colors, but also for some of our most valuable drugs. The valuable drug antipyrine, discovered in 1883 by Dr. Knorr, of Erlangen, is considered even better than quinine as an assuager of fevers, and is much cheaper in price. Another is thallium, discovered by Skraup, which has the special power of mitigating yellow fever, or the "yellow Jack," the dread of every colonist. Phenacetine is still another, possessing valuable antipyretic properties. Sulphonal, discovered by Prof. Baeyer, is a hypnotic. But perhaps the most remarkable substance obtained from tar is saccharine, 220 times sweeter than cane-sugar, useful for sweetening fruit preserves, jams, jellies, etc., where ordinary cane-sugar would mold and ferment in course of time. A most interesting and important property is that it does not nourish and fatten the body as cane-sugar does. Hence it is of value in certain troubles like diabetes, where it is often recommended by the physician for sweetening tea or coffee in place of cane-sugar.

Vanilin, now obtained from this tar, is a delicate flavoring essence resembling the true vanilla from the vanilla bean, and the cultivation of the plant in the Cordilleras and Mauritius has been greatly restricted from the introduction of this artificial vanilla. By mixing essence of mirbane with a certain proportion of this coal-tar vanilla, Lord Roscoe has prepared a delightful perfume known as white heliotrope, and many of the pleasant perfumes which play an important part in the toilet of every pretty maiden and courtly dame are extracted, by the magic of chemistry, from that black and ill-smelling substance, tar.

Glycin and Hydroquinone Developer.

After considerable experiment we have found the combined glycin and hydroquinone developer to be not only very effective and durable, but also one of the cleanest yet tried, which makes it particularly suitable for amateurs whose dark rooms have to be bath rooms, for it will not stain marble, towels, or the hands, should any of the developer come in contact with them.

It is also a very flexible developer, capable of being adjusted to most any kind of exposure, by simply adding, from time to time during development, a few drops at a time of the carbonate of potash solution, strength of one ounce dissolved in ten ounces of water, or instead, a solution which has previously been used and kept for a few days.

In one mixing it is possible to develop two dozen plates in succession, one as clear as the other. The developer is absolutely free from producing chemical fog, even during prolonged development.

Two solutions are prepared as follows:

No. 1.

Glycin (Hauff)	180 grains or	12 grammes.
Hydroquinone	60 grains or	4 grammes.
Carbonate of potash	180 grains or	12 grammes.
Sulphite of soda, crystals	690 grains or	45 grammes.
Water, hot or very warm	10½ oz.	or 300 c. c.

In hot weather it is advisable to preserve it in small bottles, and place in lower part of icebox.

No. 2.

Carbonate of potash	1 oz.
Water (cold)	10 oz.

For use, take one part of Solution No. 1 and two parts of No. 2. Bromide of potassium is not necessary, as the negatives will be clear without it.

With a slight modification it is possible to produce with this developer very good negatives from plates which have been greatly overexposed by using the following solution:

No. 3.

Glycin	75 grains or	5 grammes.
Sulphite of soda, crystals	450 grains or	30 grammes.
Carbonate of potash	390 grains or	26 grammes.
Bromide of potash	15 grains or	1 gram.
Water, warm	20 ozs.	or 625 c. c.

This solution can also be used repeatedly. For doubtful cases, as an overexposure, it will be a very sure way to use half and half. That is, mix of Solutions No. 1 and No. 2 only half the quantity needed, and add the other half from Solution No. 3.

For ordinary exposures with the developer showing a temperature of 70 deg. F., the image usually appears in about twenty seconds after the plate is covered with the developer, and development is generally completed in about four to five minutes. If at this time the plate is not sufficiently dense when viewed by transmitted light, it is only necessary to continue the development until the desired density is reached.

Electromotive Force Developed Between Magnetized and Unmagnetized Iron.

It has been found that if two iron electrodes are placed in acidulated water, one of these, upon being magnetized, becomes positive to the other, causing an electromotive force to be set up. The experiments of Dr. Hurmuzescu have shown that up to a magnetization of 7,000 units the curve which unites the electromotive force to the strength of the magnetic field developed in the iron has a form analogous to the curve of magnetization of iron, that is, the electromotive force, increasing at first with an increase of magnetization, afterward increases more slowly. M. René Paillot has extended these researches to very intense magnetic fields, and finds that the electromotive force seems to arrive at a limit beyond which it cannot be increased by further magnetizing the iron. In order to reach this limit a very intense magnetic field was needed, and this was obtained by using the semi-circular electromagnet devised by Dubois, by which in the intrapolar space a magnetic field as high as 30,000 units is obtained. The experiment was carried out with electrodes in the form of iron wire carefully annealed; these were placed in the vertical branches of a tube bent up at each end, and filled with a dilute solution of acetic or oxalic acid. One of the branches of the tube, containing an electrode, is placed in the magnetic field between the poles, and as the lower straight portion is 12 inches long, the second branch with its electrode is entirely outside the field. The electromotive force, which was very small, was read by a Lippmann electro-capillary voltmeter, sensitive to the 10,000th part of a volt. The magnetic field was measured by the ballistic galvanometer. A number of observations were made, which agreed very closely, and the results are expressed in the following table:

Field strength H.	Electromotive force volts.	Field strength H.	Electromotive force volts.
804	0.0022	20210	0.0298
1698	.0040	23492	.0320
3106	.0074	24500	.0324
5000	.0110	26505	.0330
8712	.0171	27018	.0328
10504	.0191	28886	.0330
12193	.0210	29510	.0332
17043	.0272	30187	.0330

It will thus be seen that the electromotive force developed between magnetized and unmagnetized iron cannot be made to pass a certain limit. This limit, which is 0.0330 volt, is reached when the iron is magnetized to 25,000 units, and is not increased at a field-strength of 30,000 units, which is about as high as can well be obtained. The value of this limit depends somewhat upon the sample of iron and the strength of the acid, but does not vary greatly from the above.

STEAM HEAT WITH CONDENSING ENGINES.

BY ALTON D. ADAMS.

Industrial works have usually to choose between condensing engines and exhaust steam heat. If condensers are used, most of the heat of steam is rejected in their water, and the heating system must be supplied from the boilers. Should it be decided to use the exhaust steam in the radiating surface, at a little more than atmospheric pressure, the power and efficiency of the engine both suffer not only by the absence of a partial vacuum, but also from the positive back pressure. A compromise is sometimes adopted, by using condensers in the summer and the exhaust steam for heating purposes in the winter. This expedient makes a very material difference between the power of engines in warm and cold weather, also in the amount of coal consumed. The steam consumption per indicated horse power increases by 25 to 30 per cent during the cold season. Besides this loss of efficiency, the maximum power of an engine, working at one-quarter cut-off, would be reduced about 27 per cent by changing the exhaust connections from condenser to heating system, provided that five pounds back pressure is carried in the exhaust steam-pipes. Fortunately it is no longer necessary either to waste the heat of exhaust steam, when wanted for heating purposes, or to reduce by one-quarter the efficiency and outputs of engines during one half of each year. A vacuum of 26 inches may receive the engine exhaust for twelve months of the year, and the heat of this steam be applied for general warming to any extent desired. This desirable result is accomplished through the vacuum system of steam heating. The heating surface of this system, when operating with exhaust steam, does the work of a condenser; that is, it changes the steam to water and thus produces a partial vacuum. The latent heat of the steam, instead of heating condensing water, warms the air of spaces in which radiators are placed. The latent heat of steam in a partial vacuum is even greater per pound than at atmospheric pressure, and the heating power of the engine exhaust remains nearly constant, whatever the pressure, if rightly applied. To ensure the constant flow and condensation of steam throughout the heating system, air and water must be removed from the radiating surface as fast as they accumulate. This is effected by arrangements of suction pipes and valves that ensure the removal of air while they prevent its entry, and by suitable return pipes for the water.

As a result, the heating system when in use is constantly filled with steam of the pressure at which the vacuum is operated. The radiating surface for general warming will obviously have its greatest condensing action in the coldest weather. If this surface for general warming is the only one that may be used to maintain the vacuum, this vacuum must vary with the outside temperature. To avoid such variation of the vacuum against which the engines work, and to provide for condensation during hot weather, a condenser of one of the usual types should be provided, to operate in connection with the general heating system. If the exhaust is only sufficient for warming purposes in the coldest weather, the vacuum will be maintained by the condensation in the heating system. In warmer weather a part of the exhaust must be condensed by the use of water in the condenser, and when no general warming is required the regular type of condenser may do all of the cooling. This use of a heating system as a condenser for engines saves either the entire cost of fuel for general warming during the winter, or adds a material per cent to engine capacity and efficiency. The temperature of steam is only about 140 deg. F. in a vacuum of 24 inches. In other words, each pound of steam on condensation in a high vacuum gives up more heat units than at open air pressure, but the temperature at which this energy is liberated is greatly reduced. The vacuum heating system will warm as much space with a given weight of exhaust steam, as though operated at or slightly above atmospheric pressure, but a much larger amount of radiating surface must be employed for the purpose. Radiating surface is effective for warming purposes in proportion to its elevation in temperature above that of the surrounding air. The actual amount of heat given off per hour by a square foot of radiator surface per degree of temperature difference, varies with its construction, the movement of the air and other factors, but two heat units may be taken as an average figure. On this basis one square foot of radiation, supplied with steam at five pounds above atmospheric pressure, and with a temperature of 227 deg., delivers 314 heat units per hour to air at 70 deg. temperature. In contrast with this result, one square foot of radiator surface, heated by steam in a vacuum of 24 inches, has a temperature of 140 deg. and supplies only 140 heat units per hour to the surrounding air at 70 deg. under like conditions. To produce the same general heating effect the vacuum system must, therefore, contain two and one-quarter times the radiating surface that would be necessary for steam at five pounds pressure. Assuming that one square foot of radiating surface is in use 1,500 hours per year, at five pounds pressure, with surrounding air at 70 deg. F., it gives off 471,000 heat units during that period. If steam for this heat is taken directly from a boiler with an efficiency of 70 per cent, the coal consumed per square foot of heating surface must contain 672,888 heat units. At 13,500 heat units per pound, the coal per year for each square foot of radiation amounts to fifty pounds. With coal at $3 per ton, fifty pounds cost 7.5 cents. In order to use the vacuum system of heating with steam from condensing engines as above, one and one-quarter square feet of radiating surface must be added to each square foot necessary with steam at five pounds above air pressure, to give off an equal amount of heat. No increase is required for the vacuum system in the size of pipes to the heating surface, since the necessary weight of steam is not larger than at five pounds pressure. The cost of 1.25 square feet of rough heating surface, constructed with 1 or 1.25-inch pipe, as is common in industrial works, is 15 to 20 cents. Coal alone, during a single season was found to cost yearly 7.5 cents per square foot of heating surface in a system at five pounds pressure. When to this fuel outlay there is added the interest on investment for boilers to supply the heating system independent of the exhaust steam, the total will probably equal the cost of extra heating surface for the vacuum system in a single year. If the cost of decreased capacity and efficiency at the steam engine is figured for the case where condensing operation is abandoned, in order to supply exhaust to a heating system, this cost will be found to represent a very large annual interest on an outlay for the additional heating surface necessary in a vacuum system.

In summer as well as in winter the heat of exhaust steam from condensing engines may be put to useful work. Among the most commonly desired effects in summer are cooling and ice making. These processes are readily carried on by the heat of vacuum exhaust, on the absorption system of refrigeration. On this system, heat instead of mechanical power supplies most of the energy necessary to keep up the set of operations by which ammonia conveys heat from the substances cooled. This heat can be extracted from tubes in which the engine exhaust condenses, by the ammonia solution.

Where condensers are operated only during the summer, the exhaust is used for steam heating at a little above atmospheric pressure in the winter.

The law enacted at the last session of the Connecticut Legislature regarding the speed of automobiles went into effect August 1. The law limits the speed of all power vehicles to 12 miles an hour in cities and 15 miles on the country roads. If the driver of a horse holds up his hand to an approaching automobile the operator must stop immediately. A penalty of not over $200 is attached to the statute.

Automobile News.

It is said that the Mors racers of 28 nominal horse power, of which several, including Fournier's, were in the Paris-Berlin race, are required to do a kilometer in 32 seconds before they are passed by the makers. This is just a shade under 70 miles an hour. The nominal power of these machines is believed to be much less than the maximum of which they are capable. Their weight is put at 2,860 pounds, as against 2,640 pounds for the Panhards of the same nominal power, says The Automobile.

The 7 horse power Renault voiturettes which performed so remarkably in the same race are said to weigh but 870 pounds. They are fitted with De Dion motors, giving a maximum of 8-horse power.

Consul Chester reports from Budapest, June 29, 1901: The first Automobile Exposition in Hungary was opened on the 17th instant. About seventy machines were on exhibition. The only American make was that of the Locomobile Company of America, which was represented by two steam automobiles. It has only one agent in Vienna for the whole monarchy. The German firm of Benz & Company put on a motor machine, as did the French firms of Peugeot and Darrocq, all of which have appointed agents in Budapest. Austria was represented by Daimler & Company and the Braun Automobile Company, with a motor and an electrical machine, respectively. Hungary's home manufacture consisted of an electrical autotricycle made by Geza Szám, electrical engineer in that city. The Velodrom Company, of Budapest, agents for the Peugeot machine (French), made the best showing, with pleasure automobiles, government post-collection tricycles, and delivery wagons. American manufacturers should at once represent themselves here.

The coasting race from Spa to Malchamps, organized by the Belgian Automobile Club, was run on the 21st of July and proved an interesting event. This route has 3.4 miles of a very steep grade, such as is characteristic of the Ardennes region. Osmont, on a De Dion motocycle, was the winner, and climbed the grade at a speed of over 36 miles an hour, in 5 min. 21 2-5 sec., thus beating considerably the previous record made by Baron de Crawhez of 7 min. 21 sec. In the voiturette class (up to 880 pounds) Orban-Viot was the winner, in 12 min. 57 3-5 sec., on a De Dion machine. A much better performance was made by Baron Joseph de Crawhez on a 28 horse power Panhard machine, in the heavy vehicle class, or 7 min. 37 4-5 sec. In the light vehicle class, Roland, on a Gobron machine of 9 horse power, made 7 min. 46 1-5 sec. The weather was fine, and the race was watched by a large crowd. The coasting races organized in France and in Austria will no doubt prove equally interesting. The former of these has been fixed for the 11th of August, and takes place over the celebrated Raffrey grade, near Vizille, which is four miles long and slopes from 7 to 13 per cent, with an average of 9.3 per cent. It has been organized by the Dauphinois Club, and affords an excellent test for the machines. On the 15th of September will be held the Schottwien-Semmering coasting race, arranged by the Austrian Automobile Club. It will include motocycles, voiturettes, light and heavy machines, and a fifth class for electrics.

In the travels which the Etat-Major of the German army have been making through all parts of the country, automobiles and motocycles are used almost exclusively. The officers are thus enabled to cover a considerable stretch of country without fatigue, and to visit all the important military posts. The bicycle, with petroleum motor, is also coming into favor among the officers. In the grand maneuvers, horses are now almost entirely replaced by automobiles and bicycles for the officers' use. In France the coming maneuvers will be of exceptional importance, and it is said that a number of specially designed automobiles will be used. These have been carefully studied with a view to the various needs of the army and will be given a thorough trial. A notice has been recently issued that those who wish to make their annual 28 days of service during the fall maneuvers as automobilists with the machines belonging to them, are to make a demand to that effect at the recruiting offices. The daily allowance for these machines has been fixed this year at $2.40 per day for the voiturettes and $4 a day for the machines of 8 horse power and over, in addition to the regular army rates allowed to the soldiers. In Italy the Minister of War has decided to study a special type of military automobile which shall be adapted to all the services which such a machine should render in time of war. When this machine has been designed, the Minister of War will have a certain number of them built, and will then establish a series of annual prizes to be awarded to those of the constructors who show the greatest aptitude for building machines for army use. In this way the army will always know where to find the machines it may need at any given time, and will not be obliged to spend great sums every year in the construction of a type of machine which is constantly being improved.

Electrical Notes.

A 160-foot mast has been set up at Siasconset, Mass., for the wireless telegraph station which will receive messages from the Nantucket lightship. The ground connections were made by placing eight heavy metallic plates, 2½ by 8 feet, in the ground.

The cardinal's hat has been conferred upon Agostino Riboldi, Bishop of Pavia, who is well known for his work in physics, and especially in electricity. Several other ecclesiastics interested in electric subjects have recently been raised to the episcopal throne.

Nikola Tesla is about to establish his first wireless telegraph station at Wardenclyffe, nine miles from Port Jefferson, L. I. Two hundred acres of land have been purchased, and the necessary buildings will be put up at once. The main building will contain a 350-horse power electric plant. This will be the first of a chain of stations by means of which Mr. Tesla expects to communicate with all parts of the world.

An interesting report has recently been issued of the work done during 1900 by one of the chief Berlin laboratories, which make a special feature of analyzing calcium carbide and the various accessories required in acetylene generation according the specifications of the German Acetylen Verein, says the English Electrical Review. Of the samples of large carbide tested, 36 per cent evolved less than 285 liters of gas per kilometer (4.53 cubic feet per pound); 52 per cent evolved between 285 and 290 liters (4.53 to 4.62 feet); 8 per cent evolved between 290 and 300 liters (4.62 to 4.76 feet); and only 4 per cent gave more than 300 liters. The samples of granulated carbide gave on an average 210 liters (3.33 feet), the yield sometimes falling to 150 or 180 liters (2.4 to 2.9 feet); and much of this stuff was "guaranteed 300 liters."

The electrophone is enjoying increasing popularity in London. The London Electrophone Company have recently reduced their rates and now it will be possible for one to enjoy unlimited supplies of music, speeches, and so forth, for less than four cents per day. The company intend to reduce their tariff from its present rate of $50 to $12 per annum, and there will be no extra charges for installing the system into a private house, or for maintenance. The company has recently introduced several new devices in the apparatus which considerably improves it. One of the most important is a loud-sounding receiver. With this device it is only necessary to turn the switch, and everyone within the room in which the receiver is installed is able to hear. The instrument is already connected with the Grand Opera House, leading amusement halls and churches in the metropolis. The company also proposes to introduce a traveling telephone, applicable to railway carriages.

The telegraph department of the British Post Office has been carrying out some important experiments between London and Glasgow with a new device to cheapen the cost of transmitting telegrams. The apparatus is the invention of a French engineer named Mercadier, and by its application it is possible to forward twelve messages over one wire. The system may also be duplexed, so that when the exigency arises, twenty-four separate messages may be dispatched over the same wire. The apparatus is extremely simple in its design. At the sending end of the trunk wire are twelve short wires connected with twelve sending keys. The currents are interrupted by twelve rapidly vibrating metal reeds, each of which oscillates at a certain speed. At the receiving end of the wire are attached another set of twelve short wires, in this instance connected to twelve telephone receivers, each of which is fitted with a membrane capable of vibrating only at a rate synchronous with one of the vibrators at the sending end of the wire. When the messages are dispatched the twelve messages enter the wire with a certain vibration. When they arrive at the receiving station they pass through a microphonic receiver which increases their strength, and then each current enters the telephone receiver corresponding to its vibrations. Owing to the bad weather which has been experienced in England, the experiments have not been entirely successful, but when certain improvements in the apparatus have been embodied, there appears every possibility of the postal authorities adopting the invention. For some time past there has been an agitation in England for the reduction in the cost of transmitting telegrams. At present it costs twelve cents to forward a telegram of twelve words to any distance, and the public desires it to be reduced to six cents per message of the same length. The telegraph authorities contend that the expense of maintaining the wires and the cost of erecting new wires to cope with the increased traffic preclude the possibility of such a reduction being carried out until the cost of transmitting telegrams is reduced. The authorities hope that by means of this device it will be possible to increase the carrying capacity of the existent wires twelvefold, in which event the idea of six-cent telegrams will be realized. The new system is fully described in the current SUPPLEMENT.

Engineering Notes.

Comparison of the economy of the compound and triple-stage expansion types of engines in similar work and in vessels substantially the same, extending over one year in both cases, shows that the triple stage engine cost less for coal by 18 per cent, the cost of upkeep being no greater with one type than with the other.

On a private railroad, used chiefly to carry coal to and bricks from a brickyard in Prussia, a locomotive using alcohol as fuel is used. It was built for a society for the promotion of the use of spirits, which, in that part of the world, are largely produced in distilleries of large landholders, to utilize sirup produced in making beet sugar, unmarketable potatoes, etc.

Trade reports in various lines throughout the country, as shown by the journals representing manufacturing interests generally, say that there is no anxiety as to fall prices, nor any as regards the prevalence of strikes, outside of the loss of trade in districts immediately affected. No fears exist as to the crops and all lines are stocking up to be ready for trade when it arrives.

Contrary to the general belief the engines of torpedo boats are not at all extravagant in the use of steam, but approach high economy, considering that they are driven regardless of cost, the sole view being to get the highest possible piston speed in the shortest time with forced draft of greatest intensity—an air pressure of six inches in the fire-room in the case of the "Bagley," built by the Bath Iron Works. The coal burned per initial horse power was only 1.88 pounds per hour, with a consumption of 68 pounds per square foot of gas.

This paragraph from The Engineer, London, has a certain interest at this time: "As comparisons between English and American workmen are everlastingly cropping up, we quote from a local press representative who interviewed Mr. Stewart, in charge of the British Westinghouse Company's works at Trafford Park. He said: 'Well, I guess it's like this: The British workman (skilled man) works mighty hard and well; if you show you have some snap in you he will soon let you see that he possesses snap also. They soon fall into their work under our methods and we jog along well, getting the full quantity of work out of everybody.' "

The "American Invasion" continues to invade foreign countries, capturing large orders from the natives thereof, who profess to feel that they have hereditary rights in the trade of their own country which outlanders are bound to respect. The British Westinghouse Company has just placed a large order for a shop outfit of shafts and pulleys with the American Iron and Steel Works of Pittsburg, this concern having taken the contract against bidders from English and German manufacturers. An old adage says that there is no friendship in trade; there seems to be a lack of patriotism also, so called, which forbids people from buying at home when they can buy abroad at more satisfactory prices.

An icing station for refrigerator cars at Chicago is described in a recent issue of The American Engineer. The refrigerator cars are placed on a track beside a trestle which carries the ice cars, and the ice is run from the ice cars upon a long platform which is the right height to skid the ice into the tanks in the refrigerators. The approach to the trestle is inclined and is about 590 feet long. The icing platform is 156 feet long and is level. The trestle is 300 feet long and about one-half is on the grade. About 350 cars are iced per month, 4,000 to 4,500 pounds of ice being used for each car. With this arrangement the ice may be carried along the platform in a small truck, from which it is broken up and then dumped into the cars.

A foreign contemporary says: "Heavy censure has fallen upon English engineers because they have not constructed works for building locomotives. Why should orders go to the United States for railway engines? Why not keep the trade in this country? The answer to all this is that locomotive building represents a form of investment that may or may not prove remunerative; . . in one word, the lack of power to build locomotives for foreigners is not due to indolence, failure to understand the situation, or ignorance of the facts, but simply to the conviction that money invested in locomotive works could not be made to pay adequate dividends. . . . All the complaints urged against British methods work out in the main to a statement that, as a manufacturing people, we are not sufficiently speculative; we are content with 4 or 5 per cent when we might have had 25 or 50 per cent." This is a flat statement that locomotive building in England is not profitable; if it is correct we cannot understand why such strenuous objection should be made to other people building them, and why English and colonial railway managers in all the ends of the earth are bitterly upbraided for sending orders to us.