SCIENTIFIC AMERICAN

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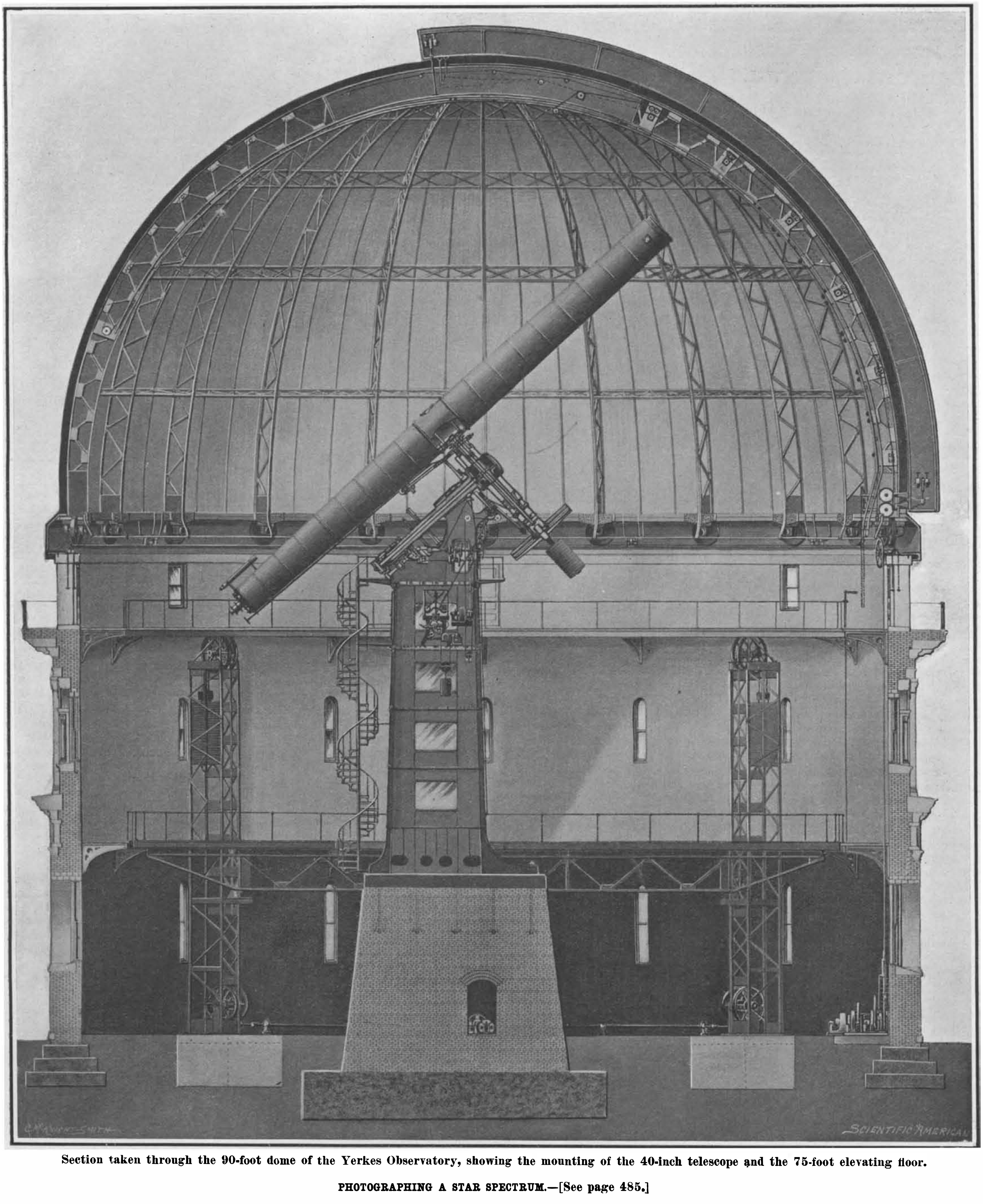

Section taken through the 90-foot dome of the Yerkes Observatory, showing the mounting of the 40-inch telescope and the 75-foot elevating floor.

PHOTOGRAPHING A STAR SPECTRUM.—[See page 485.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, DECEMBER 25th, 1909.

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

A WARNING.

It is quite conceivable that the great loss of property and the equally serious loss of prestige occasioned by the fall of the Quebec Bridge have been already fully compensated by the valuable lessons learned from that disaster. It was worth the loss of a Quebec Bridge to learn that tests of the strength of a small model can no longer be taken as a basis in estimating the strength of a structure which is an exact reproduction of that model on much larger scale. That was the principal illuminating fact brought out by the commission which made an exhaustive examination of the wrecked bridge. Furthermore, it was proved that when the members of a framed structure are themselves made up of a large number of assembled pieces, as in the case of built-up chords, posts, girders, etc., the results obtained on the smaller models are particularly unreliable in determining the strength of the full-size members.

If it be necessary to proceed with caution in the case of a structure in which the assembled parts consist of the same kind of material, possessing similar elasticity and breaking strength, there is a call for even greater caution when the materials of construction are not homogeneous, and the bond between them is of a more or less doubtful character. This last condition exists in the case of reinforced concrete construction, and especially when it is used in the building of truss bridges and similar framed structures.

We are therefore in thorough accord with our esteemed contemporary Engineering News when it draws attention editorially to the construction of a reinforced concrete truss, the strength of which was determined, or attempted to be determined, by the testing of a model of one-tenth the linear dimensions and one-hundredth the cross-sectional dimensions of the finished bridge. Our readers will remember that in the various failures which we have recorded of reinforced concrete, the breakdown has most frequently occurred at the points of junction of one member to another; such, for instance, as the connection between a floor beam and a vertical post. It is admittedly difficult to design these connections in such a way as to render it possible to determine their strength with the same certainty that obtains in designing such a connection in an all-steel structure; and a concrete truss bridge, because of the multiplicity of the joints and the complicated character of the stresses which occur, must be particularly liable to this uncertainty.

We have no wish to throw any general doubt upon reinforced concrete construction as such; but we do believe that now that a determined effort is being made to apply the system to the more difficult problems of bridge work, our engineers should proceed with the greatest caution, and advance only upon well-proved data. The call for testing machines capable of trying out to absolute destruction the largest size members is particularly urgent when these members are built up of such widely different materials as steel and concrete, the strength of the bond between which is greatly dependent upon careful work during erection.

ELECTRIFICATION OF A CHICAGO RAILWAY TERMINAL.

At a recent meeting of the stockholders of the Illinois Central Railway, the proposal to electrify the terminal lines of that company in the city of Chicago was rejected. The city now proposes to force the hand of the railway company by means of local ordinances. The railway company objects to the change on the ground, first, that there is a heavy interchange of traffic with other railways that use the Illinois Central terminal, and secondly, that the main line and suburban passenger and freight tracks are all included in the terminal system. Therefore, it would be difficult and enormously expensive to equip the entire system for electric traction, while serious difficulties and dangers would result from the operation of the yard and the switching service by electric traction.

These objections have a familiar sound in the ears of residents of New York city, who have not forgotten the agitation which preceded the wonderfully successful installation of electric traction at the terminal of the New York Central Railroad Company in this city. They are also mindful of the fact that, long before the electric service was in full operation, the Chief Engineer of the railroad announced that the benefits derived by the railroad company itself, to say nothing of its patrons, from the new service exceeded even the most sanguine expectations. Not only was the city freed from the nuisance of smoke and noise, but the railroad company itself was able to handle its trains more expeditiously, and to reduce the number of train movements enormously. Although no definite figures have been given out as to the decrease in the cost of operation, it is generally understood that the reduction has been very considerable.

We confess to considerable surprise that so enlightened a journal as Engineering News should side with the Illinois Central Railway in its present obstructionist policy, which it does by stating that it is "unreasonable to make the objection of the people of Chicago to the noise and dirt from the engines a basis for saddling the railways with the enormous cost of converting the entire terminal system to electric traction."

It seems to us a simple matter of equity that the holders of a valuable franchise should bear the expense of any changes that will render their operations under that franchise as free as possible from inconvenience and nuisance to the city that gave it. The smoke and noise arising from the operation of the Illinois Central tracks by steam, constitute a most serious disfigurement and drawback to the Chicago water front; and the great improvement which resulted from the electrification of the terminal of the New York Central Railroad will be even more marked in the long stretch of water front which is now so greatly marred by existing conditions at Chicago.

REPORT OF THE NAVAL BUREAU OF ORDNANCE.

We learn from the report of Rear Admiral Mason, Chief of the Naval Bureau of Ordnance, that the tests of the new 12-inch 50-caliber gun showed it to be fully equal to any gun of that caliber thus far proposed for any navy. In the proving ground tests it developed an initial velocity of 3,030 feet per second and a muzzle energy of 52,500 tons. This is the gun that will be mounted on our two largest "Dreadnoughts," the "Arkansas" and "Wyoming," which will carry twelve guns of this pattern. More powerful than this, however, will be the new 14-inch type gun, which will pass through its tests before the end of the present year. It is designed to fire a 1,400-pound projectile with a velocity of 2,600 feet per second and a muzzle energy of 65,600 tons.

It is gratifying to learn that our present nitrocellulose powder has been developed to a point which leaves little room for improvement. Moreover, a new pattern of projectile is now being built, carrying the long pointed head that has been found to give such good results in small arms, which has shown a considerable increase in range, flatness of trajectory, danger space, striking velocity, and penetration at the longer ranges. Our older guns have been modernized, and this work has included the relining and strengthening of the 12-inch guns of our battleships of a date prior to, and including, the "Virginia" class.

The Bureau is much gratified at the remarkable results which have been obtained in target practice with equipment which was designed many years before the present principles and demands of target practice had been developed; and a new system of sighting mechanism has been worked out, and is being applied to all turret guns. Our latest ships are being fitted with complete refrigerating plants for the cooling of the magazines, and the magazines of the older ships are to be similarly fitted as opportunity offers. Changes have been made in the rotation band of projectiles, which will considerably prolong the accuracy life of the projectiles after the gun has been so much worn that its accuracy with the older bands would have been much impaired.

THE ARMY ORDNANCE REPORT.

In his Annual Report, Gen. Crozier, Chief of Ordnance, U. S. A., speaking of the occasional failures of heavy guns, states that the trouble arises, not from a defect in the design of the guns, but from concealed defects in the forgings or the development of thermal or heat cracks. The danger arises from imperfections lying within the finished dimensions of the forgings, which are not apparent on the surface, and cannot be detected even by the most thorough inspection. These heat cracks are due to the high temperature of the powder gases, and they increase in depth and number as the number of rounds fired increases. By way of remedy, the Department has decided to reline the guns as soon as these thermal cracks have become very pronounced. Henceforth all seacoast guns of 6-inch caliber and over, except mortars, will be provided with double tubes, so that, should the inner tube give way, the damage will not extend to the outer tube and the enveloping jacket and hoops. This will permit the restoration at small cost of guns whose tubes give way, and will facilitate the rehabilitation of guns whose accuracy has been lost through erosion and wear of the bore.

The six 6-inch and four 14-inch guns authorized by Congress at its last session will be of the wire-wound type and will have these double tubes and in the 14-inch guns the caliber length will be raised from 34 calibers, as in the guns now under construction, to 40 calibers. Within the next few months the Department hopes to test the new 34-caliber 14-inch wire-wound gun and one of the new 12-inch wire-wound mortars.

The construction of hand grenades for our army marks the reintroduction of an ancient form of weapon. They were used with good effect, we believe, in the Russo-Japanese war. The grenade can be thrown by hand a distance of about 100 feet from a standing position. Lieut.-Col. Babbitt has designed a rifle-shrapnel grenade to be fired from the musket carried by the infantry. Troops will be furnished with both the hand and rifle-shrapnel grenades in a reasonable quantity whenever there is a call for them.

Another item of interest gleaned from the report is that Gen. Crozier is of the opinion that the government can now manufacture cheaper than it can buy; that is, if everything is taken into account except the manufacturers' profit. As an instance of this, he quotes the fact that the 3-inch field gun, which under contract costs $2,029.80, can be manufactured at the arsenals for $1,276.90; and that the 12-inch disappearing carriages, which cost under contract $1,568.47, cost only $605.35 when built at the arsenals.

THE ORIGIN OF EUROPEAN PEOPLES.

In a recently published work on the origin of European peoples, Sergy recognizes eight races of men, only three of which have left remains in caverns. These races are *Homo Europœus*, *H. Eurafricus*, *H. Eurasicus*. The first race is extinct. It was characterized by a very low forehead and an enormous protrusion of the glabellum and the superorbital arches, forming a sort of visor. Remains of this race have been found at Taubach, Krapina, Neanderthal, Spy, Schipka, La Naulette, and Malarnand. Sergy assigns the middle of the Pliocene as the period of this race.

The second race is still in existence. It has a visorless skull, dolichocephalic or mesocephalic. It came from the north of Africa and has left remains in the loess of Egnisheim, Galley Hill (England) and Piedmont (Moravia), and in the caves of Langerie, Chancelede, and Baoussé-Roussé. Sergy ascribes to this race the palæolithic civilization of the later Quaternary in the south of France, and finds in that civilization analogies with the Mycenian or prehistoric Egyptian civilization, apparently later than the Quaternary but in reality contemporaneous with it in the development of the arts. There is no apparent reason why this race should not have penetrated into the southwest of France.

The synchronism of two ages, however, is very difficult to prove, because the palæontological criterion of the Quaternary is not uniform throughout Europe, owing to differences in climate. For example, no trace of *Elephas primigenius*, *Rhinoceros tichorinus*, or *Cervus taraudus* has yet been found in Italy.

Homo Eurafricus persisted into the neolithic age at Cro-Magnon, Baumes-Chaudes, Arène-Candide, etc. Toward the end of the neolithic age the third race (*Homo Eurasicus*) came into Europe from western Asia and left remains at Grenoble and Furfoor. This is the still existing brachycephalic race.

The Frankenholz mine, near Mittelbesesack in the Palatinate, has devised an ingenious but seemingly very uncertain plan for utilizing the fire damp given off in certain of its galleries, much as is done sometimes with hydrocarbon gases in salt mines. The mine has a depth of 500 meters. Before working upon the coal seam at this level, it was deemed prudent to drill to a depth of 50 meters, to discover any possible escape of fire damp. It was found that there was an abundant escape of this dangerous gas. A 1,500-meter conduit was built for drawing the gas to the surface. In June, 1908, the gas pressure was still 12 atmospheres; the idea was then conceived of finding a practical use for the gas and it was decided to use it for heating the boilers feeding the steam engines at the mine. A special plant was installed accordingly.

ENGINEERING.

The "Vanguard," the new British "Dreadnought," recently completed an eight-hour trial at the remarkable speed of 22.4 knots, a full knot in excess of the Admiralty's stipulation.

In the endeavor to apply a slow-speed turbine economically to cargo steamers the Parsons Company purchased the cargo steamer "Vespasian," and, after running her with a careful record of steam and coal consumption, they have taken out the engine and put in turbine machinery of the same power. The vessel is now being run under exactly similar conditions as to load and speed, and, before long, valuable particulars of the relative efficiency of the two types of engine will be available.

A number of motor cars for the suburban service of the New Haven Railroad are now being completed at the Westinghouse shops. They are 70 feet long; weigh 86 tons; and seat 72 persons. The cars are equipped with motors of 200 horse-power, and each is guaranteed to haul two 50-ton trailers at a normal acceleration of 0.7 mile per hour per second. They are designed to operate on both the 11,000-volt alternating current of the New Haven, and the 600-volt direct current of the New York Central Railroad.

The Public Service Commission for New York city has published designs for the elevated portions of the new subways, which have been approved by the Municipal Arts Commission. They embody, among other things, a scheme for deadening the noise of the trains, which consists of a concrete floor, 11 to 15 inches in thickness, upon which the wooden ties will be laid. The asthetic appearance of the structures will be improved by the use of curved steel brackets connecting the columns with the longitudinal and transverse girders.

According to a report from Washington, the officers of our latest and fastest torpedo boats of the "Flusser" and "Reid" type, which have made a speed of over thirty-three knots on trial, are to be furnished with special headgear equipped with a form of automobile goggles to protect them against the fierce rush of wind and spray. Thirty-three knots is equal to about thirty-eight miles an hour, and at this speed, especially when steaming against a strong wind, some form of protection to the eyes becomes a positive necessity.

The New Haven Railroad is constructing a mile of experimental overhead trolley line beyond the Stamford terminus of its present electrical road. The new system is designed to lessen the weight and cost, and eliminate certain undesirable features, of the existing style of construction from Woodlawn to Stamford. Apart from the reduced cost, the new construction will have the great advantage that the trolley wire only will be alive and carried upon the customary insulators, breakages of which have been frequent. The main cables will be strung directly from the supporting columns.

In a series of experiments to determine whether concrete could be conveyed in the plastic condition from the place of mixing to the point where it was to be deposited, Messrs. Buzzell and Larkin recently made some experiments which seem to determine the feasibility of this plan. The experimental plant, as described in Engineering News, consisted of a hopper tank maintained under compressed air, in which the concrete was placed, and from which a pipe led to the point of deposit. Half a cubic yard of broken stone concrete was deposited at the end of 400 feet of 4-inch pipe in less than 5 seconds.

The second attempt to raise the United States cruiser "Yankee" to the surface of Buzzard's Bay failed at the very moment when it appeared to be successful. The method adopted, as explained and illustrated in our issue of November 27th, was to exclude the water from certain compartments by forcing in air under pressure, and thereby give the vessel sufficient buoyancy to bring her to the surface. On December 2nd the vessel was raised until the top of the deckhouse aft was three feet above the water. At this stage a certain portion of the hull or deck gave way, allowing the air to escape, and the vessel settled to the bottom. Further details of the mishap will be given in a later issue.

In an exhaustive analysis of the various types of aeroplane, a writer in Engineering gives the following particulars: The Wright biplane for each horse-power weighs 41.6 pounds and spreads 21.6 square feet of surface. For the Farman biplane the respective quantities are 24.2 pounds and 8.2 square feet; and for the Curtiss biplane, 18.3 pounds and 9 square feet. Among the monoplanes the Antoinette, per horsepower, weighs 20.8 pounds and spreads 7.3 square feet of surface; the Bleriot weighs 19.2 pounds per horsepower and spreads 6 square feet; while Santos Dumont's little machine, the "Demoiselle," weighs only 8 pounds per horse-power, or one-fifth as much, and spreads 3.8 square feet of surface per horse-power, or less than one-fifth as much as the Wright machine.

ELECTRICITY.

An International Congress of Radiology and Electricity will be held at Brussels next year on September 6th, 7th, and 8th. The subjects to be taken up for discussion are the methods of measuring radioactivity, theories of electricity and radiations, and the effect of radiation on living organisms.

The American Electro-Chemical Society has appointed a committee to devise a method of rating and testing dry cells. The present methods have long been considered unsatisfactory, but have continued in force because of the difficulty of obtaining a rating which would be applicable for the various uses of the cell.

A new safety lamp for miners has been invented, comprising a battery and a metal-filament lamp which are completely incased. The circuit of the lamp is kept closed by means of a spring-pressed rod bearing against a light ring on the glass casing of the lamp. Should the glass be broken, the ring would be sure to break or be displaced, opening the circuit of the lamp, so that there would be no danger of igniting the gases with the incandescent filament.

The city of Chicago is discussing the possibility of utilizing the water power obtainable from the Drainage Canal to extend the street lighting system. A large part of the city is illuminated with gas and gasoline lamps, but by making use of the power from the Drainage Canal these lights could be replaced with electric arcs. There are 13,000 arc lamps now in use, and if the gas and gasoline lamps are done away with, 29,000 arcs will be required.

During one of the automobile endurance tests between San Antonio and Dallas, Texas, one of the entrants, who is president of a telephone company, carried telephone apparatus with him, and by using a long fishing pole could tap the telephone lines along the route without leaving his car. By this means he was able to keep in touch with points in advance of the run, and arrange for relief in case of accident or for hotel accommodations.

The city of Austin, Texas, used to have a large lake, formed by a huge dam built across the Colorado River. This dam was 1,275 feet long and 67 feet high above bedrock. A plant placed just below the dam converted the water power into electricity, which was used for lighting the city and operating the street railways, as well as for a number of industrial plants. In 1900 the dam and power plant were washed away by a flood, and the city was too crippled to replace them. A movement is on foot now to rebuild this dam, making it of reinforced concrete. The power obtainable will probably attract many manufacturing industries, which would undoubtedly contribute materially to the development and growth of the city.

Now that Christmas is here, and amateurs are lighting their trees with electricity, it is well to call attention to the warning issued by the Chicago Board of Underwriters to the general public, and especially to merchants who have holiday window displays. Ordinary Christmas decorations are highly inflammable, and it is even more important to take every precaution with the wiring than if the wiring were to be permanently used in the store or house. Chicago merchants have been warned to have special watchmen keep guard at their windows during the danger season.

A new form of mercury interrupter has recently been invented in which there are no reciprocating parts, but the interruptions are produced by a ripple formed in a stream of mercury. The mercury is contained in a revolving vessel within which a contact piece is fixed. The mercury is thrown by centrifugal force to the inner periphery of the vessel. At one point the stream of mercury is obliged to pass over a deflector, producing a ripple or wave, and the contact piece dips into the mercury stream at this point as it revolves with the vessel. The frequency of the interruptions may be varied by having the deflector revolve slowly in the same direction as the vessel is revolving, or in the opposite direction, or having it remain stationary.

An inventor has recently devised a form of explorer for locating conductors when searching for faults in a high-tension underground cable. It depends for its operation upon the fact that the three conductors of the ordinary cable are spirally wound with a pitch or "lay" of 20 inches. By connecting two of the conductors at the power station, signals which are sent out through the conductors form magnetic lines of force that lie at right angles to those produced by ground currents in the sheath of the cable. Consequently, the magnetic circuit of the instrument is unaffected by these currents. By using a double telephone receiver in connection with the instrument signaling currents sent over the line produce very intense sound when the explorer is on the sheath and the sound is quite noticeable, even when the explorer is placed on the tile duct outside.

SCIENCE.

Dr. Ludwig Mond, the distinguished chemist, died on December 11th in his London residence at the age of sixty years. Dr. Mond was well known as the inventor of many valuable commercial processes, among them the process for the manufacture of ammonia and soda and producer gas.

In view of recent discussion concerning the possibility of adopting an international set of symbols for the principal electrical engineering quantities, Prof. A. E. Kennelly has made a statistical examination of recent textbooks in various countries. The results of his examination are published in the Electrical World. It seems that there are twenty-one quantities in the list and fifteen subsidiary fundamental quantities.

In his "Reminiscences of an Astronomer," the late Prof. Simon Newcomb took occasion to pay a tribute to the brilliant work of Dr. George W. Hill of West Nyack, N. Y. That tribute was paid, we suspect, not only because Prof. Newcomb admired Dr. Hill's remarkable mathematical attainments, but also because he wished to drive home to the public some conception of the value of his service as one of the Naval Observatory staff. No doubt Prof. Newcomb would have rejoiced with every American scientific man in the awarding of the Copley Medal to Dr. George W. Hill, the highest distinction conferred by the Royal Society.

An earthquake was recently felt at a mineral spring in Austria. Soon after the shock the water of the spring was found to deposit a brown sediment and to evolve more carbon dioxide than usual. The water soon became clear, but the abnormal evolution of gas continued for several hours. Mineral springs at great distances from the center of disturbance have often been observed to be affected by earthquakes. Prof. Suess explains the phenomenon as follows: Agitation of a supersaturated gas solution causes a rapid evolution of gas, as may be proved by shaking a bottle of soda water. The gas is evolved still more copiously when the solution is thrown into molecular vibration. After an earthquake the rocks surrounding even distant springs are thrown into vibration, which is transmitted to the water, causing rapid evolution of gas, expansion of the mixture of gas and water, and expulsion of solid particles.

The Radium Institute of America was formed at a meeting in the building of the New York Yacht Club recently. The purpose is to study radium, discover any radioferous deposits in the United States, and buy quantities of it in Europe for clinical use in the United States. It is the idea of the founders to establish a clinic in connection with some New York hospital, where radium treatment will be administered free to those needing it. The institute will take steps to protect the public from the false claims of patent medicine manufacturers that certain of their remedies contain radium, and will set a standard that those desiring to deal in radium commercially will have to live up to. Dr. Charles F. Chandler was elected president; Dr. Robert Abbe, vice-president; Prof. William Hallock, secretary; Prof. George B. Betram, assistant secretary, and Dr. Hugo Lieber, treasurer.

Prof. A. Mallock has made a careful study of the utilization of the energy stored in springs for the production of mechanical work, with the object of showing in what way the work stored in stretched India rubber may be most fully utilized so as to supply power at a constant rate. It seems that the most convenient form in which the India rubber can be used is that of a long strip or band wound on a drum or reel under tension, and in order to convert the potential energy into mechanical work Prof. Mallock shows the conversion cannot be effected continuously, but must proceed in cycles, and that the condition of efficiency is that each portion of the elastic band whose contraction is being utilized must be unwound from the drum without change of tension, and that the part so unwound must then be isolated by clamping or otherwise, and allowed to contract without contact with other bodies except at the clamped ends.

The third annual convention of the American Society of Agricultural Engineers will be held at the Iowa State College, Ames, Iowa, on December 28th and 29th. The society was formed at Madison, Wis., in 1908, by a few men, most of whom were then engaged in teaching agricultural engineering in the universities throughout the country. The importance of the work to be accomplished by such an organization was soon realized by prominent manufacturers and others interested in this field both commercially and professionally, the result being that during the last two years the membership of the society was increased fully four hundred per cent. A word explaining the term "agricultural engineering" may be of interest to many who have not become fully acquainted with the work. Within the scope of the term falls a study of farm machinery, farm buildings, farm conveniences, and irrigation and drainage. In short, it deals with the mechanical side of farm life, involving teaching, investigation, and manufacturing activities.

A NEW THEORY OF THE SCREW PROPELLER.

Prof. Oswald Flamm of the Technische Hochschule at Charlottenburg, the principal engineering school of Germany, very recently completed a remarkable investigation of the action of a ship's screw propeller. As a lecturer on naval architecture and engineering, he admitted that the theory of the marine screw had worked out very indifferently in practice. His investigation, which involved formidable complications, was reduced to a highly mathematical form; but on concluding his practical experiments, Flamm was nearly ready to deny that the theory had any real value. Propellers elaborately calculated on that theory were found, in practice, to require so much "cutting and trying" that calculation was simply wasted. The entire theory is now regarded by him as a mere dry abstraction. It gives no clear idea of the precise physical motion that a screw imparts to water.

Flamm finds that the most obvious features of a ship's screw were entirely overlooked by its originators, yet these very features indicate the real reasons for a propeller's action. One of these was the seething mass of water immediately behind a steamer's stern, and another, that familiar condition of any cast-off propeller, that when they have lost their usefulness they have a peculiar shape. The edges of the blades are always rough and irregular through erosion. Why are only the ends in that condition while the hub remains unimpaired? Prof. Flamm's experiments not only explain this paradox but also dispose of two very common notions; that a screw at the highest speed of its revolution, loses propelling effect through "cavitation" (a vacuum formed in the water behind the blades) and that the propelling effect may be increased

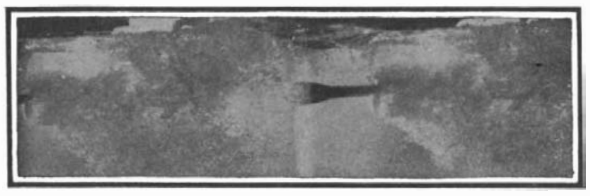
VELOCITY OF PROPELLER, 2 METERS PER SECOND.

by inclosing the propeller in a tube to prevent water that is being acted upon, from escaping at the sides.

Flamm's method of investigation meets the problem so clearly and fits the requirements so perfectly that it seems odd he should have been the first to try it. Much of our useful knowledge about screw propellers has been obtained at great expense by fitting propellers of various designs to a ship and in this way, measuring their efficiency. Flamm constructed a testing apparatus which reproduced similar conditions on a small scale at less cost, and at the same time permitted more complete and accurate observation and measurement.

A screw was observed while it was propelling. The minutest features of the process, the water itself, were photographed by means of extremely sensitive plates that gave perfect pictures at exposures of only 1/1000 part of a second. It had been intended to make the stream lines visible by adding an opaque powdery substance to the water, as used successfully in photographing the stream lines around moving bodies. This was not necessary; enough air was mixed with the water by the propeller to make the screw's movement plainly visible. These pictures were stereoscopic and kinematographic views. The apparatus was very simple, a long glass tank filled with water, over which ran a small car along a railing; to the car was attached an electrically-driven screw propeller immersed in the water. There was no track resistance to the car, to which was fastened a cord running over a pulley at one end of the tank. This cord was attached to a cup for holding weights. The cup's range of fall was as long as the tank, therefore the resistance of the car to propulsion was measured with exactness. From one side of the tank two electric arc lights of 24,000 combined candle-power, sent their rays through the water on the level of the propeller, to the photographic lens on the opposite side. The tank was 32 feet and 9 inches long and 2 feet and 7 inches wide and deep; the diameter of the propeller was less than 4 inches. Fourteen different patterns were tested, including all the standard types. Accurate measurements were obtained of the number of the propeller's revolutions and of its push, but the amount of energy it consumed could not be determined with the same accuracy in this simple apparatus nor was it possible to ascertain the maximum push any certain propeller was capable of giving, except when the car was held stationary. Even so, many conclusions may be drawn. It is evident that a propeller's efficiency depends on the processes in the water, and that these processes obey definite laws. Flamm discovered a sucking action to be the real basis of the efficiency of all screw propellers. In naval practice, a ship's propeller is quite near the meeting line of water and air; this fact gives the sucking action a peculiar "by-effect" that is so incidental and variable, it has escaped much critical attention. As a result, all former theorizing was futile.

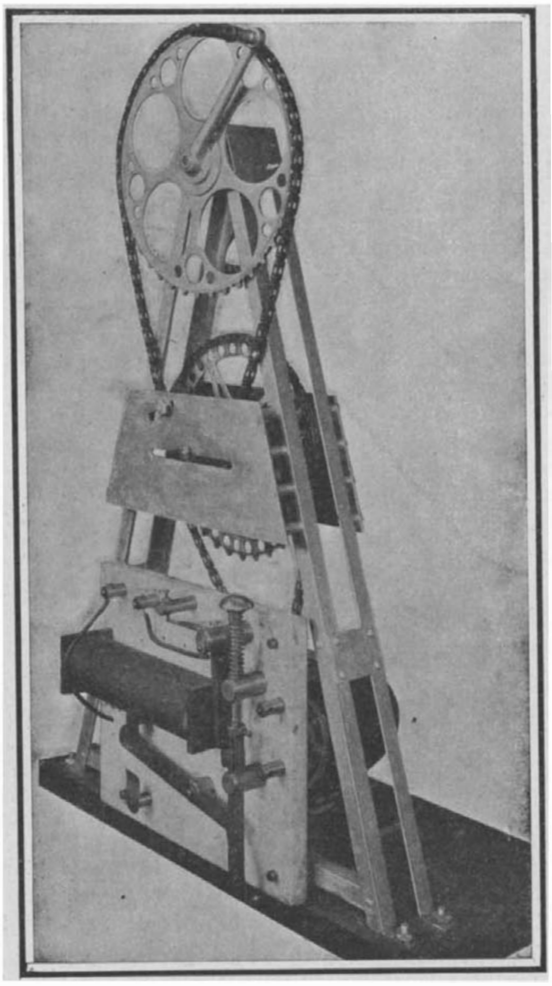
All the Flamm pictures show a positive dent in the water-level, immediately above the screw's periphery—the water is being sucked down to the screw's center with such force that it cannot flow in quickly enough from the sides to fill up the vortex. Flamm states that this dent exists even around a freight steamer's propeller when it is so far out of the water that the top blade projects above the surface. The water's quick turbulency on the slopes of this dent engulfs air, which is taken down to the blades; this peculiar ad-



PROPELLER SUCKING IN AIR FROM SURFACE.

hesion and attraction between air and water produces foam. Consequently, the screw does not work on water alone but on water mixed with more or less air. Thus is explained the paradox, how an implement placed as far below the surface as a ship's screw, whips the water into a frothing mass. Another fact, hitherto unsuspected, is presented by these experiments: What has been called the propeller's "slip," that difference between its pitch speed and the velocity with which it drives the ship, is variable for the same energy and size and shape of the screw. It depends on the volume of air that is sucked in; this in turn depends on various conditions.

Flamm found that the phenomenon attending any sudden loss of efficiency of a ship's propeller when it is driven above a certain number of revolutions a minute, was not one of "cavitation," as heretofore assumed. "Cavitation" has been explained as the hollowing out of water by the screw, meaning that the blades when passing too rapidly through the water, leave an instantaneous vacuum in their wake, thus losing their "grip" on the water, as a whip-lash leaves a vacuum in the air. On the contrary, it has been demonstrated that in all these cases of so-called "cavitation," the suction from the water's surface had become so strong that an immense volume of air rushed in from above, with the suddenness of an explosion. The water is instantly whipped into foam around the propeller, the blades lose all hold and the screw races away furiously as it does when lifted entirely out of the water when the ship pitches violently. In Flamm's experiment,

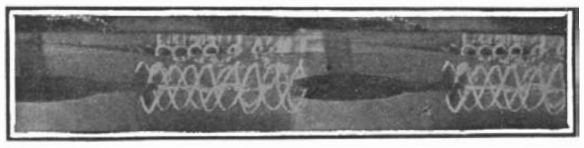


A MACHINE FOR FIRING BLASTS SIMULTANEOUSLY.

with the propeller working at very high speed, the car was dragged back by the weight in the cup.

There was an obvious remedy either under the experimental conditions or in water more or less smooth. When the car was fitted with a board that covered the water-level on top of the revolving screw, it permitted running the propeller even at higher speed; no "cavitation" occurred because the air was excluded. The efficiency of a ship's propeller may also be increased by a stern having a long overhang immediately below the surface. A screw's efficiency is impaired by any air screen too far below the surface because in that event it excludes the water as well as the air. A half-cylinder of sheet metal directly above the screw would be useless. Everything therefore urges placing the screw as far below the surface as possible. This seems to explain the efficiency that is obtained in fast motor boats by inclining the propeller's axis. Even a layer of water no deeper than the screw's diameter was not a very efficient shield against the entrainment of air. It was still more curious that when the revolving speed at which the board excluded "cavitation" was only slightly exceeded, "air tubes" were formed in the water. These traveled from the edge of the board to the propeller, again destroying efficiency. It was necessary to have the shielding board of ample size.

Observations of a worm-shaped air-space behind the hub of the experimental screws were not productive of much surprise. This was a neutral space without suction or pressure, as indicated by introducing a small tube. Air blown through that tube considerably increased the waterless space below the surface. Nevertheless, Flamm found that true "cavitation" exists, but that, quite contrary to established notions, it marks the very climax of a screw's efficiency. As this efficiency depends to its greatest extent on suction, it becomes evident that a screw is most efficient at the moment there is enough suction to actually create a vacuum. "Cavitation" is wasteful in that from the instant it begins, any increasing of the number of revolutions per minute does not increase the propeller's efficiency at the same rate that it costs power. It



VELOCITY OF PROPELLER, 3.7 METERS PER SECOND.

cannot increase a suction that is already at its maximum. These tests of real "cavitation" were conducted under a large protecting board. It was also found that starting a screw very suddenly increased the air-suction to a marked extent.

Prof. Flamm obtained a great number of excellent photographs. The air sucked in not only illustrates the stream lines next to the propeller but also reveals the wake of the blades for considerable distance behind the propeller. On examining these photographs, the reason propellers corrode at the edges of the blades, becomes very clear; especially upon considering that each little dent when first created by the erosion becomes a nest for air bubbles. Suction is strongest at the edges of the blades. Prof. Flamm also gave great attention to skin friction of the water. He advises running a propeller rapidly because the friction that forms an important part of its resistance to revolving, increases at a lower power of the speed than its push, and because "cavitation" may be obtained with a small screw. He found wide blades wasteful of power. He designed a very efficient screw with increasing pitch and narrow blades. These trials are to be resumed on a larger scale.

A MACHINE FOR SIMULTANEOUSLY FIRING MANY BLASTS.

BY FRANK C. PERKINS.

The electric machine for exploding blasts pictured in the accompanying illustration is said to effect a reduction of one-third in the amount of explosive used, on account of the simultaneous firing of the charges.

All the charges must be exploded at the same instant, this being far more effective than a number of intermittent explosions, separated even by only a fraction of a second.

The electric firing machine illustrated consists of a small dynamo of 12 volts pressure mounted on the base of the machine, and driven with a crank by means of sprocket wheels and chains, the best results being obtained from a dynamo 25 per cent over-compounded. By the use of the hand-operated machine, it is stated that one hundred casts have been fired at one time, all of the charges exploding precisely at the same instant.

An electro-magnetic switch, mounted on a marble slab on the front of the machine, accomplishes this desired end, and the current from the dynamo first passing around the coil of the electro-magnet, which has an iron core. The magnetic strength of the iron core increases as the current around the coil becomes stronger while the dynamo is being speeded up. When the electric generator is working at full speed, and the current is strong enough to explode all the fuses at once, a vertical armature is pulled over, and an iron core is sufficiently energized. A catch on the vertical shaft noted at the right of the coil in the illustration is thereby released, and a spring pulls the shaft up with a jerk. A switch beneath the coil is operated

(*Concluded on page 499.*)

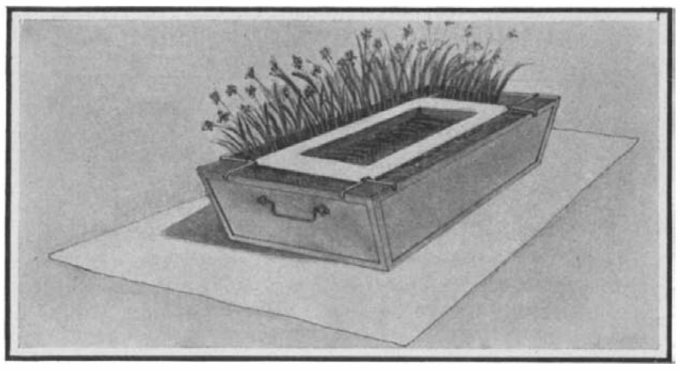
A POLLEN-GATHERING PATENT DEDICATED TO THE PUBLIC.

Mr. E. Moulié of Jacksonville, Fla., has invented a pollen-gathering device, patents for which he has dedicated to the public for the general good. Furthermore, he will place the device at the disposal of scientific men who are interested in the gathering of pollen. The apparatus is suitable for universities and colleges, and such institutions where botany is taught.

The importance of the invention may perhaps be gaged if we consider the previous methods of gathering pollen. With the first of his machines Mr. Moulié, under the most favorable circumstances, gathered one and a half ounces of pure pollen of the ragweed (*Ambrosia Artemisafolia*) in three days, and this with three charges of twigs, one for each day. It was the opinion of the late Prof. A. A. Curtiss, a prominent botanist, formerly connected with the Smithsonian Institution, that to collect that amount of pollen it would have taken one hundred persons thirty-six hours.

Mr. Moulié's device consists of a vessel provided with means for holding the slips or twigs bearing the blossoms from which the pollen is to be collected. The vessel is filled with water, so as to keep the twigs fresh and ripen the blossoms. The blossoms overhang the edge of the vessel, so that the pollen falls upon a paper sheet spread closely around the bottom of the vessel, which bottom is narrower than the top of the vessel, so that the paper is free to be removed without touching the vessel. The vessel or tank is made of sheet metal. Over the top of the tank is a sheet-metal plate supported over two longitudinal and two transverse rods, the edges of the plate being bent around the rods. This cover plate is smaller in area than the top of the tank, so that a narrow channel or opening is formed around the entire perimeter of the plate. The rods project across this opening, their ends being bent over the rim of the tank. Into the openings around the plate the twigs and branches are inserted, their lower limbs being immersed in water. The branches are tilted, so that their upper ends project beyond the sides of the tank. To keep them in this position, and to prevent them from sliding too far into the tank, the cover is cut at the center to form a pair of flaps, which are bent outward and engage the stems. As previously stated, the tank is surrounded by sheets of paper, on which the pollen falls as the blossom ripens. The ripening is brought about by the gradual rise of temperature in the room where the operation takes place. When desired, the water in the tank may be drawn off without disturbing the branches, through a tube connected with a stopcock near the bottom of the tank. Fresh water can be poured through an opening in the cover plate. The device renders it possible to collect the pollen of flowers in unlimited quantity in its full state of fertilizing power, a thing impossible to be sure of by the ordinary process, hitherto the only method available. The ease with which much pollen can be collected at practically no cost renders it possible to obtain a sufficient quantity for accurate and exhaustive analysis, and to add to our knowledge of that wonderful mystery of nature, the breeding of plants. Moreover, an antitoxin for diseases such as hay fever could probably be prepared from the pollen of the ragweed. If the device served this purpose alone, it would reflect considerable credit upon its inventor.

To obtain pollen from the ragweed, Mr. Moulié selected a room having a single window exposed to the east, two windows exposed to the south, and one window exposed to the west. The apparatus was charged with twigs bearing ragweed flowers which were not quite open. The charged apparatus was placed upon a table extending from one end of the room to the other, with a space of two feet between the apparatus and the walls. The vessel was filled with clean water poured in through the opening at the top, care being taken not to spill any of the water on the flowers. The paper was then spread around the apparatus, so as to cover a sufficient space from the bottom of the apparatus to about six or eight inches beyond the perpendicular line of the top of the twigs, so that the pollen could not drop outside of the paper. The paper employed was a thick Manila brand. After the apparatus was installed, all the windows and adjacent doors were closed, and a Rochester kerosene lamp having a burner one inch in diameter was placed on the floor. To avoid the danger of fire, the lamp was placed in a large tin can. After the lamp had been lit, the apparatus was left to itself, and the door of the room locked until the next morning.



MOULIÉ POLLEN GATHERER.

The twigs selected must be used as quickly as possible after they are gathered. Moreover, they must be gathered in the morning before the sun is too high, but not before they are free from moisture (dew or rain). This brings the work of gathering to about noontime. After the room is opened, care must be taken in opening the doors, so as not to create a draft which might blow the pollen off the sheets upon which it has dropped during the half day and night. The door must be closed immediately for the same reason. The temperature at that time ought to be between 85 and 88 deg. Fah. In order to gather the pollen, Mr. Moulié took one sheet loaded with it, and placed it on a table in an adjacent room, closing the connecting door between the rooms as well as the windows and other openings. The pollen was collected by means of a feather and dropped into wide mouthed two-ounce jars, similar to those in which vaseline is sold. The jars were filled to about one-half inch from the bottom. The collected pollen contains a certain amount of moisture, which must be evaporated for safe keeping. To effect this, Mr. Moulié placed the jar or jars behind the windows in the room where the apparatus was installed, and arranged them so that they touched the windows. The rays of the sun streaming through the window pane and the glass jar caused evaporation to take place in about thirty minutes. Then after shaking gently until there were no more lumps, the jars were brought into the next room, and left there for one hour before they were corked. The corks selected were of the best quality and wrapped with a fine paraffine paper, so as to effect a tight closure.

Small quantities of pollen can be poured in a single jar to the height of the neck. Very few readers of this journal realize what an ounce of pollen means. Perhaps some conception of the task may be had, if one imagines the collecting of an ounce of dust from the wings of butterflies.

PHOTOGRAPHING A STAR SPECTRUM.

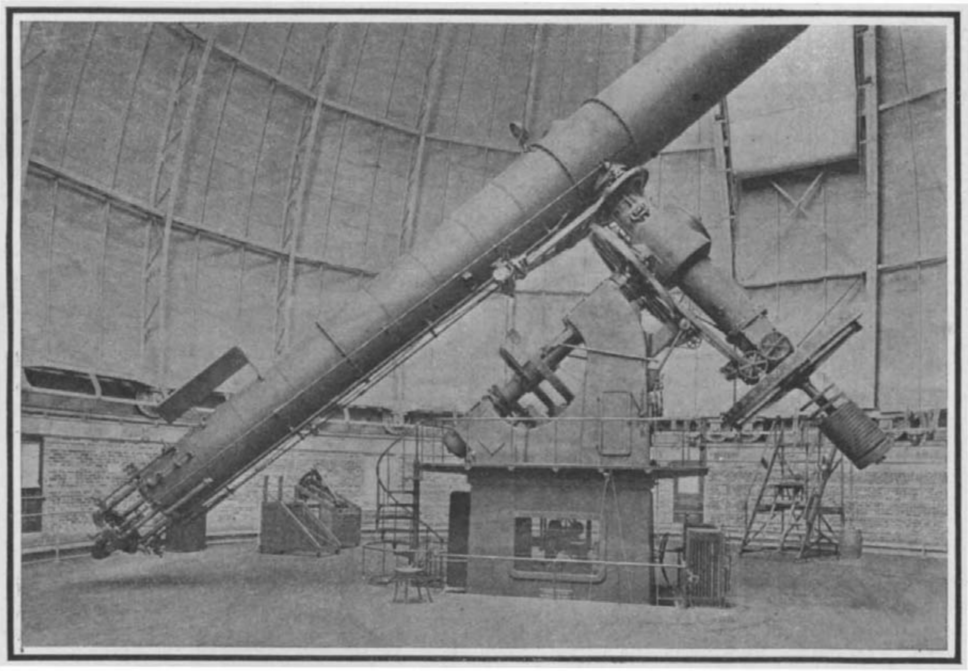
BY PROF. S. A. MITCHELL, COLUMBIA UNIVERSITY.

If one should go to the Sandy Hook lightship off the entrance to New York Bay, and at night should see the lights of a steamer headed for the harbor, it would be practically impossible, merely by looking at these lights, to learn how fast the steamer was approaching. A rough guess might be made by watching the lights grow gradually brighter, but it would be the roughest sort of an approximation. But the astronomer with his telescope, observing the distant stars millions on millions and millions of miles away, can tell to an absolute certainty just how fast a particular star is moving toward us or away from us, giving the motion accurately to the fraction of a mile per second. Nor is this result obtained by watching the increase or decrease in the star's light, due to its approach or recession, for the stars are so far distant that no change in their brightness would be observed in a thousand years from their change of distance alone. The measurement of a star's motion in the line of sight is one of the new fields for the astronomer, and many and valuable are the scientific results accruing from this line of work.

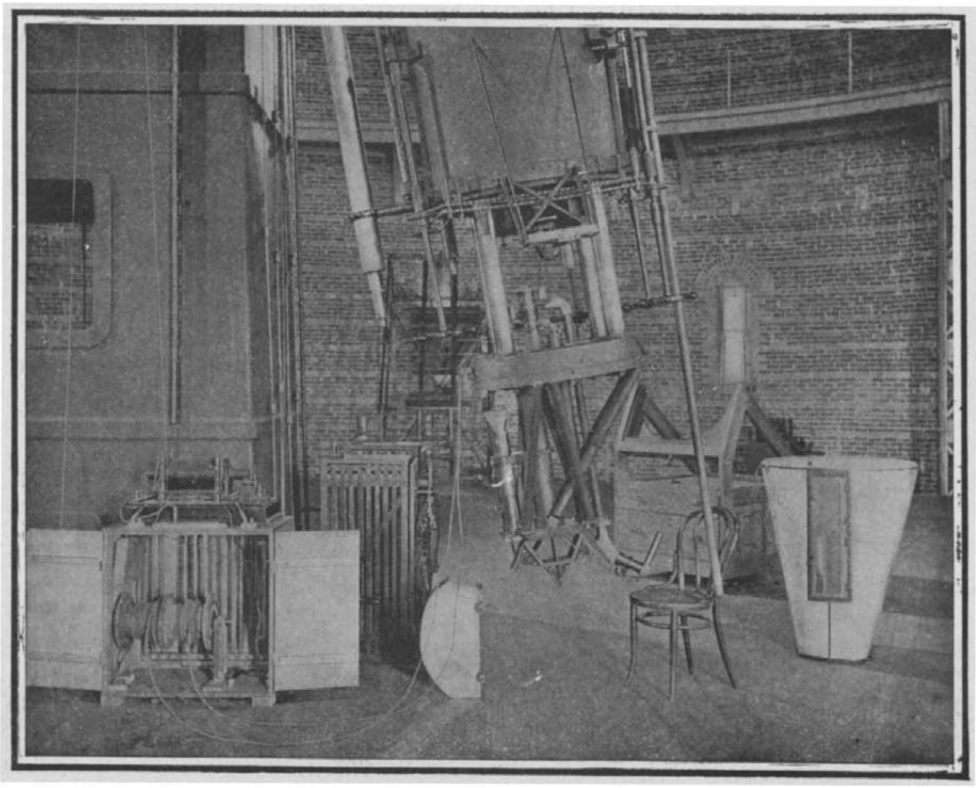
The writer was at the Yerkes Observatory last summer, taking part in the campaign for measuring the radial velocities of all the brighter stars that can be seen from northern latitudes, and assisting in photographing the spectra of stars with the 40-inch telescope and its attached spectrograph. And what a magnificent instrument this greatest refractor in the world is! To work with this great telescope causes a feeling akin to awe in realizing that puny man, on this infinitesimal speck in the universe, called earth, by the aid of such an instrument, is able to fathom the depths of space, and reveal the secrets of stars millions and millions of miles away. Truly, there is no science which can show the matchless power of the human mind quite so well as does the old science of astronomy. the parent of all the sciences. A view of the largest refractor in the world shows also the high degree to which engineering skill has advanced in recent years, again attesting to the close union between pure and applied science.

The observatory, presented to the University of Chicago by Charles T. Yerkes, is situated seventy-five miles from Chicago on the shores

(*Continued on page 495.*)



The Yerkes telescope with floor raised to highest position.



Bruce spectrograph fitted to the Yerkes telescope.

PHOTOGRAPHING A STAR SPECTRUM.

A Proposed Revival of Spinal Anæsthetization.

A distinguished European surgeon is now visiting New York. The gentleman is Prof. Jonnesco, of the University of Bucharest, and his mission is to demonstrate the value of surgical anæsthesia without loss of consciousness. The procedure which he is understood to advocate is that of injecting into the spinal canal a solution of stovaine and strychnine. The demonstrations which he has thus far given in New York have been highly satisfactory, and it is felt that he has made great advances in the technique of spinal anæsthetization. Nevertheless, there is really nothing new in his method.

The synthetic compound known as stovaine has for several years been recognized as an efficient local anæsthetic, and, moreover, it has been used to some extent within the rhachidian canal. There is, too, no novelty about Prof. Jonnesco's procedure even in the addition of strychnine to the solution employed, for Dr. J. Leonard Corning, of New York, who first employed spinal anæsthetization, used strychnine with cocaine experimentally more than twenty years ago. If the high point at which the injection is given is regarded as a novelty, let him who so regards it remember that, as early as in 1899, Dudley Tait had made injections between the sixth and seventh cervical vertebræ. Prof. Jonnesco's main achievement seems to us to lie in the fact of his nice adjustment of doses to individual cases.

It must not be forgotten that the danger incident to spinal anæsthetization is not the sole cause of the comparative desuetude into which the practice has fallen; there are in many cases grave objections to the very existence of anæsthesia without loss of consciousness, though there are a few surgeons who still push the use of local anæsthetics beyond what seem to us to be the bounds of reason. Local anæsthesia in its proper sphere is unquestionably a boon, for general anæsthetization has not yet been freed of all drawbacks. Nevertheless, it appears to us that, for all but minor operations, the embarrassment which may arise in consequence of a patient's consciousness must often outweigh those drawbacks.

Prof. Jonnesco is properly meeting with a fair hearing, but we must deprecate the newspaper notoriety with which his mission has thus far been attended, though it has been mild in comparison with what has sometimes accompanied the exploitation of similar undertakings. Its tendency is chiefly harmful by reason of its leading the public to expect the impossible and to insist upon imposing its own inferences upon surgeons who undertake major operations. It is manifest that such a state of things is not only undesirable, but positively detrimental to the satisfactory practice of surgery.—New York Medical Journal.

Fraud in Electric Lamps.

English technical journals have been warning purchasers of incandescent electric lamps against swindlers who install lamps which purport to contain metallic filaments but which soon prove to be very short-lived carbon filament lamps. The lamps, when first installed, give a brilliant light and appear to be very economical, as tested with the agent's ammeter, but the bulbs soon become blackened, the luminosity diminishes, and in a short time the lamps break—often breaking the insurance also. They are simply ordinary carbon filament lamps, overloaded. When an incandescent lamp is subjected to a voltage higher than that for which it is designed, it gives a very brilliant white light, and, on the other hand, the light becomes weak and reddish if too low a voltage is employed. The swindle is operated by putting, for example, 150-volt lamps on a 200-volt circuit. The overload of 50 volts accounts both for the initial brilliancy and for the short life of the lamps. Bulbs of ground glass are employed, so that the purchaser cannot see the alleged metallic filaments.

Continued Ephemeris of Halley's Comet.

A letter has been received at Harvard Observatory from Father G. M. Searle, C.S.P., of New York, giving the following "Continued Ephemeris of Halley's Comet. T assumed to be Apr. 19 d. 692 G. M. T."

Gr. Mean Noon. 1910.	R. A. (1910.0) h. m. s.	Dec. Deg. M.	Log. Δ	Br. (Sept. 11 = 1.)
February 3	1 0 25	+ 8 16.2		
February 5	0 57 43	8 11.5	0.243	20
February 7	0 55 10	8 7.5		
February 9	0 52 46	8 4.0	0.252	21
February 11	0 50 29	8 1.0		
February 13	0 48 19	7 58.7	0.260	22
February 15	0 46 15	7 56.9		
February 17	0 44 17	7 55.5	0.267	24
February 19	0 42 24	7 54.5		
February 21	0 40 36	7 53.8	0.270	25
February 23	0 38 52	7 53.5		
February 25	0 37 11	7 53.6	0.275	27
February 27	0 35 33	7 53.8		
March 1	0 33 57	7 54.3	0.278	30
March 3	0 32 23	7 54.9		
March 5	0 30 51	+ 7 55.8	0.278	33

THE PHASES OF VENUS.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

The present time offers an excellent opportunity for observations of Venus, which is now evening star, and may be seen for some time after sunset. The planet is daily approaching the earth, and increasing in brilliancy.

With the exception of Mercury, no other planet presents as great a variety of phases; but Mercury's diameter is not much more than three-eighths that of Venus, and on account of Mercury's greater distance from the earth at inferior conjunction, the apparent diameter is not as variable as that of the more

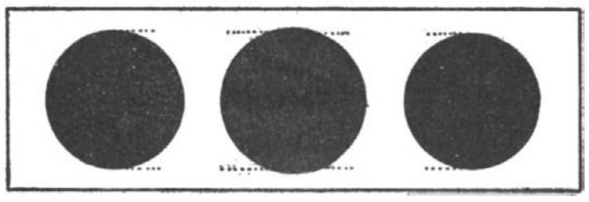


Fig. 1.—APPARENT DIAMETERS OF VENUS AT CONJUNCTIONS OF 1908, 1910 AND 1911.

brilliant planet. While Mercury is rarely seen, owing to his proximity to the sun, Venus as evening star is visible after sunset, for several months; and again for several months as morning star, she is visible before sunrise, no other planet approaching as near the earth.

The mean distance between the earth and Venus at inferior conjunction is about twenty-six million miles, with a variation mainly dependent upon the position of the earth in its orbit. The eccentricity of the orbit of Venus is less than that of any other planet, and is barely visible in the plot. It is less than one-

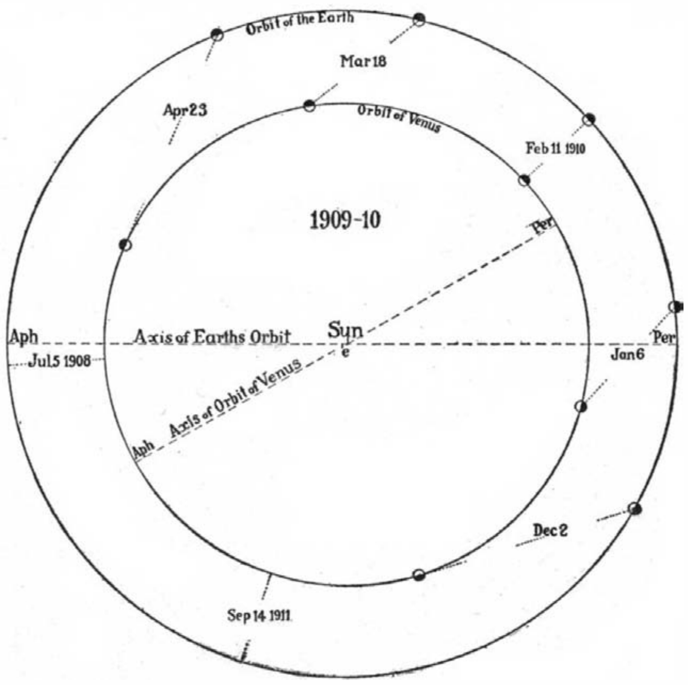
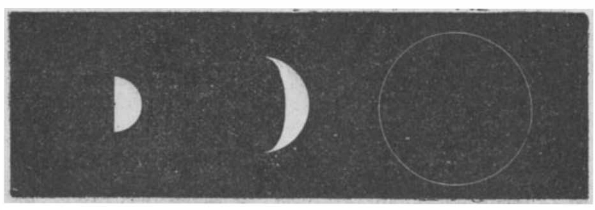


Fig. 2.—THE ORBITS OF VENUS AND THE EARTH.

third of e, the linear eccentricity of the earth's orbit, which is a little over one and a half million miles.

The last inferior conjunction occurred on July 5th, 1908, when the earth was near aphelion, and the distance between the planets was very nearly twenty-seven million miles. The next inferior conjunction will occur on February 11th, 1910, when the distance will be reduced to twenty-five and one-third million miles. The interval between inferior conjunctions is about one year and seven months. That of 1911 will occur on September 14th, when the distance between the earth and Venus will be nearly twenty-six and a



Dec. 2. Jan. 6. Feb. 11.

Fig. 3.—PHASES OF THE PLANET VENUS.

third million miles. These distances correspond with those shown in the plot of the orbits, and the difference between them is apparent even in a drawing which is made to a scale small enough to bring it within the limits of this page. The effect of this variation of distance in changing the apparent diameter of Venus is shown in Fig. 1, which represents the planet magnified as it would appear projected on the sun's disk at the time of a transit. Its apparent diameter is inversely proportional to its distance from the earth. At the date of the approaching conjunction (February 11th, 1910) the planet will be very much nearer the earth than at either the preceding or succeeding conjunctions.

Fig. 2 shows Venus at the date of the greatest elongation from the sun (December 2nd) when the half-moon phase is presented, and at the date of greatest brilliancy (January 6th, 1910) which is the crescent phase. In order to show the rapidity with which the apparent diameter increases as Venus approaches the earth during the months of December and January, the outline of the planet is faintly traced as it would appear, were it possible to see it on February 11th.

Fig. 2 inverted gives the phases which will be repeated after conjunction, when Venus will be morning star. The dates of greatest brilliancy and of greatest elongation are respectively March 18th and April 23rd, and the apparent diameters will not differ much from those of January 6th and December 2nd.

It should be noted that prior to the date of the greatest eastern elongation, and subsequent to that of the greatest western elongation, Venus presents the gibbous phase; that is, while the apparent diameter is diminished, more than one-half of the visible surface is illuminated.

Word Blindness.

It is scarcely open to question that all education should be individual, but unfortunately this requirement cannot be met in our crowded schools. The State is compelled to require a definite amount of knowledge from all engaged in the same course. The difficulties to which this may give rise are illustrated by the following stories of pupils, who despite earnest endeavor could never learn to write correctly, or to read fluently, or to pass the examinations provided for the lowest classes, although some of them are able to accomplish important scientific work. A per-

> fectly healthy fifteen-year-old girl, one of the best pupils of the highest class of a German school, could not spell correctly either German or foreign words, either from dictation or from memory. She could write single characters perfectly; she could also read a single series of musical notes, and play the violin by note, but she could not read piano music. The difficulty was that she was unable to impress the picture of the word on her memory. By the employment of a great number of aids to memory she succeeded in making much progress, but she continued to make the most incredible errors in writing, which sharply contrasted with the general excellence of her work at school. She could not read fluently, because the image of the word was not present to her memory.
>
> The girl's grandmother, a highly-educated woman, her great-uncle, and a son of the latter exhibited the same defects. Each of the men wrote a number of scientific works, but the spelling had to be corrected by others.
>
> In this case, therefore, this same defect, which the English call "word blindness," appeared in four members of one family. As we know that the brain contains a special center for the memory of words, we must conclude that the entire absence of this elementary faculty in persons otherwise of good mental equipment, must be caused by a defect of this small part of the brain.

As such persons cannot satisfy the requirements exacted in the lowest classes, they are in danger of never reaching the higher ones. In London, one case of word blindness was found among each two thousand school children. With proper appreciation of the conditions, it should be possible to carry on the education of such a child if otherwise intelligent. This, however, cannot be done by the school; it must be accomplished by the parents or by benevolent societies.—Umschau.

To Our Subscribers.

We are at the close of another year—the sixty-fifth of the SCIENTIFIC AMERICAN's life. Since the subscription of many a subscriber expires, it will not be amiss to call attention to the fact that the sending of the paper will be discontinued if the subscription be not renewed. In order to avoid any interruption in the receipt of the paper, subscriptions should be renewed before the publication of the first issue of the new year. To those who are not familiar with the SUPPLEMENT, a word may not be out of place. The SUPPLEMENT contains articles too long for insertion in the SCIENTIFIC AMERICAN, as well as translations from foreign periodicals, the information contained in which would otherwise be inaccessible. By taking the SCIENTIFIC AMERICAN and SUPPLEMENT the subscriber receives the benefit of a reduction in the subscription price.

The trials of the new German improved "Dreadnought" "Westfalen" in the North Sea are stated to have been highly satisfactory. She developed 24,000 horse-power and attained a speed of 20 knots, compared with the 20,000 horse-power and 19 knots stipulated for in the contract with the Weser yard.

Correspondence.

THE FARCE OF OUR MILITARY MANEUVERS.

To the Editor of the Scientific American:

The results of the recent Boston maneuvers led an enthusiastic militiaman to inquire, "What's the matter with the militia?" As far as I know, an answer has never been attempted.

The writer participated as a regular officer in the Manassas maneuvers of 1904, and later served in the New York State troops. He has had occasion to view military maneuvers both from the standpoint of a regular and from that of a militiaman. In other words, he has maneuvered on a full stomach when physically fit, and when the work imposed upon him was little more than that which regularly befell his command, and he has taken part in military encampments when fresh from an office desk, unhardened to tramping, exposure to sun, rain, heat and cold, and the coarse, half-cooked food at which his stomach revolted.

Field instruction as now imparted consists of a senseless, unnecessary physical tax upon the health and strength of our militia. Nothing but the enthusiasm, the nerve, the gameness, of our citizen soldiers enable them to stand up under the work required of them, and enable them to perform duties which no regular officer would expect or require of his men, seasoned and hardened as they are, unless matters of the gravest import were at stake. In fact, I doubt if even the splendid discipline of our finest troops could stand such a test, for men experienced in military matters know that empty stomachs are not easy to reason with, and they certainly do not prompt blind obedience.

The armory affords but one form of instruction, and that form should be perfected as nearly as possible, and too much interest cannot be created in the organization, in order that the necessary tedium of drill may not drive the men away. The day of tin soldiery, of strutting about in feathers and gaudy colors, has passed.

The fault then, as I see it, is not with the militia nor the present system of armory training, which does well enough. The fault lies in the system of field instruction, as conducted by the War Department of the United States of America.

No one denies that maneuvers when properly conducted afford splendid training for the troops engaged therein; for any large assemblage of troops is certain to yield valuable experience to men as well as officers. But there are many ways of conducting maneuvers, and the wrong way is the one people find fault with.

Thoroughbred colts, however carefully bred for speed, require hard training and severe work to win on the track; but do trainers take likely animals and gallop them under great weight until every limb of their bodies aches, until their backs, unaccustomed to the saddle, blister and gall, until they become foot-sore and fall from exhaustion? Are these colts then dragged to strange quarters, exposed to the elements, and fed on sour corn and ill-prepared food? No. Their food is carefully prepared, and they are comfortably housed. It is only after they are seasoned that serious work is imposed upon them, and that great exertion is exacted of them. They are but animals after all. They are creatures of flesh and blood, and there is a limit to their endurance. And so is the poor militiaman an animal of limited strength, though this fact has been lost sight of on the occasions known as "military maneuvers." The fact remains as true now, however, after the Manassas and Boston affairs, as it did before, for our War Department cannot change nature, nor can it reasonably hope to make a nation of seasoned war material by periodically overtaxing and maltreating a handful of citizens, who in their military zeal crowd up to the sacrifice of the maneuvers.

Did I say that these men were maltreated? Well, they are, for I have seen them with my own eyes trudging over the heaviest roads, weak and worn, with tender, bleeding feet bound with their handkerchiefs, while the relentless sun beat down upon their dizzy heads. I have seen them sweltering in stale clothes that stunk with the sweat of days, and no provision made to give them a change of clothing. I have seen them crawl like filthy animals from under insufficient covering to take up the labors of an endless day, filling their stomachs with ginger pop and doughnuts, while the nearby regulars, warm and dry, breakfasted on good hot coffee, bacon, hash, and bread. Is it not pitiful to think that these poor fellows are misled into believing that such is the life of a soldier?

How can men under such conditions profit by the object lesson intended for them? The events, in which they play a sad part, are as non-understandable to these poor militiamen as ignorance and folly can make them. They flit through their weakened minds like troublous dreams. A waking dream it is, however, for seldom is the citizen soldier allowed to drown his troubles in sleep to recoup his depleted strength in repose. The night hikes, the fiasco of guard duty, the din of the camp added to by numberless officers who rate their ability by the amount of noise they can make, render sleep a foreigner to the militia camp.

Such, then, are some of the conditions which repeat themselves maneuver after maneuver. Much thought and time are spent on plans of attack, on entraining and detraining the troops, on testing the water supply and inspecting pits, but having lured the guardsman to the camp, little time is spent on his personal instruction.

He is taught not to shoot at his friends with real charges, and asked to march, march, march, day and night without food, without rest, without the slightest attention to bodily cleanliness, all of which are fundamental in the preservation of health and sanitary conditions.

Having criticised and condemned the present method of conducting maneuvers, it is only fair to answer the question, How can the militia be really benefited by field maneuvers?

In the first place, the time usually allotted is absolutely insufficient to permit of any real benefit to the militia, for the militiaman is not physically fit to stand the work of field movements on a large scale. Before such exertions are required of them, they should have at least a week or ten days to accustom themselves to camp fare and field conditions, to learn to make themselves comfortable in camp and bivouac, to toughen themselves gradually. With each command of militia should be camped enough regular troops to supply each militia company with a competent cook, to instruct the men in the preparation of their rations. To each company should be detailed several regulars, to instruct the men in tent pitching, camp police, how to keep themselves and their equipment clean, how to make comfortable pallets on hard ground, how to secure rest at night, in matters of camp sanitation and numberless other things which experienced soldiers regard as necessary. Such instructions would indeed be valuable, for these are things which are not to be learned in the armory.

For the first week or ten days in camp, tedious drills and ceremonies should be dispensed with, and instead the men should be given light exercise in the form of short marches during the cool of the day, so as to allow them to adjust their packs, break in their shoes, and harden their feet to marching. Upon returning from such marches, they should be required to wash themselves and change clothing, and then be allowed to rest. Dress parades, reviews, and such displays should be dispensed with. They do not instruct the men. After the machinery of the camp is in good working order, and the quartermasters and commissaries have distributed their supplies, after the sore feet and weaklings have been weeded out, night attacks, forced marches, picket duty, etc., may be indulged in, with some advantage to the field officers at least, and without very great punishment to the men of their command. The men will by this time be in a physical condition which will permit of discipline, and will not be broken down and demoralized, so that they will go home utterly exhausted, and with the idea firmly rooted in their minds that the mobilization of a large body of troops means confusion and neglect of all semblance of the order and the precision which have been drilled into them by their officers at home. I may here say that my experience has been that it takes a number of drills after an encampment to get the men back in shape, so demoralized do they become under the influence of the so-called field discipline, which should be, if possible, even greater than garrison discipline.

Tactical movements as maneuvers can be instructive only to field officers and their staffs; the other participants are not in a position to follow the movement of the army as a whole. Therefore, since the junior officers and men must remain necessarily in more or less ignorance concerning the movements of the army, unless something is devised for their instruction and benefit, the maneuver, so far as the great mass of participants is concerned, is a useless farce. This being so, every move and every order emanating from the commander of a maneuver army should have in view the instruction of the individuals of the army, and no move should ever be made which would sacrifice order and discipline in the ranks, even to the tactical success of the commander.

Now, then, it will be said that the militiamen cannot spare the time to follow out the above plan; that they cannot neglect their business, upon which they depend for a living; and that to require the militia to spend two or three weeks now and then in camp, would be to set up requirements which would discourage enlistment in the State organizations. This is an old argument, and apparently has some weight; but upon investigation it will be found that the average militiaman, under present methods, is rendered unfit for effective work for a much longer period than that actively spent in camp. Some of them, poor fellows, never return to work. Many more go to the hospitals and to their sick beds for weeks, and the demoralization of mind, due to utter exhaustion of the body, renders the majority of the remainder unfit for work for varying periods of time.

But suppose the militia could not be mobilized for two weeks, or better still, a month, every second year, so as to throw an encampment in every man's enlistment; is it not better to give up the present farcical, cruel, and demoralizing system of maneuvers, than to subject the militia to such senseless physical tests?

Even if such methods as now employed were capable of putting our citizen soldiers in fit physical condition, would they remain so indefinitely? Would they not be soft, and again unseasoned upon the advent of war? Is not the fact that our militia is demoralized and unfit for the slightest additional effort at the end of the maneuver periods, ample proof that the present system is erroneous? There is but one correct answer to each of these questions, and it is a crying shame for the sages of our War Department to take enthusiastic militiamen, far more intelligent than the average regular soldier, eager to learn and unselfish in the devotion of their time to their State, and subject them to hardships which regulars could not be expected to bear under similar circumstances.

As a regular, I have smiled and looked with scorn upon the disorganized and crippled ranks of our citizen soldiers in the maneuver field, but as a militiaman I have felt the indignities which earnest and willing men have borne in those exhausted ranks.

I say that the fault lies not with the militia, far from perfect as it is, but with our War Department and those who conduct the field maneuvers. If their judgment were as faultless as the enthusiasm and willingness of the average militiaman is great, much good would result from field instruction.

Jennings C. Wise.

An American Demonstration of the Urban-Smith Process of Animated Color Photography.

The evening of December 11th a demonstration was given in the concert hall of Madison Square Garden, New York city, of a new process of moving pictures in natural colors, which has been perfected during the last two years by Mr. G. Albert Smith of London, England. A large audience was entertained for two hours with a considerable number of kinematograph views in natural colors. These pictures, besides being excellent reproductions of the original subjects both as to shade and color, were not so tiring to the eyes as the ordinary moving pictures, due probably to two reasons, viz., double the number of pictures thrown upon the screen, thirty-two in a second, and the toning down of the light by the color screens.

The new process is a modification of the Friesse-Greene process illustrated in the issue of this journal of October 9th last. Instead of using three color screens—red, green, and blue—in connection with two films, as does this inventor, Messrs. Urban and Smith have combined the blue and the green into a single blue-green screen. One-half the pictures are taken through a red screen, and the other half through this blue-green screen. The screens, of colored gelatine, are arranged so that each forms half of a revolving disk placed in front of the lens. The pictures are taken on a specially-prepared film made panchromatic by means of suitable dyes. As a result of this there is scarcely any difference in the density of the two images made through the different color screens. A positive is made from the negative upon ordinary film. When this is projected through the colored screens—each picture of course being projected through the same colored screen as that through which it was taken—the spectator sees the view in its natural colors, since the eye retains the color impression of the red, for example, while the blue-green picture is being substituted for it and after the latter is in its place. The combination of these two colors produces white light in much the same way as three colors do this with the Ives process. The single film and single revolving screen in front of the lens is a great simplification of the Friesse-Greene two-film process. The pictures can be made with an ordinary machine with but few changes. The subjects shown varied widely, extending from flowers to animals and birds, harvest scenes, military reviews, waterfalls and surf, etc. In all of these pictures the coloring was excellent and altogether true to nature. Such colored pictures have been shown for some time in several large music halls abroad, and they will soon be produced, no doubt, in similar places in this country.

A sliding embankment on the Pennsylvania lines west of Pittsburg near Dinsmore, Pa., which had given trouble for some years, was remedied at a time when a new culvert was put through it by driving two small tunnels entirely through the embankment and filling them with riprap. The embankment is 30 feet high and is on a sharp curve on a hillside having a slope of 20 deg., down the face of which runs a small stream. When the tunnels pierced the core of the embankment water gushed out for several hours in a stream large enough to fill a 12-inch pipe. These tunnels keep the embankment drained, and no trouble has occurred.

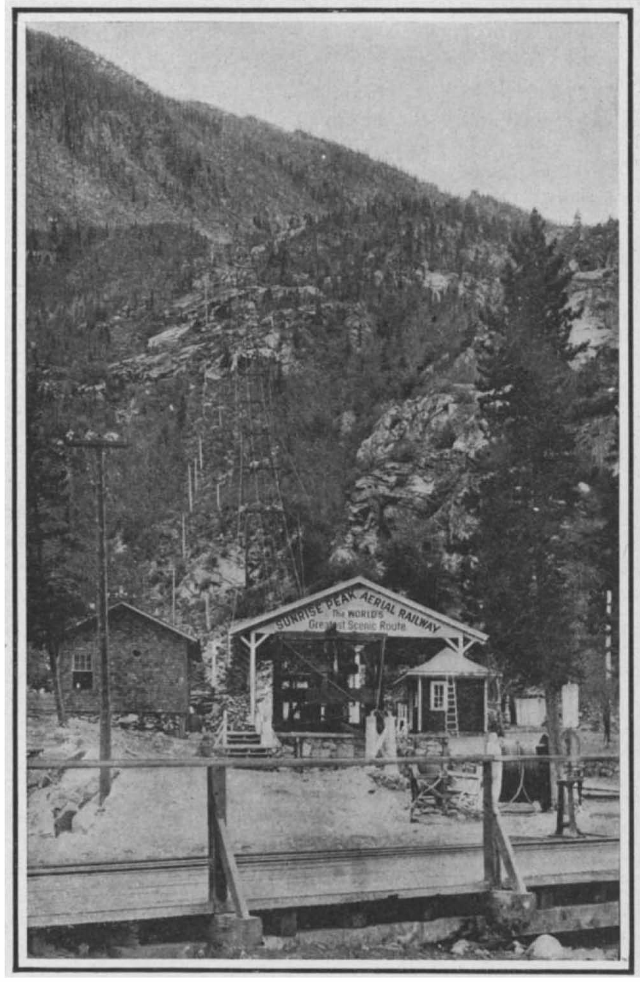
AN AERIAL PASSENGER RAILWAY.

BY ROLAND ASHFORD PHILLIPS.

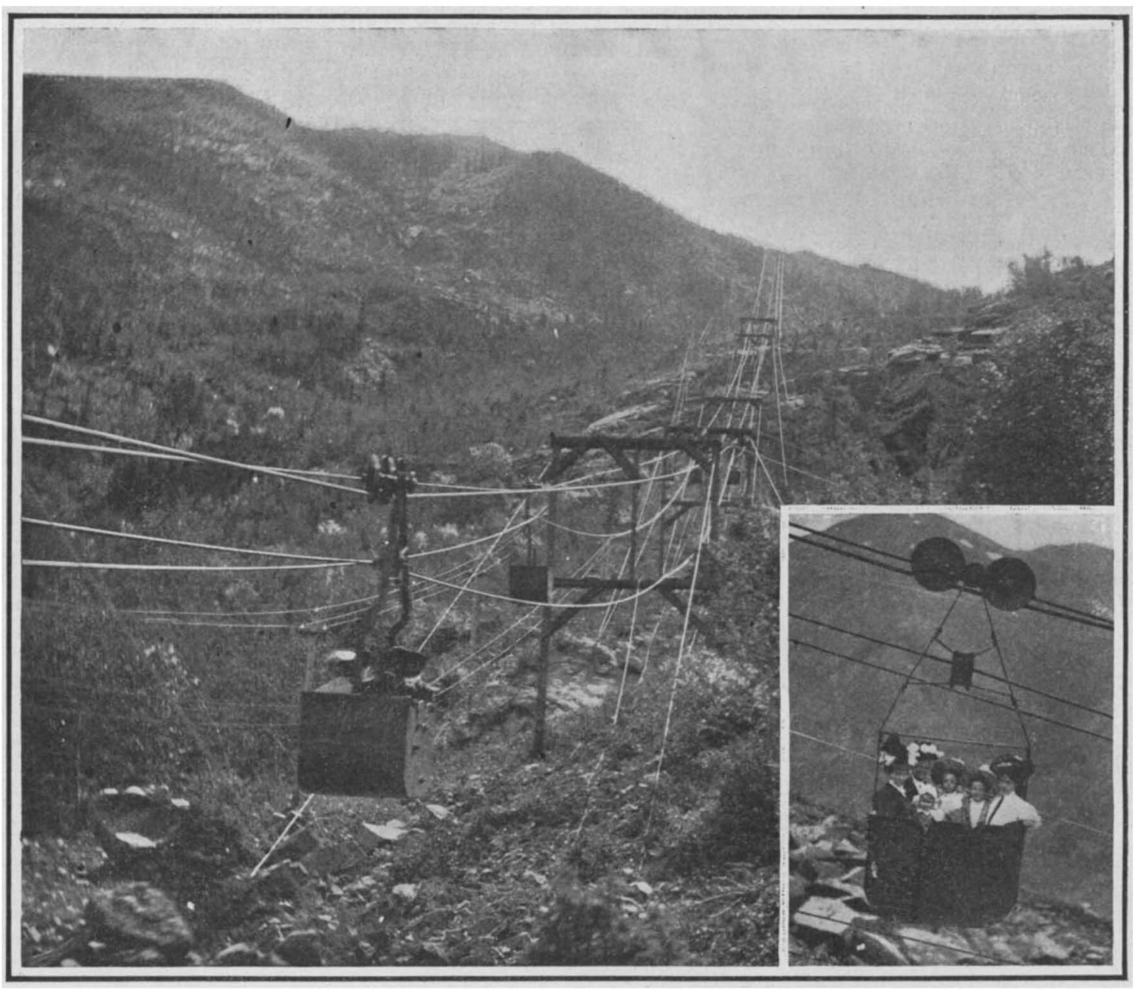
It is as easy now to ride in a bucket from the base to the very summit of the loftiest mountain chain in the Rockies, as to trolley across Brooklyn Bridge.

around. There to your right are towering cliffs, a dozen times as lofty and as massive as the tallest skyscraper. In another direction are deep cañons, rocky gorges, and steep, verdant slopes. Still you go up. Sometimes you clip the swaying tips of a monster

from view by a mantle of snow. A wonderful, bewildering half hour is gone. The bucket stops, and you step out upon the cold, snow-clad summit of the peak. At intervals fleecy clouds drift across your vision, blotting out the valley below.



The station, showing the cables leaving the drum.

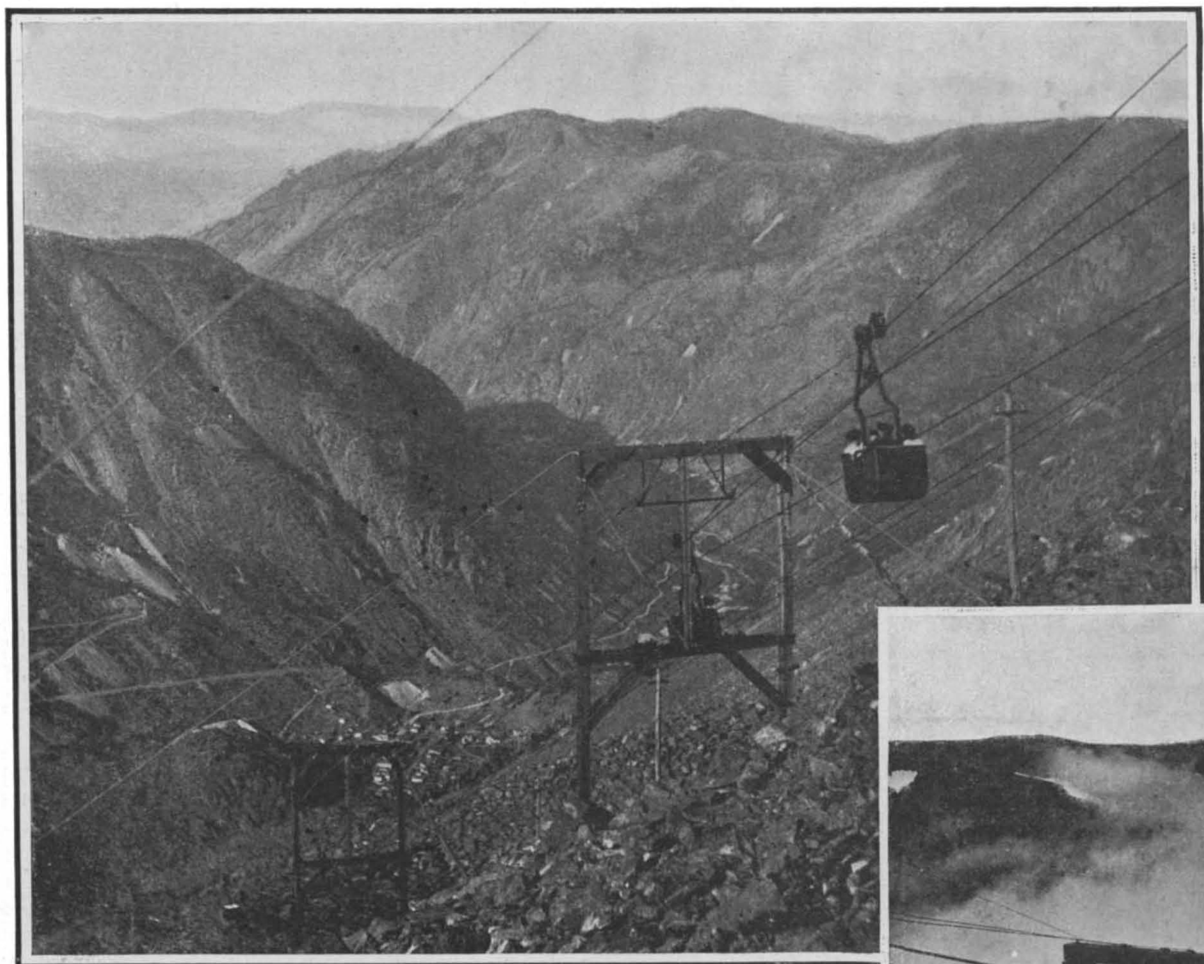


The bucket has just left the power house. An empty bucket is seen coming back.

To take this wonderful ride on the Sunrise Peak road, you leave Silver Plume and walk a few blocks to the aerial station. Under this cover you wait for your bucket. As it swoops down and stops, you step into it. The man shuts the door and locks it secure. A bell clangs, and you are off. The bucket swings away, and you hold tightly to the iron rim. The little depot with its crowd slips away below. You look around. There are no confining walls—nothing but clear Colorado air. Your sensations are comparable with those of a balloonist.

You begin to gather a bit more courage. You look

primeval pine tree, and again you are swaying over an all but bottomless cañon. Then a broad green valley slips along below you, colored with myriads of wild flowers. Now, marked like some gigantic belt, comes the timber line. The flowers give way to stunted brush and barren stretches of dull rock. And both of these in turn are soon hid



This picture was taken about half way to the summit. Silver Plume looms in the distance. The wagon road is seen winding up into the hills; also the creek, down the cañon of which the railway runs which connects with Denver.

You have gone to the sky in a bucket; you are standing above the clouds, two and one-half miles higher than New York city.

When the clouds clear away, you note the filmy line of cables stretching down, from tower to tower, not unlike the silken web of some gigantic spider, swaying in the sunlight, finally to dip over a ragged shoulder of a ridge and disappear.

The idea of these traveling buckets is by no means new, particularly to readers of this journal, since the identical principle is in use throughout the mining world as a means of transporting ore from the mines to the mills. In some instances these are worked by gravity, and in others by motive power.

It remained, however, for a western engineer to utilize this system of carriers, not for business but for pleasure. For a good many years Sunrise Peak was a noted attraction for the tourist, but all methods of reaching its lofty summit were crude indeed. Confident of his success, the engineer interested a few wealthy men. The aerial railroad is the result. In Italy this method of transportation is largely in favor, especially across bodies of water, but the Sunrise Peak line is the only one in America.

There are two main cables, the stationary and the

(*Continued on page 496.*)

At the summit, Sunrise Peak, high above the clouds. Elevation, 12,500 feet.

AN AERIAL PASSENGER RAILWAY.

HOW YOUR EYEGLASSES ARE MADE.

BY C. H. CLAUDY.

No man ever had but one pair of eyes. Most men value them above all other senses. Yet is a man often careless of his eyes, neglecting the visit to the optician and the glasses which may improve and prolong his sight, and ninety-nine out of a hundred of him never think or ask, "Am I getting the best-made lens the market affords?" He takes what the optician gives him on faith. The hundredth man goes through a spectacle lens factory, and forever after he is extremely particular about his glasses. He finds out how difficult and how delicate an operation lens-grinding is. He knows how easy it would be to make an error.

First he sees the imported blank pieces of glass sorted by machinery before being ground—for greater accuracy. Then he watches a workman attaching them with pitch to "blocks" and "shells," concave or convex pieces of iron of exact curvature, which are revolved in their mates with abrasive, to do the grinding. He notices that the more powerful the lens is to be, the smaller the shell and block, and the less the number of blanks it will accommodate. Hence the increase in price of strong lenses over weak ones. Wandering through the labyrinthian corridors in the basement of a great factory, and seeing the thousands and thousands of pairs of shells and blocks used for spectacle-lens grinding alone, he stops to wonder at the science and the knowledge which devised this enormous number of possible curvatures. Here glass working and metal working join hands. The alliance is vital, since the curve of the lens depends on the curve of the shell and block, the perfection of which means the perfection of the original lathe.

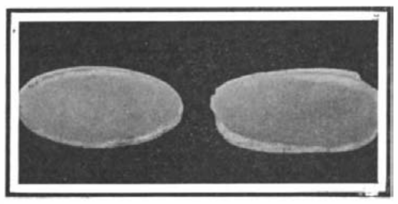


Fig. 1.—Fine grinding of a pair of eyeglass lenses.

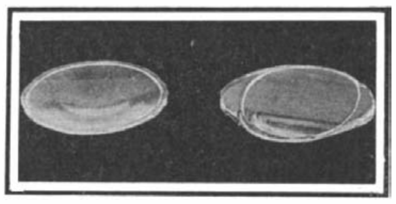


Fig. 2.—Lenses cut but outer rim not broken off.

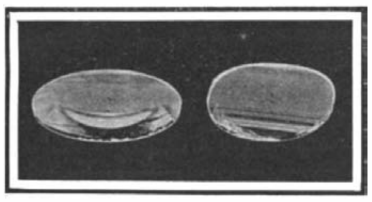


Fig. 3.—Centered lenses, showing center mark and reflection of this mark below it.

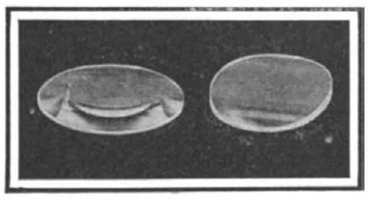


Fig. 4.—Polished and edged lenses of a pair of eyeglasses.

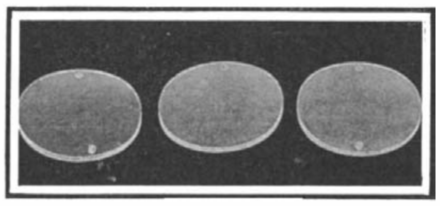


Fig. 5.—Lenses entirely finished, drilled, edged, and ready for the stock room.

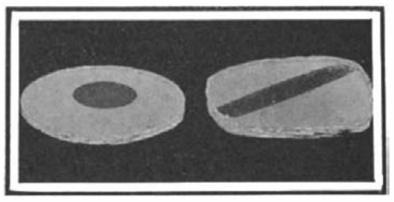


Fig. 6.—Improperly polished lenses, the black spot and band showing portion which has remained rough.

The sightseer may walk through aisle after aisle of room after room, filled, in long, long ranks, with hundreds of grinding machines. He will see machine tenders, each with his set of machines to watch, keeping each set of lenses supplied with abrasive, changing blocks and shells from the rough grinders to the second grinders, from the second grinders to the fine grinders, and from the fine grinders to the polishing machines, where felt, carefully mounted on block or shell of proper curvature, and rouge, take the place of iron and emery, working out the last tiny abrasive mark and leaving the lens with a highly glossy surface, perfectly polished. He will watch the "picker" detaching lenses from the pitch with a pointed tool and may perhaps ask to try it (it looks so easy) and may well break up several dollars' worth of lenses in attempting to imitate the skillful movements of the trained workman. He will watch the reblocking of the lenses, this time in the shell, or upon another block, if the lens is a double convex, see the whole range of operations repeated, and note the even greater care taken now; for it is no longer only glass which is being ground, but a partly finished lens, the cost of which has far exceeded the first cost of the raw materials. But he will not be able to watch any individual lens through all of its operations. Clock hands mark four and one-half hours for each of the rough, second, and fine grindings, and as long for polishing—more than two days to complete any one lens. Cylindrical lenses require even longer —five hours for each grinding and seven for the polishing.

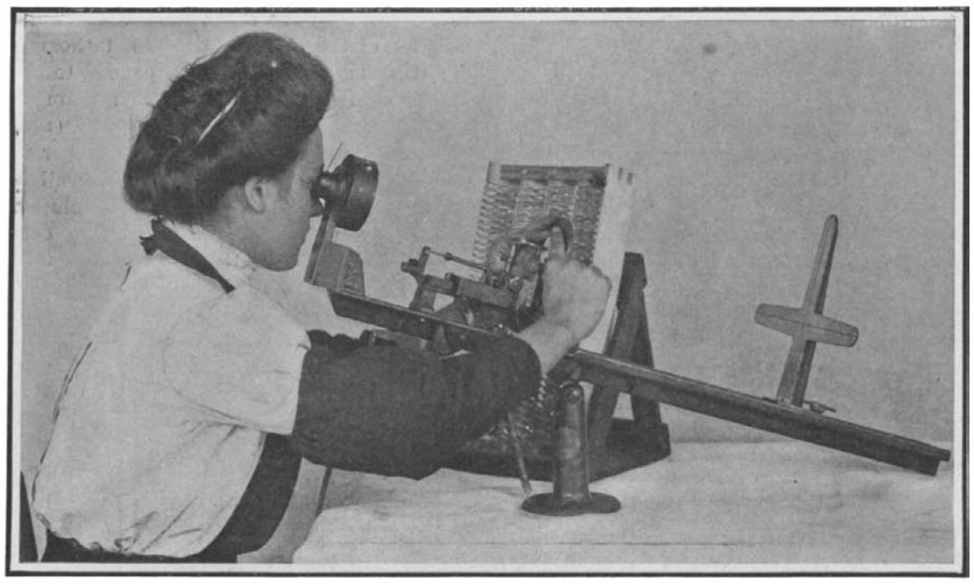
There is something uncanny about the grinding machines. To grind any glass evenly and truly requires more than one movement. While the shell or block revolves, the axis of the companion fitting it nutates back and forth and revolves also, so that each lens continually changes its angle with the grinding or polishing surface. With the cylindrical grinding machines there is no revolution of the grinding surface, but a constant shifting back and forth, which accomplishes the same purpose. One machine would not impress, ten would hardly get a curious stare, but thousands and thousands, all nodding and bowing, certainly command attention.

The visitor will hear something about the names and kinds of spectacle lenses. For instance, a periscopic lens is a meniscus, or a convexo-concave lens. Periscopic means "all seeing," and the use of this form in eyeglasses not only gives the eyes a wider angle of view than does the plane lens, but better accommodates the sweep of eyelashes, decreases reflections from behind, and, when the periscopic curve is deep, maintains all parts of the lens as nearly as possible equidistant from the pupil of the eye, no matter in which direction the eye itself be turned.

The ordinary two-curve or sphero-cylinder lens, used for the correction of hypermetropia or myopia and astigmatism at the same time, having one side of the lens ground to the section of a cylinder and the other side to the section of a sphere, obviously cannot be made periscopic if the spherical curve be convex, nor deeply periscopic if the spherical curve be concave. Yet the advantages of a deep periscopic glass are as great with the sphero-cylinder lens as with any other.

How is the problem solved? The solution was known long ago—the toric lens—but only recently has its successful manufacture been possible. A spherical lens has the same curvature measured in any meridian. A cylindrical lens has no curvature in one meridian, and its greatest curvature in the meridian at right angles to the first.

A sphero-cylindrical lens has a spherical curve on one side and a cylindrical curve on the other. A toric lens is one having two different degrees of curvature in two meridians at right angles to each other on the same side of the glass. These two curvatures have the effect of a sphero-cylindrical



Centering the lens. This operation is highly important; for on the ink spot placed on the center of the lens depend the mechanical and optical properties of the finished lens.

Making the oval cut with a diamond point on an oval swinging upright lathe.

Drilling holes with diamond drills for rimless glasses.

HOW YOUR EYEGLASSES ARE MADE.

lens. The difficulties of the manufacture of toric lenses are enormous, as may be imagined, requiring special machinery to grind two curves at once on one side of one piece of glass. Only in recent years have such lenses been commercially possible. These grinding machines have meant the expenditure of thousands and thousands of dollars and of years and years of time.

Ground, the lenses go to the cleaning room, where, in wooden trays, they are soused and soused again in ten different baths, acid and water, and alkali and water, and soap and water, and repeat. Finally they are plunged in a bath of rouge, which leaves the wooden trays dyed the familiar red of the optical factory, and with a film of rouge on each glass for the final hand polishing and cleaning.

So far the glass has been merely glass, raw material in various stages of manufacture. Now it is a lens. Before it goes further in the tedious costly process of making raw glass into an aid to eye sight, it is rigidly inspected.

Inspection is for striæ (streaks), for air bubbles, for picker's scratches, for grinding scratches, for failure to "polish out," for too great thickness or thinness, for cracks, for breaks, for nicks, and for "target polishing," or polishing in rings. The girls who inspect for defects and for quality, who decide whether a lens is of first quality or not, become extremely expert. They see things in an instant which you may not be able to see even when pointed out. Every sphero-cylinder or cylinder lens must cut a circle thirty-nine millimeters. Its axis can then be ground at any angle for a normal eye. Larger lenses are supplied on order. In the spherical glasses, the inspection test must not show any defect within an oval thirty-nine by thirty millimeters, nor any serious defect, such as chip or striæ, beyond that size.

After inspection, a series of operations, bewildering in the dexterity with which they are accomplished, the lens is centered. A girl fits the glass on the centering instrument, takes a swift look through an eyepiece, sees that a cross hair behind the eyeglass and a cross hair behind the eyepiece of her instrument are in line, and "click," a little ink-spotted pointer has touched the center of the lens, the optical center. If the lens has a cylindrical curve, and consequently a major axis, three ink spots are made upon it, one for the optical center and one at each end to show the axis.

For axial determination, the instrument is accurate to within one-half a degree. The lenses are gaged for thickness, and sorted to size, and then gaged and sorted for actual area; lenses are "two eye," "one eye," "0 eye," "00," "000," "0000 eye," and finally "jumbo" in size, and each must be gaged to see what size it will cut.

Spherical lenses are usually finished at the factory, edge-ground and packed ready for use, and, since a spherical lens has no axis, it can be cut with the long axis of the oval in any direction to the shape of the ground and polished blank. But the cylindrical lens, the sphero-cylinder, or the toric, must be left unfinished as to edge, except for special order, since the angle the axis of the cylinder curve is to make with the astigmatic eye is important.

If the lens is to be edge-ground, the next operator upon it fits the lens over a size gage upon the table of a little machine, turns a handle, and behold, a tiny diamond cutter has oval-ringed the glass with a scratch the shape of the finished lens. Another girl breaks off the rough edges with pliers and, perhaps, a rough pair of iron shears. To see her surrounded with splinters and tiny spikes of glass all over her lap and bench, you would imagine she was in imminent danger of injury, but cuts are rare even with the thickest and heaviest of lenses.

For rimless eyeglasses or spectacles, the lens must have holes drilled in it. It goes to a girl with a drilling machine and diamond-pointed drills. As the tough material is bored, a steady stream of cleanly odorous camphorated turpentine plays upon the glass and the drill, and the little automatic machines, each with its impassive feminine watcher, turn out lens after lens with one or two tiny smooth-edged holes at the ends, ready for the next operation.

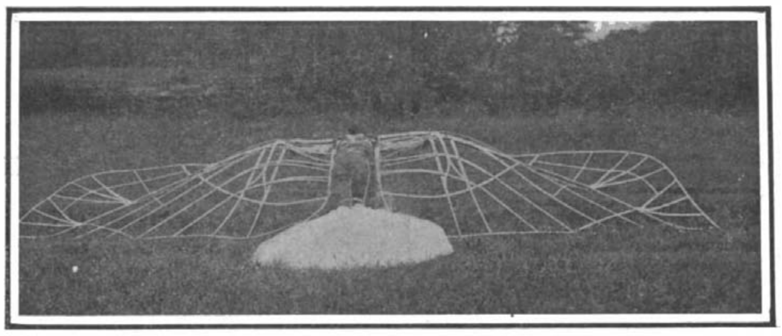
More washing and cleaning follow, and then edge grinding, a matter of wonderfully ingenious machinery, by which the rough-chipped edges are made smooth and the lens, so far as working the glass is concerned, is finished.

Then this product of many operations is focused, much as the elements of a photographic lens are focused, by a girl with a special focusing camera, wiped again, packed, labeled, and stocked. Two hundred and twenty-five gross pairs, or sixty-three thousand lenses, are so finished every day in one big factory.

Nearly a million pounds of optical glass are made into eyeglasses in this one factory every year. It takes thirty tons of emery to grind, and twenty tons of rouge to polish this product. It requires five thousand yards of toweling every year to wipe it clean. For every unedged lens, there are forty-nine operations; for every edged lens, sixty-eight operations. A spectacle lens is simple to look at, but after you have visited the factory, you will know it for what it is—a very complex thing.

FLIGHT WITH FLAPPING WINGS.

Human flight by flapping wings is impossible for several reasons, chief among which is that Nature has failed to furnish us with the anatomy or the muscular strength which are necessary for flight of this kind.



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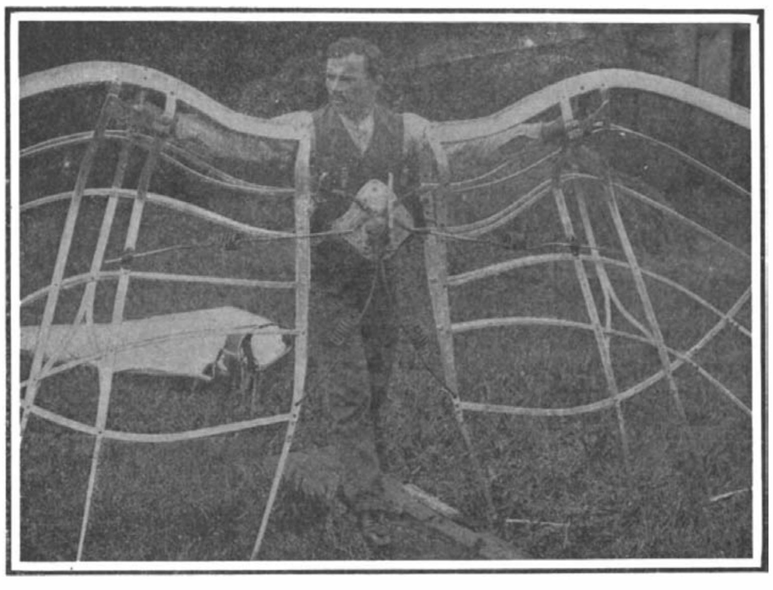
Rear view showing the wing framing and the tail.

It is evident that the motive power for the machine herewith illustrated is to be furnished by the arms of the operator, and the movements when the body was in horizontal flight, would consist of a vertical oscillatory movement of the arms when stretched to their full extent. The power for lifting and propelling the man and the machine, whose weight would be at least two hundred pounds, would therefore have to be furnished entirely by certain muscles of the chest and shoulders, which are rarely brought into strenuous use, and are feeble compared with other muscles of the body.

Furthermore, with the slow rate of oscillation of the wings of which a man would be capable, their area would have to be very large, and their weight would of course increase rapidly in proportion. Prof. Langley pointed out that the difficulty of flying with flapping wings increases rapidly with the increase in size and weight; this being due to the mathematical law that the area in bodies increases as the square of their dimensions, while their weight increases as the cube. He pointed out that "the larger the creature or machine, the less the relative area of support may be (that is, if we consider the mathematical relationship, without reference to the question whether this diminished support is actually physically sufficient or not), so that we soon reach a condition where we cannot imagine flight possible. Thus, if in a soaring bird, which we may suppose to weigh 2 pounds, we should find that it had 2 square feet of surface, or a rate of a foot to a pound, it would follow from the law just stated that in a soaring bird of twice the dimensions we would have a weight of 16 pounds and an area of 8 square feet, or only half a square foot of supporting surface to the pound of weight, so if flight is possible in the first case, it would appear to be highly improbable in the second. The difficulty grows greater as we increase the size, for when we have a creature of three times the dimensions we shall have twenty-seven times the weight and only nine times the sustaining surface, which is but one-third of a foot to a pound. This is a consequence of a mathematical law, from which it would appear to follow that we cannot have a flying creature much greater than a limit of area like the condor, unless endued with extraordinary strength of wing."



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The frame is of aluminium and covered with balloon cloth. There is no motor. The designer hopes to fly by man power.

FLIGHT WITH FLAPPING WINGS.

To fly with the machine herewith illustrated would call for an expenditure of horse-power far beyond that which the strongest man on record ever possessed. It is doubtful if the average man is capable of exerting more than a quarter to a third of a horse-power continuously. It is true that, in supreme moments of effort, and for a very brief period, athletes may exert as high as one horse-power or a little over. The motorless aeroplane, or glider, is the only successful medium of human flight. Flapping wings are clumsy, difficult to construct, uneconomical in operation, and, according to present knowledge and experience in the subject, they form a wholly impossible means of human flight.

Depth of the Gulf Stream.

In Lieut. Pillsbury's examination of the Gulf Stream at various points from Hatteras southward, he found that the stream reaches to the very bottom in some places and tabulated its velocity at different depths. His results, as well as a review of the whole field of Gulf Stream investigation, are found in appendix 10, report for 1890, of the United States Coast and Geodetic Survey. It must not be inferred from the foregoing that all ocean currents extend to the bottom of the sea. Many instances are at hand of ocean currents extending to great depths. For example, Admiral Erminger, of the Danish navy, found that the northwesterly current in latitude 25 deg. 04 min. N., longitude 65 deg. 41 min. W., prevailed to a depth of 200 meters; Commander John R. Bartlett, United States navy, found a current in the Windward Passage to the depth of more than 800 fathoms (1,460 meters), and concluded that it reached to the bottom; between Key West and Havana the stream was measured in 1860 to a depth of 600 fathoms (nearly 1,100 meters), and was found to be only 10 per cent less than at the surface.

It is well established that the Gulf Stream loses in depth, temperature, and velocity, and gains in width, especially after passing Cape Hatteras, until the 40th meridian it becomes a drift current, reinforced on its right flank by the powerful Bahama current. Various measurements for temperature show that the Gulf Stream is shallower than its northeastern extension beyond the 40th meridian. Thus Commander Chimmo, R. N., commanding H. B. M. S. "Gannet," during the summer of 1868, found the warm water of the Gulf Stream to be less than 50 fathoms deep in latitude 44 deg. 03 min. N., longitude 48 deg. 07 min. W. Ten degrees to the eastward the warm water had deepened to 100 fathoms or more and in latitude 43 deg. 43 min. N., longitude 37 deg. 47 min. W., the warm water was found to extend down about 250 fathoms. Observations made on board H. B. M. S. "Porcupine," during the summer of 1869, showed remarkable depths in the Gulf Stream drift, as follows: In latitude 59 deg. 35 min. N., longitude 9 deg. 11 min. W., the warm water was found to extend to the very bottom of the sea, 767 fathoms (1,400 meters); at Rockall the warm drift was found to reach down 900 fathoms below the surface, and similarly again in latitude 47 deg. 38 min. N., longitude 12 deg. 08 min. W. At the last-mentioned observation spots the warm water was found to be underrun by a polar current at depths of more than 900 fathoms. A similar phenomenon is often observed near the Grand Banks where the Labrador current dips under the Gulf Stream at comparatively shallow depths, 50 to 100 fathoms.

Daniel's Comet.

The comet discovered by Mr. Daniel of Princeton Observatory has received considerable attention throughout the country. Dr. H. C. Wilson of the Goodsell Observatory, and Prof. E. B. Frost, Director of Yerkes Observatory, have both sent communications on the subject to Harvard College Observatory. Furthermore, Dr. Ebell of Kiel has computed an ephemeris. From the photograph which has been made at Yerkes Observatory it seems that the comet has no stellar nucleus; a short tail is suspected.

THE BABY MUSK OX AND THE ALASKAN BEAR OF THE NEW YORK ZOOLOGICAL GARDENS.

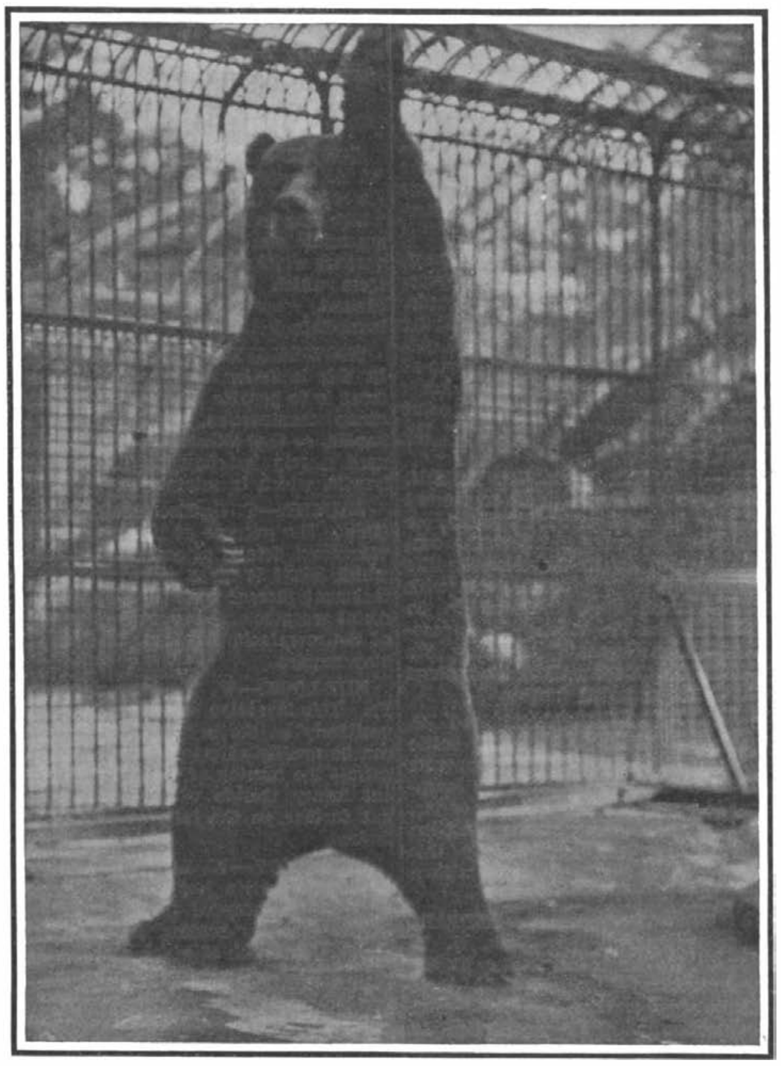
BY WALTER L. BEASLEY.

Through the efforts of Director W. T. Hornaday of the New York Zoological Society, New York has acquired two most interesting new animals—one a baby musk ox, and the other a giant Alaskan brown bear.

Although the musk ox is a typical polar animal, this is perhaps the only specimen to be found in captivity. Whether our climate will so far affect the animal's health that it will perish, remains to be seen. This particular specimen was captured on Melville Island, six thousand miles from the Zoo. The price paid was $700. The animal is about six months old, and in splendid physical condition. The entire body is covered with a dense mass of fine brown wool. Across the forehead is a broad band of white, and on the back a light gray saddle mark. A thick mass of wool hides the short horns. In time these horns will grow until they meet at the center of the forehead. When fully grown the whole top of the head will be covered by a pair of horns considerably flattened at the base, meeting in the center of the forehead, thence sweeping downward over the edge of the cranium, close to the cheeks, and finally recurving upward before coming to a point. The animal illustrated is about 3 feet long, nearly 2½ feet in height, is about half grown, weighing 190 pounds. A full-size adult male stands 4 feet 5 inches high at the shoulders and is 6 feet 7 inches in length, weighing about 1,200 pounds. The species shown in our photographs, from the marked characteristic of the large whitish patch on the face and saddle mark on the back, has been named by Mr. R. Lydekker, of the British Museum, *Ovibos Moschatus* Wardi, in honor of Mr. Howland Ward, the natural history dealer of Piccadilly, London, from two types of a mounted male and female from East Greenland, in his possession. The other form or species of the musk ox, *Ovibos Moschatus*, is confined mainly to the Arctic Barren Ground regions east of the Mackenzie River, and formerly thought to have had a continuous distribution westward across Alaska.

Of the 5,530 living animals in the New York Zoological Park, one of the most remarkable is the great Alaskan brown bear Ivan. This colossal animal belongs to the species *Ursus dalligyas* Merriam, and was captured at Moeller Bay, Alaska Peninsula.

The writer was able to obtain a very striking picture of the giant Ivan, standing seven feet in the air with uplifted front paw, by venturing inside the inclosure with an attendant. A tempting fish coaxed the big animal to assume an upright pose. Ivan recently gave a practical exhibition of his astonishing strength and vigor by tearing out a panel of the heavy steel bars that separate his quarters from those adjoining and engaging in a fierce battle with a hated rival. In ten minutes the monster bear wrenched and trampled down the barricade of steel bars as if they had been made of reeds. It would have taken six men an hour with block and tackle, sledge hammers, etc., to have accomplished such a damage. The enraged giant fought with his antagonist until finally clubbed off by the keepers. Ivan's long shining and shaggy brown coat converted into a rug would be worth nearly one thousand dollars. Ivan is one of the few living examples of the fast disappearing species of the giant brown bears of America in captivity, a species especially interesting as possessing some very extraordinary, intelligent habits. In his distant Alaskan home Ivan practised the art of salmon fishing. As soon as the salmon begin to enter the streams in July, from the sea, big brown bears of his species make fishing their chief business. Both the old male and female fish for salmon in order to furnish a plentiful supply to satisfy their own enormous appetites and those of their young. The cubs do not attempt to fish, but stay on the bank and receive contributions tossed up by one of the parents. The she-bear stands upright, and wades in water even up to her neck, going very slowly with the current, watching the water, and scarcely making a ripple in it. She holds her arms down at her sides with hands or paws spread, and when she feels a salmon coming up against her, quickly clutches it with her paws, and throws it out on the bank to the expectant cubs. After supplying the cubs she tosses up a pile for herself. The last fish she puts in her mouth, and goes ashore to enjoy her feast.



IVAN, THE GREAT ALASKAN BROWN BEAR OF THE NEW YORK ZOO.

Artificial Petroleum.

The origin of petroleum is still an object of much dispute among savants; some attribute it to inorganic sources, others to organic. In America there is an inclination toward the latter solution of the problem, at least so far as concerns the petroleum of the New World, for the layers of schist which carry it always contain the *débris* of diatoms, foraminiferæ, the skeletons and scales of fish, etc.

Impressed with this latter detail a savant (of whom the name is not given) has, as a result of many trials, made it seem certain that petroleum was formed by a sort of distillation of extinct sea fish. According to indications, states the Revue des Eclairages, manufacturers should collect a large number of fish and should have them distilled. They ought then, moreover, to obtain a result something like that from the following first trial:

THE NEW BABY MUSK OX OF THE NEW YORK ZOO.

The savant then conceived the idea of mixing the fish with a large quantity of salt. The novel experiment was made tentatively, the fish were strung upon cords and brought into a large retort, where they were mixed with a quantity of sea salt; the whole, upon distillation, gave a petroleum of excellent quality, which could be used for the lighting of buoys. We have no information, unfortunately, about the economy of such a method of procedure, and do not know, moreover, if the company which has made this trial has been able to continue with success which justifies commercial development.

We confess that we are a little skeptical regarding this novelty. It may well be that there was obtained by this procedure an oil capable of burning; that may be granted, but was it petroleum? It might be well to preserve this idea, which would be of some use when the natural suply of petroleum is exhausted.

The Current Supplement.

"How Sponges Are Gathered and Artificially Grown" is the title of an article by Newton Forest which opens the current Supplement, No. 1773. Mr. R. M. Strong's excellent comparison of gasoline and alcohol engines is continued. The first experiments made in aviation were desultory, and were made without the help of any well-established rules. Hence it is that the fundamental principles and mechanical properties of fluids were not as well understood as they should be. To that end institutions have been established in Europe for the express purpose of obtaining a really scientific knowledge of the air and propellers and plane surfaces. One of these institutions is described. C. G. Derrick reviews the methods in current use for waterproofing concrete structures. Capt. A. C. Knowles writes on the Army Signal School and its work. Whether the wax bust purchased by Dr. Wilhelm Bode for the Kaiser Friedrich Museum at Berlin is really the work of Leonardo da Vinci, as is claimed, or of a modern craftsman, is discussed. The evidence *pro* and *con* is impartially given. Under the striking title "The Blood of Plants" Mr. Victor Graef writes on some modern botanical researches. The reappearance of Halley's comet renders particularly timely Mr. Arthur Stanley Eddington's paper on light pressure and comets' tails. Dr. Alfred Gradenwitz contributes an excellent article on wireless transmission of diagrams, handwriting, and photographs. The startling success of Mr. Louis Brennan with his gyrostatic car lends peculiar interest to an article by Mr. Horace B. McCabe on the principles and applications of the gyrostat.

Cooling Tower Practice.

In an article on cooling tower practice, which appeared in the Electric World some little time ago, the author states that tests on both open and closed types of towers, under various hygrometric conditions, have shown that, with an average range in temperature extending over several days of from 140 deg. to 170 deg. F., the fall in temperature obtainable has resulted in outflowing water of from 90 deg. to 60 deg. F. with atmospheric temperatures between 55 deg. and 85 deg. F., and hygrometric conditions ranging from 30 to 50 per cent of normal saturation. An open type tower capable of cooling from 400 to 600 gallons of water per minute, as dependent upon its special construction, will be roughly 20 feet by 20 feet by 40 feet or 45 feet for cubical contents, and will have at least six so-called drip pans or retarding surfaces in its make-up. The cost of such a tower with a capacity of 400 gallons per minute would range between $1,200 and $1,500, and in general each additional 100 gallons per minute capacity increases the cost by approximately $200. The closed type costs from three to four times that amount for installation, and the additional increases range at about double the price for the open type. In cost of operation about $2 per day will be required for maintenance of the tower and for fuel and water for operation of fans, pumps, etc. If water costs 6 cents per 1,000 gallons or more, the author maintains that it pays to erect the cooling tower if the total water lift does not exceed 80 feet.

The only export tax in Mexico on minerals or mineral products is on gold and silver. All other products of the mines are exported free except for a nominal customs charge at the port of export.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COMBINED SOCK AND GARTER.—L. O. Gitchell, New York, N. Y. This garment fastener comprises a combined sock and garter arranged to insure correct support of the sock on the leg, and to allow ready closing and opening of the garter, the latter being for this purpose permanently attached to extension flaps formed integrally on the upper end of the sock at the sides thereof.

RACK.—G. H. McGregor, New Glasgow, Nova Scotia, Canada, and A. S. Rudland, New York, N. Y. One object of this invention is to provide a simple and inexpensive and compactly-built rack for displaying and preserving articles such as garments and the like, which can be easily taken apart and packed into a small space, and in which the articles can be protected from dust, moisture and so forth.

Electrical Devices.

BINDING-POST. — L. Steinberger, New York, Mr. Steinberger's invention comprehends a post having a central stem encircled by a spiral spring of metal, and adjacent to the ends of this spring clamping plates arranged in pairs, the plates of each pair being pressed together by the action of the spring and the outer edges of the clamping plates being slightly curved to facilitate the entrance of the wire therebetween.

Of Interest to Farmers.

SELF-BINDER ATTACHMENT.—E. Pennington, Westhope, N. D. The inventor has means for depositing the bundles of grain delivered from a self-binder in shocks while the machine is in motion. An object is to provide means whereby the bundles of grain as they are delivered from the self-binder may be held together in shock form and at the will of the operator deposited in shocks.

CORN-PLANTER.—G. M. Gorman, Anamosa, Iowa. The inventor employs a marking device for seed-planters, whereby the rows of hills are maintained in parallel lines and equidistant; and provides a mechanism for accurately operating the marking devices, which mechanism may be raised and lowered out of and into operative contact with the ground, conjointly with the planting device.

FRAME.—L. B. Stetson, Bellevue, Wash. This invention relates more particularly to adjustable frames, such as are adapted to be used in the cultivation of plants, such as tomato vines and the like, and which consist of uprights adapted to be driven into the ground, and having arms pivotally secured thereto, means for holding the arms extended, and supports removably arranged on the arms of the uprights.

GRAIN-CUTTER.—L. Clark, Greenfield, Ind. The cutter is for use in connection with binders. The object of the inventor is to provide a combined cutter and binder, whereby the grain may be bound into bundles while in upright position, as it is cut from the ground. Means provide for dividing the grain as it is about to be cut and supporting said grain after it is cut, in upright position, and transporting it to a binder mechanism while still in the upright position.

CORN-RACK.—J. S. Winton, Milford, Iowa. In the present patent the invention is an improved rack and belongs to that class of such devices in which a number of corn-ear impaling-pins project from a support and sustain the ears in spaced relation and at known points during the period of curing, storing and testing.

EGG-TESTER.—Evelyn Leiss, Bronxville, N. Y. By this device eggs may be conveniently inspected at the outside of the usual egg-testing box. The box has egg-seating openings in the top and is provided at the side with a door having a mirror on its inner face, the door being hinged to swing downwardly and outwardly to a position to reflect the light passing through the openings.

Of General Interest.

WELL-TUBING AND MEANS FOR CONNECTING SECTIONS THEREOF.—G. A. Pittman, Deweese, Neb. The object here is to provide a tube of any length, from vitrified clay, formed in sections before baking the same, and also provide clamping means for joining the tube sections together endwise, thus producing a practical lining which may be placed in a well bore or removed therefrom with the same means used to insert and remove iron lining tubes.

ARTIFICIAL HAND.—W. A. Hennessey, Ashland, Wis. In view in this invention are the following objects: To provide means whereby the fingers of an artificial hand may be caused to fold and to grip an object, to lift the same; to provide means whereby the fingers of an artificial hand may be maintained in a released position; and to simplify the construction so that the hand may be automatically operated.

DRY YEAST COMPOUND.—J. E. Yost, Arkansas City, Kan. The more particular purpose of the invention is to provide a carrier for certain yeast compounds originally prepared in the form of a liquid and afterward dried. The product consists of vegetable pith, and a yeast compound, the pith being in the form of small particles and the compound being coated superficially upon the particles.

FOLDING CRATE.—F. C. Mary, Chehalis, Wash. The object of this improvement is to provide a crate or like receptacle, having its parts arranged for convenient erection or folding into a flat package and locking the folded parts in place. It relates to crates, such as shown and described in the Letters Patent of the U. S., formerly granted to Mr. Mary.

SELF-CLOSING BOTTOM FOR WELL-STRAINERS.—J. A. Pollard, Oakland, Miss. In the present patent the invention relates to self-closing bottoms for well-strainers, which are adapted to be attached to a well-strainer of any suitable type and to be lowered into a well, together with a strainer, by means of a force pipe, the latter being afterward removed.

SYRUP-PERCOLATOR.—F. De Clercq, New York, N. Y. The aim of the invention is to produce a percolator in which sugar can be readily dissolved without coming into contact with the air, and from which the syrup may be readily withdrawn from the syrup compartment beneath. A further object is to provide a filtering bottom for the sugar compartment.

DRAG.—J. Bladholm and A. Bladholm, Marshall, Minn. The invention is an improvement in drags for smoothing and shaping roads, etc., and has in view such a device embodying elements of strength and durability, and primarily built of standard cross-sectional forms of rolled steel, the drag being capable of being drawn either in alinement with the road or at an angle thereto, and operating to shear the dirt off rather than tear it apart.

ENVELOP.—L. C. Van Riper, New York, N. Y. The envelop is provided with an ungummed flap which may be held within a pocket, or removed therefrom in order to allow the contents of the envelop to be inspected by the postal authorities. It is provided also with an ordinary gummed flap, intended to be sealed in order to give the envelop the appearance of a sealed envelop and yet allow the same to be sent through the mail at the postage rates required for unsealed matter.

TELLTALE-BOTTLE.—A. Midbo and G. Gulbrandson New York, N. Y. This bottle is adapted to indicate if the original contents have been removed and the object of the invention is to produce a closure for a bottle or jar, which cannot be placed in its former condition after the bottle has been opened. By this means the reselling of the bottle filled with a spurious substance is prevented.

PROCESS FOR TREATING CERTAIN ORES.—H. A. Auerbach, New York, N. Y. In this instance the invention relates to the electrolytic separation of metals from their ores, and admits of general use, but is of special value in connection with the production of metallic lead from galena and other plumbic ores. The method has no direct relation to any particular form of apparatus.

AERIAL VESSEL.—J. Suter, Jersey City, N. J. The aim in this invention is to provide a vessel or aeronef, arranged to present a large sustaining surface, and provided with means for conveniently causing the vessel to rise, descend and travel in the desired direction, the vessel being also capable of traveling on water or land.

CONCENTRATOR AND AMALGAMATOR.—J. I. E. Nelson, Bettles, Alaska. This apparatus is designed for the recovery of refined gold which with the foreign matter is held in suspension in a stream of water caused to drop perpendicularly into a mixer from which regulated outlet ports lead. The material to be treated contacts with quicksilver to effect the amalgamation and is forced upward again against the downward current, the purpose being to effect a thorough amalgamation with expedition.

CONCRETE DAM.—H. A. Icke, Church Stretton, Shropshire, England. The reinforced concrete dam is of cellular construction, capable of compensating for expansion and contraction due to climatic changes, and open on the upstream side of the dam to form pockets for reception of water, to utilize the latter to give stability to the structure and producing direct tensile instead of transverse and compression stresses, thus insuring the desired resistance and providing at the same time suitable spillways for surplus water.

WATER-WHEEL.—J. L. Beil, Galena, Ill. The purpose in this improvement is to provide a water-wheel adapted to be partially immersed in a stream in a horizontal position, and wherein the rotor comprises a plurality of vertically movable vanes, which by the movement of the rotor are moved out of and into the water.

METAL FRAME FOR GLASS PANES.—A. Busse, New York, N. Y. The intention here is to provide a frame in which no bulging or upsetting of the metal is necessary at the front of the frame, to bring the flanges or heads of the bars into the same plane in order that the glass panes may bear flat against the inner faces of both the mullions and transoms.

BLOCK-MOLD.—E. May, New York, N. Y.— The inventor provides a casting mold arranged to permit of conveniently closing or opening the mold for placing the plaster material therein, and for removing the block after it has been formed and the material has set and hardened. The mold is provided with removable partitions for forming a large number of blocks simultaneously, the interior faces of the mold members being provided with registering of adjacent ribs, to provide each block or slab with a continuous groove along its sides.

COMPOUND BOAT.—J. D. White, 50 Clanricardens, London, England. The main object in this case is to provide a compound boat which shall combine great stability with small displacement, and in which each of the several hulls shall have sufficient freedom to roll, pitch, and adjust its heading, so as to avoid those excessive strains which have hitherto hindered the development of boats of this type.

SMOKING-PIPE.—E. B. Whitney, Oakland, Cal. Mr. Whitney's invention is specially constructed for cooling smoke, insuring deposit of nicotine therefrom, and for facilitating cleaning, when required. A comparatively long circuitous passage is provided for the smoke, so that it is cooled more than would be practicable if it had a direct passage.

Hardware.

DEVICE FOR HOLDING WIRE SCREEN.—W. A. Smitson, and A. German, Elwood, Ind. An object of the invention is to provide a device which may be located on a counter, or similarly accessible place, upon which rolls of screen of various widths and sizes may be mounted and from which the strips may be unwound as desired, measured, cut off and rolled up for immediate delivery.

SNOW-SHOVEL.—G. C. Port, Ebensburg, Pa. In this invention the purpose of the improvement is to provide a strong shovel of easy and cheap construction, and with an adjustable handle, so that either edge of the shovel may be used merely by changing the position of the handle, which is rotatable.

FAUCET.—T. O. Thompson, Zacapa, Guatemala. The purpose of the invention is to provide novel details of construction for a faucet, which adapt it for a secure but removable attachment thereof upon the side wall of a plate metal receptacle, for a removal of the contents of the receptacle from time to time as occasion may require.

NUT-LOCK.—W. W. Senn, Munson Station, Pa. This invention can be used to lock the nut positively on the bolt and the locking devices can be readily adjusted to unlocked position to permit the turning of the nut on the bolt without injury thereto when desired to turn the nut farther on the bolt, or off the bolt, if so desired.

DOOR-STOP.—W. La Baw, Asbury Park, N. J. The invention has reference to door-stops, such as are adapted to be revolubly secured to the floor for holding the door in an open position, and each of which consists of a wedge-shaped body pivoted to the floor at its thinner end, so that it can be swung into a plurality of positions.

SAFETY-GUARD FOR LOCKS AND LATCHES.—G. E. Hosch, New York, N. Y. The more particular purpose here is to provide a guard having substantially the form of a plate provided with means whereby it may be fastened upon a door-jamb, or the like, for the purpose of preventing the bolt of the lock or latch from being forced back, from the outside of the door, with the aid of a knife, screw-driver, or other instrument.

DINNER-PAIL.—W. A. Edwards, Pine Bluff, Ark. An object in this case is to provide a device in which articles such as soup and coffee can be heated with very little trouble and in which the remainder of the victuals can be warmed without any danger of burning. Means provide for carrying liquid fuel for heating purposes.

SHUTTER-OPERATOR.—A. Weber, Long Branch, N. J. One object of the inventor is to so construct the device that it may be more easily applied to a window-sill and casing, and a further object is to so construct the device that it will operate upon the exterior rather than the interior surface of the blind or shutter. The invention relates more particularly to that type of operator illustrated in a former patent granted to Mr. Weber.

RATCHET-DRILL.—G. W. Figg, Los Angeles, Cal. The object of the improvement is to provide a device simple and serviceable in construction and inexpensive to manufacture, which is constructed to obviate the danger of the supporting point and its advancing member being unscrewed too far and thus causing an injury to the device.

PERMUTATION-LOCK.—G. H. Hamilton, Portland, Ore. In view in this invention is a construction embodying a latch spindle having the customary knob and revoluble independently of the latch operating mechanism, the spindle being provided with a push bar to lock it to said mechanism, and also having a spring pawl to lock the bar in innermost and retracted positions, controlled by a permutation mechanism mounted on the spindle at the outside of and adjacent to the outer door knob.

LADDER.—J. Vaghi, Bethel, Conn. The inventor provides a ladder more especially designed for use on buildings, provides a safe escape in fire and allows firemen to quickly reach the upper stories, the ladder having its side bars formed of lazy tongs, and the rungs forming pivots on which the members of the tongs are fulcrumed, the ladder when folded taking little room, and in use is locked in extended position and spaced a sufficient distance from the face of the building to allow ascent and descent of persons.

KEY-FASTENER.—P. J. Ryan, Spokane, Wash. The aim of this invention is to provide for preventing rotation of the key in the lock from the outside or from the opposite side of the door, and to provide a device devoid of complicated parts, which may be easily inserted or removed from the key, and which when not in use may be folded for carriage in the pocket.

Heating and Lighting.

HEATER.—G. W. Bowman, and J. A. Becraft, Palisades, Colo. The invention relates especially to such heaters as are used out-of-doors. The object is to produce a heater of simple construction having a form which especially facilitates a good draft and the rapid ignition of the fuel when the fire is started. It is adapted to be formed of sheet metal.

GAS-ESCAPE.—H. H. Fulton, Oroville, Cal. The design is to provide an appliance for the escape of gases from gas, vapor and similar heaters, the appliance being applicable to windows of various sizes and easily set up and removed. The invention consists of an extensible window-stopper, a pipe carried by and projecting outwardly from the stopper, with which the flue of the gas or oil heater connects, and a hood spaced from and covering the outer end of the pipe.

SWITCH FOR INCANDESCENT-LAMP SOCKETS.—W. A. McDonald, Grampian, Pa. Of the several objects of this invention the main is to provide a switch for an incandescent socket which may be easily operated, requiring a great deal less force to manipulate it than the ordinary key, and which can be operated by one hand without straining the suspending cord.

COMBINED VENTILATOR AND SMOKE-CONSUMER.—J. Wood, Noroton, Conn. The invention pertains to stoves and furnaces, the more particular purpose being to provide an appliance for regulating the draft, facilitating the combustion of the smoke, ventilating the room through which the smoke-pipe passes, collecting unburned cinders from the smoke and enabling these cinders to be readily ejected.

MINER'S LAMP.—J. Van Liew and A. M. Van Liew, Houghton, Mich. The lamp is adapted to burn wax, oil or other suitable fuels, and the invention refers more particularly to the construction of the wick tube and burner. The device is provided with a form of combustion chamber whereby a uniform supply of air will reach the flame, thus obviating the production of smoke and other noxious gases.

Household Utilities.

CONVERTIBLE COUCH AND BED.—L. B. Jeffcott, New York, N. Y. This article can be conveniently converted from a couch into a double bed and vice versa, and when in the form of a couch the two bed sections are spaced apart to accommodate the bed sections, and when these are extended they range one along side the other to form a double bed. For this use is made of a frame on which one bed section is pivoted, and the other is adapted to be raised into an active position or lowered into a folded position.

FOLDING BED.—L. B. Jeffcott, New York, N. Y. This bed is arranged to permit of conveniently and quickly folding it longitudinally into a small space, and with the bedding between the head and foot of the bed, and to allow its extension for use without danger of collapsing. For this purpose, each of the side rails is formed of bars pivotally connected with each other and with the ends at the head and foot, so that the bars swing longitudinally on folding or extending the bed.

SUSPENDED CLOTHES-RACK.—B. B. Bosworth, New York, N. Y. This invention refers to elevating racks or driers adapted to support clothes or similar articles to dry. The aim is to provide a device extremely light and simple in construction, with improved means for elevating the supporting frame and for maintaining it in a horizontal position.

Machines and Mechanical Devices.

TENSION DEVICE FOR WARP-BEAMS.—G. Keller, New York, N. Y. An object of this inventor is to provide a tension device, strong and durable and which is adapted to replace the weights usually employed at the present time to keep the warp threads under tension, while at the same time utilizing the disk or drum provided upon the warp-beams in connection with the weights.

NEEDLE-CAM FOR STRAIGHT INDEPENDENT-NEEDLE KNITTING-MACHINES. — B. Popp, Couvet, Neuchâtel, Switzerland. The invention relates to knitting machines of the straight independent-needle type and more especially to the so-called locks. In the needle cam of the present invention pronounced disadvantages are overcome by preventing the needles when they are in the needle channels from an unintentional movement beyond the permissible limits.

VERTICAL ROUNDABOUT.—W. A. Sullivan, New York, N. Y. The more particular purpose in this patent is to provide a roundabout, including large beams journaled upon a frame and adapted to turn bodily end over end, its motive power being wholly or partially controlled by the slow descent of passengers or of heavy passenger carriages.

SPEEDOMETER.—H. C. Berry, Toledo, Ohio. A shaft is journaled at one side of the center of gravity of the speedometer, the shaft being adapted to be secured to a rotating piece of machinery, and by means of a pawl and ratchet wheel and a chain of gearing it is adapted to rotate a shaft on which a governor is mounted to revolve therewith, the governor having a collar slidably mounted on the shaft which operates levers which draw tape wound on a drum secured to the indicator wheel shaft.

MIXING-MACHINE.—W. McRAE, Eastman, Ga. This invention relates to mixing-machines of the rotatable box type, and the improvements are designed more particularly for a machine for the mixing of guano or commercial fertilizer. The machine comprises a rectangular box mounted for rotation about one of its diagonals as an axis, and a series of stationary paddles mounted within the box on a shaft disposed on the diagonal.

APPARATUS FOR THE CONTROL AND THE REGISTRATION OF THE OPERATIONS PERFORMED BY DISTRIBUTING-MACHINES.—G. I. F. SOULAGE, 44 Rue de Chausy, Paris, France. The present invention has reference to a device for use in controlling and registering the operations performed by distributing-machines of all kinds and more particularly to machines for distributing railway tickets. The object of the inventor is to add up the amounts of the individual sums borne by the tickets issued.

SYNCHRONIZING APPARATUS.—P. PIERINI, 224 Via Cavour, Rome, Italy. The object of this invention is to provide an electro-mechanical apparatus for synchronizing automatically the movement of a kinematograph with that of one or more talking machines. The talking machine is actuated by a source of power quite distinct from that which causes the rotation of the kinematograph, and preferably by the power derived from a clock-spring previously wound.

GLASS-MOULDING MACHINE. — W. J. MILLER, Coffeyville, Kan. In operation when the mold reaches the charging position, a gatherer places a charge in the mold, and starts the table operating mechanism. The table is at once partially rotated to bring the charge into position for pressing, and the pressing operation is continued a predertermined time according as the pointer is adjusted with reference to the scale. When the piston reaches the lower end of the cylinder of the timing device, it shifts the valve controlling the forming plunger cylinder, and this plunger is raised.

BAND-SAW WHEEL.—C. A. PUTNAM, Tupper Lake, N. Y. Details of construction are provided whereby the width of the faces of the pair of band-saw wheels may be decreased, to compensate for decrease in width of the saw, due to successive cutting away of the saw blade in sharpening the teeth, the saw teeth being thus projected beyond the sides of the wheels, and the band of the saw adapted for close contact with the faces of the wheels, that is essential for the rotatable movement of blade without slipping while in operation.

PULP-SHAPING MACHINE.—A. KOMP, New York, N. Y. Mr. Komp finds that he is enabled by his invention to overcome some former objections by using in the place of the rubber covering of the die, a thin resilient cover, preferably of sheet metal, which is detachable with the article produced. This cover gives a smooth finish, requiring no further work for its completion. Means provide for locking one of the dies successively closer to the other die after each movement of the latter, whereby the pulp may be subjected to repeated and increasing pressures.

Prime Movers and Their Accessories.

VALVE FOR ENGINES.—O. PEARSON, Worcester, Mass. The valve stem is mounted in a valve cage having openings for admission of gas, and outside this cage is mounted the spring for normally maintaining the valve in closed position. A rock shaft is mounted on the wall of the valve cage and one arm from this shaft engages the valve stem and the other arm is operatively connected with the spring. The spring, rock shaft and other supports are entirely outside of the valve cage and out of the path of the incoming air or gas.

Railways and Their Accessories.

COMBINED SIGNAL AND AIR-BRAKE.—A. M. JONES, Hagerstown, Md. The invention pertains to means for automatically operating the brakes and for sounding an alarm. An object is to provide devices by which the brakes may be automatically set and the alarm sounded, said devices being located alongside of the track upon which the train is running.

RAILROAD SWITCH.—G. D. WORLEY, Texarkana, Ark. In this instance the object is to provide novel details of construction for a railroad-switch, which co-operate with a fixed frog point and pivoted wing rails therefor, so as to enable the effective control of the switch and dispense with guard rails usually used in connection with a switch of the type indicated.

LOCOMOTIVE ASH-PAN.—T. W. ANDERSON, Fort Smith, Kan. The main purpose of this inventor is to provide means whereby the pan may be dumped and in which the warping of the pan proper does not necessarily interfere with the workings of the dumping mechanism. The pan joints are protected from heat, thus reducing the danger of fire from glowing coals, which are dropped through open joints along a track.

CAR-FENDER.—J. J. KELLY, New York, N. Y. This invention pertains to car-fenders such as are attached at the forward end of street or trolley cars for saving persons from being run over. The cradle is normally disposed in an inoperative position under the forward end of the car, but comprising a trip frame which when touched by the body, automatically releases the cradle so that it advances so as to present its forward edge under the body. The motorman can directly release the cradle.

AUTOMATIC SWITCH FOR RAILWAYS.—F. R. Y. TORRES and F. S. DE LA P. Y. MARTINEZ, Habana, Cuba. The switch co-operates with means carried by the car, which enables the operator of the car to throw the switch to open or closed position in advance of the car. In this way the car operator can advance the car on the main track or turn it into the siding or switch without leaving his platform.

Pertaining to Recreation.

ARTIFICIAL BAIT.—M. A. BURTHE, University, Va. The object here is to provide a bait, designed to resemble a small animal, such as a frog, cricket or grasshopper, and so constructed that the resistance of the bait as it is drawn through the water, will cause a movement of portions of the mechanism, resembling the movements of the members of the animal which the bait represents.

AMUSEMENT DEVICE.—R. H. ALEXANDER, Paterson, N. J. This device is of the rotary type and adapted to give simultaneously a reversing circular travel, a counter-whirling rotary motion, and a billowy rocking motion. It is adapted to give a variety of circular billowy motions, calculated to please the occupants.

OPTICAL-ILLUSION APPARATUS.—E. P. HOYT, New York, N. Y. A mirror is employed in this device and in connection therewith, an approximately horizontal screen, so positioned relatively to the mirror that it will serve to screen one's hand while writing or drawing on a sheet of paper or pad beneath the screen, the mirror being so positioned that the reflection of the hand and the writing or drawing will be seen.

SINKER.—G. W. TEASDALE, New York, N. Y. Mr. Teasdale's patent relates to sinkers admitting of general use, and particularly to the type used in connection with a line for purposes of fishing. The sinker comprises a body near the ends of which are slots for use in holding a cord, and a spring winding mounted on the body and provided with portions extending into the slots for the purpose of gripping the cord therein.

BASE-BALL-GAME APPARATUS.—J. W. E. DEAN, New York, N. Y. In this patent the inventor has reference to certain improvements in apparatus for playing a game closely analogous to the ordinary game of base-ball, but played by operating dummy players mounted on a suitable support representing the field and diamond.

SOUNDING TOY.—W. BARTHOLOMAE, New York, N. Y. This invention relates to a device for making a noise. More particularly stated, it comprehends a sounding body, a clapper for striking the same, and a star wheel for actuating the clapper, these parts being of approved construction so as to give the complete device a maximum of efficiency.

Pertaining to Vehicles.

MOTOR CYCLE.—J. E. ALLEN, Trenton, N. J. The inventor's intention is to provide improvements in motor cycles, whereby the main frame is spring-supported at both wheels, to reduce the shock and jar, incident to riding over rough places, to a minimum, the construction of the frame permitting the use of long and strong elliptical springs and bringing the rider's seat as low down as possible.

AUTOMOBILE-AXLE.—M. D. TINDAL, Columbia, S. C. More especially the improvements relate to axles used in automobiles and similar motor vehicles, which permit the turning of the wheels on vertical axes in response to the movements of the steering mechanism. The vertical turning axis may be located in the plane of the wheel itself instead of being outside of the plane as common in ordinary construction.

TRUCK.—C. J. INGARD, San Francisco, Cal. The object in this case is to provide a truck which may be used to store lumber on board ship and other places, the truck being so constructed that by lifting one end of the load and depressing the other end the truck with its load may be swung to the desired direction in which the load is to be moved.

WHEEL.—C. C. FOSS and C. L. WHITE, Quitman, Ga. These patentees have produced a wheel of the type in which metallic springs are arranged between the inner and outer rims. The invention resides in the special form of the springs which comprise heart-shaped bodies, the apex of which connect with one rim the other rim receiving a standard extending to the opposite end of the spring.

Designs.

DESIGN FOR A HAMMOCK. — D. W. SHOYER, New York, N. Y. The design in this case shows the hammock body ornamented by a series of grotesque images, faces, symbols, etc., which is very unique and effective.

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

Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of March 13th or will be sent by mail on request.

(12152) E. A. L. says: Kindly explain why hot water freezes more quickly in winter time than cold water. The writer set out two pans of water last winter, one of boiling water and the other of hydrant water, and the boiling water froze more rapidly than the other. A. The only physical difference we know between water which has been boiled and water which has not been boiled is that the former has lost its dissolved air by boiling. For this reason it may cool and freeze more quickly.

(12153) C. K. asks: In what year does the first point of Aries (I mean by that the point where the ecliptic cuts the celestial equator in spring) enter the sign of Aquarius? A. We have no star map which definitely locates the eastern limit of the constellation Aquarius, so that its distance from the present location of the first point of Aries can be determined. This distance in degrees, divided by 50.2 sec., the constant of precession, will give you the time required before the first of Aries will enter the constellation Aquarius. The answer to your question as you ask it is that the first point of Aries will never enter the sign Aquarius. Each sign occupies two hours, or 30 deg., on the sky, and they are always in the same order, moving backward together, around the sky, carrying the pole of the heavens around the pole of the ecliptic. The astronomers at the Naval Observatory, Washington, D. C., will have the data you require.

(12154) S. F. says: Will you please let me know if a small wireless outfit will work satisfactorily from the top of an ordinary dwelling, say 60 feet from the sidewalk? About two blocks distant in one direction is a large building twelve stories high, and in the neighborhood a couple of other high buildings. A. A wireless telegraph station will work very well in the city situated as you describe. Many young men are working with their friends under these conditions. The station on the top of the Waldorf-Astoria is sending many messages a day far out to sea to friends on steamers.

(12155) J. H. T. asks: Will you please explain in your notes how mathematical instrument makers fill the graduations (on a circle for instance) with the black paint, and what is the black paint used? A. A very good paint for filling the graduations of a rule or a thermometer is made by rubbing lampblack into shellac till the proper consistency is obtained. It should be thicker than for use with a brush. It is then rubbed on and in with a cloth. After the shellac has set, the excess can be taken off with a cloth wet with turpentine.

(12156) G. E. H. says: The commercial dry cell which contains the two elements, a zinc rod and a carbon stick, consists of such ingredients as powdered manganese dioxide and gas carbon and ammonia chloride. Now, what I am anxious to know is this: What chemical reactions are involved when a dry cell is in operation? What ultimate chemical changes have taken place in each ingredient when the cell is exhausted? That is to say, what new compounds have been formed in the cell? A. The chemical reactions in a dry cell are the same as in any cell in which the same materials are used. The manganese dioxide is changed to manganic oxide by giving off oxygen to unite with hydrogen to form water. The ammonium chloride is decomposed, and the resulting products are quite complicated. The ammonia is absorbed by the water till it is saturated, zinc chloride is formed. Double salts of zinc and ammonium crystallize upon the zinc. An excellent chapter on dry cells is contained in Cooper's "Primary Batteries," which we can supply for $4 postpaid.

(12157) R. P. D. says: Kindly give a process for preserving fruit for exhibition purposes. One that will not bleach, shrivel, or change the appearance is highly desired. I have tried an aqueous solution of salicylic acid and sterilized by heat, but the color was almost removed and the skins cracked. Some real estate agents want to show what can be raised in the way of fruits on irrigated lands. Would not petroleum benzine do the work? A. Try the following: fruit or vegetables are just dropped into it (cold of course) and sealed to bear transportation: Sulphurous (not sulphuric) acid, 1 part; alcohol, 1 part; water, 4 parts.

(12158) L. C. J. says: 1. Can an angle be trisected? If so, what is the rule? A. Some angles can be trisected, 90 deg. for example. All angles cannot be, and there is no rule for doing it. 2. If a horse is hitched close to the load, is it easier for him to pull than if he is hitched farther from it? If so, what is the cause? A. It is a common belief that a horse can draw a load more easily when the trace is short. The only reason we can see for it is that the horse tends to lift the front of the load slightly when hitched near the cart, and thus makes it easier to overcome the inequalities of the road. These questions have been frequently answered in our Notes and Queries.

NEW BOOKS, ETC.

THE CONQUEST OF THE AIR. By Alphonse Berget. New York: G. P. Putnam's Sons, 1909. 8vo.; 295 pp.; 100 illustrations. Price, $3.50.

This book is a popular work, which will serve to introduce the layman to the subject of aeronautics. It is divided into two parts, the first of which deals with dirigible balloons, and the second with aeroplanes and other forms of heavier-than-air flying machines. The book is interestingly written, and while it does not go into great detail, it gives the essential facts regarding airships and aeroplanes of the past and present. The first section of the book goes very thoroughly into the subject of the dirigible balloon and its history. Numerous fine half-tone cuts illustrate the work, and there are also nearly a score of diagrams for elucidating various principles.

AERIAL NAVIGATION OF TO-DAY. By Charles C. Turner. Philadelphia: J. B. Lippincott Company, 1910. 12mo.; 327 pp.; 70 illustrations and diagrams. Price, $1.50.

This is another popular book upon aeronautics. Besides mentioning and describing various of the leading dirigibles and aeroplanes, the author goes into the history of ballooning and of aviation. The principles of mechanical flight and of aerostatics are discussed, and the usefulness of flying machines and dirigibles for war and commerce is thoroughly gone over. The author recognizes that a new industry has been born and discusses its effect upon society. There are chapters upon aerial law, charts and landmarks, long-distance flying, and lessons in flight. The sensations experienced during flight and the limitations that surround it, are also mentioned. The book contains an appendix of various useful tables giving the specific gravity of woods and of gases, and the weights and properties of some of these woods; the weights of various birds in proportion to their wing area; thermometer conversion tables, and Chanute's table of lift and drift. There is also a glossary of aeronautic words and a table of French aeronautical terms and their meanings. The book will be read with interest by the beginner in the new science of aviation.

MASTER PAINTERS OF BRITAIN. By Gleeson White. New York: John Lane Company, 1909. 4to.; 390 pp. Price, $3, postage 35 cents.

The sumptuous volume before us is filled with excellent reproductions in half-tone of the best examples of the master painters of Britain. The selection is a most admirable one. British art has been both very bad and very good, and it is very easy to perpetuate the indifferent pieces. Among the notable engravings which are scattered through the book we note the following, which are particularly interesting: "The Death of the Earl of Chatham," by John S. Copley; "The Death of Nelson," by Benjamin West; "Stirling Castle," by Nasmyth; "The Inside of a Stable," by George Morland; "The Windmill," by John Crome; "The Hay Wain," by John Constable. Then follow reproductions of some of the works of Watts, Sir Noel Paton, Dante Gabriel Rossetti, and Sir John Millais. One of the works of the latter, entitled "Chill October," shows his first great landscape, which was received in 1871 with an outburst of popular appreciation and amazement that a figure painter should attempt pure landscape, for in those days the idea was very strong that a man should be a specialist, and not try to express himself in different branches of art. To give even the names of the other interesting pictures would be simply to give an index of the illustrations of the book. There is hardly a bad selection in the whole work. The engravings are admirably reproduced and the text is adequate.

TABLES OF THE PROPERTIES OF STEAM AND OTHER VAPORS, AND TEMPERATURE-ENTROPY TABLE. By Cecil H. Peabody. New York: John Wiley & Sons, 1909. 8vo.; 133 pp. Price, $1 net.

These tables for the use of students of engineering and for engineers in general were published twenty-one years ago; and now that the properties of steam have been redetermined by new and refined methods, they have been entirely recomputed, and there has been added a temperature-entropy table especially adapted to steam-turbine calculations. The certainty and precision of the new determination of the properties of both saturated and superheated steam, and the concordance of computations with the experimental data, are such that the tables may be used with confidence, and may be expected to have permanence.

OUTLINES OF CHEMISTRY WITH PRACTICAL WORK. By Henry John Horstman Fenton. First Part. Cambridge, England: University Press. New York: G. P. Putnam Sons. 8vo.; 367 pp. Price, $3.

Anything which emanates from the University Press is sure to be of the highest possible scientific value. The book before us is intended for students who have considerable knowledge of chemistry already. The author states that the subject matter indicated in the present volume has to be covered in less than two terms by candidates for the Natural Science Tripos at Cambridge. In the two succeeding terms the work is completed along the same lines. The outlines of electrochemistry, thermal chemistry, and photochemistry are briefly introduced, and subjects such as diffusion, colloids, alloys, allotropy, and isomerism are also dealt with. The periodic classification is considered at some length, and a descriptive account of the elements and their more important compounds is incorporated with this part of the subject, so far as time allows. If it should happen that the present book is found to be of assistance to students, it is the author's intention to publish this later part of the course as a second volume. From what has been said, it will be seen that it is doubtful if the work will prove of a great deal of assistance as an enlarged textbook, as our methods of teaching are somewhat different from those in vogue at English universities. The book, however, is an excellent one for those who already have a considerable knowledge of chemistry.

MODERN HOMES. Selected Examples of Dwelling Houses. Described and Illustrated by T. Raffles Davison. London: George Bell & Sons. New York: The Macmillan Company, 1909. 8vo.; 248 pp. Price, $5.25 net.

No one has seen more modern homes than Mr. Davison, and no one certainly knows better than he how to choose and present them to us. His architectural knowledge insures that the architecture is represented in such a manner as to satisfy the architect, while the artist in him insures that this shall not be emphasized at the expense of the general effect of his drawings. Here we have selected by one who knows, some of the best and most representative modern homes. Views of exteriors and interiors, stair cases, chimney corners, halls, and furniture are given, often accompanied by plans just sufficient to place them in their surroundings, and very often a sketch or two in the garden and sometimes a photograph. Drawings are accompanied by just enough letterpress to draw attention to the strong points of each design, with entire absence of any wearisome technical detail, which would be out of place in such a book. The book is beautifully illustrated and one which we can commend to all architects.

NOTES ON PRACTICAL MECHANICAL DRAWING. Written for the Use of Students. By Victor T. Wilson, M.E., and Carlos L. McMaster, M.E. Lansing, Mich.: Published by Wilson & McMaster, 1909. 8vo.; 186 pp.

This book is a collection of notes intended to furnish the basis for a course in elementary mechanical drawing, so arranged, it is thought, that the teacher may have the widest latitude in his choice of sequence of subjects. Since the first edition, two years ago, the book has been rearranged with this particular point in view. It has been thoroughly revised, and also enlarged by the addition of more explanatory matter and illustrations in autographic projection and a chapter on diametric and oblique drawing, and a number of chapters on working drawings and sketches. It is an excellent work.

THE ROMANCE OF MODERN CHEMISTRY. By James C. Phillips, D.Sc., Ph.D. Philadelphia: J. B. Lippincott & Co., 1909. 12mo.; 348 pp. Price, $1.50.

This book contains a description in nontechnical language of the diverse and wonderful ways in which chemical forces are at work, and of their manifold applications in modern life. Probably most people, when they think of chemistry, suppose that its fascination and its practical bearing can be appreciated only by those who have access to some sequestered laboratory, the doors of which are closed to the uninitiated. This is a mistaken view, for in countless ways unknown to the general reader chemical science is supplying the ordinary needs and contributing to the conveniences of modern life. In the present volume an attempt has been made to deal with this aspect of the subject, and the points of view adopted are different from those of the ordinary textbook. The book is fascinating, and it can be read with profit by almost anyone.

TABLES AND DIAGRAMS OF THE THERMAL PROPERTIES OF SATURATED AND SUPERHEATED STEAM. By Lionel S. Marks, M.M.E., and Harvey N. Davis, Ph.D. New York: Longmans, Green & Co., 1909. 8vo.; 166 pp. Price, $1 net.

The tables of the properties of saturated steam which have appeared up to the present time have all been based upon the classic investigations of Regnalt, carried out more than sixty years ago. More recent investigations are the necessary basis for any determination of the properties of superheated steam. These investigations, it is suggested, are a careful analysis of the authors, both as to the probable errors resulting from the method of experimentation, and also as to the relation of the experimental results to the values deduced from the thermodynamic theory so far as the latter shows any light on the matter. Where the results of the separate investigations are not closely in accord, a critical estimate has been made of the relative values to be given to each in the region under consideration. This work will prove of great value to mechanical engineers.

THE METALLURGY OF THE COMMON METALS. Gold, Silver, Iron, Copper, Lead, and Zinc. By Leonard S. Austin. San Francisco: Mining and Scientific Press, 1909. 8vo.; 494 pp. Price, $4.

This is a second revised and enlarged edition which is embellished by 195 illustrations. This book discusses principles, and illustrates them from current practice. It is simple and concise. It includes the data essential to an understanding of the treatment of gold, silver, copper, iron, lead, and zinc ores. It affords a broad, solid foundation to the general student of metallurgy, and complete information regarding related lines of work to the specialist in any one branch. Some of the illustrations are a revelation as to the latest metallurgical processes. It shows that it is an eminently practical book.

ONE THOUSAND FORMULAS. By L. W. Marshall. Boston: The Spatula Publishing Company. 99 pp.

This compilation gives the practical working druggist full information about the making of the most common and salable preparations, as well as about many others whose formulas it would be difficult to find elsewhere. As the formulas are very recent, it would admirably supplement older receipt books.

THE GARDEN CALENDAR FOR 1910. By Ellen P. Williams. Philadelphia: Franklin Printing Company, 1909. Price, $1.

This is a wall calendar of 365 sheets, each one of which is embellished by an appropriate quotation or some practical hint for the garden. The charm of the Garden Calendar by Miss E. P. Williams is the practical advice for every day in the year, advice coming at just the time it is needed; thus, on the very day you should spray your rose bushes to prevent the rust from forming, it tells you to do it. If you want advice as to your pansies, your peonies, your larkspur, your violets, your fruit trees, or even your vegetables, you will have it when you want it. You do not have to dig this advice out of a mass of other information of no immediate value. It will make an excellent holiday gift.

RULES FOR RECOVERING COAL MINES AFTER EXPLOSIONS AND FIRES. By W. E. Garforth, Mem. Inst. C.E., F.G.S. London and New York: D. Van Nostrand & Co., 1909. 18mo.; 71 pp. Price, $1.50 net.

The subject is a most important one, and has attracted great attention in this country as well as in England.

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PHOTOGRAPHING A STAR SPECTRUM.

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of Lake Geneva, the summer home of many of the Windy City's millionaires. On high ground to the north of the lake, the observatory presents a fine appearance with its great dome to the west and two smaller domes to the east of the buildings. Passing through the main doors, one enters a fine rotunda, and going up a flight of marble steps comes into the great dome, 90 feet in diameter, and gazes on the great telescope towering aloft. One beholds a massive iron stand supporting an immense steel tube of boiler plate sixty-two feet in length, five feet in diameter at the middle, tapering to three and a half feet at either end. At the upper end of the tube is the object glass, with a clear aperture of forty inches; at the other end the eyepiece and micrometer, for viewing and measuring the planets and stars, or these may be replaced by a camera attachment for photography, or by a spectrograph for obtaining the spectra of stars, planets, or sun. The telescope tube is so long that the eye end is about thirty feet higher when an object is viewed near the horizon, than when looking at a star directly overhead. To use such a telescope, requiring as it would a long system of ladders, would be well nigh impossible, were it not for an invention of Sir Howard Grubb in making the whole observing floor an elevator. The front page illustration shows the floor at its lowest point, while another view shows the floor raised as high as possible. At Yerkes the floor, seventy-five feet in diameter, big enough to seat six hundred people, can be raised and lowered through a distance of twenty-three feet, and thus the observer when working with the telescope may keep the floor at a convenient distance below the end of the telescope, the operating power being electricity. In the front-page illustration are shown two of the four counterweights that balance the floor. An idea of the size will be obtained by remembering that the dome is ninety feet in diameter. When the astronomer wishes to observe a particular star, it is necessary to turn the slit of the dome in the direction of the star, and hence the dome must be revolved. This is ninety feet in diameter and weighs one hundred and forty tons, but again by the aid of electric motors it can be rotated at will by turning on the electric current from the rising floor.

Turning to the telescope, we find a machine of fifty-three tons in weight, wherein the movable parts weigh twenty tons. This weight the astronomer has to put in motion when he turns the telescope, yet ball bearings and the refinements of modern engineering permit him to move the great machine, using only his own physical strength. For quickly turning the telescope, electric motors are used. The telescope is set up by what is known technically as the equatorial mounting, one axis, the polar axis, in the meridian parallel to the earth's axis of rotation, the other, the declination axis, at right angles to it. Circles on these two axes give the astronomer the means of locating the star by its hour angle and declination. When the star is once in the field of the telescope, it is kept there by a clockwork mechanism driving the telescope about the polar axis at a speed exactly equal and opposite to the earth's rotation. The writer of this article has used the telescope when the thermometer stood at 26 deg. below zero Fahrenheit, and yet at this temperature the mechanism worked to perfection, which speaks wonders for the excellence of this mounting made by the well-known firm of Warner & Swasey. Indeed the professional astronomer has a hard life of it, which requires a great amount of physical endurance. In the summer nights when the temperature renders life comfortable, the nights are short, the astronomer might then be permitted to join a labor union; for he can

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ITALY.—Important technical office, having widest connection in Italy, is prepared to treat with a first-class Machine-manufacturing firm. For full information and particulars, write to Ing. Michele S. Foa, Turin (Italy), Corso Oporto 31bis.

Inquiry No. 8987.—Wanted, the manufacturers of the Van Winkle Woods & Sons, and the Weber power meters.

EDUCATIONAL.

CIVIL SERVICE EMPLOYEES are paid well for easy work; examinations of all kinds soon; expert advice, sample questions and Booklet 40 describing positions and telling easiest and quickest way to secure them free. Washington Civil Service School, Washington, D. C.

Inquiry No. 8990.—For information regarding shoes not made of leather but similar to the same and are as durable.

PATENTS FOR SALE.

PATENT FOR SALE.—Something New, Automobile Automatic Drop Brake. For further particulars, address Box 45, W. Enfield, Maine.

Inquiry No. 8996.—Wanted addresses of manufacturers of machinery for working orange wood manicure sticks.

FOR SALE.—States' rights or outright, Patent 937,891 for Safety Gas Hose Connection. Instantly and absolutely seals hose on detachment from stove. Can't suicide by Safety Hose. Dennis Tangney, 213 So. 6th St., Philadelphia, Pa.

Inquiry No. 9014.—For manufacturers of machinery, supplies, etc., to equip a small plant for the manufacture of iridium-tipped gold nib making for fountain pens.

FOR SALE.

FOR SALE.—Engine lathe, swings 9½ in., takes 25 in. between centers. Complete with full set change gears to cut all size threads, 3 to 40 in. Price only $43.50. Address L. F. Grammes & Sons, Allentown, Pa.

Inquiry No. 9016.—Wanted, machinery necessary for an installation of a plant for refining salt by a modification of the Bessemer process.

WANTED.

WANTED TO BUY Water Cooled Stationary Gasoline Engines, from 1 to 10 h. p. from manufacturers of same willing to furnish under our own name, in carload lots, or large quantities, for cash. Manufacturers state full particulars to Water Works, Box 773, New York.

Inquiry No. 9023.—Wanted, to buy silk machines from re-reeling, twisting, doubling, to the final process of making it into clothes.

LISTS OF MANUFACTURERS.

COMPLETE LISTS of manufacturers in all lines supplied at short notice at moderate rates. Small and special lists compiled to order at various prices. Estimates should be obtained in advance. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9025.—Wanted, address of rubber manufacturers in Germany.

A LIST OF 1,500 mining and consulting engineers on cards. A very valuable list for circularizing, etc. Price $15.00. Address Munn & Co., Inc., List Department, Box 773, New York.

Inquiry No. 9029.—Wanted, catalogues and all information on machinery for braiding straw in manufacturing straw hats.

Inquiry No. 9034.—For manufacturers of machinery that could reduce stumps to kindling wood.

Inquiry No. 9036.—Wanted, the address of the manufacturers of "Cycle Ball Bearing Suspenders."

Inquiry No. 9038.—Wanted, the address of the Chipman Electric Purifying Co.

Inquiry No. 9042.—Wanted the address of Farney Safety Razor Co.

Inquiry No. 9044.—Wanted to buy outfits necessary for agate polishing.

Inquiry No. 9046.—Wanted, machinery used for the manufacture of all kinds of fruit boxes, baskets and crates.

Inquiry No. 9048.—Wanted, address of manufacturers of metal table slides for extension tables.

Inquiry No. 9049.—Wanted, to buy rotary brushes suitable for a shoe shining machine.

Inquiry No. 9052.—Wanted, to buy machinery, etc., for a beer plant, that manufactures beer by means of glucose.

Inquiry No. 9053.—Wanted, address of firms who install plants to manufacture nitrogen.

Inquiry No. 9054.—Wanted, address of manufacturers of articles made from mica.

Inquiry No. 9055.—Wanted, address of parties interested in Log Cleaning Machines.

Inquiry No. 9056.—For manufacturers of window shades.

Inquiry No. 9057.—For manufacturers of glass and china balls, used as fixtures or ornaments on lightning rod equipment, also weather vanes for same purpose.

Inquiry No. 9058.—Wanted, firms who make machinery used for pulverizing soap-stone.

Inquiry No. 9059.—For manufacturers of flexible steel chain mail.

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work but eight hours. But he would be obliged to resign from the union in the winter time; for observing starts at five in the evening and continues till seven the next morning, fourteen hours without a break. And how pleasant this is with the thermometer twenty-six degrees below zero! It needs quite a deal of enthusiasm to keep one from freezing to death!

To photograph the spectrum of a star, a spectroscope or rather spectrograph is attached to the eye end of the telescope. The object glass focuses the star's light on a fine slip not more than one hundredth of an inch in width and one-eighth of an inch in length. After the light passes through this slit it passes through the collimating telescope, then through the prism or prisms which break the star's light up into its component colors or spectrum, then through the camera lens and is finally brought to a focus on the photographic plate where is obtained a photograph of the star's spectrum. Much careful thought and many refinements were necessary before the spectroscope was brought to its present great degree of precision. To mention a few of them. How is it possible to keep the great telescope tube so accurately directed to the star that its light is focused on the center of the slit one-hundredth of an inch wide, for if the light does not pass through the slit it will not fall on the photographic plate. This was made possible by making the slit jaws of polished silver, and watching the stray light reflected from the silver jaws by combining prisms and lenses in a rather curious fashion. The observer keeps his eye at an eyepiece where he can see the star image on the slit, and causes the star image to remain centered there by using the slow motions of the telescope. The exposure necessary to make a photograph depends on the brightness of the star and may last from a few minutes to two, three, or five hours, or in some few cases to eight or ten hours. During this long exposure the temperature has probably fallen a number of degrees, and the instrument has been affected by all its parts contracting. This might result in a change in the prisms with the consequence that the photographed spectrum will not be sharp and in as good definition as it might be. To overcome these difficulties, the whole spectrograph was inclosed in a tight aluminium case lined with glass work so as to be non-conducting. Fine wires were placed inside this case. While the exposure was being made a thermometer inside the case was watched through a glass window, and if the temperature dropped, a current of electricity was turned through the wires inside the case, and kept turned on till the proper temperature was reached. Within the past year a thermostat has been introduced and the temperature is automatically kept constant. And hence while the exposure is being made the spectrograph is kept at a constant temperature, there is no change in its several parts and a sharply-defined spectrum will result. A wonderfully accurate instrument this makes leading to results of the highest degree of precision.

AN AERIAL PASSENGER RAILWAY.

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haulage. From the haulage cable, which is one and one-half inches in diameter, the buckets are suspended, their entire weight being sustained by two steel four-inch flanged wheels running over the stationary cable.

These buckets are constructed of heavy wrought iron, six feet long and four wide, with a door opening on the right side, which door is securely bolted when the bucket is *en route*. There are twenty-six buckets on the line, carried by the haul-

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age cable, spaced at equal distances of 485 feet apart. These buckets are held to the runners by a one-half by two-inch steel frame, allowing it to swing freely on an axle between the flanged wheels. The seating capacity of each bucket is four.

In the entire distance there are fifty towers, built of eight by eight timbers, most of which were cut within a mile of the road. Over these towers run the cables. The stationary cable is the higher one, the haulage cable being two feet below and carried midway in the frame that supports the buckets. This haulage cable is endless, winding about a huge drum at either terminal. The towers are not placed an equal distance apart, but according to the slope and the contour of the ground. On the longer stretches they are frequently two hundred feet between, while at the base and summit they are within a few feet of one another. Perhaps the best example of the entire simple working plan may be found in the large stores of a city, where package carriers are in use. The little wire baskets that carry your purchases from the clerk to the wrapper are in miniature duplicates of these huge, man-carrying buckets, save where the former are operated by springs, the latter are moved by electric power.

The entire distance covered, from base to summit, is one and one-half miles, and in traveling this you are raised from nine thousand feet at Silver Plume to something greater than twelve thousand five hundred feet at the summit. This is, approximately, one foot lift for every two feet covered. In order to attain the same elevation, any road in the world—Pike's Peak cog road a possible exception—would have to traverse several times the distance. The time is thirty minutes each way.

The motive power is electric, the current being transmitted from Georgetown, four miles distant. Two motors are used, both of thirty-five horse-power each, and both located at the upper terminal. One motor is sufficient to operate the endless cables on an average haul, but on other occasions, where the buckets are filled, both are thrown in.

The entire road is equipped with electric signals and telephones. In its length are five stations, built about the towers, each with its watchman. The slightest accident is promptly telephoned to the engineer, and the buckets stopped.

The plans were first drawn up late in 1905, and the construction commenced the year following. It was not until the summer of 1908, however, that the road was in full running order. The total cost was slightly in excess of $70,000.

A MACHINE FOR SIMULTANEOUSLY FIRING MANY BLASTS.

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by the shaft. When the switch is thrown to the lower contact, the fuse circuit receives the whole current from the electric generator.

All of the fuses are melted instantly by the heavy rush of current accentuated by the inductive kick of the coil, thus producing a simultaneous firing of all the charges of explosives used. In deepening the river at Sault Ste. Marie for the United States government, the contracting firm used three similar machines, but larger and more powerful, operated by compressed-air engines. These machines were perfectly automatic and unfailing in operation. In all cases the fuses were arranged in parallel circuit between the two mains of the dynamos, the pressure being 12 volts. It is stated that these devices operated so simply that it required only the opening of an air valve to fire three hundred charges of dynamite at one time.

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A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since 1863, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.