30,000 tons, to which America will be able to add 15,000 tons. In 1909 the capital invested in this industry will certainly exceed $30,000,000. The price of the metal has fallen below 18 cents per pound.

A NOVEL FRENCH AEROPLANE.

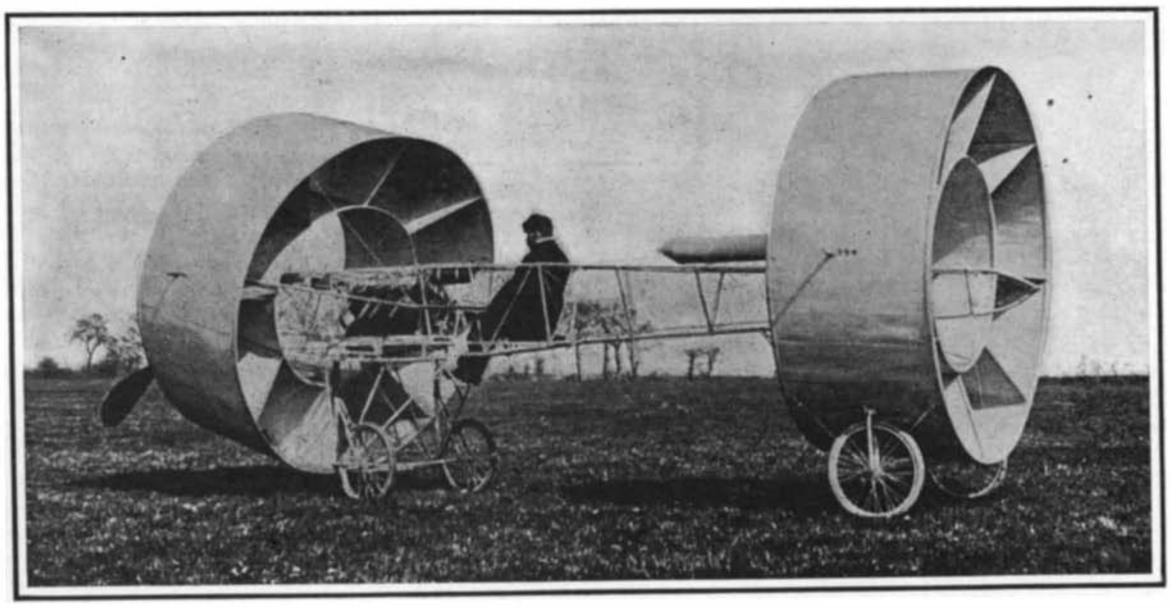
The peculiar aeroplane illustrated on this page is that of M. Givaudan. It has recently been constructed at Vermorel. It is of the multicellular type, and consists of two concentric drums mounted near the ends of a body framework that passes through the center of each, and carries at its forward end a tractor screw. These drums are united by small planes spaced uniformly apart, thus forming a cellular structure. The front cell thus formed is movable in every direction, while the rear one is stationary. The carrying surfaces of this machine are so formed, that the machine will have the same amount of supporting surface whatever its lateral inclination may be, so that when it tips to one side in making a turn, or from any other cause, the weight carried per square foot of surface remains the same; while, on the other hand, the center of gravity being situated below the center of pressure, the machine will return automatically to its normal position and be in equilibrium. The two cells are placed sufficiently far enough apart, so that the front one will not interfere seriously with the one at the rear. There are no rudders, the movement of the front cell both sideways and up and down being used in place of these to direct the machine both laterally and in a vertical plane.

The radiating planes of the drums act as carrying and stabilizing surfaces. Only the projecting surface of these radiating planes is counted upon as useful carrying surface. Within both the front and rear drums there is a horizontal cross shaft supported upon the main frame. The front cell rests on the main frame by a bearing, which makes it possible for this cell to oscillate about a vertical axis, while the horizontal shaft just mentioned can oscillate upon a horizontal axis.

Inclination of the front cell in a vertical direction varies the angle of incidence, and causes the machine to rise or descend; it thus takes the place of the horizontal rudder. Inclination of the cell in the horizontal direction fulfills the rôle of the vertical rudder. This double movement of the cell is obtained by means of a rod connecting two levers of sufficient length to make the operation of the cell possible without too great fatigue. The levers have a band-brake arrangement to hold the cell in the position in which it is set.

The machine rests on four wheels, the front pair of which can be turned in order to steer the machine. The wheels are fitted with suitable springs to absorb the shock when landing. The propeller is 2.4 meters (7.87 feet) in diameter, and is driven from the motor through reduction gears. The motor is a special eight-cylinder V engine of the air-cooled type. The bore and stroke are 90 and 120 millimeters (3.6 and 4.8 inches) respectively. The motor develops 40 horsepower and weighs 80 kilogrammes (176 pounds) including the fly-wheel, two carbureters, and magneto. All the valves are mechanically operated from a single camshaft. The motor, notwithstanding its light weight and the fact that it is air-cooled, has been run several hours consecutively. M. Givaudan is one of the first men to construct a motor of the V type and place it upon the market.

This new aeroplane is very interesting, but it is doubtful whether a freakish machine of this kind can be made to operate satisfactorily. If any successful trials are made, we shall be glad to apprise our readers of the fact.



The Givaudan circular aeroplane—a new French machine of novel design.

SOME NEW AMERICAN AEROPLANES.

Recent activity by members of the Aeronautic Society has resulted in the production of several new aeroplanes at Morris Park, one or two of which have already been given their first trials. At the present time there are completed or under construction upon the society's grounds, a monoplane, four biplanes, and one triplane, as well as a new helicopter.

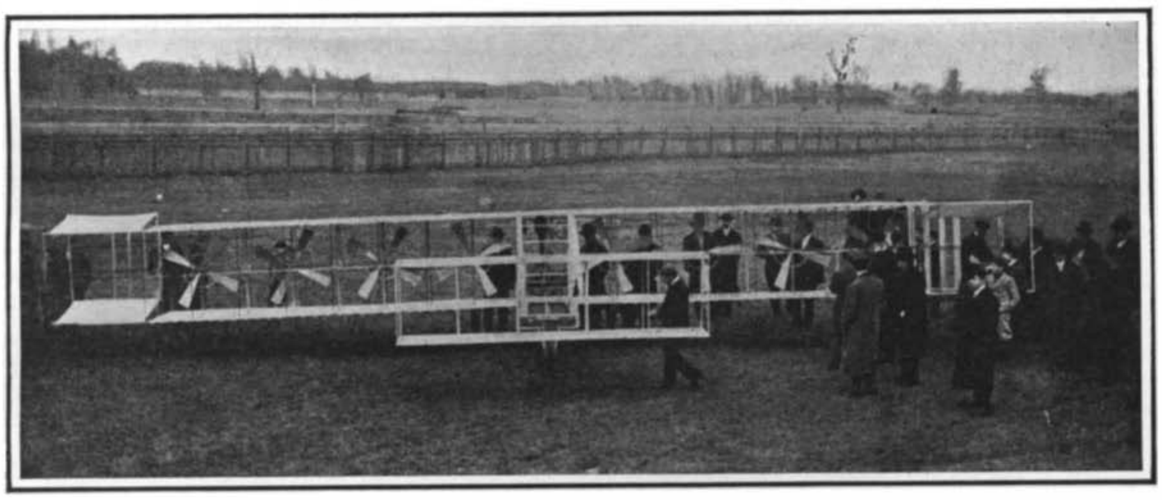
One of the novel machines now completed, and which has already undergone several tests, is the triplane of Morris Bokor. This machine is shown in one of our illustrations. Its three planes have a spread of 26 feet and a width of 6½ feet, making a total surface of 507 square feet. A 14 x 2½ foot horizontal rudder has 70 square feet additional supporting surface, while the tail, consisting of two pairs of surfaces at a sharp dihedral angle, is 14 feet long and has 72 square feet. The total weight of the machine, with water, oil, and gasoline, and with Mr. Bokor on board is 1,181 pounds, so that the usual ratio of weight to supporting surface —2 pounds to the square foot—is closely adhered to. The upper and lower planes are 6 and 5 feet above and below the middle plane respectively. The inventor's theory as to why less space between the lower and middle planes can be used than is required between the middle and upper one is that the draft of the propellers will draw the air back below the middle plane, and thus tend to check or neutralize the interference of the lower plane. The two propellers, which are driven in opposite directions by chains from the motor, are 8 feet in diameter, with an 11-foot pitch. They are made of wood and have quite narrow blades, covered partly with cloth. The propellers make one revolution to 3½ of the motor. They gave 248 pounds thrust at 500 R. P. M. with the machine held stationary. The motor used is a four-cylinder, 4 x 4-inch, A and B four-cycle automobile motor. The inventor claims 38 horse-power for it at 1,800 R. P. M., but this figure is probably somewhat high. The motor alone weighs 310 pounds, but with all accessories including a 15-pound magneto, a 30-pound Livingston radiator, 30 pounds of water, and 34 pounds of fuel and fuel tank, the weight is 419 pounds.

The main feature of the Bokor aeroplane is the use of a pendulum seat for the aviator, which is connected by cables to the ends of the lower plane at the rear. The outer rear parts of this plane are supported upon flexible trusses running along it, and which are in turn carried upon hinged rods extending back from the vertical uprights at the ends of the planes.

When the machine tips to one side or the other the aviator's seat remains horizontal and exerts a pull upon the flexible rear edges of the lower plane, thus giving it the proper inclination to cause the machine to right itself again. Another feature of this aeroplane is the tail, consisting of two large tetrahedral-like cells, which should aid in giving the machine stability. Since the photograph reproduced herewith was taken, the inventor has mounted his aeroplane upon skids. In starting, the whole machine is placed upon a four-wheeled chassis, to enable it to run along upon the ground. This chassis is left behind when the machine rises. In all probability, however, a larger engine will have to be installed before the triplane can be made to soar.

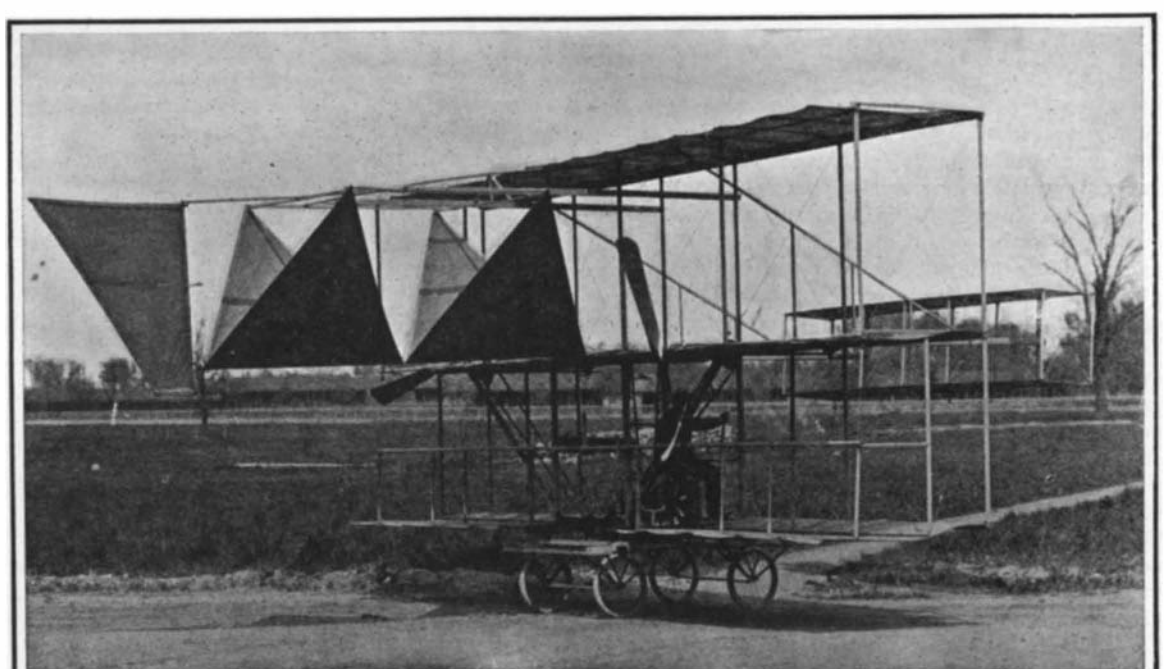
The other American aeroplane which we illustrate is that of Mr. Wilbur M. Kimball, the secretary of the Aeronautic Society. Mr. Kimball, it will be remembered, last fall built a helicopter consisting of a large number of small propellers. In constructing his bi-

(*Continued on page 431.*)



Front view of the Kimball biplane.

The notable features of this machine are the multiple propellers and rudders between the planes at the rear of the wing tips.



Three-quarter rear view of the Bokor triplane.

The double V-shaped tail and swinging aviator's seat (which warps the lower plane) are this machines main features.

NEW FRENCH AND AMERICAN AEROPLANES.

different parts of a coil, since such formulas have proved a very poor reliance when applied to an actual case. Slight differences in quality of material and sizes, or in thickness of insulation may lead one astray in the rigid application of a formula. Mr. Collins has taken up each part of an induction coil by itself and has discussed its size, construction, and adaptation to the other parts in a most complete and satisfactory manner. The best proportions are given for a series of coils giving a spark of twelve inches and under. Higher than this it is not necessary to go, since one requiring more energy than can be converted by a coil giving a spark twelve inches long will use a transformer and not an induction coil. The different uses of a coil are also considered and such variations as are necessary to adapt a coil to Roentgen-ray or wireless telegraph work are given. Of course these differences are principally in the secondary winding, where will be found in separate columns the data for these two services. This is a very important advantage of this book over other books recently published upon this subject. One cannot but notice the care with which small details are worked out. The numerous cuts show every separate piece in fullness and completeness. The volume contains 160 illustrations, while a single illustration may contain as many as 21 cuts as does the one on page 101, illustrating the construction of an interrupter. The data furnished in the form of tables are quite as full. Of tables there are 122, containing the sizes and dimensions of every detail of every part of an induction coil, and also the prices of every kind of material to enter into it. It is difficult to see how any one with the slightest skill in the use of tools can fail to build a good coil under the guidance this book affords. We believe it will displace all other books upon this subject.

THE MANUAL OF STATISTICS. Stock Exchange Handbook. New York: The Manual of Statistics Company, 1909. 12mo.; 1194 pp. Price, $5.

The thirty-first annual issue deals with railroad securities, industrial securities, government securities, stock exchange quotations, mining, grain, provisions, cotton, money, bank and trust companies. It is admirably printed and the maps are clear and numerous. The information conveyed is of exactly the nature which is of almost daily request in offices where financial matters are of any moment. It should be on the desk of every railway and bank official.

THE BANKING AND CURRENCY PROBLEM IN THE UNITED STATES. By Victor Morawetz. New York: North American Review Publishing Company. 12mo.

The author of this book, Mr. Victor Morawetz, is an authority on corporations and finance. His book is chiefly concerned with solving the problem of currency shortage, which seems to confront this country at recurring periods. He advances a plan for cooperation between the banks and the Treasury, which includes a note redemption fund to be elastic, regulating the uncovered volume of notes outstanding, and thus giving stability to financial institutions generally.

THE NEW BUILDING ESTIMATOR. A Practical Guide to Estimating the Cost of Labor and Material in Building Construction, from Excavation to Finish, with Various Practical Examples of Work presented in Detail, and with Labor Figured Chiefly in Hours and Quantities. A Handbook for Architects, Builders, Contractors, Appraisers, Engineers, Superintendents, and Draftsmen. By William Arthur, Box 482, Omaha, Neb. New York: Published by David Williams Company.

Probably no task requires nicer judgment on the part of the engineer or architect than the estimation of building costs. For this reason any book which will materially help him in solving the peculiar problems which are presented to him must be welcomed. Mr. Arthur in his previous edition has demonstrated the fact that he is certainly competent to guide the estimating engineer and architect. The new edition of his book brings the prices up to date and incorporates much new tabulated matter.

INDEX OF INVENTIONS

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May 25, 1909,

AND EACH BEARING THAT DATE

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Acid derivative and making the same, salicylic, Ach & Sutter 922,995
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SOME NEW AMERICAN AEROPLANES.

(*Concluded from page 421.*)

plane he has made use of eight of these propellers, and has arranged them in a line between the two planes, the idea being to give a propulsive effort throughout the entire width of the machine. It has also been proven that a number of small propellers will give a greater thrust per horse-power than one or two large ones. Mr. Kimball makes use of the same motor and wire-rope drive that he employed in his helicopter; but he has improved upon this drive by installing a friction clutch between the driving drum of the motor and the driven drum carrying the wire ropes. The clutch consists of a cast-iron floating ring, and also of a leather lining in these two drums. It allows a certain amount of slipping to occur at the start, so that the propellers are not strained and broken as before. It is also set so that it will slip with a 25 per cent overload. This improvement, according to the inventor, has made a rope drive for aeroplanes entirely practicable. The wire rope used is only 1/8 of an inch in diameter, and consists of six strands, each of which contains 19 wires. The rope has a tensile strength of 2,000 pounds, while the pull to which it is actually submitted is only 80 to 90 pounds. There are two endless cables, one for each set of four propellers. They are held under proper tension by a single idler for each one. The motor makes 1,900 revolutions per minute to 1,600 of the propeller, and the cable travels at the rate of 7,500 feet per minute, or about 86 miles an hour. The propellers have four blades each. They are 3 feet 10 inches in diameter, and have a pitch of 4 feet. The thrust obtained is about 175 pounds. The motor is a four-cylinder, two-cycle engine of an improved type, the cylinders being 4 x 4. It develops 50 horse-power at 2,000 R.P.M.

The main planes of the Kimball machine are 37 feet by 6½ feet, and they are spaced 4 feet 2 inches apart. They have a very slight curve of about 1 in 26, and their angle of incidence is about 5 deg. The rear edges project out 18 inches beyond the main plane and are rather flexible. The machine is provided with movable wing tips, 4 by 4 feet in size, on the ends of both planes. There is a double-surface horizontal rudder in front, 12 by 2½ feet in size, the planes of which are spaced 3 feet apart. This rudder is located 9¾ feet in front of the main planes. It is operated by a lever convenient to the right hand of the aviator, while another lever worked by the left hand operates the two sets of four vertical rudders each, placed on the rear of the movable wing tips. This lever also operates the front wheel, in order to steer when running on the ground.

The main features of the Kimball aeroplane are the use of multiple propellers and fitting of quadruple vertical rudders close to the main planes, near their extremities. If the inventor can run his propellers at a high enough speed to obtain from 300 to 400 pounds thrust, he will probably be able to get in the air; but at the present writing he has made only one attempt, which was unsuccessful in this respect.

MAKING THE EYE OF SCIENCE.

(*Continued from page 425.*)

of the proper shape and curvature.

But, you will want to know, how does the workman know when the glass to be tested fits the test glass? It is in this "how" that the exquisite fineness of the test resides, for the beautiful phenomena of Newton's rings comes into play here. Any extremely thin and attenuated film will show diffraction colors—soap bubbles are common examples. Every child knows that the bigger the bubble, the more beautiful the colors, and the grown-up knows that the bigger the bubble, the thinner the film. When the glass to be tested is laid in the test-glass hollow, there is a thin film of air left between

(*Continued on page 432.*)

The Progress of the Metallic Filament Lamp.

BY HERBERT T. WADE.

The recent development of high-efficiency electric incandescent lamps and their manufacture on a large scale has had an important bearing on electric lighting and on illumination problems generally, for the simple reason that these new lamps enable three times as much light to be obtained with the same amount of current. The practical result is that they seem destined to supersede both the open and inclosed arc for interior lighting as well as for certain forms of street lighting, while the quality of the light, on account of its close resemblance to daylight, makes these lamps most useful and valuable where color considerations are important, as in matching shades. The superiority and economy of these recent lamps can best be understood by comparison with the older types. Of these the carbon filament incandescent lamp has been used generally for a quarter of a century with but few improvements in its efficiency or economy, notwithstanding the fact that apparatus and methods for its manufacture have been so perfected that the cost has been enormously reduced; so that to-day, aside from first cost, the carbon filament lamp is undeniably an expensive form of illumination. The efficiency of such a lamp ranges from 3.5 to 3.1 watts per candle, the practice being to rate these lamps according to the number of watts required to produce illumination equal to one candle-power. Now the watt or unit of power is the power produced by an electric current of one ampere per second under a pressure or difference of potential of one volt, and the kilowatt, or 1,000 watts, in the form of a kilowatt-hour is the usual basis for the sale of current. For example, on a 110-volt direct current circuit a 16-candle-power lamp requires approximately 0.5 ampere, so that the power consumed by the lamp is 55 watts or 3.4 watts per candle.

Now the light emitted by an incandescent body depends upon its temperature, and this of course in the case of a lamp filament depends upon the current, so that to make it glow more brightly the voltage must be increased. But carbon, unlike the metals, has a negative temperature coefficient and its resistance decreases as its temperature rises, and a greater current flows through the lamp with a correspondingly increased expense for power consumed. Furthermore, above a certain temperature the carbon filament begins rapidly to disintegrate and to become volatilized. The reasons underlying the lack of efficiency of the ordinary carbon filament have long been realized, but it has been only in the last five years that satisfactory progress has been made toward securing materials of sufficient resistance and strength to supplant it. First came the metallized filament where the carbon loop, after it had been formed, was subjected to the heat of the electric furnace and was made much more refractory and durable, its resistance being increased so that it could withstand a much higher temperature. In this way there was evolved a lamp which was rated at 2.5 watts per candle, and a regular type of lamp was put on the market, which, consuming 50 watts, could work at from 90 to 130 volts, and furnish 19 to 20 candle-power of illumination. In this lamp there was a saving of 20 per cent in current over an ordinary carbon filament lamp of the same candle-power. Then came the tantalum lamp with an efficiency of 2 watts per candle, where a long wire of tantalum was supported within an exhausted globe, and when incandescent diffused a brilliant and white light.

But this was by no means the end, for the tungsten lamp was produced with an efficiency of 1¼ watts per candle by using a filament of this highly refractory metal whose melting point is about 3,050 deg. C. Here is a lamp that gives three times the illumination for the same amount of current consumed as the ordinary carbon filament lamp, and while better results are promised for various experimental lamps, this to-day represents the maximum efficiency for commercial incandescent lamps. Now these high efficiency metallic filament lamps, being made of materials more difficult to obtain and work, naturally command higher prices than the ordinary carbon filament lamps where cellulose from cotton is transformed into carbon. But their efficiency is so great that they pay for themselves in a comparatively short time, and accordingly have been installed in the new large office buildings in New York city. Furthermore, since they are made in large sizes they are able to supplant the arc lamp with a gain in economy as well as in producing a light of much more pleasing quality without flickering or noise, and without the dirt and inconvenience incidental to trimming. As a result, in stores, large auditoriums and public places, as well as in residences, hotels, and theaters, they can be used advantageously.

So much in successful illumination depends upon the proper placing as well as selection of the lamps in accordance with the principles of the modern science of illuminating engineering, that in planning new installations of these high-efficiency lamps particular attention is being paid to their proper arrangement and the use of suitable reflectors and shades. The results already achieved seem to indicate that substantial progress has been made in raising the standard of illumination, and make of interest a few of the fundamental considerations. In illuminating engineering the basis is the candle-power or light emitted by a standard candle prepared according to specifications and burning in a specified way. In speaking ordinarily of candle-power in the case of an incandescent lamp is meant the mean horizontal candle-power or intensity of light emitted at right angles to its axis when the lamp is vertical. This, of course, is different from the intensity measured in some other direction, as under the tip or around the socket, where naturally little or no light is emitted. Now for each lamp a diagram showing the spherical distribution of candle-power is computed and then various forms of reflectors and shades are added and their effects ascertained, as it is desirable to intercept and reflect most, if not all, of the light sent out by the lamp above the horizontal plane and bring it down to tables or elsewhere below, where it will be of service. In this way, by using a reflector of proper shape instead of having light pass up and be reflected from ceiling and walls, it can be evenly distributed below the lamp so that there will be an increase in intensity even over the mean horizontal candle-power by which the lamp is rated.

Uniformity of illumination is the chief end of successful lighting, and if the engineer knows the intensity and distribution of a given unit of lamp and reflector he can calculate the number required and their distribution to afford any desired degree of illumination to the apartment. The standard for measuring the intensity of illumination on a surface is the foot candle and is the amount of illumination supplied by a standard candle at a distance of one foot. As the intensity of light varies inversely as the square of the distance, a 16-candle-power lamp at a distance of 4 feet from a surface would give one foot candle or one-sixteenth the illumination that it would afford at a distance of 1 foot, where the intensity would be 16 foot-candles. The number of foot-candles required depends upon the purpose for which the room is to be used. For a passage hall or a reception room needing only a fair amount of illumination ½ foot-candle will suffice, but for reading at least one foot-candle, and better two, are required; while for store lighting, where articles must be examined in a strong light and as much illumination as possible is desirable, four or more foot-candles can be used. The degree of intensity must be considered with reference to some working plane at a distance above the floor depending of course upon the purpose of the room. Thus, for a store the level of the counters could be taken for this purpose, while for an office the height of the desks would serve. In all illumination the lamps must always be kept out of the line of direct vision, as not only is the glare unpleasant, but the observer's attention is directed to the lamps themselves, and this while always unpleasant is a fatal defect in show-window illumination, where the object is to concentrate the attention of a future purchaser on the goods exhibited, and show them as effectively as possible.

The most satisfactory arrangement of lights for almost any size of room is to group them symmetrically at or near the ceiling, and by knowing the foot-candles per square foot of area a given lamp will give, select and so place the units that the distribution will be uniform. This can be tested by taking a series of stations at various points in the working plane, and then computing the intensity of illumination in foot-candles at each of these stations. For each style and size of lamp together with its systems of reflectors and shades the manufacturers prepare tables showing the value of its illumination in foot-candles when placed at different heights above the working plane, not only directly beneath the lamp, but at various distances from a point directly beneath. In this way can be found the number of foot-candles that each lamp produces at a single station, and then taking the sum of these effects, the total illumination at that point is obtained. As these stations should be well distributed about a room, a good idea of the distribution of the illumination is afforded, and it can be ascertained whether the uniformity and intensity meet the requirements. Reflection from wall and ceiling also plays its part in illumination considerations, but this differs greatly with their color and material, so that the general effect is to increase the available light in the lower part of the room and more evenly to diffuse it. So much depends upon the successful treatment of illumination problems, that the manufacturers of the new high-efficiency electric lamps and the lighting companies are anxious that they should be used as effectively as possible in order that their many advantages over the arc and older incandescent lamps may be as thoroughly demonstrated as their economy. If proper attention is given to the placing of the lamps and the installation of the best units, much better illumination can be secured under all conditions with a considerable economy.

The Tachypod.

The tachypod is a new instrument of locomotion invented by Petrini, a tutor in the University of Upsala, Sweden. It is a sort of roller skate, with two large wheels resembling those of a bicycle. The wheels are attached to the lower ends of two arms which are movable about the joint which connects their upper ends, so that the arms can open and shut like the blades of a pair of shears. Above the joint is a plate or shoe on which the foot of the operator rests and which is fastened to the ankle by a brace. When the weight of the body is allowed to press on the shoe the wheels and the arms separate and unwind a wire cable which is wound on a reel carried by the axle of the rear wheel and fastened by one end to the axle of the front wheel. When the pressure is removed, by shifting the weight of the body to the other foot, the wheels are brought together and the cable is wound up by a spring. The reel is so mounted on the axle that it runs loose when the cable is wound up, but engages with a pawl and turns the axle when the cable is unwound; that is, when the wheels are forced asunder by the weight of the body. Hence the rear wheel acts as a driving wheel, the source of energy being the weight of the body; and as the weight is shifted alternately to the right and the left foot, in the ordinary motion of walking, one or the other driver is continually in operation and the wearer is impelled forward with considerable and nearly uniform velocity. The inventor has attained a speed about equal to that of a good bicyclist.

Effect of Sunlight on Wireless Signals.

In 1902 Marconi found the radius of action of a wireless sending station to be three times greater at night than in daylight and attributed this difference to the action of sunlight in dissipating the negative charge of the sending antenna. A different explanation was given by J. E. Taylor. The experiments of J. J. Thomson proved that electric waves are strongly absorbed in traversing space containing free electrons. The sun continually emits electrons which ionize the air exposed to sunlight. Hence the difference in the effective radius, by day and night, would appear to be due to the greater absorption of the waves by day, resulting from the increased ionization of the air between the two stations. Recent experiments by Mosler prove that the emission is not affected by sunlight and that absorption, increasing with the distance, must take place between the two stations. Zenneck has shown, however, that ionization, and consequently absorption, are very small in the lowest stratum of the atmosphere. Hence it appears plausible to assume that electric waves passing between distant stations traverse atmospheric strata of considerable height. This assumption is supported by the recently published theoretical conclusions of Zenneck, according to which electric waves are chiefly radiated, not parallel to the earth's surface, but obliquely upward. Hence the greater part of the path of the waves passing between two very distant stations must traverse high atmospheric strata which are strongly ionized by solar radiation.

The Current Supplement.

The opening article of the current SUPPLEMENT, No. 1744, discusses the Davidson "Gyropter" flying machine, which is a form of helicopter. Prof. Carl C. Thomas writes on Some Recent Advances in Mechanical Engineering, and points out the progress which has been made in prime movers, such as gas engines and steam engines, with particular reference to blast-furnace gas. W. R. Beattie's excellent monograph on the Repair of Farm Equipment is concluded. H. Quentin writes on the "Omnicolor" Plate for Color Photography. The Production of Sulphate of Ammonia from Peat is described in detail by the English correspondent of the SCIENTIFIC AMERICAN. A person attacked by diseases of microbial origin becomes immune to that disease for a longer or shorter period, and often for life. Why? The answer will be found in an article entitled "The Mechanism of Immunity." J. G. Gore, the well-known astronomer, contributes an article on Some Astronomical Curiosities. The Electrolytic Preparation of Lead Compounds is discussed by Carl Duvivier. The usual engineering notes, science notes, and trade notes will also be found in the SUPPLEMENT.

Petraliter is an explosive invented by Söjberg in Stockholm. The composition is as follows: 60 parts nitrocetyl (from spermaceti), 60 parts nitroceryl (from Chinese wax), 60 parts nitroglycerine (these three substances in variable proportions to each other according to the effect the explosive is desired to produce), 16 parts potassium (sodium or ammonium) nitrate, 1 part palmatinate of cetyl (purified spermaceti), 1 part carbonate of lime, 6 parts nitrocellulose, 16 parts prepared wood charcoal.