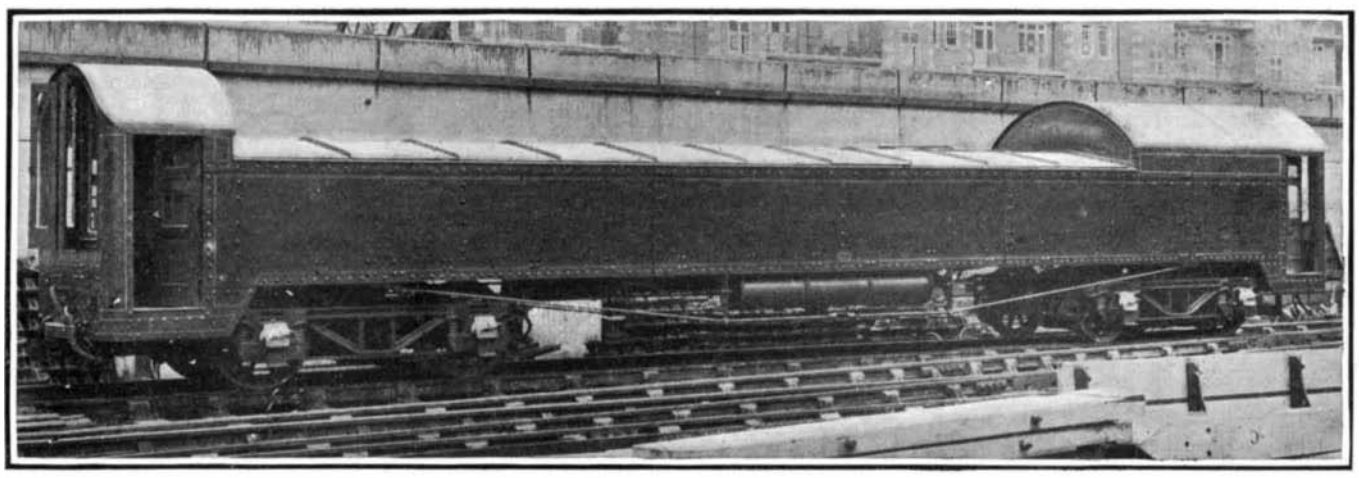
A STORAGE-BATTERY LOCOMOTIVE.

BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

A novel type of electric locomotive has been designed for service upon the Great Northern, Piccadilly & Brompton Railroad, the new deep-level tube for London, that is in course of construction. In this locomotive the motive power is derived from storage batteries.

This engine has been especially constructed for the transport of the excavated ballast from the railroad head, and the carriage of the constructional materials such as the iron segments for lining the tube, rails, ties, etc., to the point of erection. The general practice of carrying out this work with animal traction proved too slow and laborious. With the aid of this battery locomotive a train of several cars can be hauled simultaneously, thereby considerably facilitating and expediting the work. When the railroad is completed and opened for traffic the storage battery locomotives, of which two have been built, will be requisitioned for breakdown work, such as hauling trains out of the tunnels when the current fails, shunting, and other side-track work.



Electric Storage Battery Locomotive for Construction and Emergency Use in One of the New Deep-Level Subways of London.

The general appearance of the locomotive may be comprehensively gathered from the accompanying illustrations. The total length of the engine is 51 feet 3 inches over buffers and 49 feet 3 inches over the body. The total width is 8 feet and the height from the rail level to the top of the driving cabs 9 feet 6 inches and to the top of the battery tank 6 feet 8 inches. There are two driving cabs, one at either end. Each cab is fitted with a British Thomson-Houston master controller, so that the locomotive may be driven from either end. The two driving cabs, however, are not of the same dimensions, one occupying only 3 feet 6 inches of the total length of the locomotive, while the cab at the opposite end takes up 10 feet 10 inches. The larger dimensions of the latter cab are necessary for the accommodation of the controlling apparatus and braking equipment, comprising air compressor and receiver. Between the two driving cabs is placed the tank for carrying the storage battery cells, the length of the tank being 34 feet 11 inches.

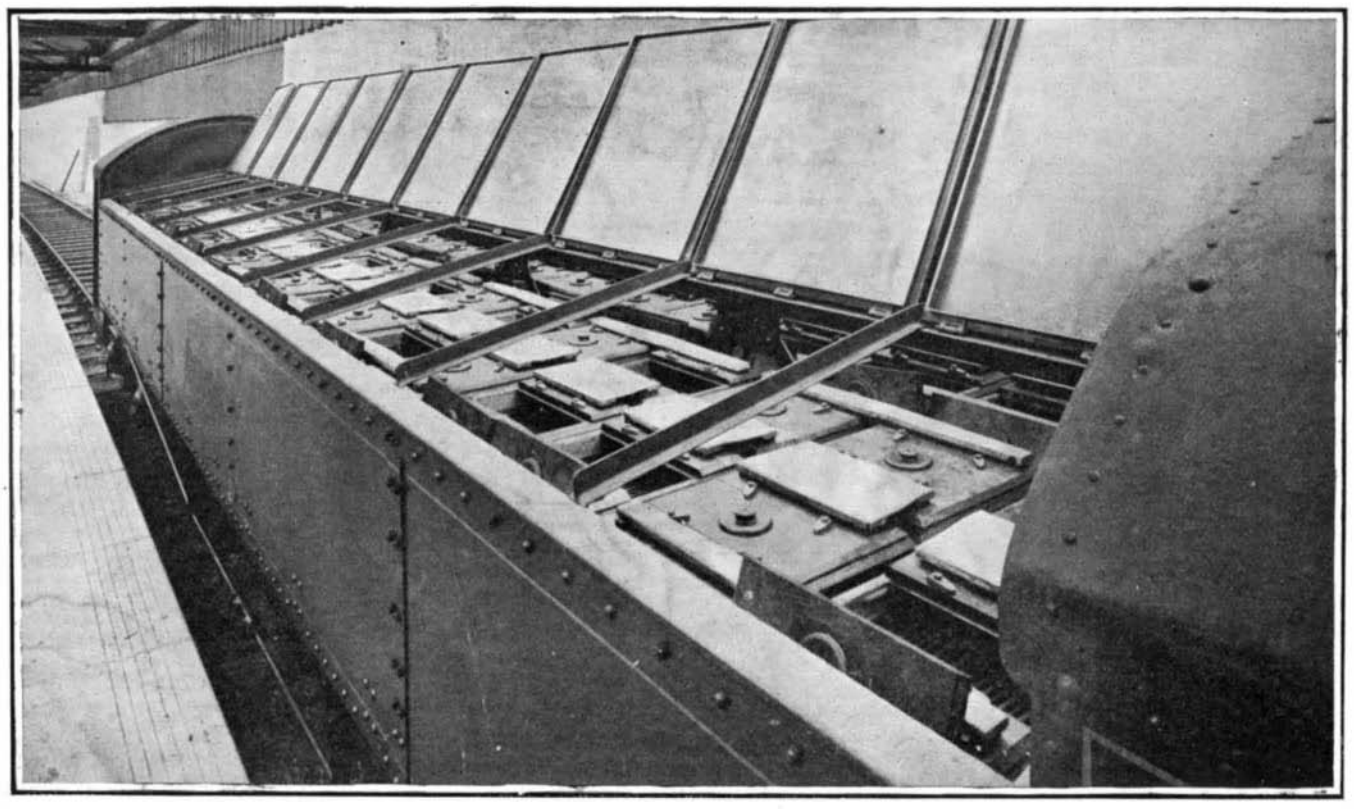
The locomotive comprises a main floor or platform built of channel steel 9 x 3½ x ½ inches, the side sills being 8 x 2 x ½-inch steel girders, and provided with a flooring of jarrah wood.

The frame is carried upon two four-wheeled bogie trucks, to each of which is fitted a British Thomson-Houston electric motor wound to 160 volts. The driver's cabs and battery tank are constructed entirely of steel, and the cabs are so arranged that they join the portion carrying the battery.

The battery equipment is carried on the jarrah wood floor. The accommodation for the cells is divided into two sections by a lattice girder frame extending longitudinally through the tank and so arranged as to provide a sloping top from the center to either side of the tank. The roof comprises throughout a series of doors placed on either side of the central girder to which they are hinged, so that access may be easily and quickly gained to any separate cell, or the roof may be entirely opened. The battery comprises eighty cells of the C. W. type, each cell containing twenty-one plates, supplied by the Chloride Electrical Storage Company, Ltd., of Manchester. The plates are contained in lead-lined wood boxes, fitted with lids. The capacity of the equipment is a normal discharge of 179 amperes, and a maximum emergency rate of 800 amperes, the total available energy being 230,400 watt-hours.

The total weight of the locomotive is approximately 65 tons, of which 31 tons represents the weight of the batteries. The free running speed on the level when hauling a load of 60 tons ranges from 7 to 9 miles per hour. The batteries are of sufficient capacity to operate the locomotive for a whole working day upon one charge, the re-charging being carried out during the cessation of work at night. The locomotive is fitted with automatic center coupler buffers, and the Westinghouse air brake. A special type of flat car has been designed for operation with this locomotive. These cars are constructed simply of steel girders and plate floors mounted on wheels, and are fitted with air brakes.

The working of these engines is being closely followed by engineers interested in electric railroad traction, since they should prove of great value for emergency purposes. As their motive power is self-contained they are useful for the haulage of trains that have been brought to a sudden standstill upon an electric system owing to failure from any cause of the current supply.



Battery Compartment Containing 80 Cells of 230,400 Watt-Hours, or 308 Horse-Power-Hours, Capacity.

This battery supplies 40 horse-power normally and as high as 160 horse-power in emergencies.

Korn's System of Electrical Telephotography.

The problem of transmitting pictures, drawings, signatures, and the like over considerable distances is old; in fact, it dates back to the fifties of the nineteenth century. Many attempts have been made to solve it, but with scant meed of success. Now, however, the difficulty seems overcome, judging from a lecture given on October 28, 1905, by Prof. Korn, of Munich, before the Electrotechnischen Verein (Electrotechnical Union) of Berlin, accompanied by demonstrations with the apparatus itself. Prof. Korn's apparatus is able to transmit a perfect copy of a *carte de visite* within the brief space of ten minutes, and, should it be found practicable by the German postal authorities, who are now testing it, it will inaugurate a new era in connection with press work, criminal investigation, transmission of photographs of fugitives from justice, etc. We will now describe the apparatus itself. Both the transmitting and receiving station are provided with two perfectly synchronous cylinders (i.e., two cylinders running with perfect uniformity of speed and motion, although hundreds of miles may intervene between the two stations), similar to the mechanism already known in connection with the Hughes printing telegraph, and the Siemens telegraphic apparatus. With Korn's apparatus the cylinders at both stations are actuated by shunt-wound electromotors, and an automatic regulating device is employed to prevent any lack of uniformity in their running. The cylinder at the transmitting station is of transparent glass, and the photograph (which has been copied upon a translucent film) is wound around it. A casing at the side of this cylinder carries a Nernst lamp, the light from which is, by means of a lens, concentrated upon a small spot on the surface of the cylinder. Now, according to whether more or less transparent parts of the photograph wound upon the cylinder pass the spot of light, can more or fewer rays of light penetrate the interior of the cylinder. As the cylinder not only rotates but also slowly moves lengthwise, each point of the photograph is compelled to pass under the spot of light. Inside the cylinder there is also a selenium cell, composed of a coil of selenic wire, upon which the light penetrating the cylinder impinges. Selenium is a non-conductor when in the dark, but the more it is illuminated the greater does its conductive power become. This cell is in connection with a battery, and a wire which leads to the other station. Now, when a dark portion of the photo to be transmitted passes the spot of light, no light will be able to penetrate the interior of the glass cylinder at the transmitting station; the selenium cell inside this cylinder becomes non-conductive and no current will be able to leave the battery through the said cell and find its way to the receiving station. The brighter the parts, however, which pass the light spot, the stronger will be the currents passing to the receiving station, where they (being in themselves too weak to be used for reproducing the photograph) are employed to release other currents of greater power.

At the receiving station there is another synchronous glass cylinder, perfectly similar to that at the transmitting station. It is covered with sensitized paper, and facing it there is a small Tesla tube which is made luminous by subjecting it to Tesla currents. The whole of this tube is covered with indurated rubber in such wise that light can only escape at one point, whence it falls upon the surface of the sensitized paper in the form of a spot of light. The Tesla tube is fed by the already known Tesla inductor, one of which is provided at the transmitting station. If left to itself it would, of course, give a uniform light and merely blacken the sensitized paper all over; to prevent this, use is made of the photographic currents coming from the transmitting station, and to this end they are made to operate a sensitive galvanometer. Under the influence of these photographic currents the fine needle of the galvanometer executes a greater or less movement, and acts upon the Tesla apparatus in the same ratio. According to its position it switches more or less resistance into the Tesla circuit, thus causing the Tesla tube

to become more or less luminous. In this manner an exact copy of the photograph at the transmitting station is reproduced upon the printing-off paper.

This process can also be used for the transmission of handwriting. In this case the matter is written with non-conductive ink upon tin-foil, which is then drawn through a contact device. Closing of the current then takes place upon the surface of the metal, whereas, owing to the nature of the ink, the current is broken at the written characters; in this way the above described photographic currents are produced, which are then used at the receiving station as stated above. At present from 500 to 600 words can be transmitted per hour, giving an exact replica of the original; or a stenographed message of 3,000 words can also be telephotographed in the same time.

Terms Employed by Foresters and Loggers.

"Terms Used in Forestry and Logging," just published as Bulletin No. 61 of the Bureau of Forestry, affords the lay reader an insight into a strange vernacular.

The first half of the pamphlet is devoted to forestry. There we may read all the technical terms in good use, from "absolute forest land" to "yield table." Many terms explain themselves, but where they are not so readily understood the short definition makes plain at once the idea conveyed and the need of a special word or phrase to convey it. Perspicuity, precision, and common sense seem to have been the objects sought by the compilers.

On turning to the logging terms, which are listed in the last half of the bulletin, we come across some truly remarkable expressions—terms which, though evidently derived from slang, are now in good use among woodsmen either throughout the country or in the region denoted in each case. There the uninitiated may learn the distinction between a "ball-hooter" and a "boom rat," between a "bull cook" and a "cattyman," and find that none of them refers to any lesser animal than the logger himself. Among other creatures of the logging camp may be numbered also the "alligator," the "dolphin," the "dog," the "pig," and the "road donkey," all names of objects endowed with life by the vernacular of the logger. The "alligator" proves to be "a boat used in handling logs;" the "dog" a "short, heavy piece of steel;" the "pig" a "rigging sled;" and the "road donkey" a donkey engine mounted on a heavy sled, etc. Birds are represented by the "blue jay" and the "rooster" (also called "gooseneck"), reptiles by the "snake," and insects by the "katydid." A tenderfoot intending a visit among the brawny loggers in the North Woods, the Appalachian Forest, or elsewhere, should find it decidedly in order to take along this bulletin.

As the only reliable handbook of the kind in the language, Bulletin No. 61 will be in wide request among those interested in forestry and lumbering. It may be secured by application to the Forester, Department of Agriculture, Washington, D. C.

The Gases Given Off by Actinium.

Solutions of radium salts are known to give off continually an explosive mixture, $H_2 + O$, resulting from the decomposition of the water under the influence of radium. Ramsay and Soddy have shown this mixture to contain also small amounts of helium, which, as is generally presumed, is due to the disaggregation of the radium atom.

Mr. A. Debierne, as pointed out in a recent memoir to the French Academy of Sciences, has performed a large number of experiments on a solution of radium bromide and on actinium salts both in solution and in the solid state, when a formation of helium was stated with both kinds of salts. The experimental outfit used was similar to the one employed by Ramsay and Soddy, the gaseous mixture being introduced into a glass tube containing different substances to absorb any gases susceptible of chemical reactions. Such gases as were not absorbed in one of these tubes, viz., those of the argon group, were compressed by means of mercury in a small capillary tube, about 2 cubic millimeters in capacity, and carrying two platinum electrodes. The spectrum of the gas was observed in a direct vision spectroscope of fairly great dispersive power, giving the wave length with an error of 1 or 2 units in the fourth figure. Photographs of the same spectrum were obtained by means of a quartz spectrograph, allowing the wave length to be measured with an error of one unit in the fifth figure.

The helium gas obtained in the author's experiments was found to be due to the presence of radio-active bodies as borne out by numerous checking experiments made under similar conditions.

In a previous paper, the author has shown that outside of the large amount of rapidly evolved emanation from actinium, there is a rather small amount of emanation which is evolved much more slowly. This latter emanation is found to be identical with the one given off by radium, though the amount evolved be extremely small.

It may be mentioned that Prof. Debierne has found in the spectra of the gases given off by actinium a number of lines which he has not been able as yet to ascribe to any one of the known gases.

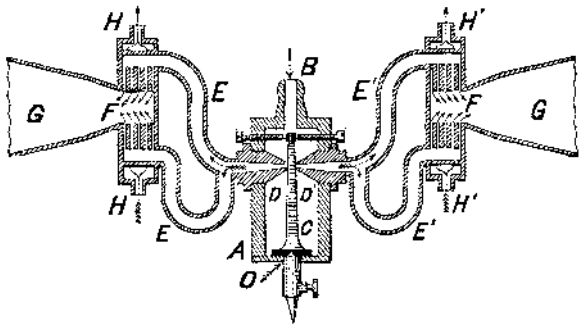
A NEW MEGAPHONE.

BY DR. ALFRED GRADENWITZ.

A novel apparatus for increasing the intensity of sounds has been invented by Messrs. G. Laudet and L. Gaumont. The principle underlying the construction of this apparatus, which was recently presented to the French Academy of Sciences, consists in transmitting the sound vibrations concerned to and from a convenient flame. After the first experiments made in this connection, utilizing the human voice, had given satisfactory results, the voice assuming a remarkable intensity, the experimenters continued their investigations, employing sources of sounds of mechanically determined intensity, with continued success.

The megaphone (shown in the accompanying engraving) consists of an equilibrated distributor to regulate the amount of the burning gas mixture, and a burner wherewith the gases are consumed in an ignition chamber. The apparatus submitted to the Academy was arranged for registering the reinforcement of sounds of any kind on ordinary phonograms. Air and acetylene were employed as burning gases.

The distributing mechanism consists of a chamber, *A*, into which the combustible mixture is introduced under pressure through a conduit, *B*. A vane, *C*, supported on knife edges at *O*, is mounted at the bottom of the chamber, *A*, an elastic ring being provided to insure airtightness in *O*. Any motion given to the pencil is transmitted to the vane, *C*, inside of the distributor. On either side of *C* openings, *D* and *D'*, are provided through which the gaseous mixtures are allowed to issue in respectively equal amounts as long as the vane is immovable. Any displacement of *C* will, however, result in an increase of the amount of gas issuing on one side, while the amount issuing on the other side is reduced. The total amount of utilized mixture remains constant, and the pressure in the interior of the chamber is also unaltered.



A NEW MEGAPHONE.

The gases are collected and conveyed to the burners through a series of conduits, *E*, *E*, *E'*, *E'*. The burners consist of a series of disks cooled by an air current, *H H'*, the gases being expanded and reduced to a temperature such that combustion always occurs in the chamber, *F F'*, just at the point where the gases escape from the openings of the burner. The apparatus further comprises two funnels, *G G'*. The power of the sounds obtained, which is truly remarkable, depends on the amount of gas mixture used and on the energy expended during its combustion.

The Current Supplement.

The current SUPPLEMENT, No. 1560, opens with a description of a 50-ton electric crane having a radius of eighty-seven feet. In a number of papers recently contributed to various scientific publications, Prof. Rutherford and others have made valuable contributions to our knowledge of the properties and life history of radium. These are reviewed in an excellent article bearing the title "Recent Study of Radium." Platinum and its alloys are briefly discussed. Prof. John J. Montgomery writes authoritatively on new principles of aerial flight. Walter J. May contributes an account of metal foundry patterns. Curious optical illusions are described by Arthur K. Bartlett, the chief being the halo of the moon. Mr. J. H. Morrison's excellent series of papers on the iron and steel hull steam vessels of the United States is brought to a conclusion. The last installment of A. Dastre's article on the stature of man at various epochs is presented. R. Kissling contributes the result of his recent investigations in the chemistry of tobacco. There are few more familiar sights than rain, and yet the method of its formation is but little understood by the ordinary reader. For his benefit the current SUPPLEMENT contains a most instructive article, in which the phenomena of rainfall are simply discussed. Prof. Dr. Hans Molisch, whose investigations on the phosphorescent light of plants have made him a leading authority on the subject, read a paper on "The Radiation of Light by Plants" before the Congress of German Naturalists and Physicians. This paper is published in full.

Engineering Notes.

In considering the proper material for a lagging, the principal elements are nonconductivity, noninflammability, efficiency, economy, ease of application, structural strength to withstand frequent removals and reapplication, freedom from corrosive agents, ability to withstand indefinitely the disintegrating effect of the action of heat, and the vibrations and concussions incident to locomotive action. In addition, the covering should be only of material which is of a porous or spongy nature, with numerous cells or spaces, which will retain air between the particles of the substance.

As an instance of the rapidly-increasing use of steam turbines in Europe, we may mention the following electric plants, which are either in construction or already running. The plants in question are all under the control of a Franco-Belgian syndicate. The first of these, and the largest, is the new electric station which is to supply an extensive section of Paris with current for lighting and motors. It is now in construction at St. Denis. The power of this station will reach nearly 30,000 horse-power, and an overload of 20 per cent can be kept on for two hours. Next comes the large electric plant of Sclessin, near Liège, which has steam turbines to the amount of 15,000 horse-power. The new electric plant of Charleroi, also in Belgium, can furnish 3,500 horse-power, while the new plants which are erecting at Brussels, Ostend, Maubeuge, and at Cairo represent in all about 15,000 horse-power. Thus we find that steam turbines to the extent of 65,000 horse-power have been installed within three years by the same company.

The question is sometimes asked whether it pays to reduce the pressure when the load is light. It hardly pays to reduce the pressure on the boiler, except in very extreme cases, but if it can be done by throttling before the steam reaches the cylinder of the engine, it would be an advantage, because this retains the heat units due to the higher pressure in the steam and the throttling has a slight superheating effect. As a matter of fact, tests made by Willans & Robinson, of England, go to show that for light loads and high pressure, a throttling engine may do even better than automatic cut-off. The ideal arrangement is to throttle the steam for light loads up to say near quarter cut-off, and after that, for heavier loads, allow the variable cut-off to come into play. This practice has been carried into effect by the design of Mr. E. J. Armstrong, in which he arranges the shaft governor so that there is negative lead up to nearly one-quarter cut-off, after which the lead becomes positive, and this has the effect of throttling the steam for the earlier loads and undoubtedly gives better economy, in addition to making the engine run more quietly.

The first tunnel which is to pass underneath the Seine near Notre Dame for one of the new sections of the Paris subway has now been commenced. The Metropolitan had been taken across hitherto upon two bridges. These latter sections have not as yet been completed, however. As to the tunnel under the Seine, the first of the caissons was sunk not long ago. It has the peculiarity that it not only serves in carrying out the work, like an ordinary caisson, but the superstructure forms the walls and vault of the tunnel itself, having straight sides and an elliptical arched top. So that it will be sunk on the spot where it is to remain and then will be covered on the inside by an envelope of cast iron and masonry. Each of the caissons thus forming a section of the tunnel is 130 feet long by 33 wide and 29 high. At this point the Seine has 16 feet depth. The lower side of the caisson will be sunk to a depth of 33 feet below the river bed and the upper part will thus lie about four feet below the ground. There will be three of these sections to form the tunnel which passes obliquely across the Seine.

In Switzerland, the number of electric and cable inclined railways for ascending the mountain slopes has greatly increased within the last few years, and when working in connection with the railroads, the system has proved very useful both for tourists and also for the inhabitants of the health-resorts which are placed at elevated points. Among the new inclines which are now in construction we may mention the one which is to be used for mounting the Wetterhorn. It is designed upon the Feldmann system, by the constructor of the well-known Barmen-Elberfeld-Vohwinkel suspended road. The peculiar feature of the new Wetterhorn incline is that the cars are suspended above the tracks upon cables. The overhead cable is made double and there are two cables, one above the other, so as to provide for breakage. The two tracks lie 25 feet apart and the cars are drawn as usual by cable. The descending car helps to draw up the ascending one. The sustaining cables are anchored separately at the upper part and at the lower are stretched by a counterweight. This makes the tension of the cables independent of the value and the position of the traveling weight due to the cars. Steel cables of about 2-inch diameter are used. The cars are very light, and the system takes less power than usual.