diminishes the speed. This method, which is simple and ingenious, does away with the usual rheostat regulation of the dynamo, and in fact the little group works with a remarkable regularity and is thus well adapted for arc and incandescent lighting, charging accumulators, and especially the batteries of electric automobiles. It may be used also for operating agricultural machines by means of a pulley fixed on the end of the shaft. In this case the dynamo works without load, but its voltmeter action still continues and it regulates the speed of the motor. The different uses of such a light and convenient plant need not be dwelt upon; its fitness for laboratories, domestic lighting, arc projectors, out-of-door work, farm use, etc., is at once apparent. The consumption for a 4 horse power group of this kind, giving 110 volts and 20 amperes, is reckoned at 0.5 gallon of gasoline per hour; this corresponds to 40 lamps of 16 candle power, or 60 of 10 candles. Counting the gasoline at $0.30 per gallon (in France), the consumption for a lamp of 10 candle power is only $0.002 per hour, and with larger motors it is still smaller.

Another view shows the same type of motor coupled to a centrifugal pump. The pump is placed, with the motor, on a cast-iron base in the interior of which is a space for the induction coil of the igniter. Above is the cylindrical gasoline reservoir, and on the right a second reservoir which supplies the water for cooling the motor. The speed of the motor is in this case about 1,400 revolutions per minute. It is started by the crank and chain-wheel arrangement seen in front. A pump of this kind is well adapted for agricultural use, especially for irrigation, also for drainage and domestic supply. It would render good service on shipboard and in many other applications, and on account of its small space and weight it can be easily mounted on a carriage and made portable. Pumps of this kind are now built from 1 to 8 horse power and will deliver from 2,000 to 30,000 gallons per hour. A number of pumping plants have been designed for furnishing villages with drinking water in different parts of France, and especially in Normandy.

Two other applications of the gasoline motor for agricultural use are shown in the engravings. The first of these is a thresher of the Foulon-Blondeau type, worked by a small motor which is concealed from view in the photograph. The advantage of this plant over most of the motor-driven threshing machines is that the motor, instead of being installed upon a separate carriage, is mounted directly upon the thresher and the plant is thus easier to transport. The dairy outfit was one of the interesting features of this section. The whole is installed upon a table; below is the motor, which is belted to a common shaft from which the different devices are operated. To the right is the cream-separator, then a barrel-churn worked from a second pulley and last a butter-worker with a corrugated cylinder, which moves over the revolving table.

HEADLIGHT WITH A VERTICAL BEAM.

A new type of headlight which has recently been put in service by the Chicago, Milwaukee and St. Paul Railway, promises to have a very extended application among the railroads of this country. It is an electric headlight which, in addition to sending a powerful ray along the tracks in front of the engine, also projects a powerful vertical beam. The vertical beam makes a very decided illumination in the heavens, so much so that it is possible not only to detect the presence of an engine, but also in many cases to follow its path and determine in which way it is heading. An engineer is by this means placed in touch with the movements of other trains in his vicinity, and is enabled to detect their presence where, if they carried ordinary horizontal beam headlights, he would be unaware of their location. Of course, the modern refinements of block systems and automatic signaling are supposed to take care of the proper location of trains with respect to one another, leaving it to the engineer to look out merely for his own particular signals. But there are cases where the most elaborate systems break down, and where the eternal watchfulness and cool nerve of the man at the throttle are all that stand between a trainload of people and disaster. It is mainly with a view to assisting the engineer in exercising a guardianship over his train which shall not be absolutely dependent upon signals, and so averting those disasters which even now occur on the best regulated roads, that the idea of the vertical-beam headlight was devised. Its greatest value will be shown on roads where the curvature is heavy and the line is located in canyons or runs largely in deep cuttings, or through heavily wooded countries, under any conditions, in short, where the horizontal-beam headlight would be visible for only a limited distance ahead. Then again on single-track roads, where trains are running in opposite directions and meeting, or supposed to meet, only at certain specified stations, the new headlight will have its greatest value. Many a head-on collision has occurred because the trains were running on curves or in hilly country, and were unable to detect each other's presence until the distance between them was too short to avoid disaster. With the vertical beam, of course, an approaching locomotive can be located when it is hidden from direct view by a curve or an intervening hill.

The headlight equipment, which is built by the Edwards Railroad Electric Light Company, consists of four parts: first, the motor, a simple-acting steam turbine; secondly, the dynamo, mounted on the same axle with the turbine and designed to yield to the arc light a current of from 30 to 33 amperes and from 30 to 33 volts; thirdly, the lamp, including the arc, the deflectors and the case; and fourthly, the bedplate on which the whole apparatus is mounted.

The steam turbine is provided with a propeller wheel which is wholly constructed of rolled steel. It has a factor of safety of about 7, for while the normal speed of the engine and dynamo is about 2,000 r. p. m., the wheel will withstand successfully a speed of about 14,000 r. p. m. The speed of the engine is held constant, or practically so, regardless of change of load or initial pressure, by a simple and efficient governor, which is so arranged with relation to the other parts of the engine as to be easily and readily accessible, should occasion demand. The wheel shaft is journaled in ball bearings, and the coefficient of friction is so low that the turbine will operate, running to its full speed, under a pressure so slight that a pointer upon a 180-pound steam gage will not leave its stop, the gage being connected between the governor valve and the nozzle. All the moving parts are incased in a cast-iron housing so designed as to thoroughly protect it from the elements, dust, dirt, etc. The lubrication is automatic and is provided by loose rings feeding the oil to the ball bearings from the oil wells.

The dynamo is of peculiar construction, designed for the particular purpose for which it is used. The field is differentially wound, and the electric circuits so arranged that a burned-out armature is impossible. Should a short circuit occur on any point of the circuit, the current is neutralized, and no matter how long the engine may run or the armature rotate, there will be no production of current whatever until the short circuit is removed. As soon as this is done the dynamo performs its proper functions and operates as usual. The current densities throughout the whole machine are very low, so that a minimum heat effect is produced, regardless of extremes of temperature or other conditions which might affect the resistance of the machine. Low-resistance carbon brushes are used, and many months of constant wear show very little deterioration of these brushes. Very large and long journal bearings are provided, and profuse lubrication is secured through the medium of loose rings dipping into the oil wells. An important feature of the equipment is the arc lamp with its parabolic reflector. It is strongly made, and care has been taken to insure a steady and constant light, free from flicker.

A valuable feature of the equipment is the provision of an auxiliary plane deflector, placed outside the goggle at an angle of 45 deg. and in such a position as to intercept about 40 per cent of the whole volume of light issuing from the parabolic reflector and direct it vertically. This vertical beam forms a constant warning signal. Reaching to a great height, and on cloudy nights striking the clouds, it can be seen for many miles. In fact, upon the Big Four road it has been seen for a distance of 21 miles, and on the Chicago, Milwaukee and St. Paul road it has been seen for a distance exceeding 16 miles. The horizontal beam is very powerful, showing up clearly three-quarters of a mile to a mile, on a clear stright track, ahead of the locomotive bearing it.

Perhaps the only valid objection that was raised to the electric headlight is the fact that upon a double-tracked road there might be some tendency to blinding an approaching engineer. To guard against this contingency the apparatus is provided with a translucent shade, within the goggle, which may be drawn at will by the engineer when he is at the proper distance from an approaching engine. This shade destroys the strong glare of the light, giving the effect of frosted glass. As soon as the approaching train is passed the engineer releases the shade and again gets the full value of the light.

The whole apparatus is generally mounted upon one cast-iron bedplate, and it is the work of only six or ten hours to apply the equipment to the locomotive. All that is necessary is to secure the bedplate at the proper place on the smoke arch by means of brackets bolted thereon, the running of a three-quarter-inch live steam pipe from the cab, and the passing of a one and one-quarter-inch exhaust pipe into the smoke arch.

New Deutsch Airship.

M. Henri Deutsch will soon make an ascent from the Aero Club's grounds at Saint Cloud, Paris, with his new airship, "La Ville de Paris." The outcome of the ascent will be awaited with interest.

Correspondence.

The Use of an Artesian Well for Power.

To the Editor of the Scientific American:

In a recent issue of your valuable publication I notice an article under the heading of "Power from an Artesian Well."

I write this to say that there is in this (Hale) county an artesian well 10 inches in diameter that throws out a volume of water sufficient to run a grist mill, cotton ginnery and cotton press and a sawmill. The well is about 600 feet deep, and was bored fifty years ago by Col. Samuel Pickens on the plantation twelve miles southwest of Greensboro, Ala., known as the "Goodrum Place," now owned by Lee M. Otts, Esq. The water comes up with such force from the well that a silver dollar thrown into its mouth will not sink, but will be thrown out. The gusher has diminished very little in the amount of water furnished during the half century it has been running. To give an idea of the amount of water that is thrown from the well, will state that the trough surrounding it is four feet across, and when the water falls back it comes near filling the trough from side to side.

The mill and ginnery run by the water from this well is situated on a hill-side about a hundred yards away, and the water is carried to it by means of a canal cut in the solid lime rock. Just under the mill house is a well 3 feet across and 40 feet deep. In this well, at a depth of 25 feet, is a turbine wheel and the water from the canal is turned on it when it is desired to run the machinery. A tunnel from the bottom of this 40-foot well has been cut a distance of 100 yards—ranging upward—and empties the waste water from the mill into a branch. Wm. E. W. Yerby.

Greensboro, Ala., September 1, 1902.

How Does the Spider Spin Its Web?

To the Editor of the Scientific American:

I was very much interested in an article that appeared in your paper of August 23 about the mystery of spiders stretching their webs across highways and other long distances.

Every observing country boy has noticed these wonderful feats of the spider in suspending his bridge from one point to another, high in air. My father often told us how he and his father, while crossing a bridge over the Merrimack River in Boscawen, N. H., early one morning, saw a spider's web extending clear across the river from one point direct to another, a distance that must have been at least 250 or 300 feet. The sun was just appearing over the treetops and shone upon the web, so that it was distinctly seen the entire length. They speculated how the spider could have spanned the stream with his web. Certainly the web could not have been strung by the help of the wind, which, nine times out of every ten, blows down the river in this locality. The prevailing winds in New Hampshire are from the northwest; and the river at this point flows from the northwest and runs southeast; the bluffs are quite high on each side, from which it follows that the east or west wind could not have blown strong enough at this point to have carried the web across.

Every open-eyed countryman knows that large spiders can walk on the water, or rather run. I have seen them frequently go so fast on the water that one could hardly see them. I have thrown them into the water many times, where the current was swift, to see how soon they would reach the shore. To anyone not familiar with this insect it would be surprising to see how swiftly it can run over the water.

My grandfather thought that the spider ran across the river, although the current was deep and strong at this point. But my father could not agree to this proposition. He said it would be impossible for a spider to regain the other shore so directly across and then carry his web so high above the water and fasten it to the tree branches on the opposite side without getting the web entangled in the branches in climbing the trees. Neither of them could solve the mystery. I have noticed in attics and barns that spiders spin their webs from one rafter to another at an angle of about 30 or 40 degrees. I have also seen them spinning webs from one branch of a tree to another. They seem to jump from one branch and swing on the web so as to reach the lower branch at sometimes an angle of 40 degrees or less. Webs formed on these angles are frequently seen. The upper cable seems to be the one that holds the web; and below this cable the web is spun. But how a web is thrown directly across a road or river is beyond my comprehension, unless the insect after having crossed the river, attaches the web to some bush, then climbs a tree, and spins down to the web, detaching and carrying it to the higher branches. This the spider can do, I am sure, for I used to like to break the webs in order to observe how carefully the insect would pick up the broken strands, mend them, and then carry the broken ends to their proper places.

Lyman Jackman.

Concord, N. H., September 1, 1902.

Electrical Notes.

A Russian specialist has decided that, contrary to the general opinion, electric light plays less havoc with the eyes than other forms of artificial light. He bases his deductions on the fact that disease and damage to the eye are proportioned to the frequency of the closure of the lids. He found that the lids close in a minute 6.8 times with candle light, 2.8 times with gas light, 2.2 times with sun light and 1.8 times with electric light.

A recent number of the Bulletin of the French Physical Society contains a note on a new "electric valve" for transforming reciprocating currents into direct currents, due to M. Nodon. This "valve" is based on the property, discovered by Buff in 1857, that an aluminium electrode plunged in an electrolyte offers a great resistance to the passage of a current in which it is the anode. The efficiency of M. Nodon's apparatus, as measured by a wattmeter, reaches 75 to 80 per cent.

The General Telegraphic Department of Germany has tested the octuplex system of typographic telegraphy invented by the late Prof. Rowland, of Johns Hopkins University. The government will test the apparatus on all lines between Hamburg and Frankfort. It is claimed that the octuplex system will enable 18,000 words per hour to be sent over a single wire by 20 operators. The system now most widely in use is the Hughes, by which only 2,200 words per hour can be sent.

A correspondent of the Electrical Review has written an earnest appeal for the standardization of the catalogues and other literary matter circulated by the manufacturing and supply concerns of the country. The writer said he was connected with one of the larger electrical companies, and had on file a great many catalogues and bulletins to which he had constant occasion to refer, and the work of keeping this mass of matter together would be greatly facilitated if they were of uniform size. Out of 3,500 catalogues in his care, he said, there were no less than 500 different sizes.

Capt. Chevallier's electric target, which was described some time ago in the columns of the SCIENTIFIC AMERICAN, is meeting with marked success in France. At a recent contest held in Rouen five targets were used. So large was the number of entries at this contest that it was impossible for all the contestants to participate. From the 12th to the 28th of July, 68,072 shells were fired with the French army-gun, model of 1899, caliber 8 millimeters, a test which surely speaks well for the durability and efficiency of the device. The electric target has been installed at Peronne for the purpose of testing French and foreign guns. The device will doubtless meet with no slight success.

It is announced that the speed trials on the Berlin-Zossen railway will be resumed next year, and in the meantime work has been begun on another train especially constructed for the purpose. This train will have a number of remarkable innovations. In the first place, it will be covered entirely with a series of metal plates resembling somewhat the scales of a fish, and these, it is thought, will reduce the matter of wind resistance to a minimum. This was found to be a more serious factor than had been anticipated, and is supposed will prove the keynote of success. Another innovation to be tried will be a conduit running along the top of the train to carry the smoke to the rear.

Owing to the number of accidents that have been caused by the tramcars in Birmingham (England) running down people, the authorities are experimenting with a new type of automatic guard or efficient life protector fitted to the vehicle for the purpose of mitigating fatalities. The designing of an efficient guard for this purpose is not a simple matter, since the government Board of Trade refuses to sanction any guard projecting beyond the front of the steam engine of the car. The automatic guard is simple in construction. There is a hanging gate at the front of the car, and this when struck by an object releases a catch, and a spring forces the life guard proper hard down onto the rails. The gate in front swings loosely to and fro. The slightest touch almost from any object coming into contact with it causes the gate to loosen a catch behind. This catch holds an iron rod which is attached to the second gate or guard, made strong and very broad, and fixed horizontally and projecting in front of the wheels. When this catch is released, the front part of the guard falls dead on the rails. It is kept there by a powerful spring, so that it is impossible for anything to pass underneath it. When the guard has once come down, it has to be placed in position again by a catch which is fixed on the driver's footboard. In the large majority of accidents the person falls in front of the car, and in such cases the simultaneous working of the hanging gate and the guard prevents the victim from passing under the wheels. The guard works automatically with the hanging gate, so that if no obstruction meets this, it does not fail.

Engineering Notes.

An amount of money has been raised sufficient to guarantee the success of the scheme to establish a John Fritz medal, to be awarded yearly to the originators of the most useful scientific and industrial achievement. An effort is being made by the projectors to make this a distinction not second to Bessemer's gold medal awarded by the Iron and Steel Institute. The medal will be awarded by a committee representing the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers. A year's deliberation is necessary before any award shall be made, and the sanction of three-fourths of the committee must be had. The eightieth birthday of John Fritz will be observed in New York on October 31 by a dinner which will be participated in by the leading mechanical and electrical engineers of the country.

A novel steam generator has been devised by Mr. Henry Braby, an Australian inventor, wherein the requisite water tubes are bored lengthwise through flat copper blocks of 3-inch or more thickness, the ends of the holes being connected by semicircular bends so as to form a continuous tube from one side of the block to the other. The blocks are so arranged that the hot gases from the furnace pass around a lower one, beneath a second and around this beneath a similar series of tubes in the cast-iron top of the boiler. The water is fed into the iron tube, where it becomes heated, then it passes successively through the top and bottom series of copper tubes, and enters a receiver as steam under a pressure of 100 pounds or more. It is claimed that, for the same power, this generator occupies only a tenth of the space of a multitubular boiler, and is only one-fourth the weight, while it cannot be exploded, is self-cleaning, and it can be heated to 100 horse power capacity in ten minutes.

Some interesting facts concerning the depth of, and cost of constructing, deep-level tubular railroads in London have been given by the various syndicates, such as the Yerkes and Morgan, interested in the extension of electric rapid transit in the English metropolis, before the Parliamentary committee investigating the schemes. In the case of the Brompton and Piccadilly Circus Railroad, under which, by a link with the Great Northern and Strand Railway, through communication will be obtained from Earls' Court in the southwest, to Finsbury Park in the north of the city, the cost of tunneling, including platforms, lifts, etc., will be $650 per yard at the stations, and $240 per yard for the rest of the line. The average depth of the line is to be 60 feet. In the case of the Charing Cross, Euston, and Hampstead Railroad, the depth of the tube beneath Hampstead Heath will vary from 110 feet to 196 feet. In the construction of the Central London Electric Railroad, the depth of the track below the street level varies from 80 feet to 120 feet. In the construction of these deep-level railroads the pulling up of the streets is forbidden, the constructors having to direct their operations from the sites for the stations. By this means no dislocation of the vehicular traffic of the street is caused.

The British Government is carrying out the first complete geodetic survey of South Africa. According to the recent report issued by the royal astronomer at the Cape, the Geodetic arc of meridian has been carried to the Zambesi. The country near the Zambesi Valley has proved the most difficult for surveying. The observing season is a very short one, as transport from Salisbury cannot begin until the rain ceases in March. In many places grass six feet in height was encountered, and as the natives commenced to burn it in July, the smoke caused a cessation in the work, as it was impossible to carry on the observations under such conditions. In the past season's work progress was most seriously delayed by difficulty in procuring oxen for transport. The original plan was that the reconnaissance and beaconing parties should start some weeks in advance of the observing party, but this became impossible because of the delay in transport equipment. Heavy clearing work and ray-cutting had to be done in some places, and progress in reconnaissance and beaconing could not be made to keep pace with the observing. At the more Northern stations first the wagons and the carts had to be abandoned, and all transport had to be done by native carriers. As the result of these delays, two, perhaps three, of the stations south of the Zambesi, yet require to be occupied with the geodetic theodolite. In the interval between the work of the last two seasons the wires used in measuring the base near Salisbury were recompared at the Royal Observatory, the measurement of the angles from the Salisbury base to the main triangulations was completed and signals were exchanged for longitude of Salisbury. The operations northward from the Zambesi will involve an entirely new departure. Observers and supplies will be landed at Chinde and carried up the Zambesi beyond Zumbo, when transport by native carriers will be organized.

Automobile News.

The programme has been announced for the next international automobile and cycle show, which will be held at Paris under the auspices of the Automobile Club in the Grand Palais, from the 10th to the 25th of December next. This will be the fifth exposition of the kind, and will no doubt be as great a success as last year's show. The exhibits have been divided into sixteen classes, of which the first includes automobiles of all kinds, motor-cycles and all vehicles using mechanical traction. Only the constructors are allowed to exhibit in this class, but exceptions are made in favor of foreign exhibits. A special category is made for the heavy-weight vehicles, tractors, etc. The second class includes cycles, and the third, material of construction and tools for the manufacture of automobiles and cycles. Next come the tires, trucks and mechanical parts, detached pieces, motors, etc. Automobile boats and airships are also provided for, and a special effort will be made, as last year, to bring out the practical applications of alcohol. As to the customs regulations, the commission is to take the necessary steps to have the exposition made a place of deposit, if possible, so that products can be entered free of duty on condition that they are exported afterward. Demands for space should be addressed to the Commissariat General de l'Exposition, 6 Place de la Concorde, before the 10th of October next, where copies of the rules can be also obtained on request.

Now that the Gordon-Bennett cup has passed from France to England, the British Club is making an effort to have the next international race held in that country, as heretofore it has always taken place in France. To do this, however, permission must be obtained from the authorities, and this may not be an easy matter. A member of Parliament, the Hon. Scott Montagu, a prominent chauffeur, has introduced a bill which will rank automobiles on the same footing as other vehicles as to travel over the routes. If the bill is passed, the next step is to obtain the permission of the local authorities. Supposing that the race is finally organized, it will probably be held from 2 to 8 o'clock in the morning so as not to interfere with the traffic, and during two days. There are several different routes which might be chosen. That of London to Edinburgh covers 400 miles, but has a considerable traffic, even during the night, which makes it undesirable. The route from Preston to Glasgow, through the North, would be preferable, as the roads are fairly good and the population is not very dense. Another route is in the region of Kendal and would pass by the Cumbrian Mountains, climbing a 10 per cent grade from Penrith to Carlisle; from here starts a fine route of 100 miles leading to Glasgow; from there the racers would cover 50 miles to Edinburgh and would then proceed to Newcastle or Sunderland.

The Current Supplement.

The interesting article begun in the last issue of the SUPPLEMENT on the Krupp exhibit at the Düsseldorf Exhibition is concluded. This last installment is illustrated just as fully as the first. Mr. Edward R. Taylor describes tersely his method of making bisulphide of carbon in the electrical furnace. The method is of rare interest to the electro-chemist. Dr. F. A. C. Perrine discourses very fully on long-distance power transmission, a subject on which he is a recognized authority. The Northrop loom, one of the most ingenious pieces of textile-making machinery ever invented, is described by Mr. Irving U. Townsend. A new method of carving by machinery is described. The recent death of Prof. Rudolf Virchow, the most famous of modern pathologists, renders a biography and an account of his life-work of great importance. "The Relation of the Psychic Life to the Nervous System" is the title of a lecture recently delivered by Prof. E. G. Conklin, of the University of Pennsylvania, before the Philadelphia Society of Ethical Culture. The paper will doubtless interest our psychological readers. The Consular Notes, Trade Notes and Selected Formulæ will be found in their usual places.

Another Pelee Eruption.

Again the terrible Mont Pelée of Martinique has wrought havoc in the stricken island. In an eruption which almost paralleled that of last May, spreading some five miles farther eastward, over two thousand persons lost their lives. After the catastrophe of last May most of the inhabitants fled, but those who remained were removed by the officials. Assuming that the vicinity of the volcano was safe, the people were transported back two weeks ago to their homes. Then came this last blow. Warships and steamers are taking the people from the coast towns and villages, whither the inhabitants from inland places have fled. It is said that the eruption was one of the most violent yet experienced. Detonations were heard as far as the island of St. Kitts. La Soufrière erupted almost simultaneously with Mont Pelée.