Mass., and Roy T. Wells, Senior Fellow in Physics, Clark University, Worcester, Mass. Boston: Ginn & Co. 1902. 8vo. Pp. 170. Price $1.35.

The work contains a set of problems typical of those met with in electrical laboratory and engineering practice, with very brief treatment of the methods of solution. The contents comprise: Twelve sets of problems and calculations on combinations of electro-motive forces and resistances in series and multiple grouping; distribution and fall of potential in railway and lighting circuits, inductance of coils, capacity of condensers, thermo-electricity, electro-chemistry; output and efficiency of batteries, generators, motors, etc.; four sets of problems on combinations of alternating electro-motive forces and currents and the impedance of circuits with constant and with varying values of resistance, inductance, capacity, and frequency; five sets of problems on calculating and making winding tables and drawings for direct and alternating current armatures, armature reactions, field windings, etc.; problems on winding and operation of transformers, rotary converters, and induction motors; and on testing of dynamos and transmission of power. Answers are given to all problems, many in the form of curves showing the effect of varying the various constants involved, such as temperature, frequency, capacity, resistance, and inductance. The text contains about forty explanatory diagrams.

A COURSE IN BOTANY AND PHARMACOGNOSY. By Henry Kraemer, Ph. B., Ph.D. Philadelphia and New York: G. E. Stechert. 1902. 8vo. Pp. 384. Price $3.50.

This book was written to meet the individual needs of the author in his work as a teacher, but can also be employed in connection with a laboratory course. Part I. contains a very full account of plant morphology and is divided into into chapters on the cell, vegetative, and reproductive parts of the plant. Part II. discusses pharmacognosy and is divided into two chapters, the one on crude vegetable drugs, and the other on powdered vegetable drugs. Part III. treats of reagents; and Part IV. comprises the illustrations and index.

COLOR PROBLEMS. A Practical Manual for the Lay Student of Color. By Emily Noyes Vanderpoel. New York, London, and Bombay: Longmans, Green & Co. 1902. 8vo. Pp. xv, 135; 117 colored plates. Price $5.

A great deal will be found in these pages that will be of practical service even to the man or the woman who claims to have a naturally good eye for color. Much attention is given to contrast of modified and subdued colors, such colors as would be required constantly in decorative designs covering large spaces, against which more positive colors would be placed. One of the greatest difficulties in arranging a color design is in determining the qualities and quantities of color. Very few works give the useful hints on this subject contained in this book. Under the heading "Historic Color" are some very interesting original diagrams presented in a way easily to be understood and made use of in actual practice. In illustrating the text the author has seen to it that admirable color schemes, beautifully reproduced, have been incorporated.

A TREATISE ON ROADS AND PAVEMENTS. By Ira Osborn Baker, C.E. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1903. 8vo. Pp. viii, 655; 171 figures, 68 tables. Price $5.

The object of this book is to give a discussion from the point of view of an engineer of the principles involved in the construction of country roads and of city pavements. Considerable space has been given to economics and location of country roads and to the construction and maintenance of earth roads, since such roads constitute more than ninety-five per cent of the mileage of the public highways and are greatly in need of careful consideration. The first four chapters of this book may be regarded as a contribution to the principles of road making and to the improvement and maintenance of our country roads. The remainder of the book, considering roads having permanently hard surfaces, is based chiefly upon American practice. The work is presented in a form for convenient practical use. Numerous cross references are given by section number, and whenever a table or figure is mentioned, the citation is accompanied by the number of the page on which it may be found.

PRECIOUS STONES. A Book of Reference for Jewelers. By W. R. Cattelle. Philadelphia and London: J. B. Lippincott Company. 1903. 8vo. Pp. 224. Price $5.

This is by far the handsomest technical book which has come to us for a long time. Beautifully bound and beautifully printed, it contrasts strongly with the general run of technical books. The information which it contains is worthy of its handsome dress. The aim has been to avoid unnecessary detail and to present facts useful to a dealer in precious stones. Especial attention has been given to stones unfamiliar to many jewelers, and for which there is a growing demand in this country.

INDEX OF INVENTIONS

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AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

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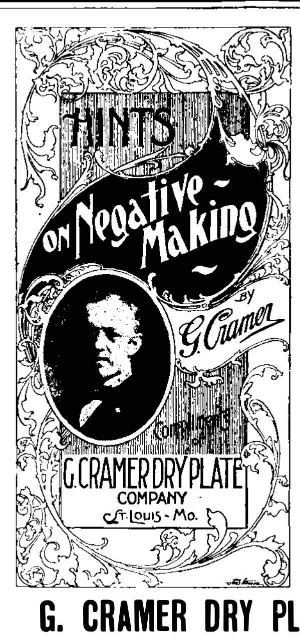

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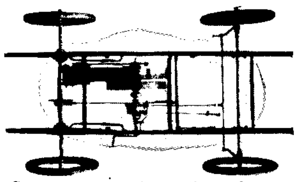

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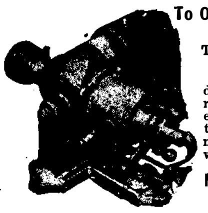

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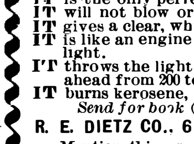

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