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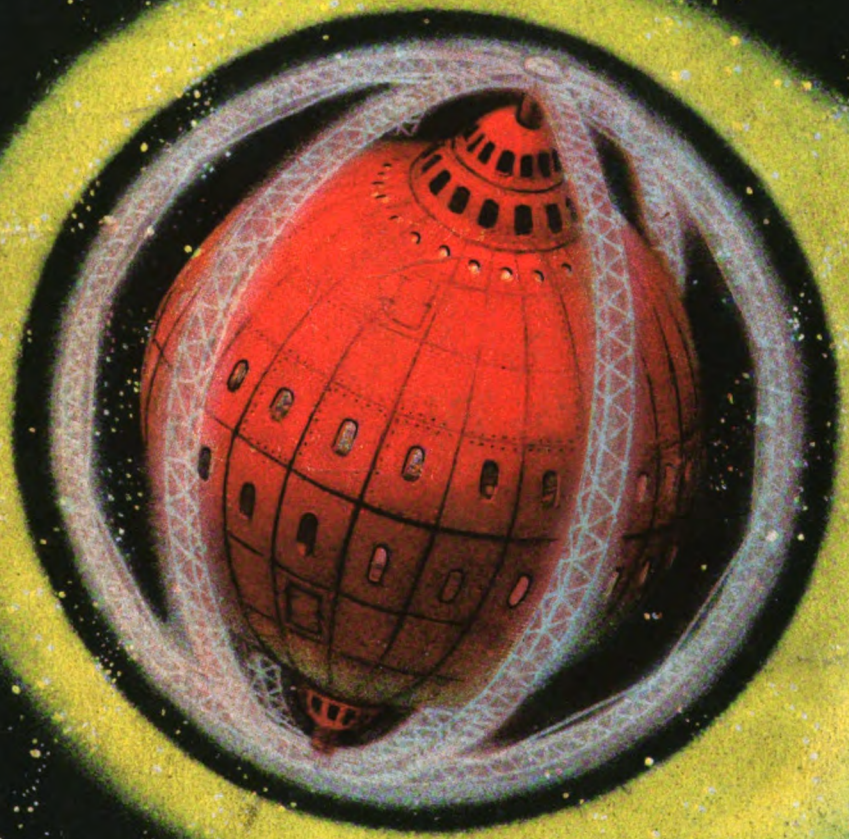
See Page 1290



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Vol. VIII
Whole No. 96

Science and Invention

FORMERLY
ELECTRICAL EXPERIMENTER
233 FULTON STREET-NEW YORK

April, 1921
No. 12

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Scientific Paradoxes

THE more we learn, the less we know—is a true saying, particularly true today. Every new discovery, every new fact opens new labyrinths to our knowledge, without end to the number to be entered in the future. Take for instance light and heat, i. e., radiant energy as originated in our sun. When on a hot summer's day we sit in a broiling sun, out steps an aviator from his airplane. He is swathed in furs and wears an electrically heated suit. His face and fingers are not thawed out yet, due to the terrific cold he experienced only four miles above your head, ten minutes ago. Your thermometer registered 120 degrees in the sun, his 30 degrees below zero in the same sun! And he was actually four miles nearer to the sun than you. Of course science tells us the reason for this paradox. The dense atmosphere charged with watery vapor and perhaps with clouds near the earth, along with the solid and liquid matter of the earth's surface, easily retains and accumulates the heat received from the sun's rays. But four miles up the air is very rarefied and very diathermic, and the heat is no longer retained but passes through to mother earth with little effects on the thin atmosphere. Heat and the earth's atmosphere in this instance act analogously to water and a sponge. Water (heat) is eagerly absorbed by the sponge (atmosphere) and is retained by the latter. Now take the same size sponge which has big holes all thru it (rarefied atmosphere). It is evident that such a sponge cannot retain as much water as a perfect one. The more water you pour in it, the quicker it runs out.

But let us go a bit further. We actually know that all heavenly bodies gravitate in a perfect vacuum. Thus we know that if we were to rise only 500 miles above the surface of the earth, we would find ourselves in an absolute vacuum. We furthermore know that out in space the temperature in this vacuum is −459.4 degrees, i. e., absolute zero. We can also demonstrate by experiment that heat cannot be propagated in a vacuum by conduction or by convection. An ordinary thermos bottle readily proves this. Fill the latter with boiling water, and the outside will stay cold, due to the vacuum separating the inside and the outside of the bottle.

The case of the sun and the earth is analogous. Heat proper cannot flow between these bodies immersed in a perfect vacuum and besides separated some 92 million miles. So we see that we *do not* and cannot receive radiant heat rays from the sun.

Paradoxically enough we know for sure that we get heat *somehow* in spite of our logic. How? Scientists have a vague notion about it, but they are not too sure. They now think that when the ether waves, devoid of all temperature coming from the sun at a speed of 186,000 miles a second strike our dense atmosphere, the terrific impact results in heat; it is analogous to a meteor, which at a temperature of absolute zero, striking our atmosphere, goes up in metal vapor, due to the enormous friction set up. So we see that after all we do not get heat from the sun at all, merely ether waves, which by shock or impact are turned into heat.

Another paradox not so readily explained is the revolution of the earth around the sun. The earth with the sun at its center swings around the latter at the frightful speed of over 65,000 miles an hour. One would think that the titanic centrifugal force set up would make the earth fly off its orbit into infinite space. It can even be calculated that in order to keep the earth from being whipt off we would require a steel cable fastened to it and reaching to the sun. The thickness of this cable would have to be almost as great as the diameter of the earth! But there is no cable as we know and the earth does not fly out of its orbit. We talk merrily about mutual gravitation holding the earth to its course, but there are many objections, logical and otherwise. The plain truth is, we don't know.

H. GERNSBACK.

CONTENTS FOR APRIL, 1921

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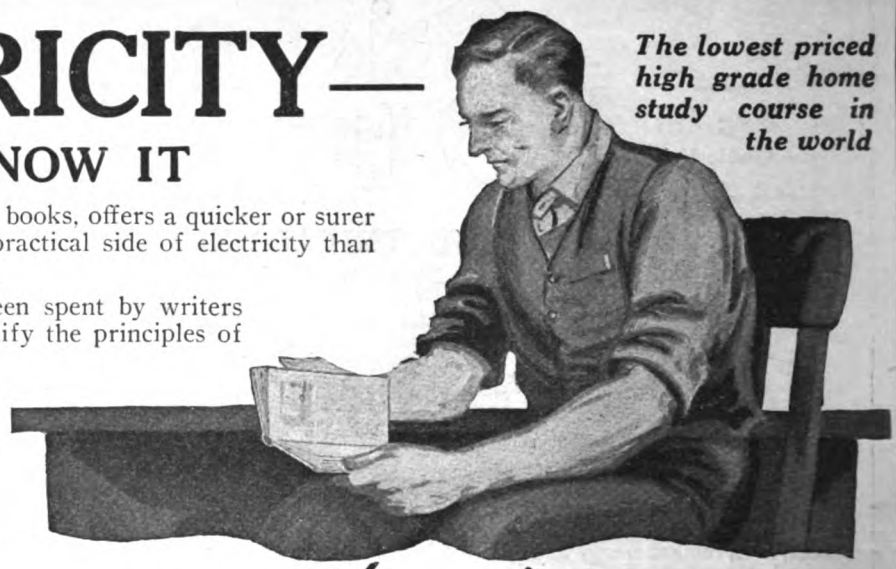

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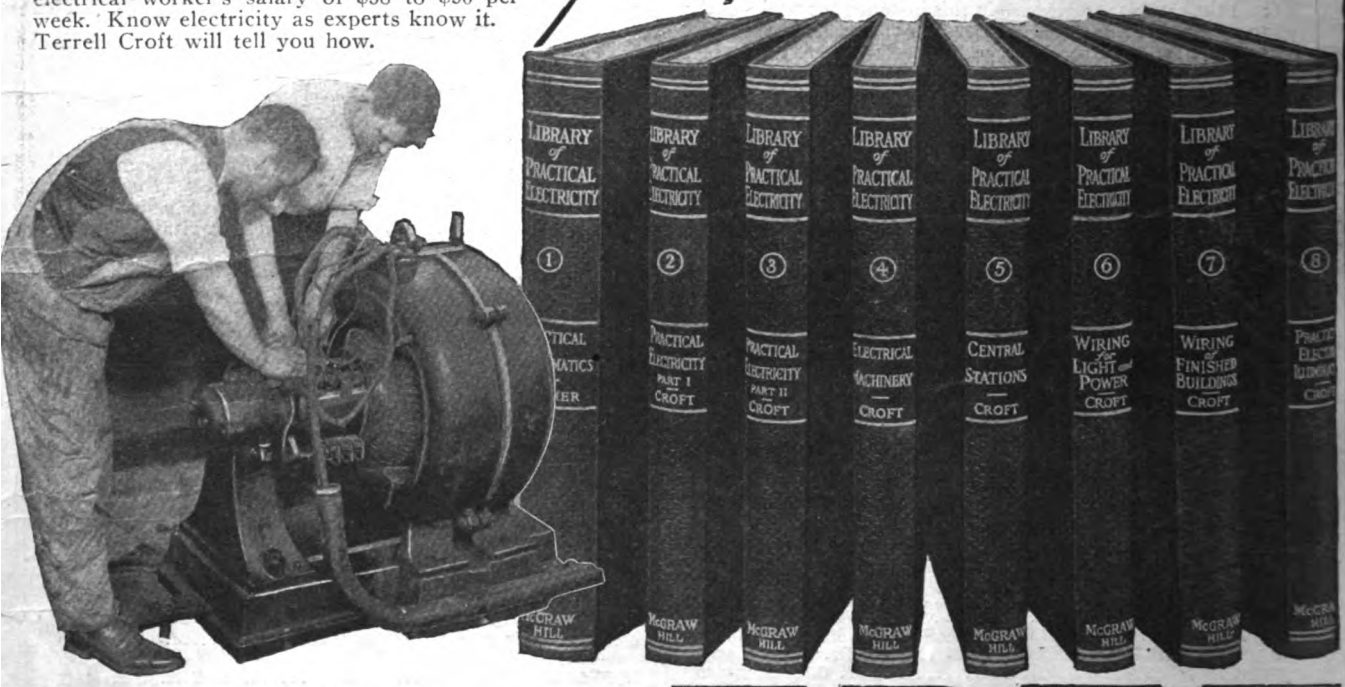

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Whole No. 96

Science and Invention

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T. O'CONOR SLOANE, Ph.D.,-ASSOCIATE EDITOR

APRIL
1921
No. 12

200-Mile-Per-Hour Air-Propelled Railway

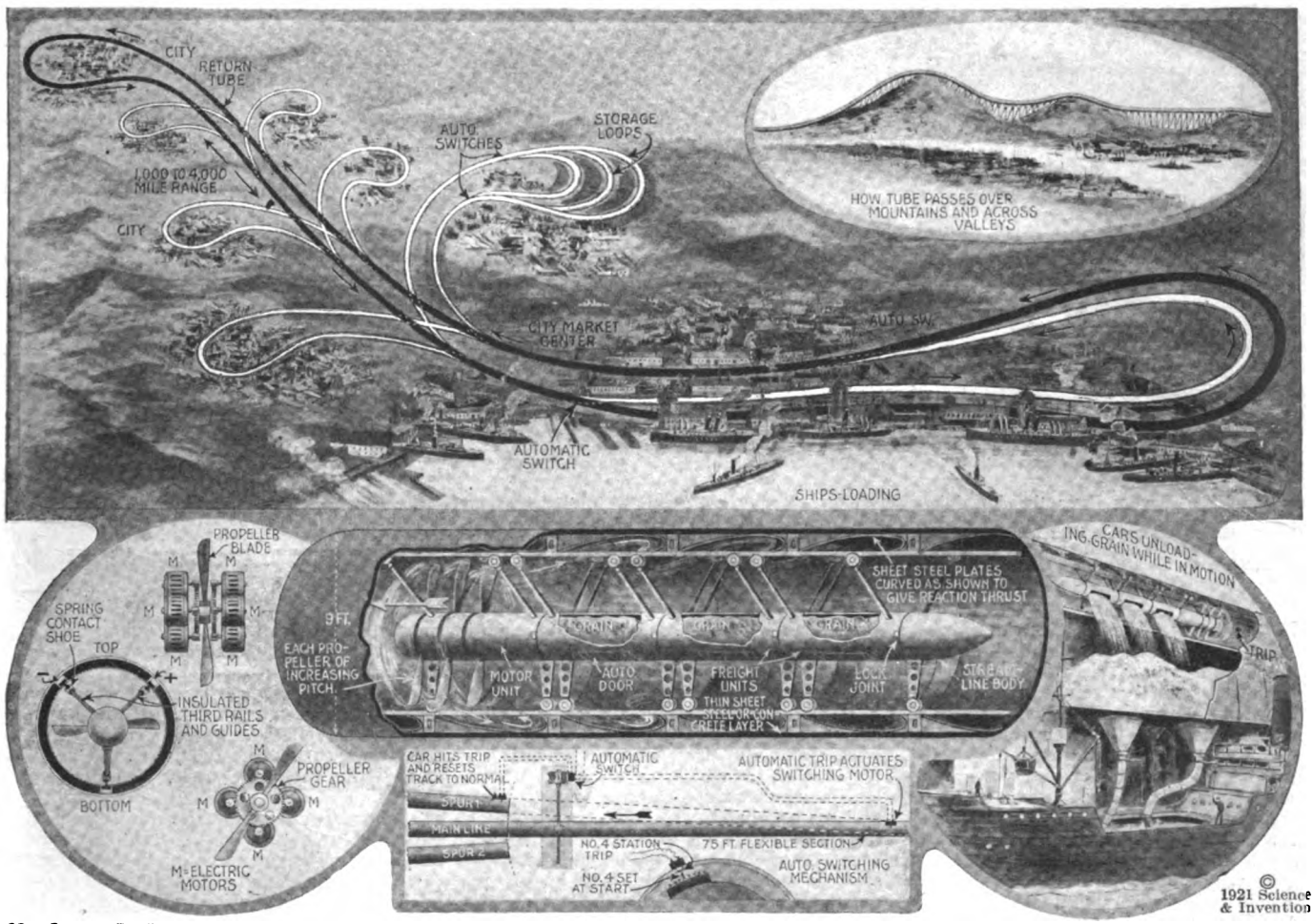
SEVERAL years ago, a Russian engineer and genius who was visiting the United States, proposed a remarkable scheme for carrying passengers as well as freight, mail and other matter thru a tubular railway system at velocities of 200 miles an hour and more, but the principal disadvantage of his system was that it was supposed to operate by a vacuum, i.e., the tubes were to be exhausted of air. Such a system as this would seem to our practical minded engineers, as being really too elaborate both from the operating as well as the constructional cost point of view.

An American inventor, Lester P. Barlow, who devised many ingenious devices successfully applied in the World War, and which helped the Allies to conquer the power of the Teutonic forces, has come forward with what appears to be a very clever invention for carrying mail and other material between different sections of the largest cities as well as between such cities as New York, Chicago, New Orleans, St. Louis, Philadelphia, etc.

In a few words, what Mr. Barlow intends to do, is to provide a steel tube, which need not be air-tight, and thru which a series of carriers or cars will shoot along at a speed of 200 miles or more per hour, being forced thru the tube at this high velocity by means of an aerial propeller or a series of three such propellers, mounted a short distance apart on the forward end of the engine unit of the train as shown.

These propellers are driven by electric motors, the motors receiving their electrical energy thru two insulated power rails as shown in the diagram in the accompanying illustration. The bottom rail is the main carrier member and takes the

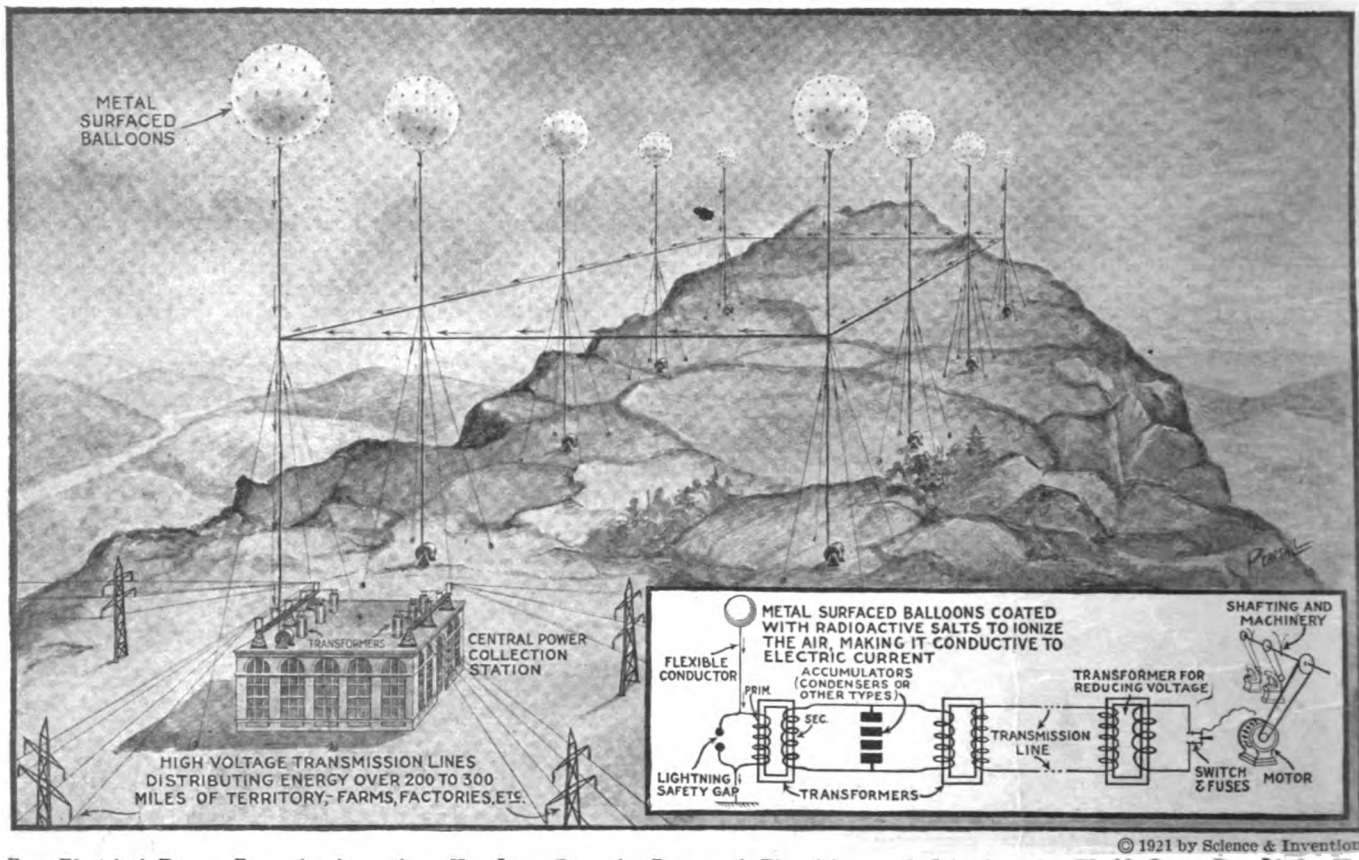
(*Continued on page* 1340)



Mr. Lester P. Barlow An American Inventor, Who Developed Valuable Ideas Which Were Used by the Allied Military and Naval Powers During the World War, Has Turned His Talents Towards Peace-Time Uses, and Here Suggests a Remarkable Air-Propelled Railway, the Cars of Which Are to Be Propelled by Air Screws Similar to Those of Airplanes, At a Speed of 200 Miles An Hour or Greater. The View At the Top of the Illustration Shows How the Light Steel Tube Might, for Example, Connect the Principal Cities Along the Mississippi Valley From Chicago to New Orleans, Enabling Grain and Other Commodities to Be Automatically Transported Between Cities or Between the Great Lake Ports At the North and the Famous Gulf Port At the South With a Maximum of Speed and a Minimum of Labor. As the Detailed Drawings Show, the Cars Are Much Smaller Than the Tube So As to Provide Space for the Air Currents. The Cars Are Propelled by Electric Motors, the Current Being Fed to These Motors by Two Insulated Rails and Suitable Contact Shoes. Mr. Barlow Has Worked Out Details Whereby the Cars or Carriers Can Discharge Their Cargoes, While They Are Still in Motion, As Shown At the Left.

ıectric Power From the Air

THE utilization of free electrical energy in the atmosphere surrounding our earth, has proven the magic goal towards which inventors have striven for several generations; but until recently there has been practically no headway made toward reaching the desired result—the obtaining of power from the air for economic uses. putting to work this free energy of the atmosphere. It is said that he has successfully demonstrated that if we send up metal-surfaced balloons or other surfaces and tap the atmospheric electrical energy, at elevations in excess of 1,000 feet, we shall be able to realize an average of 200 horse-power per square meter, which area is equivalent to 10.8 square feet. It is winter weather, the potential gradient often rises to as high as 300 volts per meter. This may seem somewhat hazy and in fact almost impossible of belief to the average person, and there are two reasons why we do not notice this startling difference of potential for every meter increase as we are elevated. One of these is that the electrical energy is



Free Electrical Energy From the Atmosphere Has Long Been the Dream of Electricians and Scientists the World Over, But Little Has Been Done Up Until the Present Time in Trying to Adapt the Tremendous Quantities of Free Electrical Energy Existing in the Atmosphere to the Everyday Utilitarian Requirements of Mankind. The Present Article Deals With Some Recent Experiments Carried Out by Dr. Plauson, a German Engineer, Which Have Shown Some Very Interesting Results. It Is Said That This Scientist Has Successfully Demonstrated, That If We Send Up Metal-Surfaced Balloons and Tap the Electrical Energy From the Atmosphere At a Level of 1000 Feet or More, We Shall Be Able to Realize an Average of 200 H. P. Per Square Meter, an Area Equivalent to 10.8 Square Feet.

In the early days of electric lighting, that is, back in the 70's and 80's, there were a number of scientific experiments carried out which received a great deal of publicity at the time, and whose recitals described how in the immediate future we would undoubtedly obtain our electrical energy for lighting and power purposes, from the atmosphere. But, as aforementioned, there has been practically nothing done in this direction until the present time, and there is a very good reason why but little has been done by scientific investigators and electricians in endeavoring to harness the natural electrical forces of nature, as resident in the atmosphere, for the everyday utilitarian requirements of mankind. This reason lies in the fact that the electrical power of nature, particularly when so-called thunder or electric storms hover above us, are not to be trifled with.

Recently there have appeared in a German publication, some notes on the new discoveries and experiments of a German scientist residing at Hamburg,—one named Plauson. Plauson has studied the subject of atmospheric electricity and its utilization for many years, and he has recently come forward with a clever scheme for even claimed that in his latest experiments, as great a quantity of electrical energy as 400 to 500 horse-power has been realized per square meter.

The atmosphere or air above the earth's surface, in normal weather, is charged with electricity, thus constituting an electrostatic field which is almost uniform and in which the surfaces of equal potential are parallel to the earth, or in which the lines of force are vertical. In the event of violent atmospheric disturbances such as before or after, and of course, during the course of electric storms, the atmospheric potential fluctuates and changes in polarity very markedly, as careful scientific investigation and measurements carried out in various parts of the world, have demonstrated.

Under normal weather and atmospheric conditions, the potential gradient, as it is called, of the atmosphere increases with comparative regularity as we rise above the surface of the ground. The atmospheric potential per foot or meter of altitude varies also, as may be well imagined, with the season of the year, and this potential or voltage has been found to average 100 volts per meter (3.28 feet) in the summer months, while during the cold mostly in the form of high voltage static electricity, but of small quantity, similar to that given off from large static machines. If you have ever stood under the discharge terminal of one of these machines and felt the *electric breeze* which sometimes causes the hair to stand vertically from the head owing to the very high voltage (but relatively small amperage or current present), the emf., of which may easily have been several hundred thousand volts, you were given a practical demonstration of how the atmosphere may be highly charged electrically and yet be unnoticed by the usual organs of sense.

Another reason why we know nothing of this increase in potential with elevation is that the experimenters usually do not have the proper instruments with which to measure the atmospheric potential, and therefore often lose sight of the fact that in the winter, for example, we may have present an emf. of 100 volts per foot. These high potentials, owing to their static nature, are measured by a very delicate electro-static voltmeter. Those interested in this phase of atmospheric electricity will find descriptions of the apparatus used, as well as results and meas-

(*Continued on page* 1343)

Lifting Stunts for Your Parlor

Some Interesting Paradoxes in Everyday Physics Including the "Johnny Coulon Lift" and Why Miss Annie Abbott, the "Georgia Magnet," Cannot be Lifted

FOR several months a young American athlete and pugilist, one Johnny Coulon, has been interesting the French public with his remarkable demonstrations of a seemingly mysterious magnetic or other power, which, call it whatever you like, has effectually prevented the strongest men in Europe from lifting his 110-pound body from the floor.

There are a number of interesting and striking preliminary experiments in physics, which, if you have not already tried them out, will provide suitable entertainment for your friends. With the aid of the accompanying illustration, we will attempt to elucidate some interesting preliminary "stunts," before taking up the methods whereby Miss Annie Abbott, the "Georgia Magnet," Johnny Coulon, and others have defied a single man or a group of them, to lift the performer from the ground.

Fig. 1 in the illustration herewith, shows a simple experiment which will prove quite surprising even when performed with a child. It is usually more effective when performed with the aid of a young woman; the lady placing either one or both of her hands firmly on top of her head as shown. You will find that it is practically impossible in most cases to lift a single hand from the head, or if both hands are clasped together with the fingers closely locked and held firmly down on the head, the entire body can be lifted by pushing upward under the arms at the wrists, but rarely is it possible to push the hands upward from the head.

The second experiment is illustrated at Fig. 2. A woman is best selected as the subject, and it doesn't matter whether she is particularly athletic and strong or not. The results will usually prove sufficiently surprising, regardless of this factor. If the subject places her hands firmly against her chest with the finger tips just touching, it will require a strong man to pull the hands apart; if the lady's wrists are grasped firmly an attempt to pull the hands apart is futile. One attempting to separate the lady's hands must not stand sidewise or attempt to jerk the hands, but he must exert a steady pull, at arm's length or with the arms bent so as to improve the leverage, which will give a greater resultant pull.

A simple little experiment to demonstrate the great power of the female of the species over the male, and one which will nonplus any athlete is illustrated at Fig. 3. If the man (it doesn't matter how big or muscular he may be) doubles up his fists and places one over the other, you will be surprised to find that even a young boy or girl can, by simply snapping one finger of either hand against each of the two fists, separate them every time. And more paradoxical still, the harder the "strong man" attempts to hold his fists together, the more easily are they separated.

LIFTING THE HUMAN BODY WITH FIVE FINGERS.

What is known as the *five finger lift* is illustrated at Fig. 4, and this provides considerable fun and scientific entertainment for parlor and club gatherings. If it is desired to put the experiment on with sure-fire success, the manager of this little act should take precautions to have his committee of four men lift the subject, picking out preferably a lady weighing about 130 to 140 pounds. If good muscular men are selected for the committee, which can usually be arranged, a woman weighing 150 to 200 pounds can be lifted with ease. The editors have tried this experiment successfully many times and with four men of the average muscular development, succeeded in thus lifting easily a 140-pound woman.

(*Continued on page* 1352)

A Number of Scientific Parlor Stunts Are Illustrated Above. First We Have a Few Simple Hand and Finger Tricks, Winding Up With the "Georgia Magnet" and "Johnny Coulon" Lifting Stunts, Which Will Surprise You, Once You Have Tried Them.

Typewriting and Stenographic Machines for the Blind

Translated from the French by Prof. T. O'Conor Sloane, Ph. D., LL. D.

WE are indebted for this article to M. Jacques Boyer, already well known to our readers as one of the leading scientific writers of France, and to whom we have already been indebted for interesting material for our columns. The recent introduction of several stenographic writing machines for the blind, notably those by Prof. Villey and Lieut. Muller, was the origin of this article, these machines enabling the blind to produce in relief-characters at stenographic speed, the reports of a lecture or of dictation as quickly as the regular stenographer, but it is quite interesting before going into the description of these machines, to trace the origin of what are called dactylographs for the blind. This is the technical name for a typewriting machine.

Going back to the 16th century, in Spain and in Italy the idea was formed of engraving letters in intaglio on wooden surfaces, to be used in printing for the blind. In 1640 a writing teacher of Paris, Pierre Moreau, made metallic types for the same purpose, but he obtained no success in his enterprise. So it is fair to say that the production of books with characters in relief goes back to the days of Valentin Haüy, a famous French inventor and student. The famous English blind mathematician, Nicholas Sannderson (1682-1739) invented an apparatus which permitted him to do mathematical operations of very complicated order, by the sense of touch. He used a tablet pierced with holes, receiving pegs of various sizes, whose value was determined by the place they occupied on the tablet, so that he was able to do the most varied kinds of calculations.

Shortly after his day, Mlle. Salignac and du Puiseaux, the latter a blind man, used relief characters for reading. Then the German, Weissenbourg, stricken with blindness at the age of seven years, produced relief maps for the blind. This goes back to the days of the celebrated Valentin Haüy. He retained the ordinary letters, putting them in relief, to be read by touch. He taught a special writing to his pupils, and had a special type cast for his books.

The effect of all this is well exprest in the words of Prof. Villey: "They spoke to the fingers, with the language of the eye." This is claimed to mark a psychological error and this error seems to be eradicated, if for the lines composing ordinary letters definite arrangements of points are substituted.

It is possible to keep the number of points used for each letter, quite restricted, and the origin of this system goes back to Charles Barbier, in 1821, but later Louis Braille, born in Lagny in 1809, blind himself, developed his famous alphabet, sometimes called "anaglyphic"; for a letter he used a maximum of six points, three high and two wide, and out of these he obtained 63 combinations. The Braille system is now universally adopted. The beauty of this system is, that it not only enables quick reading to be done, but by the use of a writing tablet, the blind can write it with a stylus, as easily as the more fortunate seeing people can write with a pen or pencil.

Braille's next effort was to produce a point writing which could be read by eye as well as by touch, putting the blind in direct communication with those who see and while this was a slower writing, gave the inspiration to the work of the celebrated blind investigator, Foucau He was blind from the age of six ye and he invented the machine termed th *raphigraph*,—the first writing machine f the blind. This goes back nearly to 184 In 1850 the same inventor developed a other machine for printing which pr duces each character by a single blo The apparatus was rather bulky, havin 60 keys; only two such machines we ever constructed, altho the operator r ceived a gold medal at the Lond World's Fair of 1851. In 1855, an Itali lawyer, Ravizza, produced a machin which, operated from a keyboard, em ployed a set of type-arms arranged in circle. This is suggestive of the ear typewriters, and we find that in 185 Mr. A. E. Beach, editor and one of th proprietors of the "Scientific American

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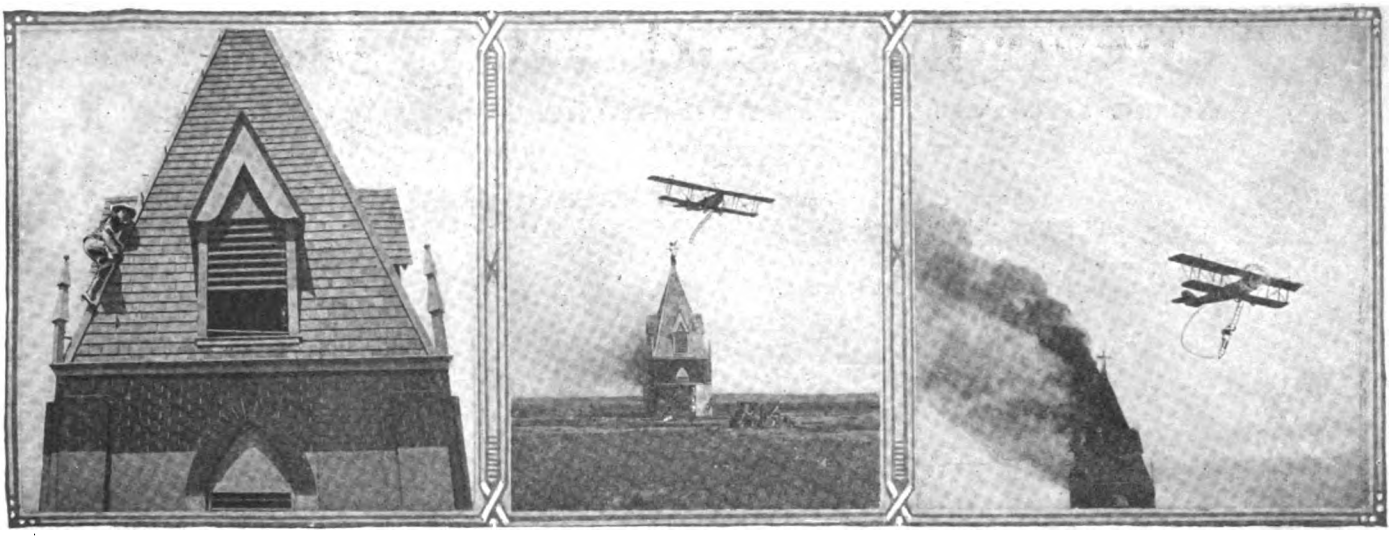


Miss Jean Paige Climbing Church Steeple. The "Church" Ablaze—But an Airplane—Aha! Saves the Heroine With a Rope Ladder

Airplane Rescue in the "Movies"

NOT all moving pictures of thrilling scenes are "faked," as can readily be seen by the photographs showing in detail the aerial rescue here portrayed from a new Vitagraph serial, *Hidden Dangers*, in which Joe Ryan and Jean Paige co-star.

The action came very near terminating in a casualty. Jean Paige, a pretty little actress, was assisted to the top of a church steeple by means of pegs driven in the side, which were removed when she had climbed the spire. There, clinging to the cross, she awaited the onslaught of the flames which were by this time leaping upward toward her.

The church had just been set afire by some diabolical fiends who thought that the fire, added to her precarious position, would now make things "hot" for her, but her hero was on the job at a nearby flying station, tuning up his plane. When word was received at the air station of what was going on some few miles away, he started off post haste to the rescue.

Sighting the heroine and speeding up so that the flames would not set fire to any part of the wing structure or to his gasoline tank, he circled the church steeple while Jean Paige reached for the rope ladder hanging from the fuselage. She mist the bottom rung and was nearly thrown from her lofty perch, while the airplane circled again in another attempt to rescue her from the flaming steeple.

Things were now rather uncomfortable as the lower part of the steeple burst into a vivid roar of flame. The airplane ladder neared her again, and she took a chance. By sheer luck she held tightly to the ladder, and was whisked off at a 60-mile clip, which, is a very high speed to leap into from a stationary position.

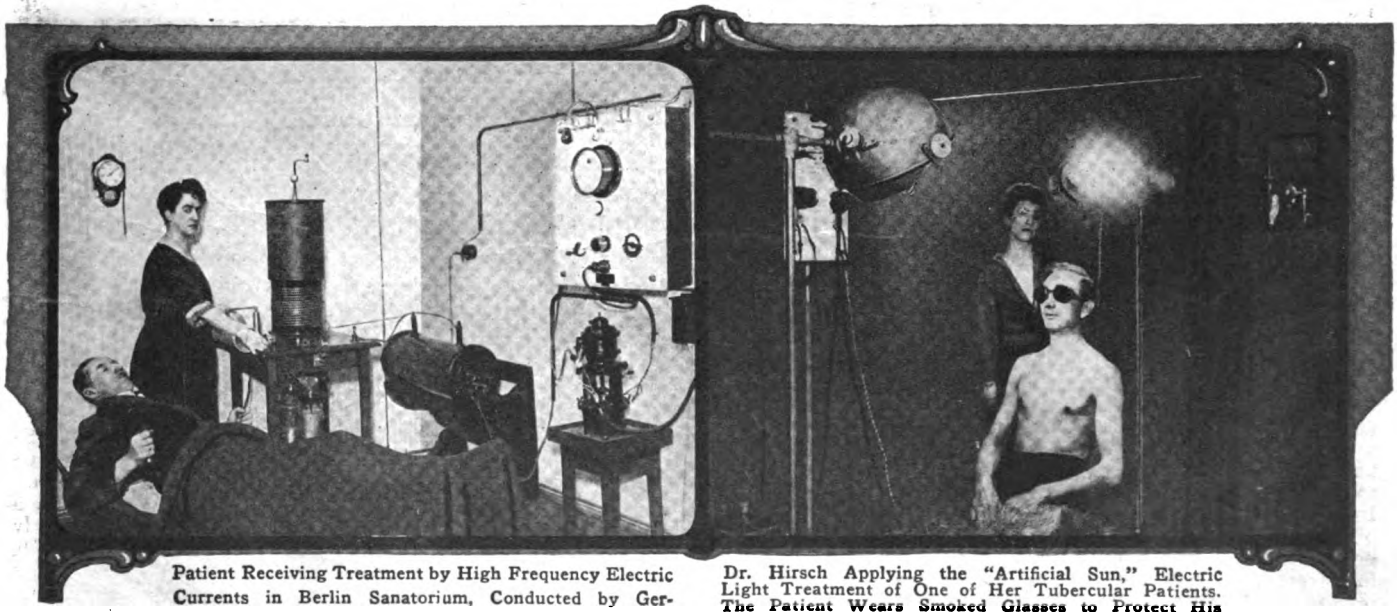
After the scene had been perfected, the aviator congratulated Miss Paige on her wonderful work, and we believe that she was well deserving of such praise. None of these scenes, however, were taken in the studio and the action portrayed is nothing short of miraculous.—*Photos Courtesy Vitagraph Films.*

Woman Doctor Cures by Electricity

THE accompanying photographs show two views of the latest electrical treatment sanatorium located in Berlin, which is presided over by Germany's foremost woman physician, Prof. R. Hirsch. This new electrical hospital has installed multiple sets of X-ray and high-frequency apparatus for the treatment of nervousness and the multifarious other ills which human flesh is heir to, and some idea of the size of this powerful equipment can be judged from the accompanying photographs.

Dr. Hirsch is a great believer in the treatment of diseases by electricity and massage instead of medicines, and in this part particularly, she is seconded by many eminent medical experts all over the world today. Prof. Hirsch has traveled in practically all of the countries of the world in search of the most powerful and the newest electric appliances with which to fit up her institution, which is said to be the finest of its kind to be found anywhere. One of the accompanying photographs shows Dr. Hirsch applying a high power apparatus to a patient suffering from rheumatism, while the second view shows the Doctor using the new high-powered electrically illuminated *artificial sun* in the treatment of a tubercular patient.

As will be noted, the patient wears dark, smoked glasses over the eyes to protect them from the intense brilliancy and heating effect of the rays produced by these lamps. The powerful light and heat rays are generated by mercury vapor lamps.



Patient Receiving Treatment by High Frequency Electric Currents in Berlin Sanatorium, Conducted by Germany's Eminent Physician, Prof. Dr. R. Hirsch.

Dr. Hirsch Applying the "Artificial Sun," Electric Light Treatment of One of Her Tubercular Patients. The Patient Wears Smoked Glasses to Protect His Eyes.

Oddities of Physics

Some Interesting Phenomena in Everyday Physics

By H. WINFIELD SECOR

Associate Member, American Institute of Electrical Engneers

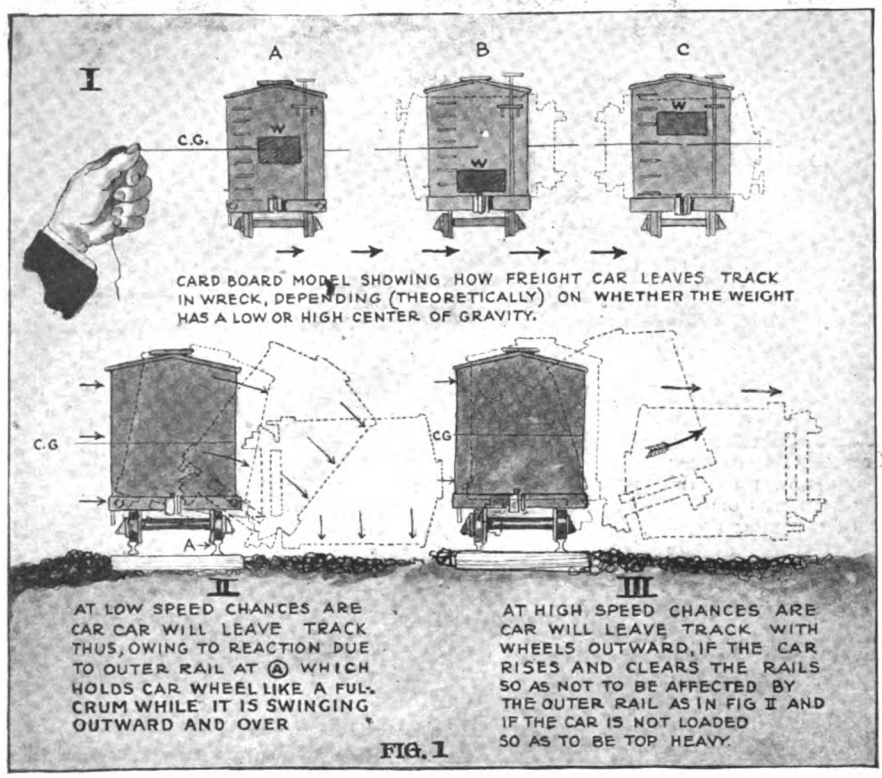


Fig. 1. Which Way do Railroad Cars Fall in a Wreck,—with the Wheels Toward or Away from the Rails? The Three Principal Ways in Which Cars Will Fall When Rounding a Curve at High Speed Are Shown Above.

DO RAILROAD CARS FALL WITH THE WHEELS TOWARD OR AWAY FROM THE TRACKS IN A WRECK?

FREQUENTLY we hear the subject discust, and the question asked as to which way railroad cars, particularly freight cars, fall in a wreck, and the accompanying illustration shows some of the theoretical considerations which apply to this every-day phase of physics. The usual answer by railroad men is that the cars fall with the wheels to the rail and while this figures out theoretically for possibly the majority of cases, there have been cases where the cars fell with the wheels away from the track, and with the top of the car lying next to the rail. The present discussion applies, of course, to a string of cars traveling around a curve.

To convince oneself as to which way a railroad car, under these conditions, would tend to fall when thrown outward from the curved rails if traveling at too high a speed, let us have recourse to the simple cardboard model shown in the figure. This model can be made about 3" x 5" and cut to the shape of a freight car. A button or small piece of lead, etc., corresponding to a movable weight "w," and which can be secured in different positions by means of a pin or otherwise, permits us to change the center of gravity so as to give a low or high center of gravity. In the actual freight car the position of the center of gravity depends upon how it is loaded, with the predominating weight toward the bottom of the car and trucks or toward the top. A string is attached to the center of the cardboard car model and when the model is spun around in a circle horizontally, holding the string between the index finger and thumb, the effect will be clearly demonstrated and proves that the car will fall in one of *three* ways, to wit:

If the center of gravity or major part of the weight is low or toward the trucks, the car will fly off the rails with the wheels pointing away from them; if the weight of the car and its load is evenly distributed as by placing the dummy weight "w" at the exact center of the model, then the car will fly outward evenly, with regard to the top and bottom; and finally, if the center of gravity and the major portion of the weight is placed toward the top of the car, then the top will fly outward and the bottom inward, so that the car theoretically at least (and if no other force is present to alter this motion), will fall with the wheels toward the rail.

In actual wrecks, however, photographs frequently show a string of cars laying along side the rails with the wheels toward the rails, and it seems to be the usual result in an accident or wreck. Fig. II, of the accompanying diagram, shows clearly why this is so. Consider that the train is moving at an abnormally high speed around the curve so that the cars are subject to great centrifugal force tending to throw them outward. If all the conditions are right, such as the center of gravity under the action of centrifugal force, the car will tend to turn outward and over, using the outer rail as a fulcrum—the cars will, in this case, invariably fall a few feet from the track with their wheels toward the rails.

A point often incorrectly entertained is that with cars going around a curve at such a speed as to keep the wheels at one side only on the rail, the outside wheels would be the ones to lift from the rails and not the inner ones, but the reverse is true as Fig. II shows, demonstrating how freight cars usually fall.

Fig. III shows a case where the cars in a wreck due to rounding a curve at very high speed, can fall with the tops of the cars towards the rails. This abnormal speed which would result in the condition like that shown at Fig. III, and with the center of gravity or load or the major part of the weight placed low or toward the tracks, the car would fly outward by centrifugal force as shown by the dotted lines and the bottom of the car would turn o

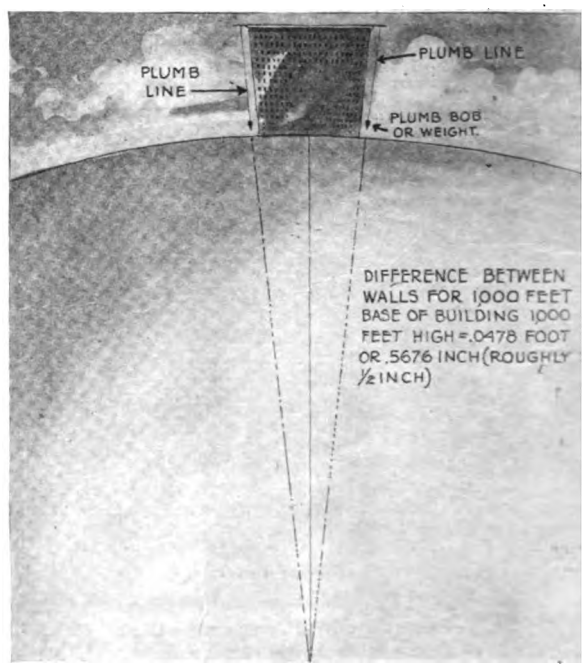


Fig. 2. Where a Plumb Line Not Plumb.—When It Lies on a Radial Line Passing Thru the Center of the Earth,—*Which is all the Time*, (Taking the Usually Accepted Meaning), and Thus if Two Sides of a Building are Erected to Correspond with Plumb Lines, They Will Not be Parallel, but Will be Found to be Farther Apart at the Roof Than at the Base of the Building. The Accompanying Illustration Shows the Difference in the Length of a Line Spread Between Two Walls of a Building at the Base, and Also at the Roof, the Structure Measuring 1,000 Feet Square and 1,000 Feet High; the Difference in This Case Would be a Trifle More Than ½ Inch.

ward and up as shown by the arrow; the conditions for this result being that the car moves at a sufficiently high velocity to cause it to be virtually lifted from the rails, so that the wheel flanges clear them. Otherwise, the result is more likely to be that of case II, if the wheels do not clear the rails or if the rails do not spread, or otherwise fail so as to nullify or eliminate any reaction pressure on the outer rails.

ARE HOUSE WALLS PERFECTLY PARALLEL?

When we build a house or other building and providing the usual degree of mechanical craftsmanship is applied in its construction, we might expect to find upon accurate measurement, that the four walls measure exactly the same distance apart at the base of the building as at the top. But such is not the case, however, as physics proves to us, for upon a little reflection it is evident to anyone that this is impossible, especially when Fig. II is examined. Where only the usual methods of construction are applied, i. e., plumbing

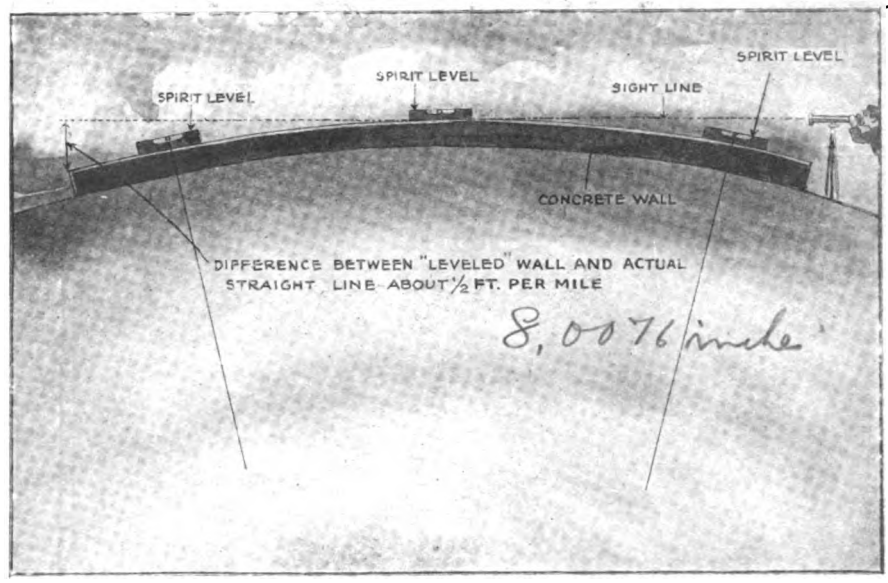


Fig. 3. The Diagram Above Shows that a Wall Constructed with Spirit Levels is not Perfectly Straight, but Curves in Accordance with the Curvature of the Earth. The Only Way to Erect a Perfectly Straight Wall Would be by Means of a Perfectly Taut Wire, or Else by Sighting Thru a Leveling Telescope as Shown in the Picture Herewith.

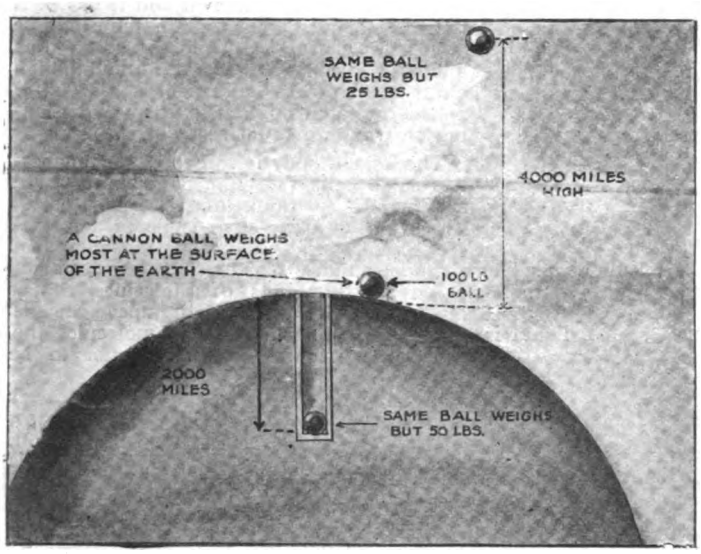


Fig. 5. Where Does a Cannon Ball Weigh the Most? You Might Not Think it, but it is a Fact a 100 Pound Ball (or any Other Body), for Example, Will Weigh the Most at the Surface of the Earth—and Less Than That Amount When Raised Above or Lowered Below the Earth's Surface.

the walls with the usual plumb line and weight or bob, it is not possible for either the side walls, or the front and rear walls to be parallel to each other or the same distance apart at the top and bottom except from inaccuracy of construction.

They must be farther apart at the top than at the bottom, as each individual wall will, if lined up with a plumb bob, be on a different radial line from the center of the earth; and the chord of the angle subtended between two radial lines as shown in the drawing, will increase progressively as we move outward from the center of the earth. Building constructors, architects and engineers are familiar with this fact and in large buildings or other constructional operations, this fact is taken into consideration. It has been computed that for a building 1,000 feet long and 1,000 feet high, the walls, if simply plumbed with a plumb and bob, would be one-half inch farther apart at the top than at the base. As the height increases, so does the difference in the chords or distance between top and bottom walls; further, as the distance between the two walls increases, the difference of chords at top and bottom of the walls will likewise be augmented.

IS A LEVEL WALL STRAIGHT?

When it comes to building long concrete walls, dams and other constructional projects a mile or more in extent, we once again bump unconsciously into the inexorable laws of Nature and for once in our lives find that a *level wall is not straight,* by any means! The truth of the matter is that such a wall is curved and actually follows the curvature of the earth. The writer remembers hearing this point argued many times, and it makes an interesting point for debate, you can well believe.

Illustration 3 demonstrates that a straight wall cannot be constructed by leveling, that is by leveling in the ordinary manner, for the reason that the level will act the same as the plumb bob, and it simply indicates that the bottom of the level is at right angle to a radial line pointing to the center of the earth, *and at that particular point only.* As soon as you move the level to a new point, even if only a few feet away, and providing you had instruments sufficiently accurate to measure the difference, you would find that the level has indicated a tangential point on the earth's surface for that particular radial line only.

It has been computed that when

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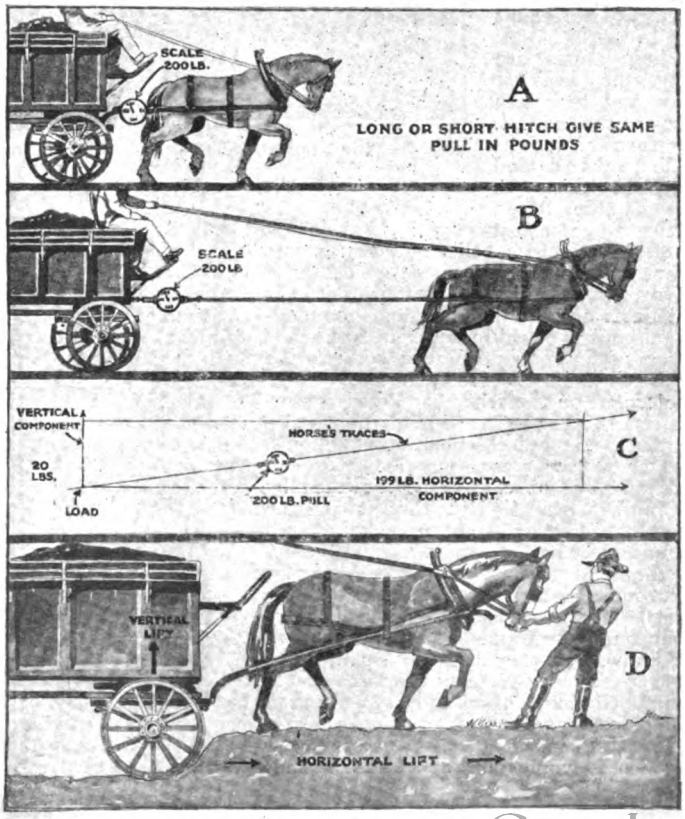

Fig. 7. Which is the Best,—a Long or Short Hitch in Pulling a Given Load? Figures "A" and "B" Show that When the Traces are Straight, this Actually Makes no Difference; But When the Traces are on a Slant or Angle, a Greater Pull Under Certain Conditions is Realized Owing to the Combination of Vertical and Horizontal Forces. In Figure "D," for Example, the Driver Stands a Better Chance of Hauling the Wagon Out of the Gulley with a Short, Angular Hitch Than with the Traces Horizontal, Owing to the Upward Force Brought into Play as the Resolution of Forces Diagrammed at Figure "C" Prove.

How Big Are Molecules?

By ROGERS D. RUSK, M. A.

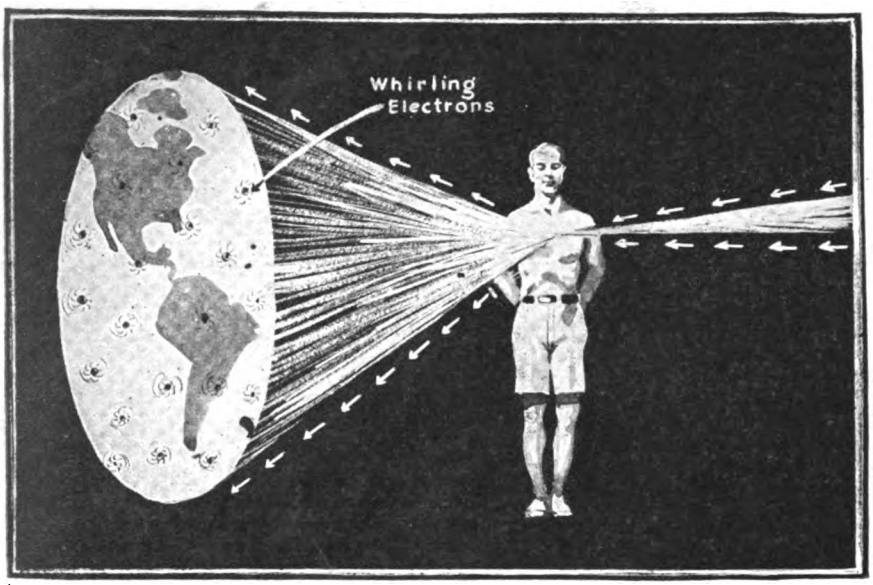

Fig. 5—To Gain Some Idea of the Extremely Minute Size of the Electron, of Which All Matter Is Now Supposed to Be Constructed, Imagine a Powerful Beam of Light Focust on to a Spot on the Human Body as Big as a Pin-Head, and the Reflected Ray Then Magnified to the Size of the Earth, or 8,000 Miles in Diameter. The Whirling Electrons Would Then Appear Visible to the Human Eye in the Manner Shown at the Left.

HOW big are molecules? Nobody has ever seen one and yet everybody talks about them. All matter is composed of them but molecules are in turn composed of atoms which must be smaller still. How big a molecule is depends on the atoms of which it is composed. Of these there are about ninety different kinds known to science that comprise the elements from which all other substances are built up.

Radium atoms are among the heaviest known and hydrogen atoms are the lightest. The former weighs two hundred and twenty-six times as much as the latter, while strange as it may seem, scientists believe radium atoms are but little over twice as large as those of hydrogen. Similarly, an atom of lead is eight times heavier than an atom of aluminum, altho it is but little larger in size, while an atom of tin is about midway between the two as shown in the first diagram.

Molecules, on the other hand, vary greatly in size because they are made up of different numbers and combinations of atoms. A water molecule contains two hydrogen atoms and one of oxygen as indicated by the familiar symbol H_2O, but it is little larger than a large atom. A single starch molecule, however, contains about twenty-five thousand atoms and is one of the largest molecules known (see Fig. 2).

Just what an atom or a molecule looks like no one knows and perhaps no one will ever know, for they are too small to be visible in any present day microscope. It is estimated that a thousand or perhaps a few hundred large molecules might make a visible speck in an ultra-microscope, but even then it would only appear as a point of light and no contour would be visible. However, if we do not know what molecules look like, we know they act just as if they are round balls, and when a liquid is boiled away or evaporates they fly off like miniature rifle balls, forming a vapor or steam.

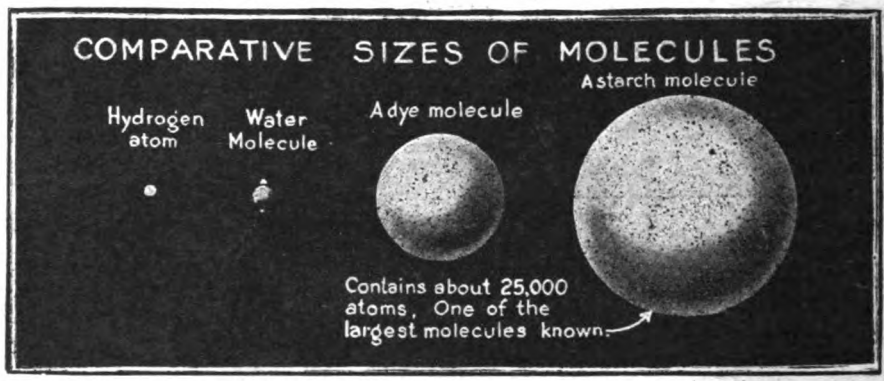

Fig. 2—This Diagram Shows in a Clear Manner the Relative Size, Magnified Thousands of Times, of Course, of the Hydrogen Atom, the Water Molecule, a Dye Molecule and a Starch Molecule—the Latter Containing About 25,000 Atoms, and Being One of the Largest Molecules Known to Science.

Steam is another familiar substance with which everybody is acquainted but which nobody has ever seen. Most people think they *see* steam when they look at the cloud issuing from the mouth of a teakettle or the exhaust of a locomotive, but they are mistaken. What they see is the vapor which has condensed in the form of a fog or a cloud of small water droplets, but steam itself is invisible because it is impossible to see the separate molecules and when the molecules join together they form minute drops of water, which are not steam. This may be easily proved by looking into a teakettle when the water is boiling. It is obviously full of steam, but there is nothing visible. If a baseball and a molecule of steam were magnified until the baseball was as large as the earth, then the molecule of steam would be about as large as the baseball was (see Fig. 4).

Fig. 3. Enlarged on the Same Scale as Fig. 2 Above, an Orange Would Appear Larger Than the Earth, as Shown by Our Artist in the Accompanying Illustration. This Also Emphasizes the Great Magnification of the Atoms and Molecules at Fig. 2.

Molecules are pretty small compared with baseballs, but when compared with electrons they are gigantic indeed. An electron is the smallest thing known and it has been proved that all atoms contain these minute electrical charges. The smallest atom known is as big as several million billion electrons, so after all, size is a relative matter and atoms are large or small depending on what we compare them with.

The human body is composed of numberless small cells (see Fig. 5) which we are accustomed to think of as being pretty small. They are easily visible in a microscope, however, and have been so studied for a long time. It is evident they are composed of thousands of molecules, which make the cell a complex organism capable of life and growth. Hence molecules that are small are not to be despised.

It is really never thought of, perhaps by the average person that his very body is composed of millions upon millions of tiny particles of living matter, which the scientist calls *electrons*. These electrons form atoms and the atoms in turn molecules. Some idea of the extremely minute mass of the electron may be obtained from the fact that no body has yet been able to see an electron thru the most powerful microscope, and probably never will. However, science has ascertained the exact size of the electron to a very high degree

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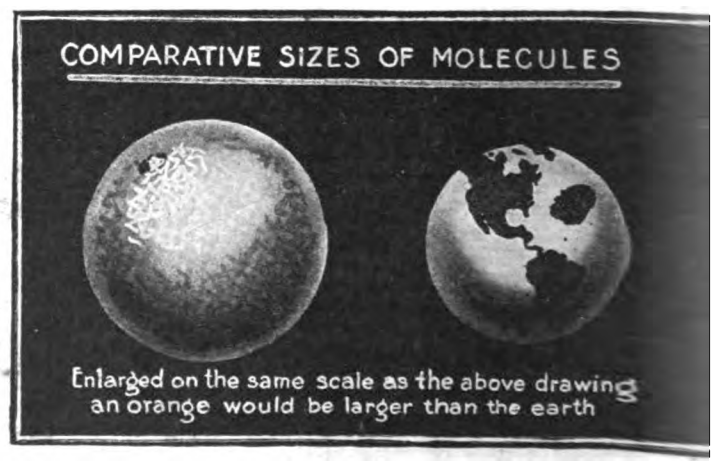


"Moviescope" Teaches Dancing

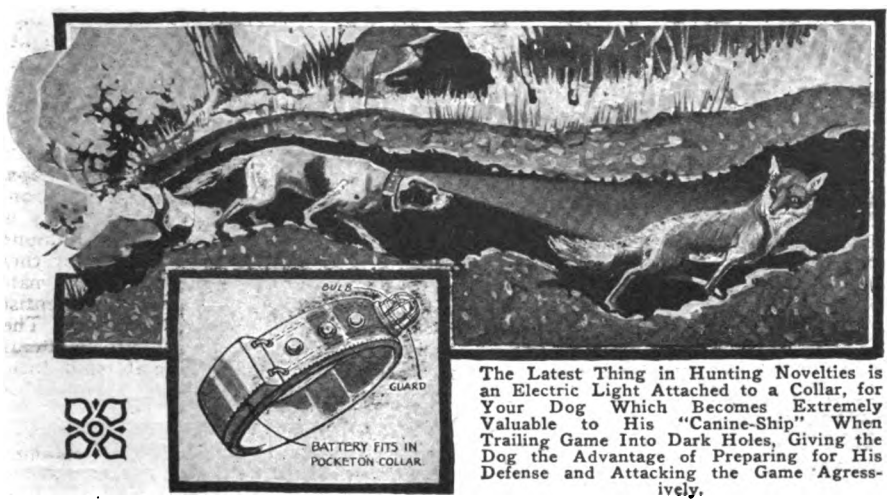
The boy in our illustration seems pleased with the idea of learning to dance by the aid of moving pictures. As he turns the crank and looks down into the machine, he sees an actual demonstration of the latest steps.

The idea was originated by Arthur Murray, a student at Georgia Tech. Some time ago, *Forbes Magazine* carried an article which stated that Arthur Murray has the largest dancing class in the world and earns $15,000 a year while going to college.

As the crank is turned, forty-two small leaves revolve around a barrel. By the rapid succession of falling leaves, the action of a dancing step is produced. The machine being operated by hand, the learner can turn as fast as he pleases and stop the movement at any time. By looking down into the machine for five minutes, the step is repeated more than one hundred times.

The process of making the finished picture requires some study as the little machine carries but 42 views and the action must be so timed and the step so arranged that the complete dancing step is photographed in exactly the same number of individual pictures. The 42 photographs then are enlarged on paper and are inked in by an artist who prepares them for the engraver, who in turn, makes line-cuts. The printer does the rest.

Dogs Carry Electric Lights



The Latest Thing in Hunting Novelties is an Electric Light Attached to a Collar, for Your Dog Which Becomes Extremely Valuable to His "Canine-Ship" When Trailing Game Into Dark Holes, Giving the Dog the Advantage of Preparing for His Defense and Attacking the Game Agressively.

In all the European countries, particularly Portugal, hunting has been one of the most well famed sports.

However, it has heretofore been an extremely difficult and dangerous task for the hunting dog, following the scent of the fox or badger, to hunt the pursued game out of their burrows; this difficulty being due to the fact that the intense darkness encountered within the long, narrow burrows rendered the dog almost helpless.

But now, it has come to pass, that for the purpose of assisting the dog in his chase for the game, he is provided with a collar to which is attached an electric lamp. In a pocket of this collar there is placed a flashlight battery which supplies the necessary current for lighting the bulb.

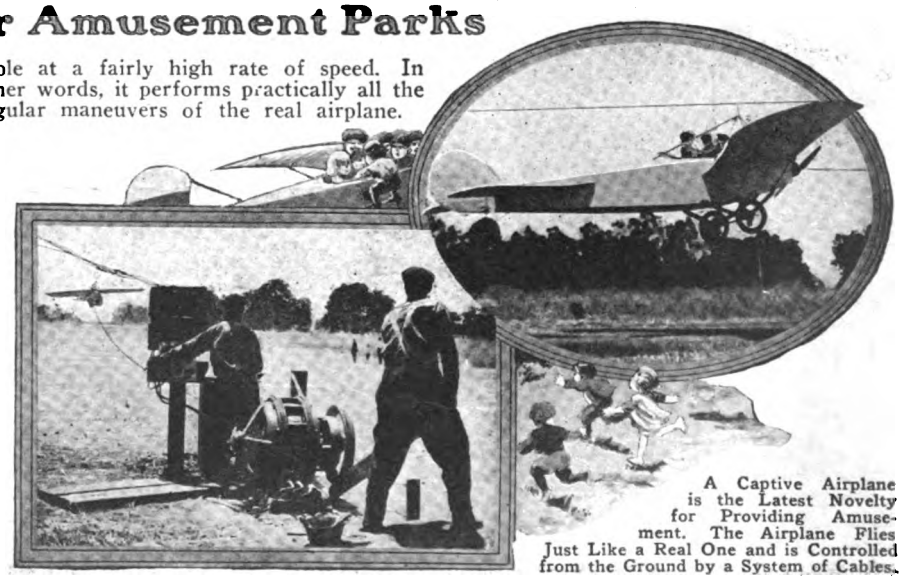
With this electric lamp which casts a beam of light a few feet ahead, it becomes an easy matter for the dog to work his way into the holes bored by the fox or badger.

Unique Thriller for Amusement Parks

One of the latest thrillers for places of amusement, is the new self-stabilizing "paraplane"—invented by R. R. Reed of Oakland, Cal. In the accompanying photograph is shown this new paraplane with its cockpit loaded with happy kiddies, flying without a pilot. It is controlled entirely from the ground, a man operating a switch arrangement for the propulsion of the plane carrying its precious load of children. A fifty horse-power electric motor furnishes the necessary power which is transmitted thru a system of cables.

This new amusement feature provides for the public, a real flight in the air in a real airplane, at a price which all can afford to pay.

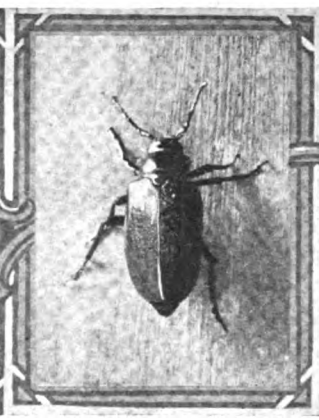
What other amusement except a ride in the paraplane, could offer so much pleasure and thrill to the kiddies? It affords a delightful little trip, and is sure to please all after but one ride. The plane guided by cables, rises gradually to a predetermined height, and thence proceeds along a taut cable at a fairly high rate of speed. In other words, it performs practically all the regular maneuvers of the real airplane.



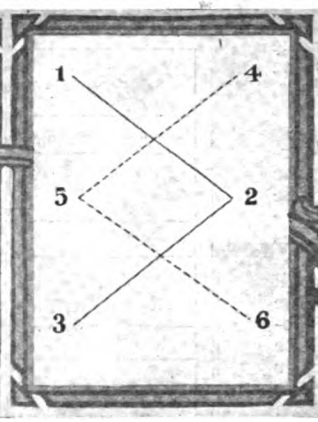
A Captive Airplane is the Latest Novelty for Providing Amusement. The Airplane Flies Just Like a Real One and is Controlled from the Ground by a System of Cables.

Peculiar Beetle Locomotion

Photo Showing Beetle in Flight With Legs Depending and Wings Extended from Their Coverings.



This Photo Shows a Ground Beetle in the Act of Walking.



How a Beetle Walks: Legs 1, 2 and 3 Move Forward, Then Legs 4, 5 and 6.

Surface Swimming Beetle Enlarged 4 Times. The Double-Eye Permits of Vision Above and Below.

IT is common knowledge that the things seen every day are not observed. One of the most common things in nature is the insect. Beetles are found everywhere. They are seen flying or else one can find them sitting on one and the same particular spot without motion, apparently lifeless. But if slightly disturbed the antennae will be seen to twitch and vibrate and if now closely observed one can see some insects inflate their body with air, spread their wing covers, and lift their membranous wings. All this goes on slowly, deliberately, but suddenly, with a whir, the insect is off on its flight. The peculiar thing about the flight of some beetles is, that the hard chitinous wing covers which are a protection to the delicate folded wings, are not used for propulsion in their flight. In some they are replaced on the back while flying, while in others they remain extended and act as gliders. Here the hind wings are used for flight and describe a figure eight while in motion. Under these circumstances the legs of the insect hang loosely downward.

Other beetles, the diving beetles, have the power of flight and also the power of diving under the water. When diving, these beetles collect a bubble of air on the under side of their abdomen and, with a swimming motion of their hind legs, and a pulling motion of their front legs, they glide under the surface of the water. Their hind legs are especially adapted for this purpose and are enlarged by the addition of hairs which give them a larger thrusting power under water. They use the bubble of air attacht to their abdomen for breathing and when they have exhausted it, they come to the top for a second and dive down again.

The common whirligig is another aquatic beetle. It is the ship of the ponds, a mighty racer, darting hither and thither upon the surface so quickly that the eye can hardly follow the individual. One would almost believe that their motion was more of a gliding on a polisht mirror than a swimming. The eyes of these beetles are peculiar, each being divided in half so that they have *four* eyes. The lower half of each eye remains under the surface of the water as the beetle glides about on the surface, therefore it can see under water. The other half remains out of the water and with it it can see into the distance.

Still another beetle is the ground beetle. These walk on the ground, and, in some species the wings are so rudimentary that they are never used for flight. Altho some of these insects are especially quick on their legs, their method of walking is peculiar. First they move their right leg forward, then their middle left leg, and finally their right hind leg. While their right hind leg is moving forward their left front leg also begins to move forward followed by their right middle leg and their left hind leg. When walking or running their motion is not jerky, but smooth and continuous.—Dr. E. Bade.

The Intelligence of Rats

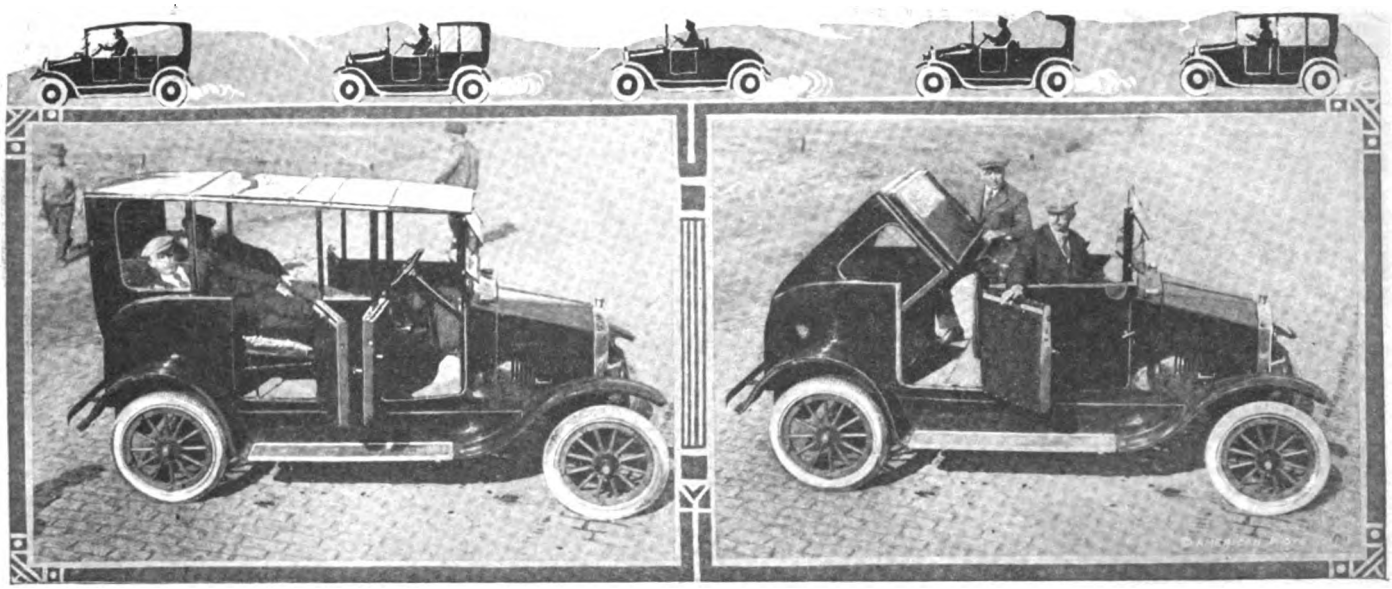
RATS are well known to be highly intelligent animals, altho to the one unfamiliar with their customs this may seem due to their wariness in regard to traps and their boldness and courage in combat. Besides these traits, many others have been noted. Stories are told of ship rats that while gnawing thru the woodwork of a ship always stop before they completely perforate the side.

The manner in which they transport eggs to their burrows is most surprising. Rodwell, in his book, "The Rat," gives a case in which a number of eggs were carried from the top of a house to the bottom by two rats devoting themselves to each egg, and alternately passing it down to each other at every step of the staircase. Rats will not only convey eggs from the top of the house to the bottom, but also from bottom to top. The male rat places himself on his fore paws, with his head downward, and raising up his hind legs and catching the egg between them pushes it up to the female, who stands on the step above, and secures it with her fore paws till he jumps up to her, and this process is repeated from step to step till the top is reached.

A writer in *The Quarterly Review* describes an instance aboard ship wherein eggs were continually being stolen from the storeroom. Having laid in a fresh stock of eggs, the Captain sat down in a location that commanded a view of the eggs and waited. Before long, to his great astonishment, he saw a number of rats approach, form a line from his eggs baskets to their hole and hand the eggs from one to another in their fore paws.

To many people, their long, narrow tails may seem of no use but they have proved very valuable in procuring food. Rats have been known to help themselves to oil by holding on some convenient support by the side of the bottle and then dipping their tails into the oil and thus extracting it.

Four Automobiles in One



We Have Often Entertained an Idea in Our Minds of a "Perfect" Automobile Which Can Be Changed by Pushing a Button or Two into Almost Any Type of Car We Might Happen to Desire—a Fully Closed Car for Rainy or Cold Weather; a Semi-Closed Car for the Spring and Fall and an Open Car for Summer Motoring. Mr. John J. McGuire Has Beat Us to It, However, and the Accompanying Photographs Show But Two of the Many Possibilities Available to the Owner of a Car Constructed Along the Lines of His Design. He Even Has a Folding Bed as Shown at the Left, While Some of the Other Possibilities Are Shown in the Miniature Machines at the Top of the Photographs.

JOHN J. McGUIRE is the inventor of a convertible type of body that is the limit of versatility; for less than a minute is required to change it to a limousine, an open touring car with victoria top, a coupe, and an open runabout.

In addition to this, a hinge on the back of the front seat can be let down and with the front and rear seats forms a snug bed. Its owner when touring need never worry about a shortage of hotel accommodations for he carries with him quite comfortable sleeping quarters.

Mr. McGuire is in business in New York City and the evolution of his idea arose from the apparent necessity of keeping two automobiles, one as a family touring car and one to get him and his brother, Mr. Bernard McGuire, back and forth from their place of business. He began to ask himself why it would not be possible to combine the two uses by having a body which would serve his business requirements and yet be available on occasions for family use also. His present design is the result of about two years of planning and work along this line.

Mr. McGuire is a practical coach builder by occupation, having learned his trade thirty-five years ago in the town of Longford, Ireland, in the days when coach building was an art, requiring the most careful and skilled hand-work. His present model naturally enough reflects the influence of the custom coach builder.

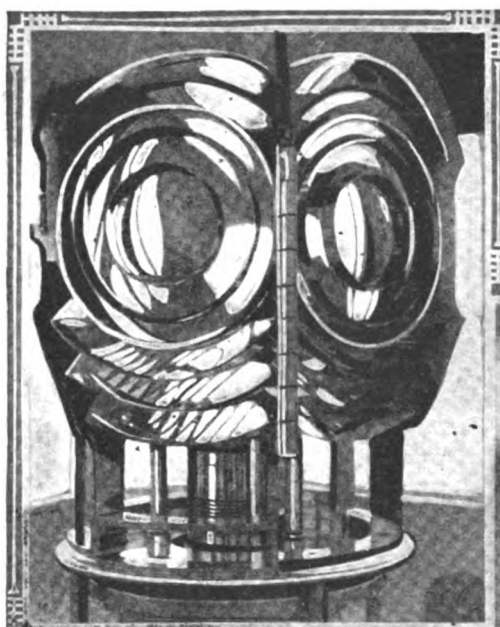
In this connection it is worthy of note that the construction of the windows comprises a separate and entirely new invention and differs from the type now in use in that the windows cannot be opened from the outside.

Mr. McGuire's car, which is mounted on a Ford chassis, took about eighteen months to complete from the day the first plans were drawn, being done in spare moments.

Mr. McGuire points out that no rack for spare tires is necessary, as they may be kept concealed under the rear seat, locked and secure from theft. He claims that his invention may be used on any chassis.

Giant Lighthouse Lenses

THE accompanying two photographs show interesting views of the famous "Robbins Reef" Lighthouse and the powerful glass lenses which throw the giant pencils of light thru the inky blackness of night. The life of a lighthouse keeper or his family, if he happens to be a married man, is one of the lonesomest in the world, as sufficient food and fuel supplies are usually kept on hand to last a month or so. Most of the big lighthouses thruout the world today are illuminated by powerful electric lamps, either of the arc or incandescent type. Some of the lighthouse electric lighting plants comprise a gasoline or other engine driving a dynamo and this is operated thru the night when the lamps are in use, the current being taken directly from the dynamo. There are lighthouses having more elaborate electric plants equipt with a storage battery which can be charged one or more times a week as the occasion may require, and the lamps then derive their current from the storage battery at night, the engine and dynamo being operated during the daylight hours to charge the battery. Those who live near seaports and have ever seen lighthouses in action at night have probably noted the different ways in which the light beams are used to signal which particular lighthouse one is looking at. There are several novel ways in which these code signals are arranged. Sometimes the light swings around in a complete circle, while in other cases it only shows its flashes in an angle or half circle, when it is situated on the shore of a harbor.



The Famous "Robbins Reef" Lighthouse at Right. The Small Boat, by Means of Which the Lighthouse Keeper and His Crew Visit the Mainland, Is Shown Hanging from Its Davits. The Life of a Lighthouse Keeper Is a Lonesome One as It Frequently Occurs That They Do Not Visit the Mainland for Perhaps One to Three Months or More.

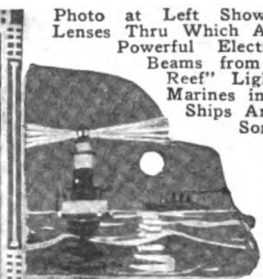
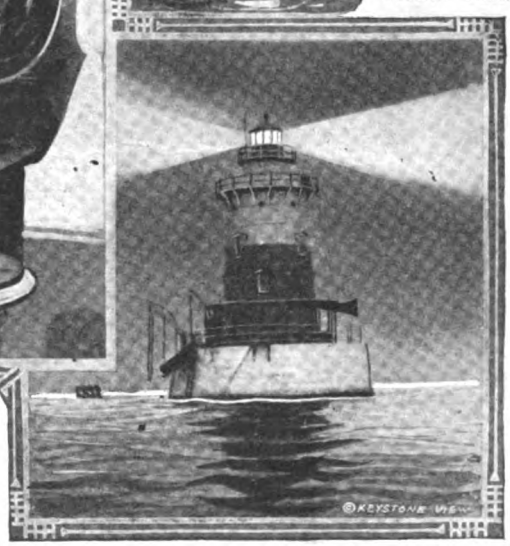
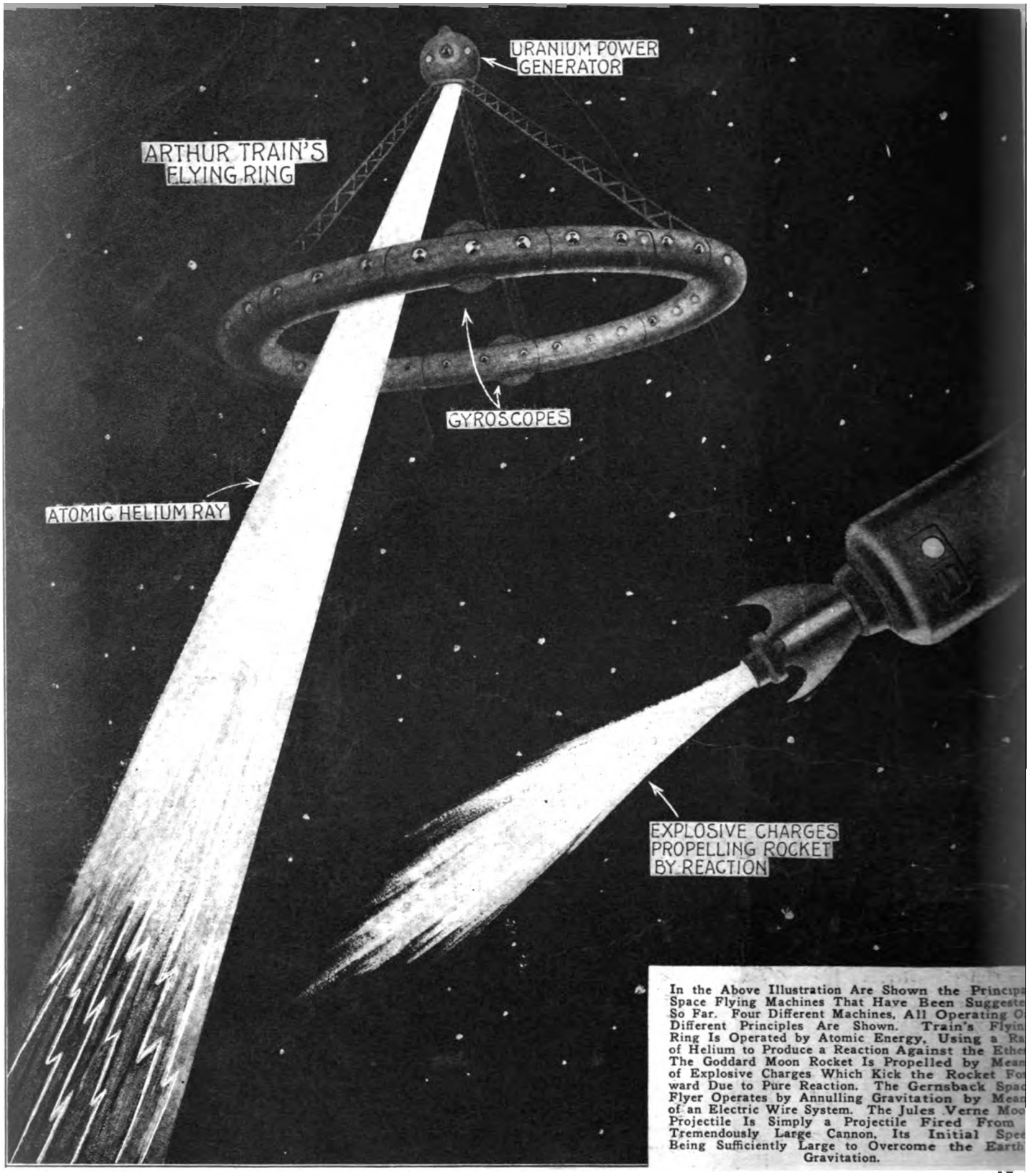


Photo at Left Shows the Fresnel Lenses Thru Which Are Flashed the Powerful Electric Searchlight Beams from the "Robbins Reef" Lighthouse to Aid Marines in Guiding Their Ships Around the Reef. Some Lighthouse Lamps Are Operated with Acetylene Gas, But Most of Them Are Electrically Operated at the Present Time.





In the Above Illustration Are Shown the Princip Space Flying Machines That Have Been Suggeste So Far. Four Different Machines, All Operating O Different Principles Are Shown. Train's Flyin Ring Is Operated by Atomic Energy, Using a Ra of Helium to Produce a Reaction Against the Ethe The Goddard Moon Rocket Is Propelled by Mean of Explosive Charges Which Kick the Rocket Fo ward Due to Pure Reaction. The Gernsback Spac Flyer Operates by Annulling Gravitation by Mean of an Electric Wire System. The Jules Verne Moo Projectile Is Simply a Projectile Fired From Tremendously Large Cannon, Its Initial Spee Being Sufficiently Large to Overcome the Earth Gravitation.

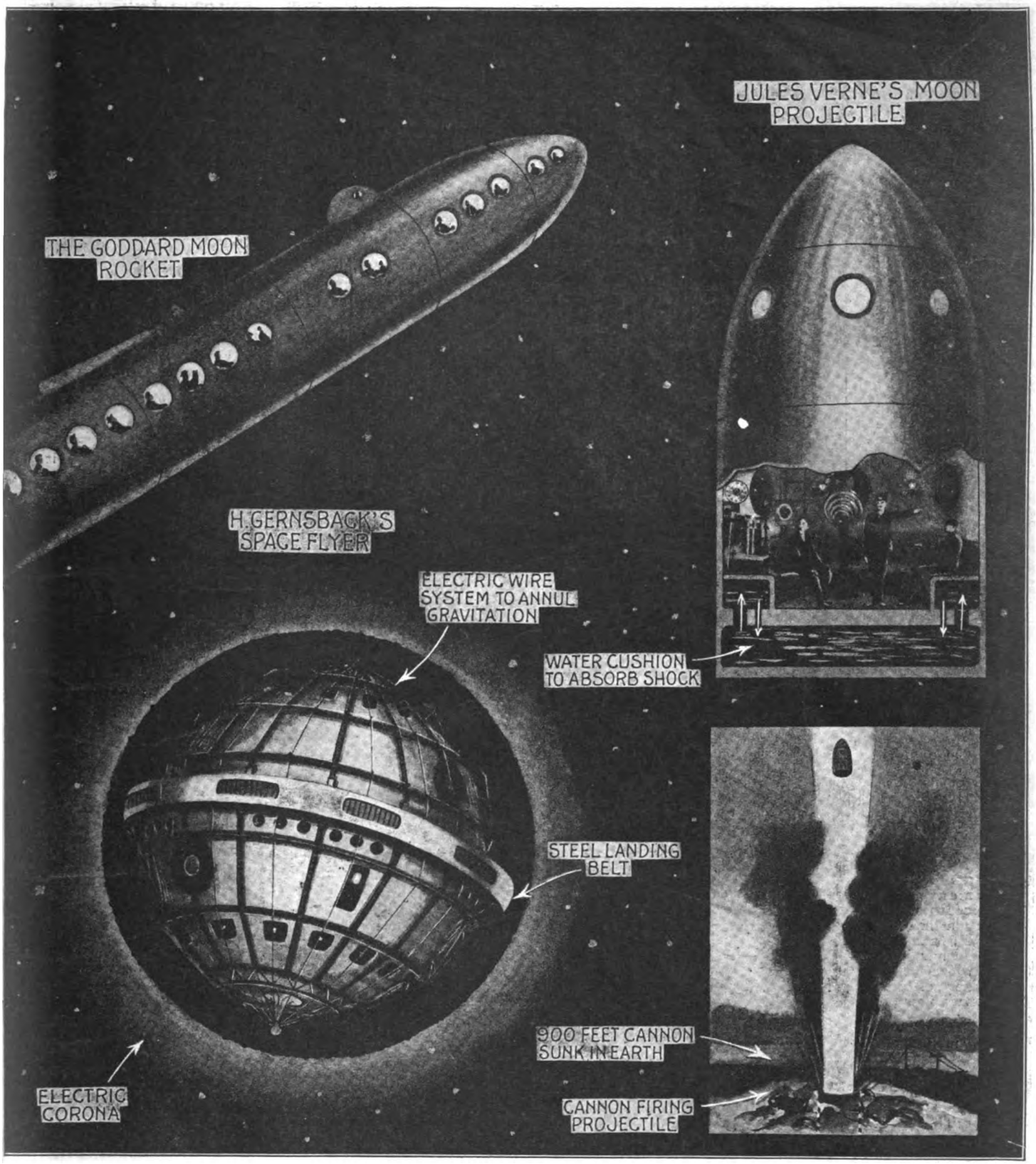
Flying In Space

By H. GERNSBACK

TWENTY-FIVE years ago mechanical flight was discussed seriously by scientists all over the world. Many scientists of great authority demonstrated mathematically that it was absolutely impossible for a man to fly a machine heavier than air. Eminent men of science sustained this view. Notwithstanding all this, we are flying today at will and we are building airplanes that can rise thousands of feet aloft and transport one hundred people over great distances. As usual our scientists were not correct as to what can or cannot be done.

The next step will be flying not only in the atmosphere, but flying in space where there is nothing to sustain a machine and where propellers and planes are no longer of use, because where there is no air there can be no mechanical flight as we know it today.

The full thickness of the earth's atmosphere is roughly speaking about 500 miles. This takes in the densest layer from the earth's surface to the outer space where there is an absolute vacuum, but our atmosphere proper is probably not thicker than



30 miles. After this distance the rarification becomes extreme. All of this, however, should not deter us from attempting to fly in space. To those who say it is impossible for a body to float in space and in vacuum, let them look at the moon or at any of the stellar bodies, and he will find that these bodies indeed float very nicely without any support whatsoever. This is, of course, due to universal gravitation, but for the moment this need not concern us.

How then can we fly in space? There are several vital points that must be considered. The main point is the earth's gravitation that holds all bodies chained to it. Take a balloon for instance. As soon as the gas gives out, the balloon must come down due to the earth's gravitation; the same thing is true of an airplane which falls or must glide down as soon as the propeller stops. If directional flight at will in space ever becomes assured, it will be absolutely necessary that we first master gravitation, or otherwise annul its effects in some way. Just how this can be accomplisht we of course do not know exactly today, altho there have been several attempts made to conquer the baffling forces that hold all objects to the earth.

The writer has stated many times in his past writings that gravitation is conceded to be an electrical effect today. If this is so, then sooner or later we will find a way to counteract gravitational force by electrical reaction, and when this happens, it will be a simple thing for us to build a machine that by means of electricity overcomes gravitation in a similar manner to a railroad engine overcoming friction by furnishing enough power to dispose of the latter. This is what makes a train move.

One of the earliest and now historical methods proposed for a machine to travel into space was the well-known moon projectile invented by the fertile brain of Jules Verne. He imagined a huge cannon sunk 900 feet into the earth. It required 400,000 pounds of gun cotton to fire the 20,000 lb. aluminum projectile which contained three travelers. The details of this invention were described in his well-known book

"From the Earth to the Moon." Scientifically this idea is absolutely sound, and if we actually would build a cannon as imagined by Jules Verne, and firing a projectile such as he described, the initial force given the projectile would be sufficient to overcome the gravitational pull of the earth and the projectile would leave the earth never to return. This is a condition fully realized by all artillerists. Given a cannon which fires a projectile whose initial speed is 12,000 yards a second, this projectile will fly out into space never to return. The passengers probably would not survive the shock, but that need not concern us here. Of course this idea was purely fanciful, and the great trouble with it is that there is no means of "navigating" such a projectile. Once out in space it becomes subject to various gravitational effects. If it came within the direct influence of the moon, for instance, it would be drawn toward the surface where it would be smashed to pieces in an instant. If, on the other hand, it would not come under the direct influence of a stellar body, it would roam around the universe for all time until finally struck by meteors or some other body.

In 1915 the writer publisht in the June issue of the "Electrical Experimenter" a machine to fly in space and he gave it the name of "Space Flyer," under which name machines of this kind have now become known. The writer's idea was to use a sphere some 75 feet in diameter which contained all the different machinery and apparatus to navigate and operate the flyer. The underlying idea was to have the whole exterior of the machine criss-crost with an electric wire system, similar to a radio station. These wires radiate over the surface of the machine from the two "poles"; the wires are insulated from the metallic shell of the flyer. The proposal was to use an electric current of a peculiar wave action, which was to annul gravitation electrically. The machine was steered very simply by switching in or out various sections of the wire system. For instance, if the machine was to leave the ground all that was necessary was to switch on the wires facing the ground, while the part pointing towards the sky was not to be electrified. A reaction would immediately set in and the machine would naturally rise as there was no gravitation to hold it back. If the machine approached the moon or a planet, the same electric current was brought into play again, and the retarding motion set up so that the flyer would not smash itself against the face of the heavenly body. There was a steel landing belt provided on which the machine was to roll upon landing. This was necessary otherwise the wire system would be destroyed.

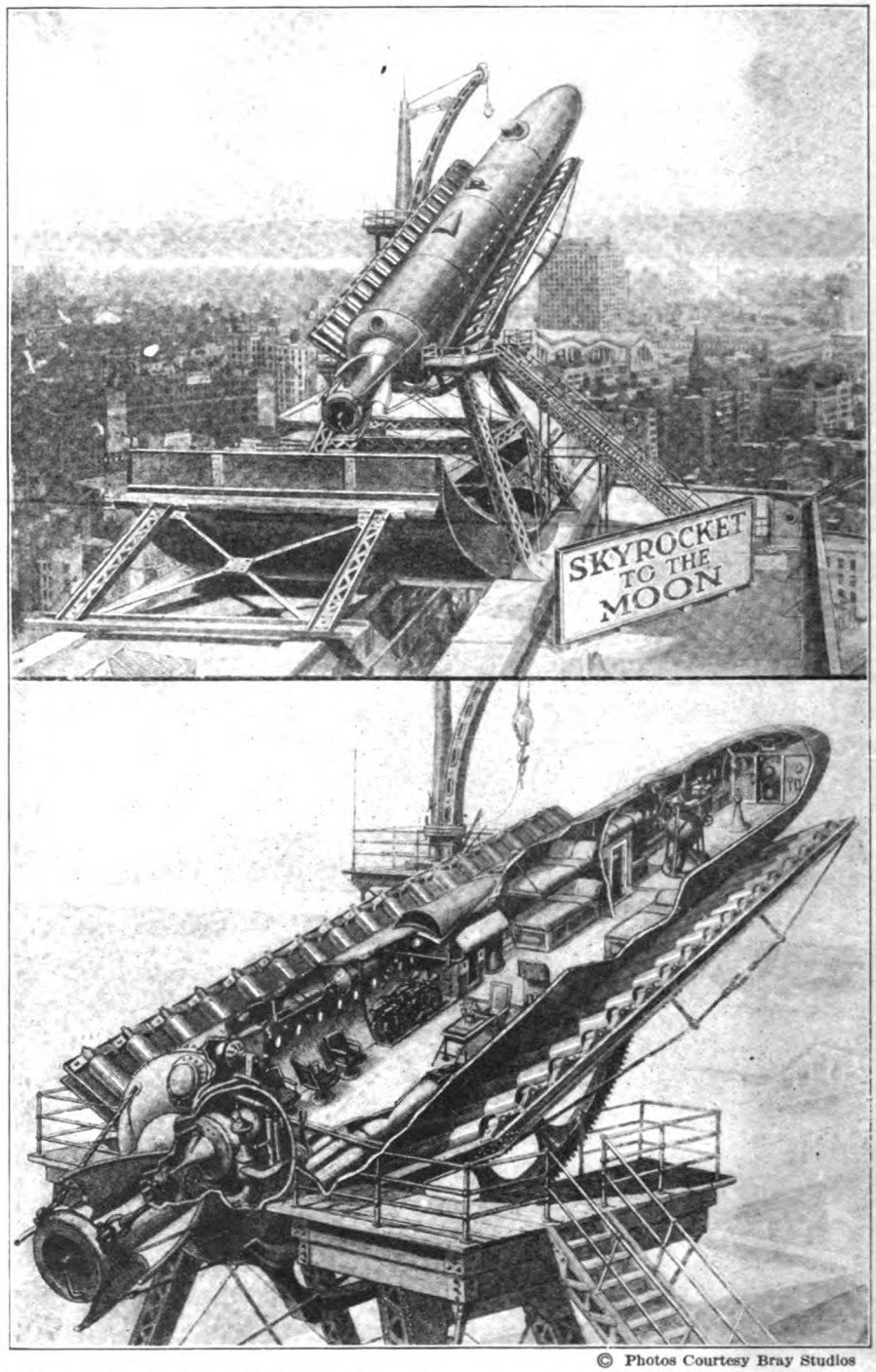
Another idea is shown in Arthur Train's "Flying Ring" publisht in 1917 in his book "The Man Who Rocked the Earth." This also was a fanciful machine and was propelled by atomic energy. The flying ring had a sort of tripod mounted upon it and at the top there was a uranium power generator which gave forth a disintegration ray of great power. This ray striking either the earth, atmosphere or the ether in space would naturally set up a reaction, lifting the ring. The direction of the machine was of course controlled by this ray. The flying ring also could be steered sideways by means of gyroscopes contained in the interior. This idea is perfectly feasible if we ever can make use of atomic energy.

The latest newcomer in space flying machines is Dr. Goddard with his now famous moon rocket. We have already described Dr. Goddard's rocket in our Feb. 1920 issue of the "Electrical Experimenter," where the detailed description of the principles can be found. Dr. Goddard's idea is sound and there is no question that it is possible to send such a rocket out into space. If we take the experimental rocket of Dr. Goddard and magnify it so that it can carry a number of people we will get a machine similar to the one shown in our illustration.

The Goddard rocket operates by explosive charges which emerge from the end of the rocket and the propulsion is accomplisht merely by reaction. It makes no difference whether these explosive charges occur in the atmosphere or in free space; the action is always the same. As a matter of fact, in free space and in a vacuum the kicking reaction of the explosive charges will propel such a machine much faster than thru an atmosphere where the air resistance tends to retard it. Not only this, but once the rocket leaves the gravitational influence of the earth, a much smaller explosive charge will propel the rocket at prodigious speed.

The matter of steering such a rocket is not a simple one and must be worked out very carefully. It would be necessary to have outlets for the explosive charges directed away from the machine at right angles, preferably at the lower end and at the bow of the machine. These explosive charges would be imperative whenever it became necessary to steer the machine to the right or to the left, to turn it about, or for landing purposes. It would not be a simple task to control such a machine by means of these charges, and it would be a ticklish business for instance to affect a smooth landing upon the surface of the moon. While of course it is not impossible to accomplish this, the matter of firing the

(*Continued on Page* 1355)



© Photos Courtesy Bray Studios

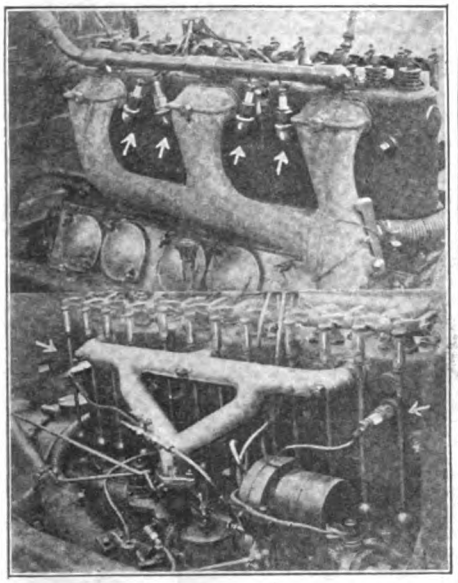
"All Aboard for the Moon"—May Not Sound So Strange to Our Ears, Fifty Years Hence. Perhaps Even Sooner the Goddard Rocket Will Have Been Perfected and Made Safe Enough to Carry Passengers Across the Intervening Chasm of Interstellar Space to Our Neighbor the Moon. The Interior Arrangement of the Passenger-Carrying Rocket Is Here Illustrated.

MOTOR HINTS

FIRST PRIZE $25.00.

"A REMEDY FOR DIRTY SPARK PLUGS."

On some of the older models of cars great trouble is often experienced due to the continuous fouling of the spark plugs.



Improving Operation of Engine When Spark Plugs Foul and Oil Up Badly by the Simple Expedient of Placing the Plugs in Male-Female Elbows. These Can Be Purchased At Any Plumbing Shop.

The main cause of this difficulty is their position. On a great many cars the plugs sit horizontal instead of vertical, allowing the oil and carbon to collect very readily.

Obtain as many male-female pipe "ells" as there are spark plugs. Next remove the plugs from the cylinders and replace them with the ells, turning them so the mouth of the ell will face up. Now screw the plugs into the ells and connect up.

As will be seen from the photo, it was only necessary to change the middle four, as the first and sixth never fouled.

I found the plugs were perfectly clean a year from the time I changed them.

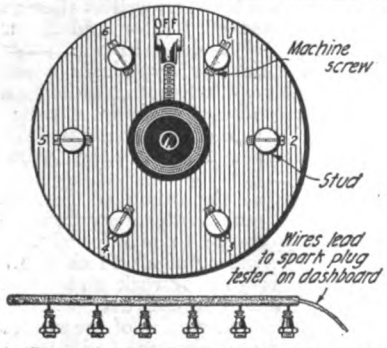
Contributed by

ORAN T. McILVAINE.

SPARK PLUG TESTING DEVICE.

This spark plug testing device is used on the dash-board when the engine is running. In the event that one, two or more of your spark plugs are not firing properly, simply turn the knob on the spark plug tester while the engine is running, and it will show you by the numbering of the studs, which one is out of order, without getting any shocks.

Contributed by WILLIAM NEBLICK.



Spark Plug Tester Suited to Mounting on the Dash-board.

$50.00 IN PRIZES

Paid for "Motor Hints."

Most of our readers have a car of their own, and any number of them have made certain improvements on that car. We want to know about these improvements. What we want are PRACTICAL ideas, not freak stunts. The idea should be simple enough, so that anyone handy with tools can duplicate it. Note that the idea does not necessarily have to be electrical in any way.

We would like to have a photograph of the stunt showing that it was actually tried, but this is not absolutely necessary to win a prize. A simple sketch will do showing the essential parts, etc.

We will pay the following prizes each month:

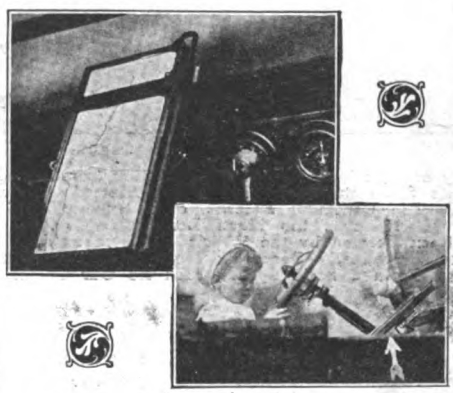
FIRST PRIZE	$25.00
SECOND PRIZE	15.00
THIRD PRIZE	10.00

All other accepted articles, which win no prizes, will be paid for at the rate of $2.00. Articles submitted should not be long ones. About one hundred to two hundred words will suffice. Address all manuscripts to Editor, "Motor Hints," care of this publication.

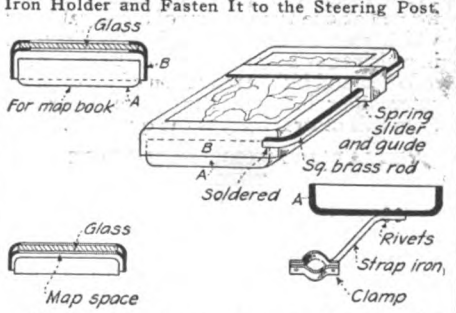
SECOND PRIZE $15.00.

INDEX ROAD GUIDE AND MAP HOLDER.

The accompanying photo and diagram show my index road guide and map holder as applied to my "flivver," and on which I am endeavoring to obtain a patent. This device brackets to dash or steering column or may be read from the hand.



Don't Hold the Road Map on Your Lap or Keep It in Your Pocket—Make This Sheet Iron Holder and Fasten It to the Steering Post.



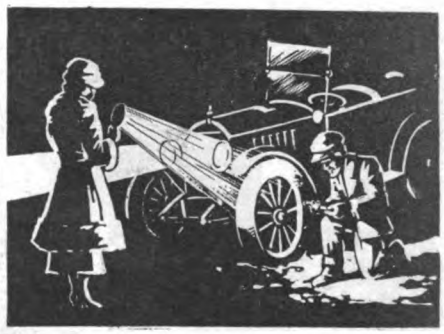
The index finger is movable and is spring clamped to guide rod, remaining in position where set. Read above the finger going from bottom to top of face—read below finger going from top to bottom. It will hold a single sheet map or an open book 1½" thick (practically all commercial maps publisht for road guide purposes). It consists of two telescoping pans, one glass bottomed, suitably clamped together as desired.

Contributed by P. C. FISH.

THIRD PRIZE $10.00.

MIRROR SERVES AS "TROUBLE LAMP."

I wish to enter your "Motor Hints" contest and I enclose sketch showing the way I have repaired my car at night on the road, with a mirror to reflect the beam from the headlight under the car. By turning the headlight to one side I could



The Simplest Trouble Light—Simply a Hand or Other Mirror Used to Reflect the Headlight Beam Rearward.

reflect the light on the rear wheels. The mirror on the car can be used with good results.

Contributed by

HARRY E. CONRAD

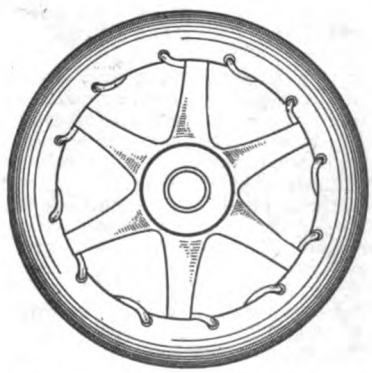
A SPARE TIRE FOR EMERGENCIES.

Many motorists have met conditions where it seemed almost necessary to "limp in on a flat," as the saying goes. When the spare tire has been used and there is no time to bother taking the tube out and making repairs the idea described here will be of service.

In addition to the regular spare, carry an old shoe, somewhat smaller than the regular equipment. The sides of this shoe should be perforated with holes as shown in the sketch and several old treads slipt inside it. When all the spares are used and a tire goes flat simply remove the flat tire, slip the old shoe over the wheel rim, lace it in place and go ahead. The rim will not be damaged, the going is not bad and it will prevent rim cuts on a good tire were you to run on it flat. The old shoe can be carried without difficulty and will be found mighty handy at times.

Contributed by

THOMAS W. BENSON.



In Addition to the Regular Spare Shoe, Carry An Old Shoe Along. This Shoe Should Be Perforated With Lacing Holes As Shown.

Popular Astronomy

By ISABEL M. LEWIS, M. A.

of U. S. Naval Observatory

THE earth is inconceivably old. The most reliable method of determining its age—that of computing from the present amount of radium and lead in the older rocks the time necessary for the disintegration of the original uranium content of the rocks into these elements—indicates that a period of nearly two billion years has elapsed since these rocks were formed. How long a time the earth was in existence as an individual member of the solar system prior to that date is not known, but it is believed to have been fully as long as the interval that has elapsed since the formation of these earlier rocks.

More recent knowledge of the condition of the earth's interior has altered radically our earlier ideas on the subject. Instead of an intensely hot, liquid interior encased in a cooled, hardened and contracting surface crust we now know that the earth has a highly elastic and rigid metallic core of great density, largely magnetic iron in composition.

The original earth-mass has more likely been increased by the addition of adjacent masses than decreased in size by contraction under gravity from a nebulous mass of great volume and low density.

All of the inherent heat of the earth originates, it is now believed, in a comparatively shallow shell of radio-active rocks less than one hundred miles in thickness instead of within its central core which probably has a temperature approaching the absolute zero of space.

We cannot consider the question of the origin of the earth without reference to the origin of the solar system. That all the planets as well as the planetoids originated from a common parent-mass is not seriously questioned. All of these bodies revolve about the sun and rotate upon their axes in the same direction—from west to east. Moreover, all of the planetary orbits lie very nearly in the same plane and are nearly circular in form.

The orbits of the planetoids are more elliptical and more highly inclined to one another than are the orbits of the planets, but on the *average* they are neither very elliptical nor very highly inclined to the planetary orbits.

The Origin of the Earth

The sun rotates upon its axis in the same direction in which the planets rotate and perform their revolutions and the orbits of the planets are inclined at small angles *to the plane of the sun's equator*.

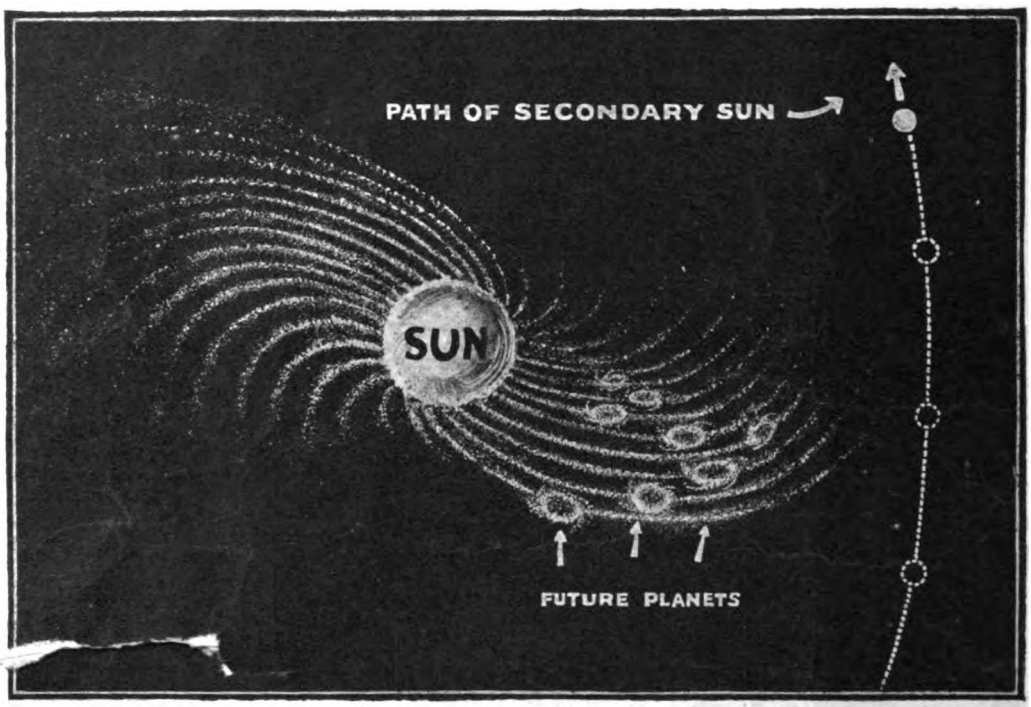


Fig. 1. Illustrating the Theory of Ejection of Streams of Matter from the Sun Under the Attraction of a Passing Sun. The Dotted Lines Show the Paths Taken by Ejected Particles (Planetesimals) After the Secondary Sun, Has Past By. The Continual Ejection of a Number of Streams Would Produce Formations Similar to the Great Spiral Nebulae, tho Much Less Extensive. This Illustration Shows Clearly How the Planets Might Have Been Formed by the Whirls of Planetesimal Particles; These Concentrated Groups of Particles Which Form, Gradually Becoming More Dense Until They Contracted Sufficiently to Form a Solid Sphere Such As Our Earth.

These facts are all significant and cannot be overlooked in formulating a theory to explain the origin of the planetary system in general and of the earth in particular. Presumably the planets and planetoids formed at one time a part of a central body which rotated on its axis in the direction in which they now revolve about the sun.

When and by the operation of what force, external or internal, they were separated from this central body is the question.

THE LA PLACE "NEBULAR HYPOTHESIS" THEORY.

In 1796 La Place advanced his celebrated *nebular hypothesis* to explain the origin of the solar system. It was received with favor both by scientists and laymen and in a short time was almost universally accepted as closely approximating to the truth.

According to the nebular hypothesis the solar nebula from which the planetary system was formed, originally extended at least as far as the orbit of Neptune and rotated slowly in the direction in which the planets now revolve. As it lost heat by radiation and contracted under the gravitation of its parts its rate of rotation necessarily increased. When the centrifugal force at the equator equalled the central gravitational force a ring was left behind by the contracting nebula. Such a ring would not be absolutely uniform and would break at some point and gather into a planetary mass under the gravitation of its parts. This planetary mass would abandon rings in turn and these would break up to form satellites. Successive rings were abandoned at intervals by the solar nebula at the present distances of the planets from the sun in the manner described above until the original solar nebula had contracted to its present size.

The rings of Saturn were supposed to be the single example remaining of this process of forming planets and satellites from a *contracting nebulous mass*.

The La Placian hypothesis attempted to explain why all the planets and their satellites revolve in the same direction in which the sun turns on its axis in nearly circular orbits and nearly in the same plane. As the time was advanced it appeared to be in accord with all the facts then known regarding the solar system.

The planetoids with their interlacing and in some instances highly inclined and elliptical orbits were then undiscovered. It would have been impossible for them to have been formed by the abandonment of successive rings.

The constitution of Saturn's rings was unknown at this time; also the fact that the moonlets of the inner ring revolve about Saturn in *half* the time required for the planet to turn on its axis—another impossibility under the nebular hypothesis.

The satellites of Mars were not discovered until many years later, as well as the retrograding satellites of Jupiter and Saturn all presenting difficulties in the way of accepting the nebular hypothesis without radical changes. Attempts, mostly unsuccessful, have been made from time to time to make these exceptional cases fit with the requirements of the nebular hypothesis.

The theory of the origin of the sun's heat through contraction advanced by Helmholtz, appeared to give considerable support to the theory of La Place but when mathematicians got to work and showed that the amount of heat that would be furnished by the contraction of the sun from dimensions beyond the orbit of Neptune to its present dimensions would be sufficient to supply

heat to the earth at the present rate for only twenty-five million years, a period far too brief, the geologists and biologists found, to cover all the vast cyclical changes that are known to have taken place upon the surface of this planet since its surface crust was formed. Evidently gravitational contraction is by no means the only or even the chief source of the solar energy.

The mathematicians, moreover, did some more figuring and showed that under the suppositions of the nebular hypothesis the hypothetical solar nebula, at the time it extended beyond the orbit of Neptune, must have had a moment of momentum *two hundred times* as great as that of the present system, though owing to the principle of the conservation of moment of momentum the two should be *equal*.

They also showed, indisputably, that it would have been impossible for successive rings to have been abandoned at certain definite intervals by a contracting nebula and granted that if a ring *could* have been abandoned it would have been impossible for it to condense into a planet, since tidal forces due to the sun would offset the gravitation of its parts.

When La Place advanced his famous theory it was, "with that distrust which everything ought to inspire that is not a result of observation or of calculation."

Were La Place living today he would be, we believe, the first to abandon a theory that is now known to be in accord neither with observation nor calculation.

Being deprived of a theory that has served to explain the outstanding features of the solar system more or less adequately for one hundred and twenty-five years, astronomers are seeking in the light of recent observations and discoveries to formulate a satisfactory theory of the origin of the solar system.

THE PLANETESIMAL THEORY

In the planetesimal theory of Chamberlin and Moulton and the recently suggested theory of the well-known English mathematician Jeans, *a second sun passing close to our own sun is assumed to have been the cause of the origin of the planetary system.*

The effect of the close approach of such a sun would be the ejection of a stream of matter from our sun as we may term it, in the direction of the passing body and also in a diametrically opposite direction, according to the *planetesimal theory* (see Fig. 1.) This ejection would be continuous as long as the stars remained near one another, the height attained by the ejected stream decreasing as the passing star receded. The result would be the formation of a *spiral nebula* in which the motion of the ejected particles, — planetesimals — would be across the spiral arms, toward and away from the passing star. After the sun had receded so far as to have no further effect upon these ejected particles they would revolve about the sun in more or less elliptical orbits which would gradually be reduced to nearly circular forms by repeated collisions between planetesimals. *Larger nuclei* would be formed and these would gradually sweep up smaller fragments and become the planets of the present system. Smaller nuclei in the vicinity of larger ones would become their satellites and in the course of many millions of years all of the larger fragments would be swept up by the planetary nuclei and their satellites—leaving only the asteriods, comets and meteors as survivors of the original spiral system.

It must be borne in mind that a spiral nebula formed by the close approach of two suns would resemble in *form only* the great spiral nebulae that are known to exist by hundreds of thousands in the heavens. These are far too extensive to form anything so small as a single solar system but would condense into systems composed of many suns,—either galaxies or star clusters.

Jean's suggested theory of the origin of the planetary system differs in its details from the above, though a passing sun is assumed to be the disturbing force that causes the ejection of a stream of matter which condenses to form the planets and their satellites. The origin of the inner planets is left greatly in doubt, however, and it is stated that the system which interests us chiefly—the earth-moon system, is the one about which it is most difficult to arrive at any definite conclusion. Our own sun, it is assumed, was dark and cold, of low density and with a diameter about equal to that of Neptune's orbit at the time of the catastrophe which is placed at some 300,000,000 years ago. In Jean's words, " . . . The time for arriving at conclusions in cosmogony has not yet come—(and it must be left)—to future investigators armed with more mathematical and observational knowledge than we at present possess to pronounce a final decision."

However, since La Place advanced his celebrated nebular hypothesis, great advances in astronomy have been made, and man is in a better position to theorize on this fascinating problem today than he was one hundred and twenty-five years ago.

All such theories must necessarily be regarded as working hypotheses only, to be discarded or modified as our knowledge and understanding of the laws of the universe increase. No theory can ever be regarded as final or perfect.

The discovery of radio-activity furnishes us with new material for new theories. The sun and the planets may be and probably are far older than we ever dreamed was possible. It is no longer necessary or reasonable to assume that a greatly extended solar nebula once existed and supplied the planets with heat through gravitational contraction or to place a time limit upon the period required for the formation of the planets and their satellites, that is not in accord with the requirements of other sciences.

We also know today that there exists within the sun powerful repulsive forces, which even under present conditions eject gaseous matter to heights of five hundred thousand miles or more with a velocity of over two hundred miles per second. Small changes in the velocity of ejection produce great differences in the height of the ejected columns.

With an initial velocity of three hundred and eighty miles per second, matter would be thrown from the solar surface to a height of fifty million miles. Were the velocity of ejection three hundred and eighty-three miles per second the height of the column would be five hundred million miles, while a further increase in the initial velocity would send matter away from the sun never to return.

Novas, or temporary stars are not considered such rare phenomena today, as they were even twenty or thirty years ago. By the aid

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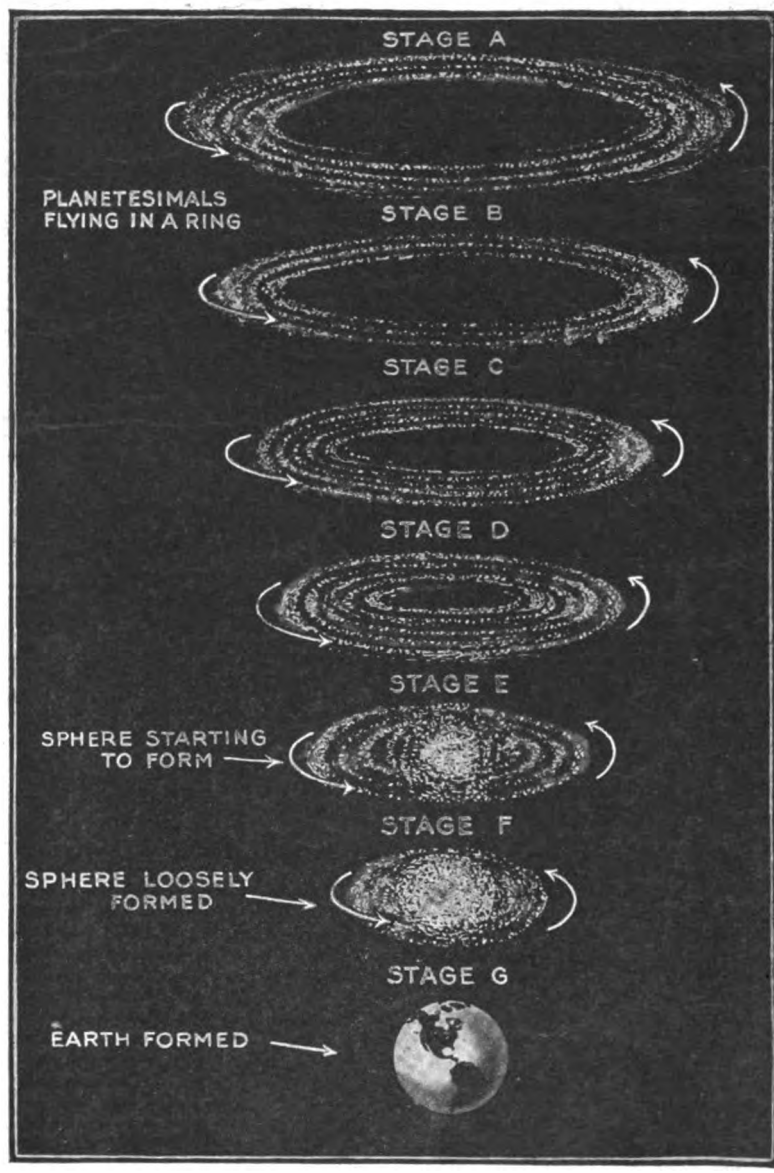
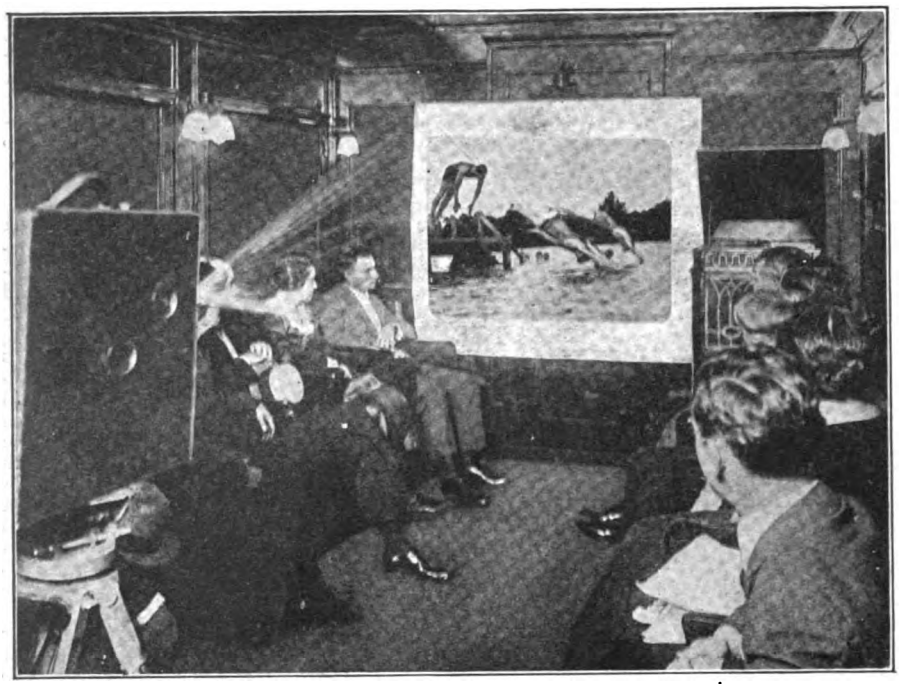


This Illustration Shows Vividly How a Planet Such as Our Earth Might Have Been Formed, Under La Place's Theory from the Whirlings of Planetesimal Particles. The Ring of Particles Acted Upon by the Gravitational Pull of Each Individual Particle, Gradually Contracts Until the Ring Itself Becomes of Smaller Diameter and More Dense, Breaking and Culminating Into a Semi-Dense Ellipsoid and Finally Into an Approximate Sphere Resembling the Present Form of Our Earth.

Movies Shown on Moving Train



A few weeks ago, the passengers aboard a southern railway train were pleasantly surprised when a phonograph was started, a screen rolled down and a movie show given.

Movie shows on trains running at a speed of 60 miles an hour, are quite a novelty, and an innovation which will add greatly to the comfort and amusement of the passengers. In conjunction with the photoplay given, a phonograph furnisht the music; and every hour, the performance of the show was repeated.

Moving Pictures "en route" While Speeding Along on a Moving Train Is One of the Latest Novelties and Pleasures Provided for Railroad Travelers. This Train Is the New Orleans Limited, and Music for the Show Is Provided by a Phonograph.

The pictures were made possible by the utilization of a specially designed generator, and in the opinion of the persons present, the show was an entire success.

Those witnessing the demonstration on the southern railway train were greatly pleased with the show, and exprest a fervent desire for the universal adaptation of this splendid idea, especially on long trips.

Many railway officials are now contemplating the installation of apparatus for furnishing movies en route.

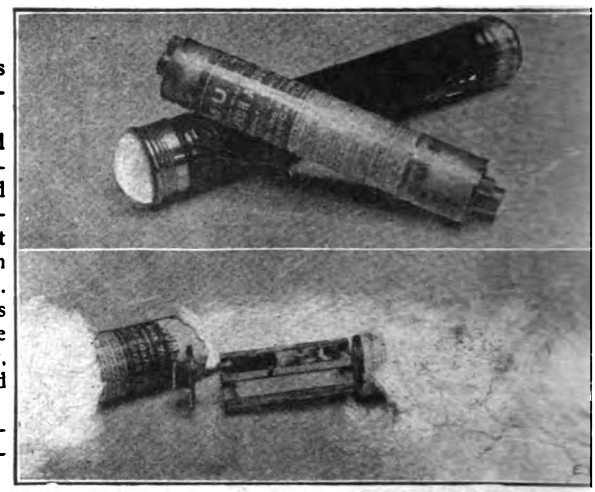
A Storage Battery Flashlight

A new so-called torch accumulator which has recently been placed on the English market promises to take the place of the dry-cell type flashlight battery. It is made to fit the standard two and three cell cases, is equally as light as those fillers, and has the distinct advantage of allowing for a complete recharge within from eight to ten hours after a complete "run down."

The photograph depicts this storage cell in its compact closed position. Cut open and dissected, it discloses great ingenuity and cleverness. A *grooved wooden separator* is filled with the red lead and litharge compounds for the positive and negative plates instead of the usual lead grid; this makes for its extreme lightness. Very little lead, except for the connections, enters into the construction of the battery. One cell is connected in series with the other thru the intercell separator.

When charging, a very small amount of sulfuric acid electrolyte is poured into each end of the battery, it is then connected to the charging circuit with the necessary resistance in series, for about eight hours. Upon removal, the acid is poured out if there should be any in the case or container, and the battery closed up and wiped dry.

This battery does not corrode the case because it is absolutely tight and acid proof.



Making Your Own Records

The new phonograph disc type record here illustrated, is the invention of C. E. Sanders, and consists of a record and reproducer operating on a wax which is placed on any standard phonograph. The recording and reproducing ments are fed across the disc by a arm traveling in a metal spiral lying in center of the disc.

New Disc Phonograph Attachment Enabling One to Record and Reproduce Their Own

Mr. Sanders has succeeded in producing a fluid cleaner, or erasing compound, which softens the surface of the wax and smooths it so that it may be used over and again from fifty to one hundred times without the usual shaving operation. The record on the wax is of the hill and dale variety, one hundred lines to the inch and runs about two and one-half minutes. The natural timbre of a voice is perfectly retained it is said. The records can be played fifty times from the wax, or they can be made permanent by sending them to the quarters for a small charge to be plated with copper, nickeled and stampt in conventional stock.

How Rocks Grow

By WILLIAM M. BUTTERFIELD

RECENTLY a motion picture of a mountain being blown apart by explosives was shown in various metropolitan theaters, probably causing most of those witnessing this thrilling exhibition of gigantic human "destruction" to think that the masses thus separated could never again form any part of solid rock, much less a mountain.

Those not familiar with the development of the stony foundations of the earth often believe rocks are unalterable masses which were created in their present shape at the birth of our globe, a very natural notion that is persistent and not easy to correct.

Rocks have changed in past ages, and have been disintegrated in a slower, less spectacular manner than was shown in the moving-picture display. Rock changes are so slow, in fact, that successive races of men often live their brief lives amid rocks, which as far as tradition and ordinary surface observation go, have never changed their contours.

The "destruction" of rock, as the breaking process shown at the movies, may under the usual understanding be called, —nevertheless, is an essential part of the history of many of the common rocks. All rocks exposed to the atmosphere, to common water, to snow, ice, glacial action and the heat of the sun, and of subterranean temperatures are subject to change; uneven expansion and contraction in the rock mass, or chemical actions may also affect them. Thus mountains may be reduced in part, to boulders, the boulders to pebbles, the pebbles to sand, and the sand to silt. Glaciers do much of this work.

Mountain streams, rivers, glaciers and even the waters of the ocean, convey this detritus and distribute it over large areas, —often thousands of square miles in extent, first as a loose soil of various degrees of fineness from boulders to the finest silt,—the mineral constituents of such soil is supplemented by vegetable and animal life and detritus. In course of time, other deposits are laid down at the bottom of the valleys, lakes and bays, one deposit on top of the other in layers of different kinds. These deposits may then be converted by cosmic force and cosmic time—lapse into rock strata, which often vary largely in composition.

Rocks are composed of various constituents that are practically indestructible, but which admit of many combinations and changes, the most important of their constituents are: oxygen, silicon, aluminum, magnesium, calcium, potassium, sodium, iron, carbon, sulfur and hydrogen. Oxygen in combination with the metal calcium and with carbon forms calcium carbonate or limestone, and this calcium with sulfur and oxygen forms calcium sulfate—gypsum.

Heat, such as is now exhibited by volcanoes, produces a typical variety of rock (the igneous rocks) and sometimes changes the character of the sedimentary and crystalline varieties. There is still an important element of rock growth and decay very rarely spoken of by geologists, but which could we think be mentioned here; it is the combined work performed unconsciously by the members of the other great kingdoms (animal and vegetable), mankind in this instance included.

Man tears the solid hills apart for building materials or minerals, he levels them to perform engineering feats, to construct water-ways, dams, traction lines, or for various other purposes. Over the entire habitable globe farmers spread on the soil some prepared constituent of rock as fertilizer, and dig up and level the soil in such a state, that water and air can more readily combine these fertilizing elements with the so-called unfertile ones.

So everywhere animals and plants are performing some such work, all of it essentially a part of rock transformation.

Lime in solution in oceans, rivers, lakes and drinking waters is made by animals into shells, corals or bones.

Glacial Action Grinding Rocks to Powder and Forming Boulders. The Streams Issuing from Their Lower Moraines are Opaque and Discolored by Suspended Mineral Matter Produced by the Grinding of the Rocks Under the Mass of Slowly Moving Ice.

An Active Volcano, Showing the Agency Which Has a Part in Forming Plutonic Rocks. What Goes on in the Interior of the Earth Can be Surmised from These Exhibitions of Cosmic Power.

A Mountain Cascade Playing Its Part in Rock Disintegration. Its Action Is Usually Mildness Itself Compared to the Slow Intensive Glacial Processes, but the Action Is Progressive and Noticeable to the Student of Geology.

Level Strata of Rock Undisturbed by Any Changes. As the Strata are Supposed to Have Been Deposited from Suspension in Water, They are Normally Level.

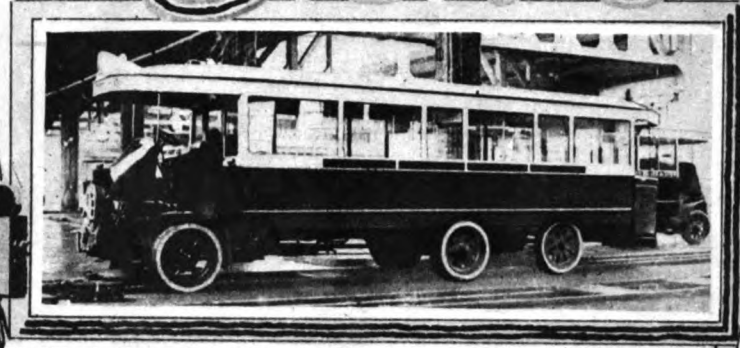
The Bending and Deformation of Originally Parallel Strata. Here We See the Normally Level Strata Thrown Out of Line and Upheaved and Depressed by Various Causes.

The Erosion and Upheaval of Rocks Forming Mountains and Making the Strata Totally Irregular. Here Volcanic and Igneous Action May Come into Play with Accompanying Metamorphosis.

Man's Mining Operations, Where He Performs the Functions of the Mole, Working Formerly Almost in Darkness, Altho at Present the Electric Light Has Enabled the Mine to be Brilliantly Lighted.

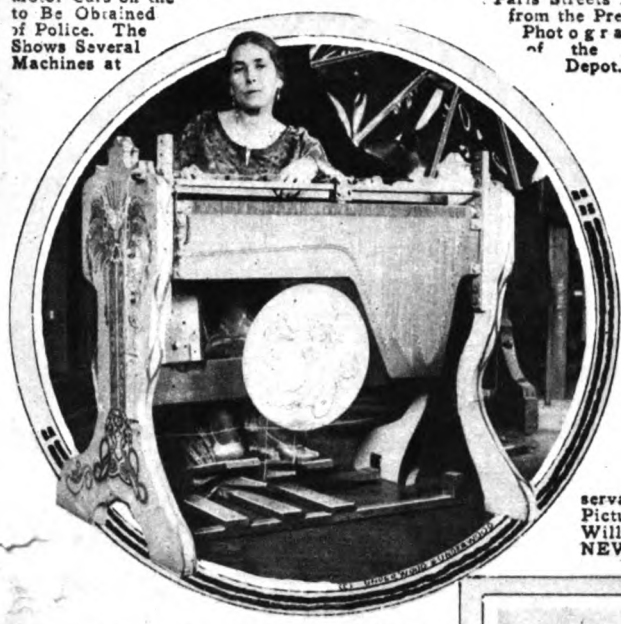
Mining Animal Rock (Coral Rock) that Forms Nearly all of the Island of Bermuda. Some Rock Can be Easily Worked Without Using High Explosives, But Other Rocks Again, Such as Granite, Are Extremely Hard to Quarry.

Science

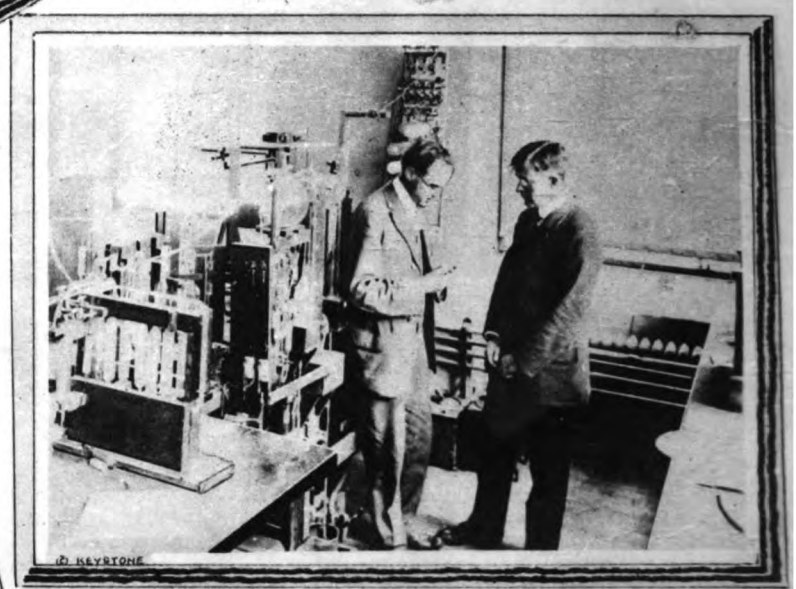


Six-Wheel Motor Bus, Recently Placed in Operation by a Paris Transportation Company. A Fleet of These Machines Has Been Placed in Commission. A Special Permit to Use the Six-Wheel Motor Cars on the Paris Streets Had to Be Obtained from the Prefect of Police. The Photograph Shows Several of the Big Machines at Machines at the Depot.

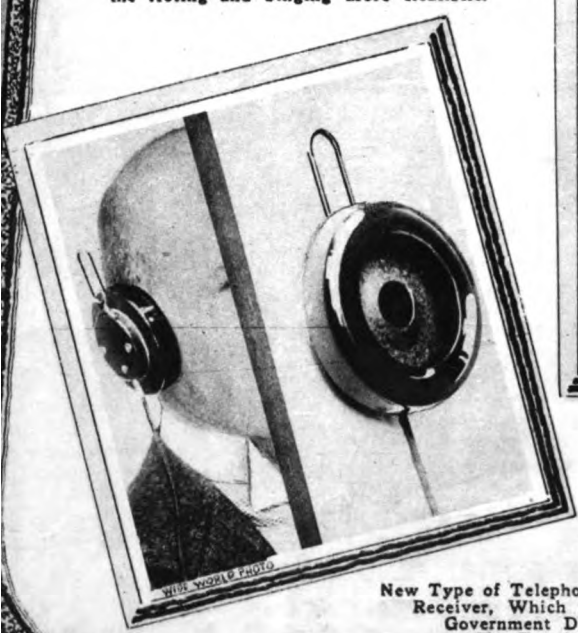
"Movies" of the Moon Were Made Recently Thru the Great Refractor Telescope at the Yerkes Observatory at Williams Bay, Lake Geneva, Wisconsin. The Pictures Were Made by the International Film Service and Will Be Shown Exclusively in the INTERNATIONAL NEWS WEEKLY.



Mrs. Mary Hallock Greenwalt of Philadelphia, With Her "Nourathar" or Instrument by Which, as One Would Play a Piano or Organ, Lights in the Theater May Be Controlled in an Amazing Number of Ways to Permit Any Expression Desired by the Orchestra Leader, So as to Make the Acting and Singing More Realistic.



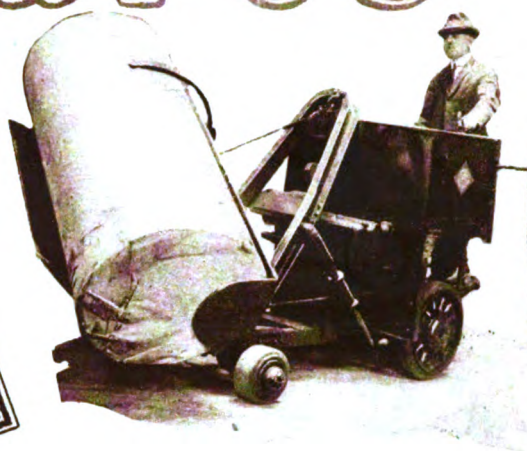
Dr. Willis R. Whitney and Dr. Irving Langmuir, Who Were Awarded Distinguished Honors for Important Scientific Research by the Society for Chemical Industry. Dr. Whitney (at Left) Is the Director of the General Electric Company's Research Laboratory and Dr. Langmuir Is Assistant Director.



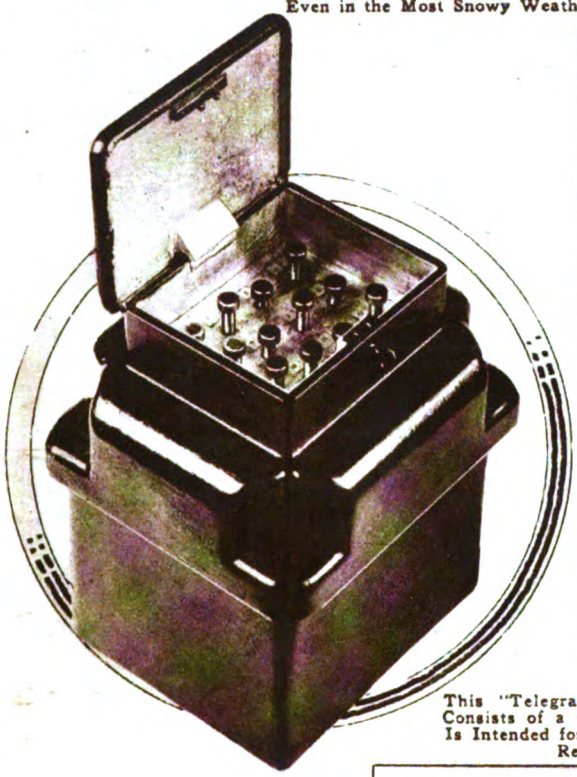
New Type of Telephone Receiver for Long Distance Calling. This Type of Receiver, Which Hooks on to the Ear, Has Been in Use by All the Government Departments of Germany and Found Highly Successful. No Sound but That of the Human Voice Over the Wire Can Creep in Thru the Sides of the Receiver While the 'Phone Is in Operation.

in Pictures

Before the Towns in This Swedish Locality Become Famous as Winter Resorts, These Places Were Utterly Snowed in. By Means of This Trolley Which Runs from One Resort to Another, and Which Is Equipt With an Efficient Snow Plow, the Road Is Kept Open Even in the Most Snowy Weather.

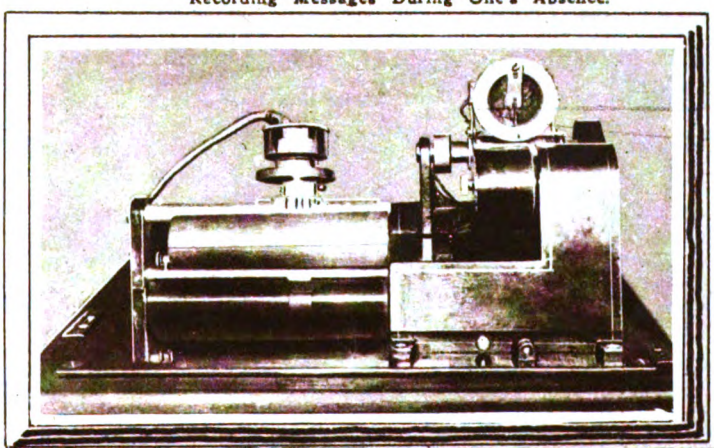


An Ingenious "Apron" Attachment to the Fore end of an Ordinary Electric Truck Has Eliminated the Heretofore Tremendous Labor Necessary to Handle the 800-Pound Rolls of Newsprint Paper. The Truck, or Apron as It Is Called, Picks Up the Heavy Rolls, Carries Them Off and Stands Them on End. The Photograph Above Shows the Ingenious Mechanism at Work.



The Machine Shown Above Shines Your Shoes While You Wait Without Extra Tips. The Machine Here Illustrated Is Fitted with Three Seats and These Three Patrons Can Be Accommodated at One Time. The Electric Motor Driven Brushes First Remove the Dust and Dirt from the Shoes, and After the Polish Is Applied, the Shoes Are Given a High Gloss by the Attendant. One Minute Completes the Process.

This "Telegraphone" Perfected by Mr. Seelan Newman of Berlin, Consists of a Combined Recording and Reproducing Phonograph. It Is Intended for Office and Home Use, and Is Attached to Telephones, Recording Messages During One's Absence.



A New Auto-thief Alarm Device Exhibited at the Chicago Auto Show Attracted Much Favorable Comment. The Alarm Is Enclosed In an Iron Box. No Part of the Machine Can Be Touched Without Starting This Alarm to Ringing. This Prevents the Stealing of Autos. Over 100,000 Combinations of the Locking Mechanism Are Possible by Means of the Keys.

The Love Machine

By CHARLES S. WOLFE

FENNIMORE ript out a surprised oath, and hurled the morning paper to the floor with such vehemence that the sad faced man who stood patiently behind his chair involuntarily bounded backward a foot or two. Such outbreaks on his master's part were unusual.

Muttering unintelligibly, Fennimore addrest himself to his coffee and rolls vigorously. This farce lasted only a few minutes, however, for the young man was past the eating stage. In spite of himself he soon gave over, reluctantly picking up the paper and turning again to the advertisement that had engendered the outburst.

He found the "Personal" column again, and located the offending ad. He read and re-read it, carefully, moodily.

"I offer my personal services to any person who finds his or her love unrequited. Success of your suit is certain if I handle it. George Parsons, 1938 M—— Street."

The words stared mockingly up at him from the printed sheet. For be it known that Fennimore, scion of wealth, accustomed to having his desires speedily realized, no matter what bizarre turn they took, was head over heels in love. Very unfortunately, the object of his affections could not, by any stretch of the imagination, be said to be in the same condition.

Fennimore, paper in hand, rose slowly to his feet, leaving his neglected breakfast to the care of the servant.

"His personal services, eh?" he muttered, "Well, we'll see what they amount to."

So it was that a half hour later, while his chauffeur loafed in the car outside, Fennimore sat in conversation with George Parsons in the M street house.

Parsons, a jovial faced, middle aged man of short stature, honestly privileged to prefix his name with "Professor" and suffixt with Heaven knows how many formidable combinations of letters, leaned back in his chair and regarded his fidgetting visitor genially.

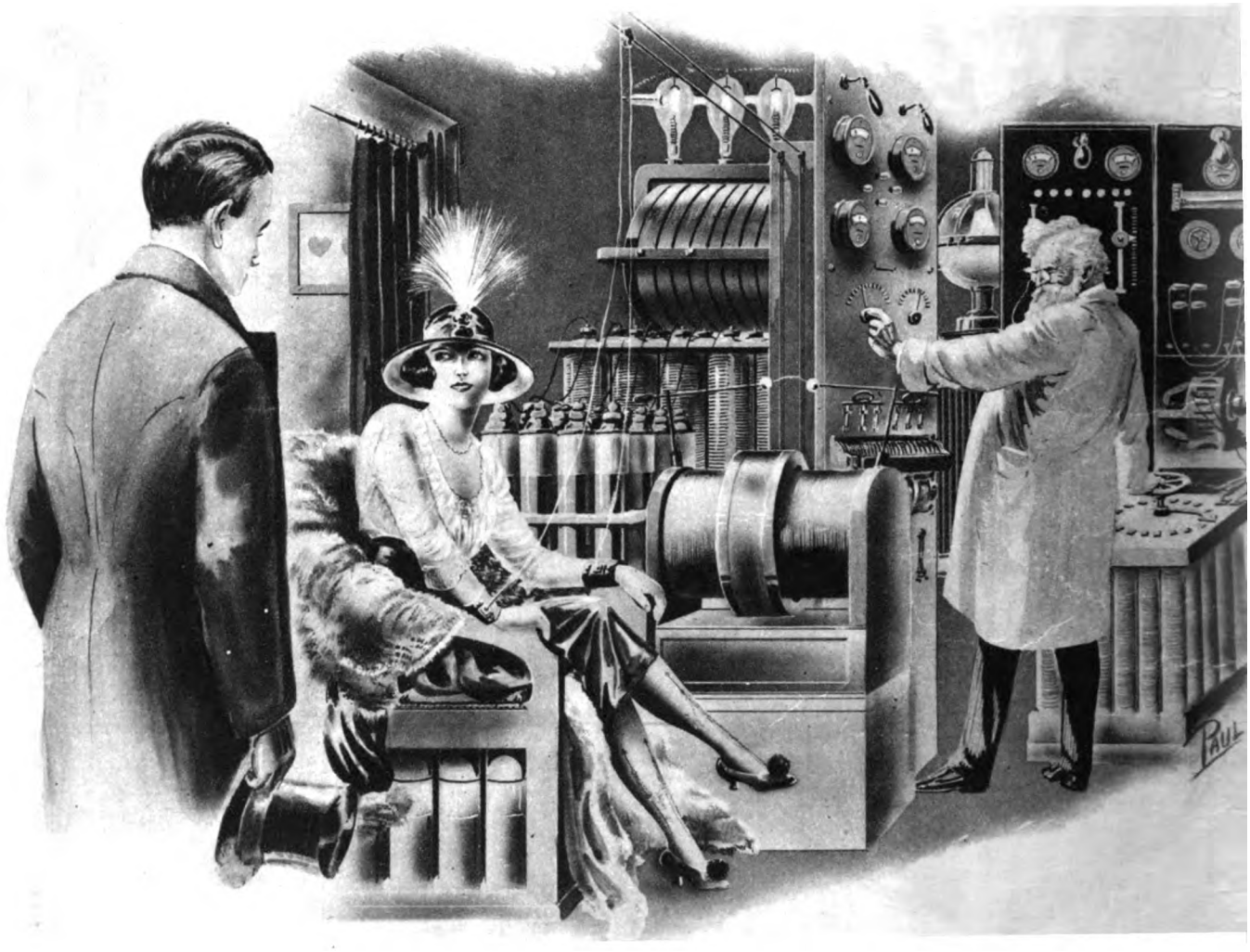
"So you are in love?" he mused. Fennimore glared without replying, a fact which disturbed the placid professor not a jot.

"Does the lady give you no encouragement whatsoever? Have you made no progress at all on your own hook?"

Fennimore's fists clenched and unclenched in the violence of his rage. "Just enough to keep me hanging around the stage door like the rest of the fools in this town," he flung out bitterly, "I'd give a million dollars to see one symptom of real affection in her whole body."

Parson looked pleased. "Oh, we won't be that steep," he said, assuringly, "Ten thousand will see you out easily."

If looks could kill, Parson's hour had struck then and there. "You're damned mercenary about it," snarled Fennimore. "That detail could have waited 'til later."



"'.....and If You Were a Hundred Times Better Looking Than You Are, I Would Not Marry You If You Were the Last Man on Earth.' Prof. Parsons snapt on a Switch and Grinned At the Disheartened Millionaire. 'You Young People Think That Love Is a Question of Looks, Circumstances and Mutual Attraction,' Said Prof. Parsons. 'You Have Fallen Into the Common Error of Mistaking the Effect the Cause. No two People Will Be Attracted to Each Other to Any Degree,—Far From Sufficient to Love,—If Their Natures Are Not Tuned Properly for the Occurrence of the Phenomenon'....."

"Just enough to keep me coming t with the supper parties after the sh

Parsons was quite unmoved. "It best that we understand this part of matter right from the start," he murred, firmly, "I'm a scientist, yo man, but I am not wedded to studies. The Almighty Dollar is no volting spectacle to me."

"And what do you propose to do earn this sum?" challenged Fennim sulkily.

"I propose to make this—— er— actress of yours the most docile, ob ent, adorable and loving young b that you ever laid eyes on."

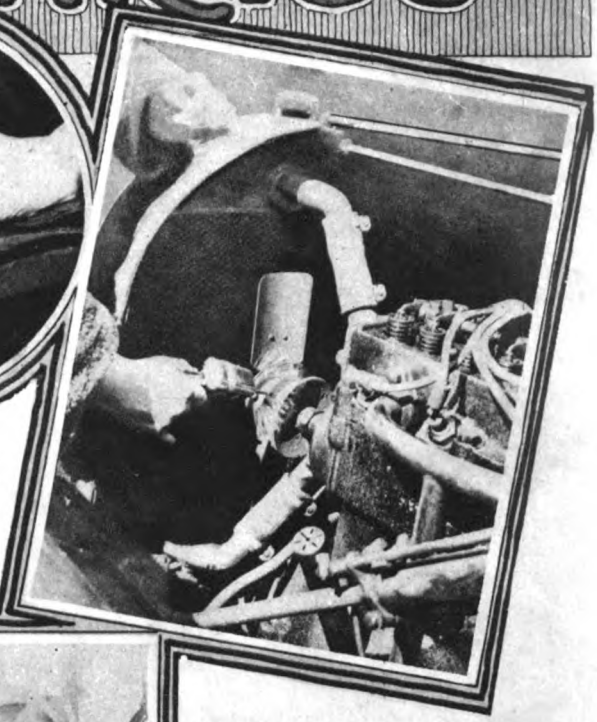
(Continued on page 1357)

Auto Wrinkles

A Stubborn Lamp Rim Will Come Off Easily Without the Damage Done by Tools If Friction Tape Is Wound Around the Rim and Given a Quick Jerk.

Two Scrub Brushes Fastened to a Mop Stick Make a Quick and Ideal Way of Cleaning Springs Without Getting Under the Car.

One Way of Quickly Mending Loose Cap on a Country Road,—by Inserting a Small Piece of Match-Stick in the Center, Preventing Further "Skidding."

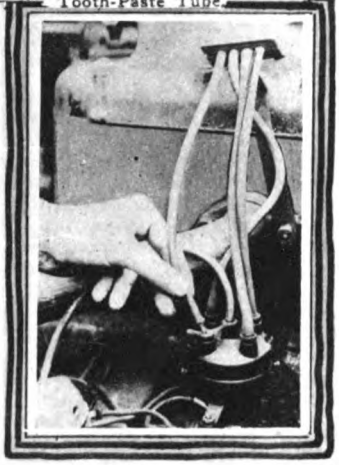


A Flashlight Attached to a Screw Driver by Means of Adhesive Tape, Throws the Light Just Where the Work on the Motor Is Being Done.

Stalled on a Country Road on Account of a Dying Battery! Don't Give Up! Stop a Passing Car. If You Have With You Two Wires, Connect the Positive Wires of the Passing Car's Battery to Your Own, Also the "Negatives." This Aid Will Enable the Car to Start and Will Give the Dying Battery a "Transfusion."

When the Distributor Holes Become Worn an Excellent Tightener May Be Made by Wedging Into the Holes the Thin and Pliable Metal of a Tooth-Paste Tube.

When "Near Mechanics" Try to Adjust Your Carburetor, It Is Often Hard to Get It Back Again Into Proper Adjustment. One Way of Preventing This Meddlesome Practise Is to Cover the Adjusting Screws of the Carburetor With Sealing Wax.



A Toy Periscope, to Which Is Attached a Small Flash-Light, Will Quickly Locate Lost Bolts and Nuts Which Have Dropt Into the Cavernous Drip Pan. Such an Electric Periscope Is Useful in Numerous Other Ways.

Take a Nail File on Your Auto Tour. It Is Available for Polishing Off the Corroded Contact Points of the Distributor When It Fails to Carry the "Juice" to the Plugs. It Is Better Practise However to Purchase a Thin Knife File Especially Made for Such Purposes, Procurable at Tool Supply and Auto Shops.

"In 1999"

"Scientific Progress in the Last Century. Presidential Address Before the American Academy of Science, September, 1999."

By FRANKLIN RUTH

Gentlemen of the Academy:

AT the close of this twentieth century we look back upon a more brilliant array of scientific achievements than man has ever been privileged to see, or imagine. within the last few decades our earth has entered upon an era that surpasses the greatest expectations of the nineteenth century philosophers. Civilization has advanced at a rate comparable to a geometric progression, and today we are living in the Golden Age of Science. In looking back upon this century, we should review some of the most significant achievements of the past, and note their bearing upon progress and their relevance to the science of today.

The dawn of modern science occurred in 1898, when the discovery of radium and its radioactive properties was made by the Curie's. The importance of this discovery can never be too greatly emphasized, for it marks the actual conception and birth of the principles upon which today's science is founded. The untiring investigations of those great pioneers of modern science, Rutherford and Soddy, in the field of radioactivity, soon caused them to announce the hypotheses of atomic disintegration and evolution of the elements. Altho these theories were at first discredited and regarded in the same light as Perpetual Motion, the undeniable existence of enormous reservoirs of energy in the minute atom, as evidenced by radium, soon attracted the attention not only of scientific circles, but of the whole world. Discovery followed discovery. Research became busy with the momentous question whether artificial means could accelerate or retard the processes of spontaneous disintegration. Civilized nations became excited and expectant. Vivid fiction, exploiting the imaginary results of the discovery of atomic disintegration, was widely read, and increased the credulity of the people.

It was at about this period that the Great War occurred. Altho this world disaster took a great toll of life, it proved to be an impetus to scientific advancement. At the close of the War the United States found itself the creditor of almost the entire European continent, whose nations were on the verge of bankruptcy and revolution. Unrest was widespread. Crises between labor and capital were imminent. Numerous strikes occurred, and Bolshevik uprisings in Russia threatened to undermine all governmental control and order. The air seemed charged with something that stifled all thoughts of resuming prewar existence. Over all hung unconscious, vague dread, grasped in its entirety by only a few minds of scientific preeminence. Prophets and religious fanatics preached the end of the world and the arrival of the Millennium. The world was ripe for some cataclysm that would overwhelm civilization and possibly sweep all life from the planet.

Suddenly, in 1924, occurred the first phenomenon of a series, which created physical disturbances sufficiently powerful to attract general attention. Scientific investigators, however, with the aid of their delicate instruments, had detected weaker but similar disturbances at previous periodic intervals. The world waited anxiously for words that might come from scientific men, identifying the cause of the mysterious phenomena. Scientists knew that the

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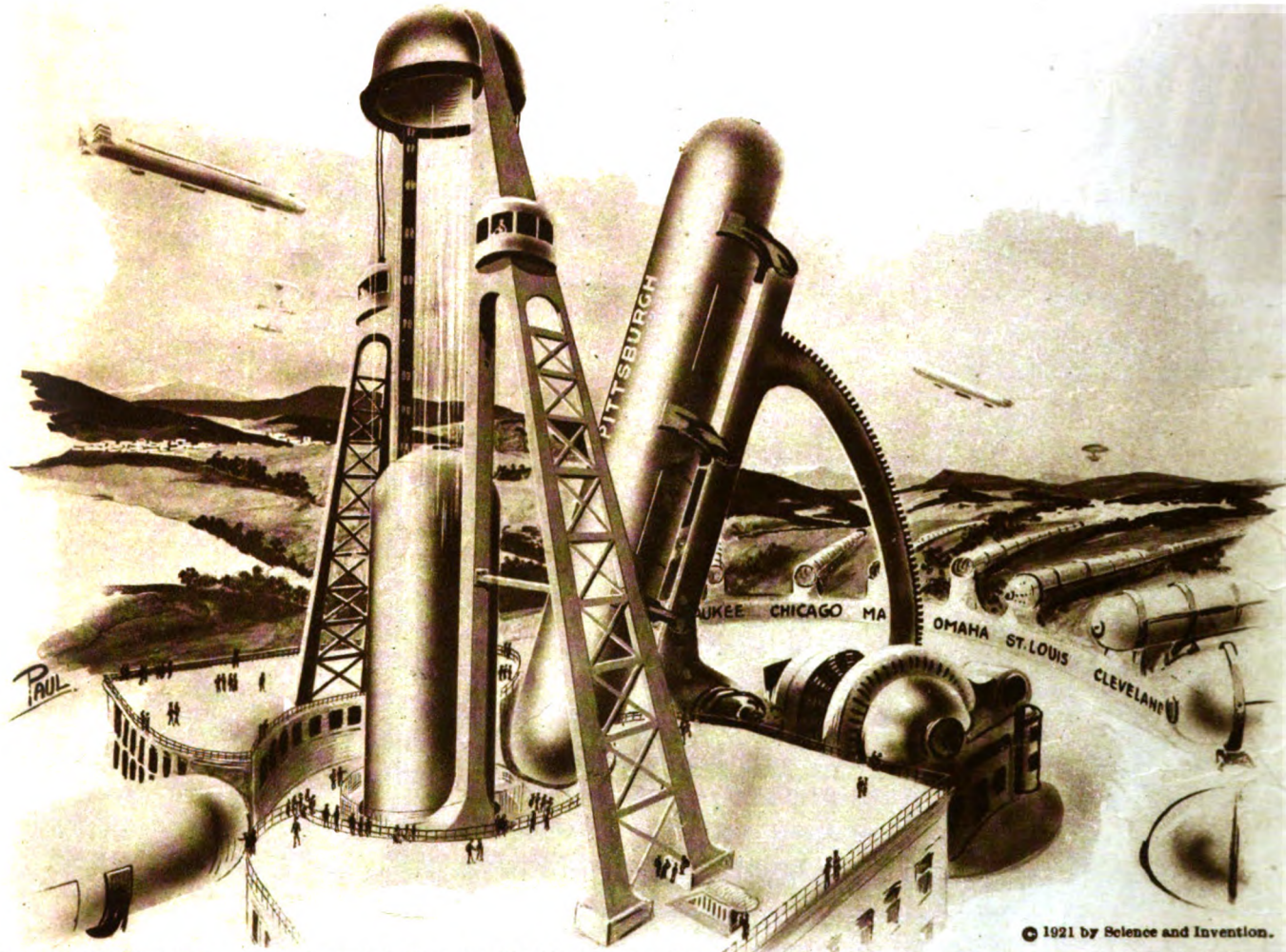
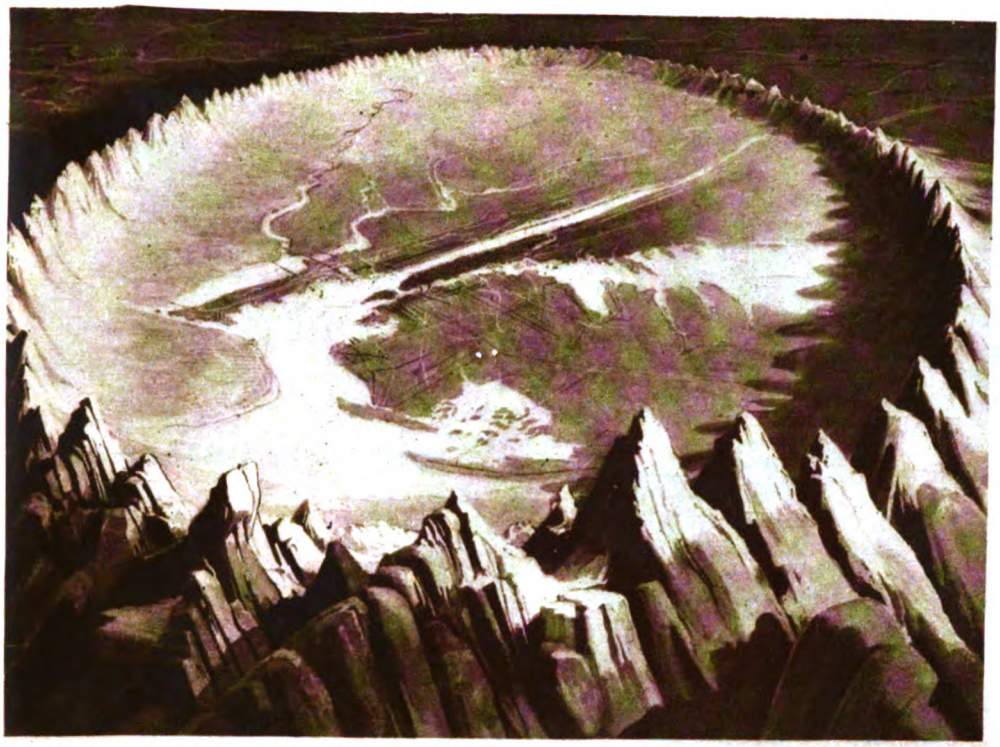


".....Thirty-Foot Tubes Were Excavated Thru the Earth's Diameter, Reaching From a Large Industrial Center on One Side to Some Extensive Agricultural Area Upon the Other. Africa, China, Australia and Parts of South America Were Touched. As These Tubes Were Sunk, They Were Lined With Browning's Electro-Heat Converting Apparatus, Which Turned the Intense Heat of the Bowels of the Earth Into An Immense Voltage, Giving An Electric Current, But Left the Interiors of the Tubes Relatively Cool and Insulated From the Fiery Medium Thru Which They Past. Food and Other Commodities Were Then Quickly Hauled Over Extensive Railroad Systems to the Mouths of the Tubes and the Elevator-Like Carriers Were Dropt Thru the Center of the Earth. The Momentum Gained in the 4000-Mile Drop Carried the Cars Past the Center of the Earth and Up to Within a Few Feet of the Opposite Surface. At This Point They Were Caught by Automatic Catches and Giant Electric Hoists Hauled Them to the Surface....."



One of the Giant Craters on the Moon's Surface Can Easily Contain the Whole of Greater New York City, as the Illustration Above Shows.

Trip to the Moon

WE know perhaps more of the configuration and physical make-up of the moon's surface than of any other heavenly body, due to our industrious and untiring astronomers. There are few regions of the moon's side facing the earth that have not been carefully explored and charted. Altho the moon is over 238,000 miles distant, our large telescopes bring the lunar landscape sufficiently into range so that all of the larger mountains with their ranges and craters are readily explored. The two illustrations on this page represent lunar scenes as we would see them, if we actually were to visit the moon.

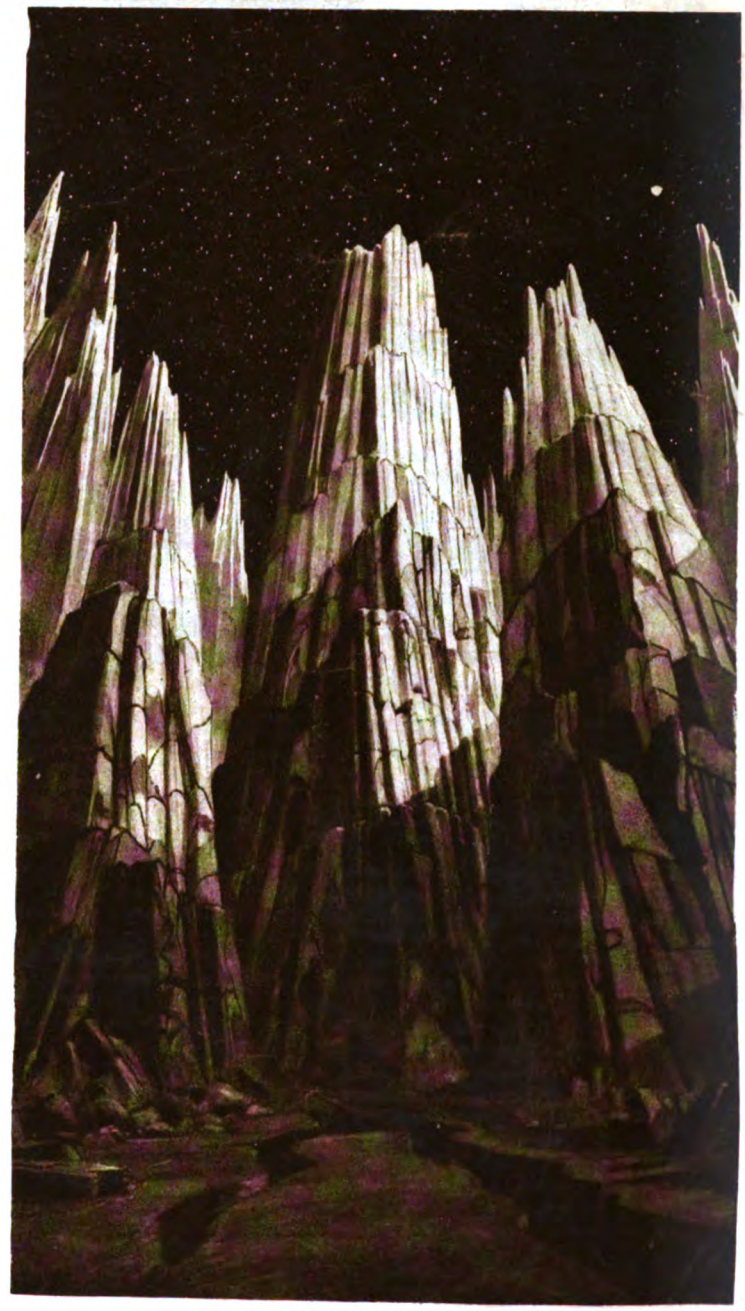
In the first place, the moon, having no atmosphere, the sky as it would be seen from our satellite, is inky black with the stars shining forth in a brilliancy never viewed from the earth. A brilliant sun shines out of a black sky, while the sun itself is surrounded by a wonderful corona with its magnificient streamers only partly seen on earth at the time of an eclipse. Some of the lunar mountain ranges are tremendous, and we have nothing like them on earth. The craters of some of these huge extinct volcanos are of tremendous size; some of them measured across the bottom are more than 150 miles in extent, and you could readily place the state of Rhode Island in one of these huge depressions.

Our top illustration shows only a moderately large size crater, and it will be seen that New York City and environs would readily fit into such a baby crater, having a diameter of some 50 miles. As for height the lunar mountains are truly titanic. Some of these mountains are over 28,000 feet in height. Standing at the foot of one of these giants they seem to topple over on one due to the perspective, the same as when you stand at the foot of a skyscraper and look upwards. It seems to be bending over on you. When the sun shines on these huge mountains, it is of course possible to see all the way up as there is no atmosphere and no clouds to impair the vision. Such a sight must be overpowering and grandiose.

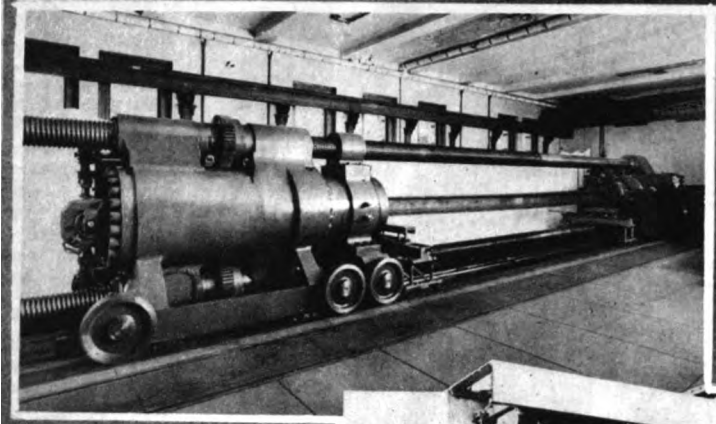
At the foot of these mountains we see huge cracks running in all directions, and these cracks are vast canyons in themselves, much deeper than we know of on earth. They extend for miles down into the bowels of the moon, and a fall into one of them would, of course, mean instant death to the traveler.

But the most impressive and terrorizing experience to the future moon traveler will undoubtedly be the vast death which is on evidence at every hand. The moon is a dead world as we all know, and there are no animals and there is probably no vegetation; only barren rocks greet the eye. Everywhere is silence; everything is dead and lifeless, and the future traveler must be encased in a sort of diver's costume with a glass-windowed helmet as he must bring with him his own air if he wishes to stay alive. And, he does not wish to stay long on the moon unless he walks around the foot of the mountains because there are possibly few places as unsafe as the moon itself. Huge meteors are crashing down almost continuously, and there is no atmosphere as on earth to act as a buffer. These

(*Continued on page* 1355)

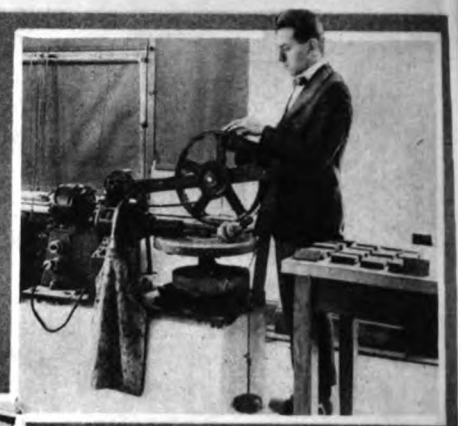


Close-up View of the Mountains of the Moon Showing Their Precipitous Sides. The Moon Has No Atmosphere and So Even If an Adventurous Earthly Being Should Make the Trip Some Day, to Our Neighbor the Moon, He Would Not Find It a Very Salubrious or Pleasant Place on Which to Take up His Habitation, for the Only Way He Could Live on the Surface of the Moon Would Be by Providing Himself With an Outfit Similar to that of a Diver's Suit, Equipt With an Oxygen Tank and Artificial Air Device.



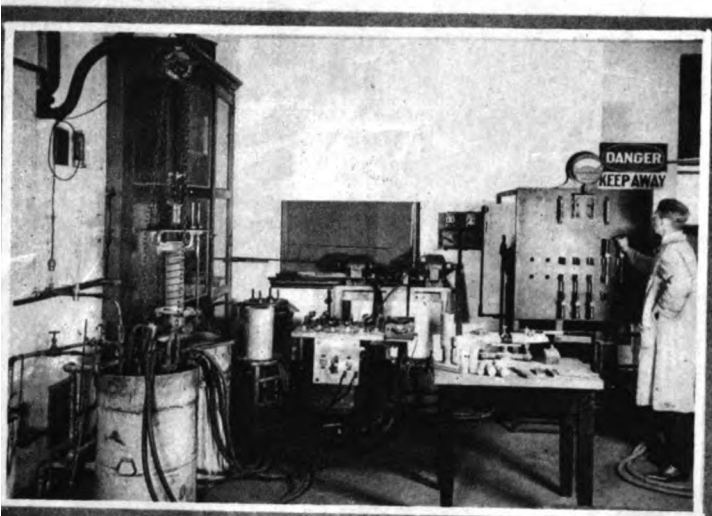
This Giant Testing Machine at the Bureau of Standards Laboratory, Washington, D. C., Can Register With Equal Accuracy, the Power Required to Crush an Egg Shell or That Required to Crumple Up the Strongest Steel Girder. Its pulling Strength Is 1,150,000 Pounds and the Maximum Crushing Power Is 2,300,000 Pounds.

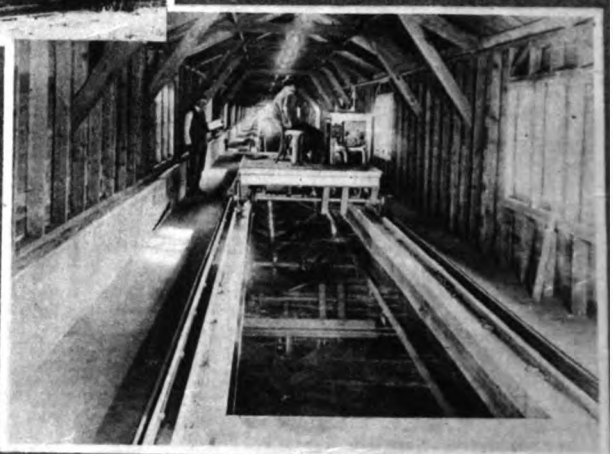
Photo at Right Shows But One of the Thousands of Activities Carried on in the Bureau of Standards Laboratories. That of Testing the Wearing Quality of Sole Leather. Pieces of Leather Are Placed on a Wheel Which Turns Against an Emery Disc, Carrying the Weight of a Man.



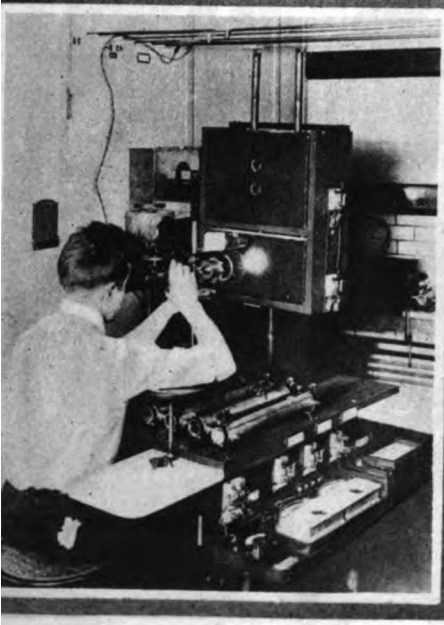
Railroad "Track Scale" Testing Car, Built By the Bureau of Standards Experts. Each Weight Has a Value of 10,000 Pounds or 5 Tons, and the Car Is Sent About the Country to Test Railroad Track Scales, and Also to Serve as a Standard By Which the Scale Testing Cars of the Various Railroad Companies Are Calibrated.

The Preparation of Pure Iron Alloys Is Carried on in the Special Laboratory Shown Below, Where Electrolytic Iron 99.97 Per Cent Pure Has Been Obtained. Two Vacuum Electric Furnaces With the Necessary Transformers and Control Switchboards Are Here Shown.

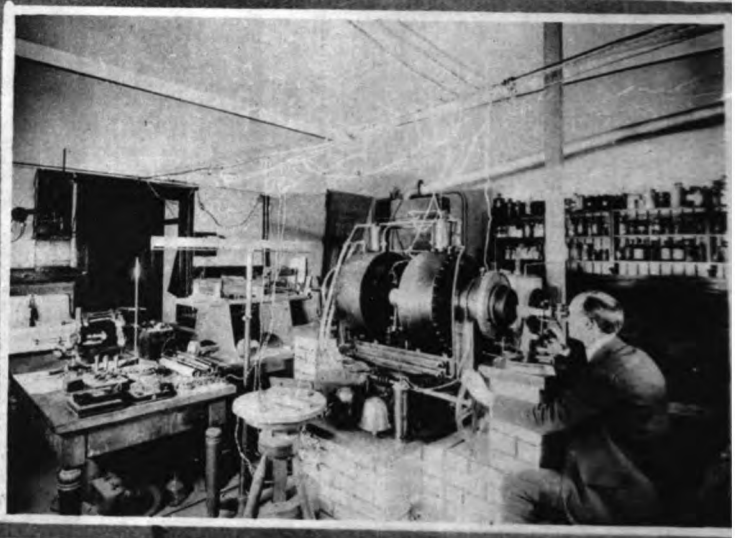




The Photograph Above Shows the Long Tank of Water Used in Calibrating Water Meters. A Miniature Control Car Runs Along the Rails at Either Side of the Tank While the Operating Mechanism of the Water Meter Being Tested Is Carried Thru the Water at Any Desired Speed and the Reading Checked With a Standard Meter Carried on the Car. The Speed of the Car Is Controlled by a Rheostat.



The Photo at the Left Shows One of the Hundred of Different Technical Departments of the Bureau of Standards Laboratories. Here We See One of the Bureau's Engineers Making Researches Into the Heat Liberated by Different Types and Makes of Electric Light Bulbs.



At a Temperature of 573 Degrees Crystalline Quartz Changes Into Anot Crystal With a Transfer of Energy During the Process. Remarkable Resu Regarding the Temperature Changes Occurring in Crystalline Quartz Ha Been Carried Out by Means of the Extremely Powerful Electro-Magnet a Auxiliary Apparatus Shown in the Photo Above.

Recent Work of the Bureau of Standards

ALTHO you and I, as citizens of a great and progressive nation, perhaps do not realize the fact, yet every time we purchase a pound of butter or a sirloin steak at the grocers or butchers, these food products are weighed out on a scale, which has been checked with the standards provided by the National Bureau of Standards Laboratories located at Washington, D. C.

One of the accompanying photographs shows a most interesting sight,—that of a railroad track scale testing car built and calibrated by the Bureau of Standards scientists. This car is fitted with weights of 10,000 pounds or 5 tons each; it is sent about the country to test the railroad track scales and it also serves to set the standard by which the test cars of the various railroad companies are evaluated.

Altho we are prone to think that the average weighing scale is accurate in the majority of cases, it has sometimes been found that as high as 50 per cent. of the larger scales inspected have been quite incorrect,—due simply to the fact that no proper facilities had been available heretofore for testing the scales.

Another photograph shows one of the thousands of activities carried on at the laboratories of the Bureau of Standards, —that of testing the wearing quality of sole leather. In the machine here illustrated, pieces of leather are placed on a wheel which turns on an emery disc carrying the weight of an average man. After carrying on this test for a definite period of time, a careful record of which is kept of course by the engineer in charge of the work, the exact wearing quality of the leather by this simple test can be determined with exactitude.

TESTING WATER METERS WITH MINIATURE ELECTRIC TROLLEY CAR AND TANK.

One of the accompanying photographs shows the long tank of water used in making accurate standardization tests on water meters,—not the ordinary variety used for integrating the number of cubic feet or gallons of water passing thru your kitchen and bathroom spigots,—but for accurately testing the large motors employed to determine the force and quantity of water used to operate mills and factories. In this case, instead of having the water flow thru a pipe or channel and also thru the meter in order to make the necessary test on it, the water simply remains stationary in the tank shown, while the meter under test is secured on an arm projecting down into the water, which arm is securely fastened to the small electrically controlled car, shown. Many of us probably envy the man who makes these tests, for most of us in our maturity, still manifest, secretly, a great deal of the juvenile love of the trolley motorman's job.

By means of the electric controller box on the trolley car, the meter can be moved at any definite speed desired, thru the still water and the readings of the meter being tested are accurately checked with those indicated by the standard meter. The standard meter used for checking such measurements in any case, is of course calibrated previously by some other means than the one usually employed in checking up the meters sent in by patrons of the Bureau. In the case of water meters, this is often done by weighing and measuring the amount of water passing thru the meter in a given time.

Another one of this interesting Bureau's tests is illustrated in the photo showing one of the engineers making researches into the heat liberated by different types and makes of electric light bulbs. Contrary to popular opinion, the services of the Bureau of Standards are intended not only for governmental work, but it is maintained and stands ready to make any test, within its functions, for private citizens, companies or corporations, at a reasonable charge.

It is a mark of distinction and of the highest order for any new invention or device, to have bona fide tests made in the Bureau of Standards' laboratories.

GIANT TESTING MACHINE MEASURES POWER TO CRUSH AN EGG.

One of the accompanying photos shows a giant testing machine operating with screw-shafts, and which machine can register with equal accuracy, the power necessary to crush an egg shell, or that required to break down the strongest steel sky-scraper girder. The machine here illustrated is suitable for testing any piece of steel, iron or other metal from a few inches in length up to 30 feet. It can exert a pulling strength up to 1,150,000 pounds and a crushing power of 2,300,000 pounds. The great screw-shafts are 40 feet long and one foot in diameter. Instead of water being used in the cylinders to furnish the necessary hydraulic power, oil is utilized.

Several of these machines are in use by the Bureau of Standards, for testing steel beams and other structural members. In the Pittsburgh branch of the Bureau of Standards' Laboratories, one of the most powerful testing machines, if not the most powerful in the world, has been installed; this is the great 10,000,000 pound Olsen testing machine. These machines are used in a series of investigations jointly conducted by the Bureau of Standards and the American Society of Civil Engineers for the purpose of quickly calibrating and checking the formulae for computing the strength of steel columns, beams and other members upon which formulas the efficiency and safety of our present day offices and industrial buildings depend.

The huge Olsen testing machine stands four stories high and somewhat resembles the horizontal type of testing machine shown in the accompanying photo if the latter were changed to the vertical position. It is often used for determining the crushing or compressive strength of such materials as a section of a brick or concrete wall, etc. It is capable of exerting a pressure as high as 10,000,000 pounds or 5,000 tons,—sufficient to break the steel propeller shaft of the greatest war vessel afloat.

A specimen brick pier made up for test to ascertain the qualities of a particular brick, measured 16 feet high by 48 inches square. Some idea of the tremendous crushing power of this machine can be gained by imagining what force must be exerted to cause this solid brick column 4 feet square and 16 feet high to crumble.

SPECIAL EQUIPMENT FOR PREPARING PURE IRON ALLOYS.

The preparation of pure iron alloys calls for special laboratory equipment, which demand has been met by the National Bureau of Standards, where electrolytic iron 99.97 per cent. pure is obtained. The illustration shows the apparatus in use, consisting of two electrical vacuum furnaces, together with transformers and switch boards for the electrical control. On the table, included in the photograph, are special crucibles, finished ingots, together with rolled bars from these ingots, and tensile test specimens.

By way of insuring a reliable foundation for the scientific study of the effects of the small portions of impurities always present in iron and steel it is essential to have accurate knowledge of the properties of really pure iron and alloys of pure iron with known amounts of single impurities, intentionally added. Such iron, in the absence of impurities, is being obtained by the Bureau of Standards. It is melted in a vacuum to

(*Continued on page* 1326.)

A Few "May" Articles

Salvaging Ships in 24 Hours with the DeVido Salvaging Apparatus.

How the Size of Betelgeuse Was Measured by the Interference of Light Waves—By Prof. T. O'Conor Sloane, Ph.D. LL.D. Popularly explained with diagrams and photos of the actual apparatus.

What a Drop of Water Looks Like —With startling microphotographs showing some of the strange organisms existing in an ordinary drop of water.

What Causes Insects to Fly Towards a Light? With photographs. An exceptionally interesting article giving the latest discoveries of science concerning this phenomenon. By Dr. E. Bade.

How Radium is Used to Cure Cancer. Clearly illustrated with exceptional pictures. By Joseph H. Kraus.

Colloidal Fuel—How the Very Essence of Coal can be Extracted and Piped for Hundred of Miles. Interestingly explained in picture and story.

Dr. Pringle discusses Ether, the Sun and the Earth. A brilliant yet popularly written scientific discourse which everyone can enjoy. Related by our learned friend—John De Quer.

Chinese Pigeon Whistles—With Actual photos.

Instruments that Measure the Stars —Illustrated.

Optical Lenses Colored by Electricity. By Harry Rosenthal, Cons. Engineer.

Simple Substitute for the Photostat—Explaining how to copy pictures and text from books, magazines, etc., directly without a camera or other apparatus. By D. P. W. Maunsell.

Monsters of Long Ago—Wonderfully Illustrated. By Dr. E. Bade.

Home Electrics

By G. L. HOADLEY, M. E.

When the Fuse Burns Out

IT usually happens that the fuse blows, putting the lights out at the worst possible time; for instance, when the housewife is nicely started on the big family wash with the electric washer, putting it out of commission Exasperating, isn't it? The head of the house is away at work too, else he could worry about it. The Electric Power Co., will send a troubleman out to make repairs—and charge you for his time and three or four fuses, when only one was needed. You will need to wait anywhere from one to two hours for him to arrive and that will delay your washing so you can't get started again till after lunch. If you only knew how to locate the blown fuse and put in a new one, you could get the washer going again in five minutes and have the wash finished by 12 o'clock. Why not learn how? The thing is very simple and if directions are followed, you can't possibly receive a shock.

First, let us consider the purpose of the fuse. Why must fuses be put in the circuit? They are a nuisance when the fuse blows we all agree, but suppose your washer had not been protected by fuses. You get something caught in the ringer that stalls the motor. It is not built to withstand so heavy an overload—for more than a few seconds before it burns out. A new motor costs $25 or $30. Repairing the motor may cost $15 or $20. A new fuse costs 8 to 10 cents. For the protection of your motor then, you need fuses from the standpoint of cost. Fire risk is much greater also without fuse protection. Any person foolishly using pennies, a nail or wire, etc., to replace blown fuses courts fire disaster, besides trouble with the Power Company if their transformer or expensive apparatus is burnt out as a result.

Fig. 1 shows the ordinary 6 to 10 ampere plug fuse used on lighting circuits. It consists of an alloy of lead and zinc principally, in the form of a wire or ribbon. In all cases it is enclosed completely in order that the heated metal will not be thrown onto material that will easily catch fire when the fuse blows.

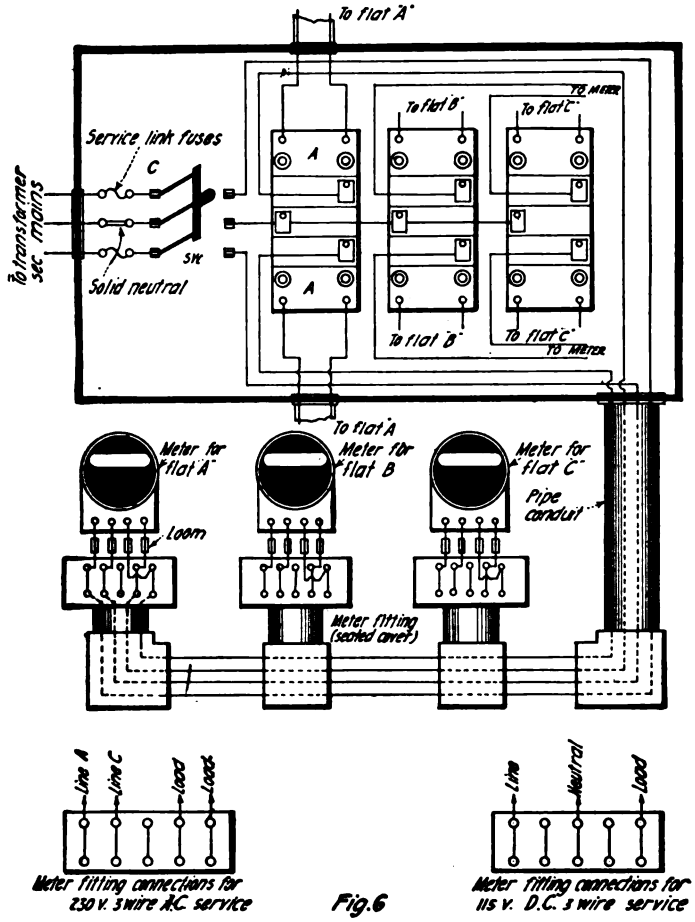


Fig. 6

How the Fuse Blocks and Electric Light Meters Are Often Arranged In an Apartment House In the Large Cities, Where Two to Three Circuits for Each Family Are Brought Down to the Cabinet Box. In Trying to Locate a Blown Fuse In Such an Installation It Is First Necessary to Determine Which Fuses Control the Circuit Leading to Your Apartment, or Else You Will Have to Test Out Each Circuit in the Cabinet, Either by Examining the Fuses or by Testing with a lamp. Once You Have Located a Blown Fuse It Is the Safest Plan to Open the Main Switch When Replacing the Fuse or Fuses.

Do not replace that 6-ampere fuse with a 20-ampere fuse for house lighting circuits, because that means NO FUSE protection for any motors, lamps or other things on the circuit which take less than 20 amperes, and you will run the risk of burning out your motors, etc. Furthermore, No. 14 B. & S. gage wire, which is ordinarily used for wiring houses, will only carry safely 15 amperes; if a heavier current is carried continuously, the wire overheats and the insulation is gradually destroyed causing trouble later or else fire results.

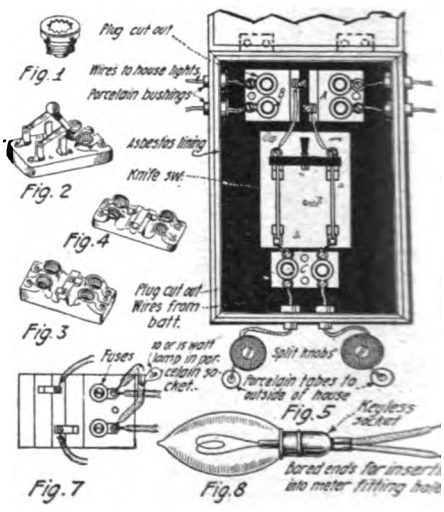
When a fuse blows it is generally caused by too big a load. It might, of course, be a *short-circuit* or *ground;* but in the majority of cases it is due to either a sudden heavy overload or else a steady heavier load than the fuses are intended to carry. This causes them to gradually heat up and melt. Getting something stuck in the ringer is an example of a sudden heavy overload; while operating the washer, the vacuum sweeper, the coffee percolator, and the toaster or some similar combination ALL at one time off of one circuit, is an example of a steady overload that will melt an ordinary 6-ampere fuse shortly.

Generally, an ordinary house will have at least two branch circuits and quite often more. Sixteen lights is all that is supposed to be put on one branch circuit. Fig. 2 shows an ordinary single branch fuse cut-out block with switch suitable for one two-wire circuit. Fig. 3 shows a double-branch fuse cut-out block used for two two-wire circuits. Fig 4 shows a fuse cut-out block for two two-wire circuits with 3-wire service. Fig. 5 illustrates a typical two-wire installation with a double branch fuse cut-out block for two separate house circuits.

The cabinet-box is usually located in the basement and has a switch inside as shown. After opening the self-closing hinged door of the cabinet-box, pull this switch open the first thing, then replace both fuses of one circuit at A, with new fuses, and close the switch. If this does not remedy the trouble, OPEN the switch and replace fuses in B with new ones Then close the switch. If the trouble was merely an overload, following these simple directions will restore service as a rule. Once in a hundred times the service fuses C are blown. You can easily observe whether or not this is the case There is absolutely no danger of you receiving a shock if you OPEN the switch before replacing the fuse. Do not attempt to replace the service fuse C, if they are blown, unless either you or the man of the house knows considerable about electricity, as those contacts are alive and dangerous. Better call up the power company and have them replace them.

In large cities, the procedure for flat buildings where two or three circuits for each family are brought down to the cabinet-box, shown in Fig. 6, is slightly different. It now becomes necessary to either first determine which cut-outs control the circuits leading to your own particular flat or else test out each circuit in the cabinet-box. The first way is safer to follow for one unfamiliar with electricity. Adopting this plan then make it the first du

(*Continued on page* 1346)



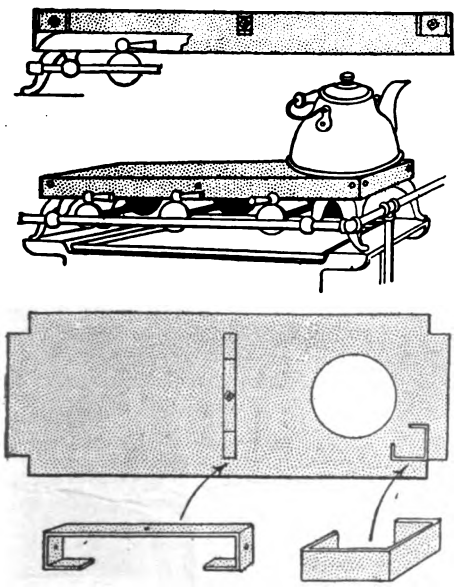
Several Styles of Fuse Blocks Are Shown the Illustration Above, as Well as a Typ Testing Socket and Lamp.

Home Mechanics

Conducted by WILLIAM M. BUTTERFIELD

HOME-MADE GAS SAVER.

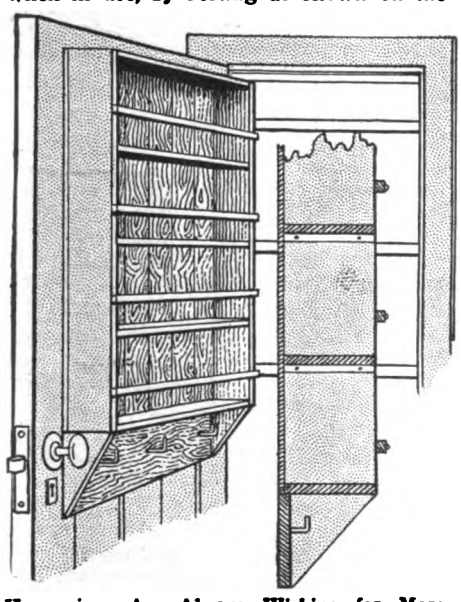
A HOME-MADE gas saver that has the value of saving that household necessity is shown in an accompanying illustration. It consists of a sheet iron, box-like cover that is made by the home mechanic to fit



This Home-Made Gas Conserver Is Constructed from a Piece of Sheet Iron Cut and Bent to the Shape Shown, or to Fit the Particular Stove at Hand. The Heat Ordinarily Wasted by the Gas Flames Shooting Up All Around the Tea Kettle or Other Vessel, for Example, Are Caused to Heat the Sheet Iron Top in the Manner Apparent—a Real Economical Idea!

closely over the top of any sized gas stove or range. It has but one hole thru which the heat from a single lighted burner may come in direct contact with any cooking utensil. The sides of the cover are held by strap iron pieces, bent into the shapes shown (3/16″ x 1″ iron), and 3/16″ bolts. These retaining pieces also serve as supports for the cover, and its load of utensils when in use, by resting as shown on the top of the stove. The cover can be attached or removed as quickly and as easily as placing a kettle on the stove.

The idea is that with one burner lighted, and a kettle over the hole above that burner, heat is confined and distributed over the area of the cover to such a degree that other utensils are heated and food cooked without any of the other burners being used, and with no loss of heat applied to the kettle over the lighted burner. In this way one burner does the work of the entire group of burners.



Housewives Are Always Wishing for More Shelves on Which to Place Their Dishes and Cooking Utensils, Especially in and About the Kitchen (Which Is Not Always So Large Nowadays). This Idea Provides Extra Shelf Room Right on the Inside of the Closet Door, Suitable for Dishes and Utensils.

CABINET FOR KITCHEN DISH-CLOSET.

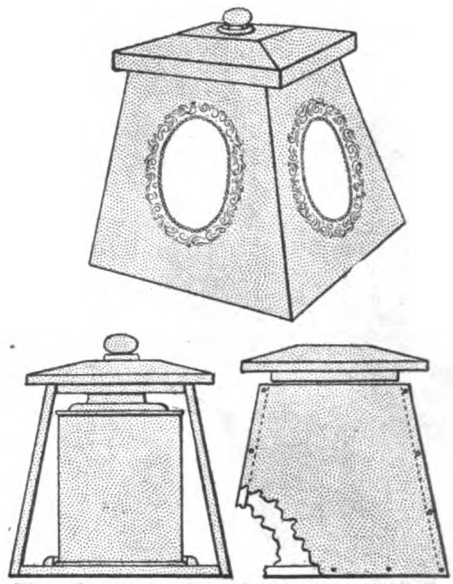
There is usually about nine inches of waste space between the inside of a closet door and the front edge of its shelves which can be used to good advantage, in these days of housing shortage. The suggestion is for the dish closet in the kitchen, and consists of a four-shelved cabinet, with its supporting brackets made useful by a connecting board with hooks for hanging up pots or frying-pans. This idea we imagine will meet with wide approval, for it has advantages which are apparent to every orderly house wife, yet for some reason such an arrangement has never been utilized. As the cabinet is swung more or less quickly on the moving door it should be secured firmly thereto with screws or nails.

LEATHER TOBACCO BOX.

Herewith is shown a leather covered and metal trimmed tobacco box that the home mechanic can make during his spare moments. The design is of that flexible kind provided to fit any special brand of tobacco can which the maker is in the habit of using, and consists of a wooden frame, with wooden cover, upon which the leather or leatherette is glued. No attempt is made to bevel the corners of the box, this part being nailed together as shown. The top consists of two pieces of wood, joined to form a lip and lid, and a brass knob—screwed on when the leather is in place. Brass oval frames, for the portraits of favorite lady friends, are also nailed over the leather in the places illustrated on the sides of the box. Frames of this sort are commonly sold for similar uses. To prevent the tobacco can from shifting about in the box a moulding is tacked to the box bottom to fit the can and hold it in place before putting in that part.

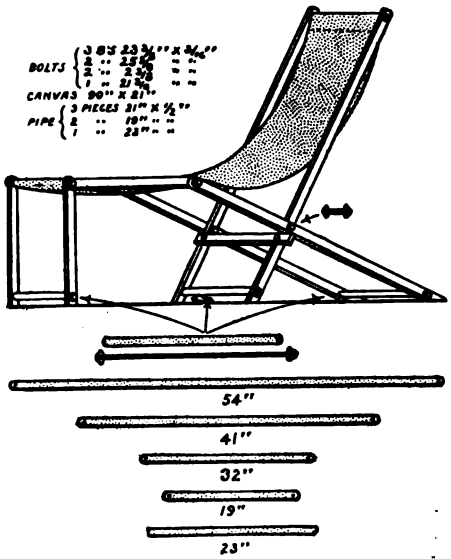
HOME-MADE STEAMER CHAIR.

One of the most comfortable lounging chairs for out-of-door use is the old home-made folding chair with foot rest, constructed somewhat along the lines of the steamer-chair. The canvas seat and rest being in one piece, and suspended at its ends, just fits somehow and makes the chair cool and "comfy." The cut herewith shows a method of constructing a chair of this sort. The lumber is 1¾″ x 1″ hardwood, say ash or oak, and should be straight-grained and extra tough. As small bolts as possible (¼″) should be used so as not to make the holes in the wood so large as to weaken it. Iron gas pipe, fitting the ¼″ bolts, is used to keep the wood pieces spaced apart and in place as shown. A stop for holding the back in position is also made of wood and screwed in the place illustrated. Heavy canvas, such as is used for tents, is provided in the rough 21″ x 90″, when a 1″ hem is then formed on each side making the piece 19″ wide. This is looped, and fastened by stitching, so that when placed over the pipe when the chair is put together the seat will hang about as shown in drawing. The bolts may be slightly riveted, once the chair is put together, to prevent nuts from working loose. Dimensions of bolts, pipe and lumber are given in the illustration.



There Is Nothing That Is More Available for the Requirements of the Man in the Household Than an Attractive Container for His Tobacco Can or Humidor, and the Author Here Describes and Illustrates a Design for Such a Container Which Should Be Finished in Leather or Burnt Wood.

When complete, this steamer chair can be placed on the porch or in the shady back yard. As no chair in the house can compare with it when it comes to comfort, this steamer chair may be desired for parlor use; and to remove any trace of its "home-made" appearance, besides adding greatly to its attractiveness, it would be advisable to have it covered with flowered cretonne or other material, so as to match the summer coverings of the other furniture.

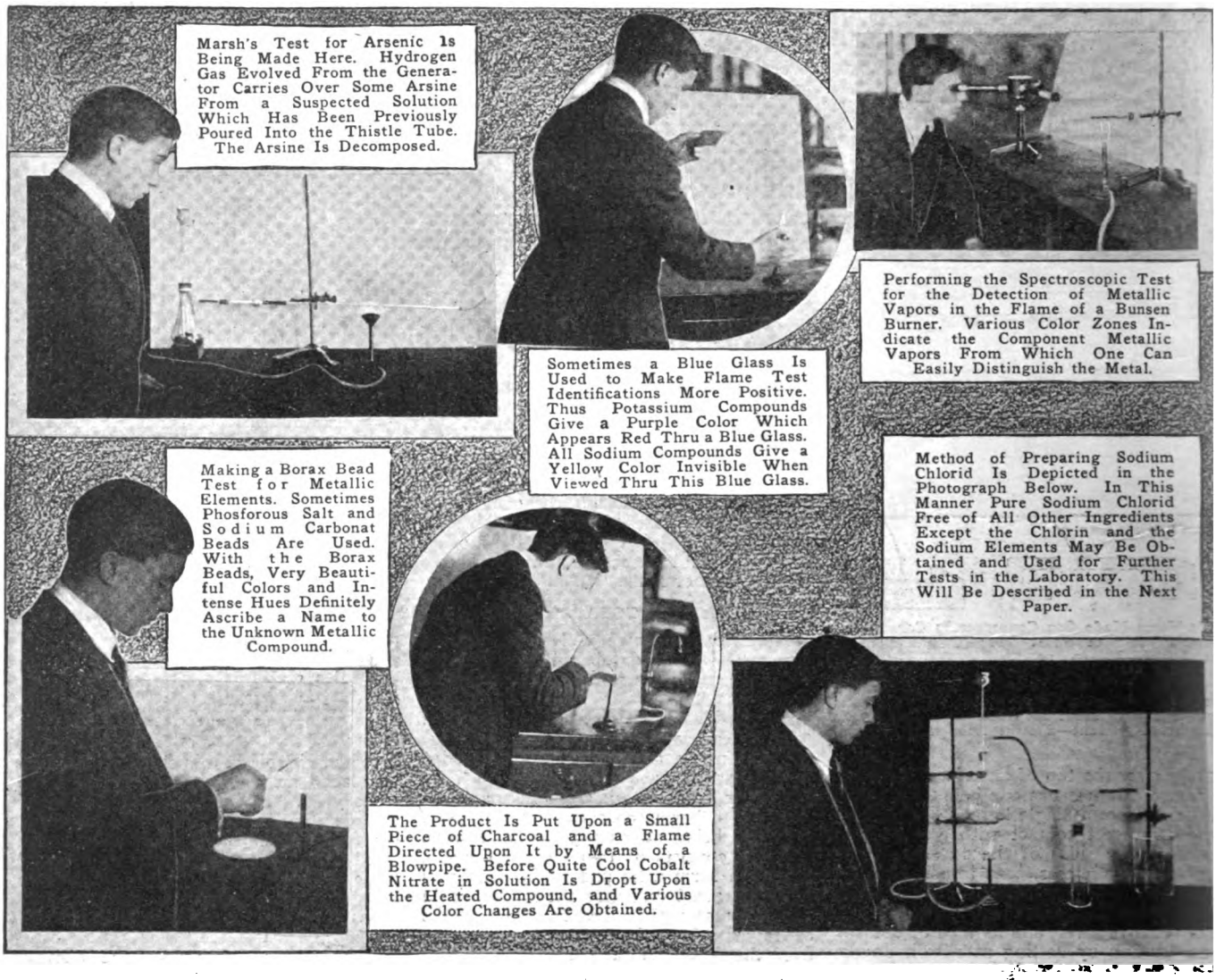


Now That Vacation Days Are Approaching, This Home-Made Steamer Chair, Which Is Simplicity in Itself, Will Appeal to Many. Contrary to General Opinion, This Type of Chair Is Much More Comfortable Than Might Be Supposed. The Canvas Forms Itself to the Contour of the Body Nicely.

Practical Chemical Experiments

By PROF. FLOYD L. DARROW

SOME SIMPLE CHEMICAL TESTS



Marsh's Test for Arsenic Is Being Made Here. Hydrogen Gas Evolved From the Generator Carries Over Some Arsine From a Suspected Solution Which Has Been Previously Poured Into the Thistle Tube. The Arsine Is Decomposed.

Sometimes a Blue Glass Is Used to Make Flame Test Identifications More Positive. Thus Potassium Compounds Give a Purple Color Which Appears Red Thru a Blue Glass. All Sodium Compounds Give a Yellow Color Invisible When Viewed Thru This Blue Glass.

Performing the Spectroscopic Test for the Detection of Metallic Vapors in the Flame of a Bunsen Burner. Various Color Zones Indicate the Component Metallic Vapors From Which One Can Easily Distinguish the Metal.

Making a Borax Bead Test for Metallic Elements. Sometimes Phosforous Salt and Sodium Carbonat Beads Are Used. With the Borax Beads, Very Beautiful Colors and Intense Hues Definitely Ascribe a Name to the Unknown Metallic Compound.

Method of Preparing Sodium Chlorid Is Depicted in the Photograph Below. In This Manner Pure Sodium Chlorid Free of All Other Ingredients Except the Chlorin and the Sodium Elements May Be Obtained and Used for Further Tests in the Laboratory. This Will Be Described in the Next Paper.

The Product Is Put Upon a Small Piece of Charcoal and a Flame Directed Upon It by Means of a Blowpipe. Before Quite Cool Cobalt Nitrate in Solution Is Dropt Upon the Heated Compound, and Various Color Changes Are Obtained.

THERE is nothing that gives the Amateur Chemist more genuine satisfaction than to be able actually to make *tests for chemical substances.* The whole subject of Qualitative Analysis, one of the chief branches of the science of chemistry, consists in doing in a systematic way this very thing. A little later I propose to take up in this series of articles an elementary course in qualitative analysis, but in the present number I shall deal only with a number of isolated sets of chemical tests which are much used in particular cases.

Flame Tests: There are a number of the metals which give to the Bunsen flame characteristic colors. In order to do this some compound of the metallic element must be present in the flame in the form of incandescent vapor. The metal which gives the most striking and persistent color to the flame is sodium. It gives a brilliant yellow and only the faintest trace of the metal is necessary to color the flame. Indeed with the aid of the *spectroscope*, a very delicate instrument for the detection of elements in the form of incandescent vapor, so small a quantity as one-hundred-thousandth of a grain of sodium may be identified with perfect certainty.

For use in making flame tests a mounted platinum wire will be necessary. Of course platinum is very expensive but the cost of a 4-inch length of about No. 22 wire will not be prohibitive. To mount it fuse one end securely into the end of a short length of small glass tubing. Clean the wire by dipping it into a solution of concentrated hydrochloric acid and then heating to incandescence in the outer, or oxidizing flame, of the Bunsen burner. Never place it in the inner, or reducing flame, and always have a colorless flame, i.e., a non-luminous flame. If not you will injure the platinum.

Draw the clean platinum wire thru your fingers and then place it in the flame. Immediately you will notice the yellow color of sodium, for this element in the form of its compounds is everywhere present, even on your hands, and, as already stated, the minutest quantities will reveal themselves in the flame.

Now dip the wire into each of a number of solutions of sodium salts and in ea case place the wire in the flame. In of them the brilliant yellow of sodium w flash out and persist for several minut Before using with any other salt solutic the wire must be cleaned by dipping it ir concentrated hydrochloric acid and heating in the flame. Always repeat tl operation until there is no color le Figure 1 shows the proper position for t wire in the flame.

Hold a short piece of glass tubing the flame until it has softened. You w note that the flame becomes yellow, sho ing the presence of sodium, for sodium always present in glass.

Obtain three small squares of cob blue glass and, having dipt the platin wire in the solution of some sodium s hold the three thicknesses of glass tween your eye and the sodium fla You will observe, however, that the low sodium flame is entirely cut off, cause blue glass will not permit the p sage of yellow light. This fact as shall see is of fundamental importance the detection of the potassium flame.

(*Continued on page* 1349)

THE CONSTRUCTOR

A Model Electric Railway De Luxe

By Earl Christmas

UP on the third floor of their home in St. Paul, Allan and James E. Trask, youthful engineers, have built a complete electric railroad, perhaps the only one of its kind in the entire country. Its miniature locomotive is modelled after the big electric locomotive used in pulling the Chicago, Milwaukee and St. Paul trains over the Rocky Mountain division; the miniature electric type embodies practically all the features of its big prototype. In fact, the builders of the model, with just the ordinary tools and a few pictures of the big locomotive, had to work out in miniature problems similar to those which the General Electric engineers had to master in constructing the big engine.

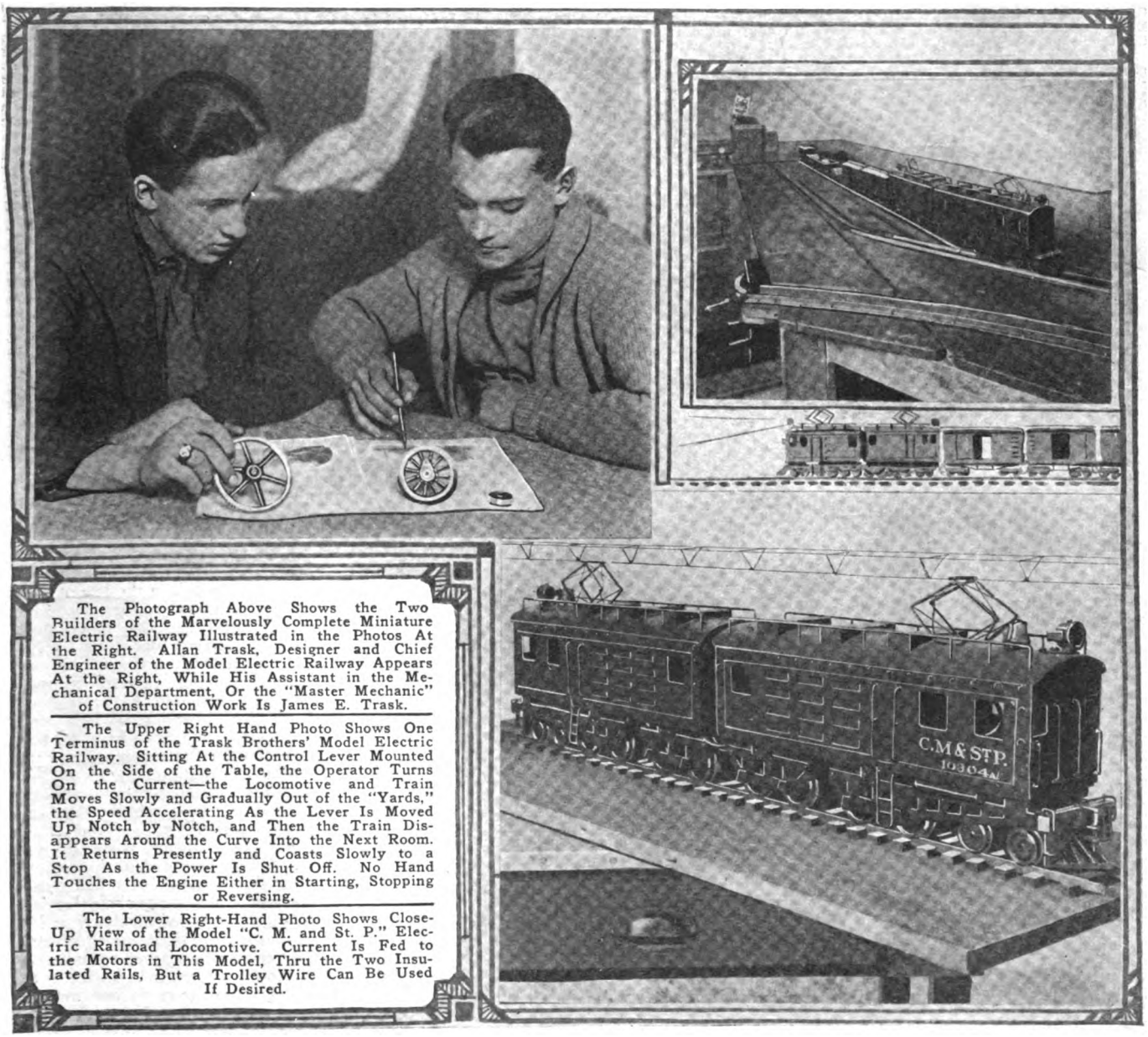
In addition, their problem was complicated to some extent by the very smallness of the model. For instance, a system of remote control had to be developed. A 300-watt generator set provides the power from the lighting current.

Sitting at the control levers, the operator turns on the current. The locomotive moves slowly and gradually out of the yards, the speed accelerating as the lever is moved up notch by notch, and the engine disappears around a curve into the next room, returning presently and coasting slowly to a stop as the power is shut off. Not a hand touches the engine in starting or stopping.

Twenty feet away, in another room, where it can't be seen by the operator, the train may be speeding along. The operator changes the levers, and back the train goes in the other direction, reversing its course electrically without the touch of a hand to the engine, so perfect has the system of control been developed.

Allan, now 22 years old, designed the miniature railroad and worked out the electrical problems. James, aged 17 years, did the necessary machine work, such as turning up the wheels and shaping the truck frames, in the shop at the local High School.

The engine is 38 inches long and weighs 48 pounds. It will exert a 10-pound pull at the draw-bar, which is sufficient to pull 250 pounds of smooth running cars on a level track. With a 100-pound train, it



The Photograph Above Shows the Two Builders of the Marvelously Complete Miniature Electric Railway Illustrated in the Photos At the Right. Allan Trask, Designer and Chief Engineer of the Model Electric Railway Appears At the Right, While His Assistant in the Mechanical Department, Or the "Master Mechanic" of Construction Work Is James E. Trask.

The Upper Right Hand Photo Shows One Terminus of the Trask Brothers' Model Electric Railway. Sitting At the Control Lever Mounted On the Side of the Table, the Operator Turns On the Current—the Locomotive and Train Moves Slowly and Gradually Out of the "Yards," the Speed Accelerating As the Lever Is Moved Up Notch by Notch, and Then the Train Disappears Around the Curve Into the Next Room. It Returns Presently and Coasts Slowly to a Stop As the Power Is Shut Off. No Hand Touches the Engine Either in Starting, Stopping or Reversing.

The Lower Right-Hand Photo Shows Close-Up View of the Model "C. M. and St. P." Electric Railroad Locomotive. Current Is Fed to the Motors in This Model, Thru the Two Insulated Rails, But a Trolley Wire Can Be Used If Desired.

will run full speed, which is proportionately 60 miles an hour.

The entire locomotive, except the motors and the gears, was built by the two boys from raw stock. The 16 driver and 8 pilot wheels were turned from solid brass castings. The wheels on one side of the locomotive have fibre bushings between the wheel and axle. As the current is carried by both rails of the track, the wheels have to be insulated one from the other.

The truck frames were cut from pieces of flat steel, drills being used to make the latticed part.

There are two motors, geared to eight drive wheels. The motors are wound for twelve volts. The drive wheels are worm driven thru a reduction of eighteen to one.

Since it would not be practical to use the current from storage batteries or to use alternating current, the builders have made a 300-watt motor generator set, composed of a one-fourth horse-power induction motor on the 110-volt lighting circuit and a small 12-volt D. C. automobile generator.

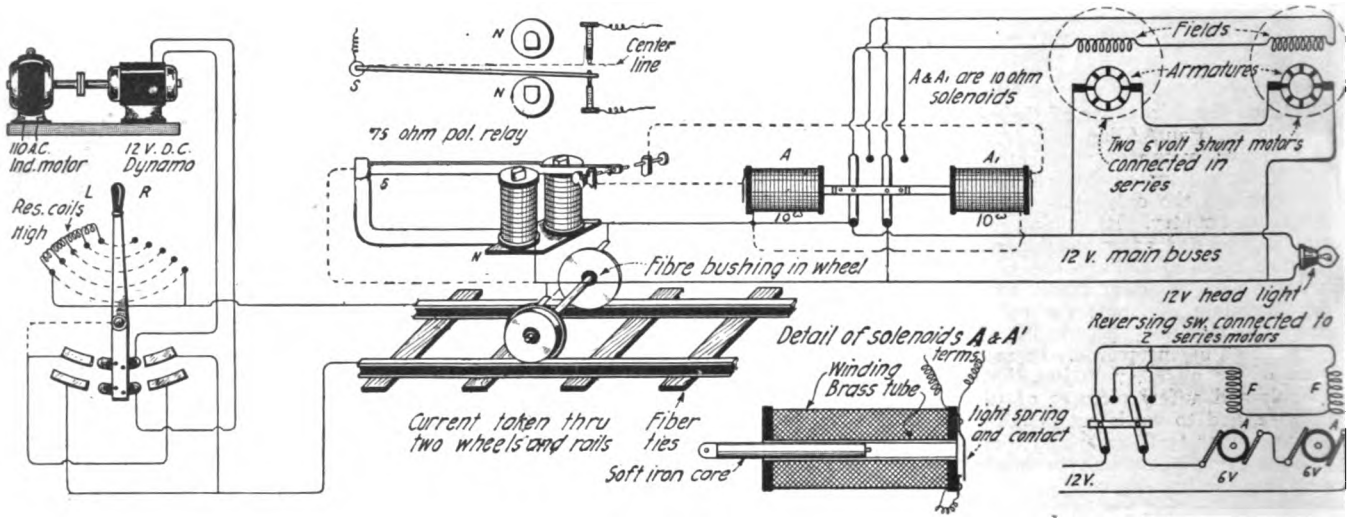
The two motors are connected in parallel to a relay reverser, which enables the locomotive to be reversed by changing the polarity of the current. This device is a combination of a permanent and an electro-magnet wound with fine wire, and shunted across the circuit in the engine. The movement of the electro-magnet mechanism on changing the polarity of the current throws a switch, which reverses the locomotive. (*A polarized relay is shown in the diagram appearing herewith.—Editor.*)

An unusual feature is a two-pound fly-wheel of solid brass mounted on the motor shaft just above the truck frame. By the use of the fly-wheel, the performance of the model is made strikingly similar to that of its monster prototype.

The body of the engine is made of heavy leaded iron such as used for automobile fenders. The bells were turned from a brass bar, and the cowcatchers were cast at a foundry from a pattern made by the youthful builders.

Railroad engineers who have called at the Trask home in St. Paul, to see the model have marveled at the correctness of the reproduction, and the ingenious manner in which the control has been adapted to the small locomotive. The C. M. and St. P. Railroad has started negotiations to borrow the miniature railroad for exhibition purposes, so much have the officials been imprest with it.

In addition to the locomotive, these two geniuses have built coal cars, box cars and a caboose, all faithful reproductions of the larger types. They have built a track some fifty feet in length, tunneling around thru the walls of three rooms and one closet, which happened to get in the way. Tunneling thru those walls almost aroused serious displeasure on the part of James E. Trask, Sr., but the desire of the builders prevailed, and with such success that Papa Trask was as much elated as the youths themselves.



One Method of Controlling Model Electric Trains Like That Shown On Page 1309, As Indicated in the Accompanying Diagram. The Necessa Direct Current for Operating the Motors Driving the Engine Can Be Taken Either From Storage Batteries, From a Step-Down Rheost Connected to 110 Volt D.C. Circuit or Else From a Small D.C. Dynamo Direct-Connected to a 110 Volt A.C. Motor. A Combination Rheost and Reversing Switch Is Suggested, Which Resembles Quite Faithfully the Large Controllers Used On Electric Locomotives and Trains. T Main "Trick" Embryo Electrical Engineers Would Be Interested in Probably, Is How the Locomotive Is Reversed While Running Along t Rails Without Having Recourse to Trip Switches Placed On the Track. One Way in Which to Reverse the Engine From the Single Cont Switch and Rheostat, Is by Means of a Polarized Relay or Similar Mechanism. A Polarized Relay, Which May Be Constructed From Polarized Bell Ringer Having a Permanent Magnet Field, Is Illustrated Above—Also Its Connections to Two Small Solenoid—Magn Employed for Operating the "Current Reverse" Switch Connected to the Field Windings of the Two Motors. The Action of the Polariz Relay Is Based On the Fact That a Current Passing Thru It in One Direction Will Not Move the Armature Away From the Lower Conta for Example; While a Current Passing Thru the Relay Magnets in the Opposite Direction Will Produce a Polarity Opposite to the Norm Field of the Relay, and Cause the Armature to Fly Over to the Upper Contact.

GARAGE TURN-TABLES AND BURGLAR ALARMS.

WE have under preparation an elaborate article for the Constructor Department in the May number which will appeal to all of our readers who own and operate an automobile, and that means almost everybody today. The automobile is hardly a luxury now,—it is considered a necessity and it is not by any means a cheap necessity for most of us, so that we are always on the *qui vive* as the French say, or on watch for new ideas which will help to protect our automobile from theft. The article on an electric turn-table for private garages also contains a lot of valuable information on various forms of burglar alarm circuits for garages, some of which operate on current obtainable from the lighting circuit, while others operate by means of closed and in some cases open-circuit batteries. Do not miss this valuable article in the next issue. Complete details for building and installing these various devices are given in detail.

HOW THE ELECTRIC LOCOMOTIVE IS REVERSED AND CONTROLLED.

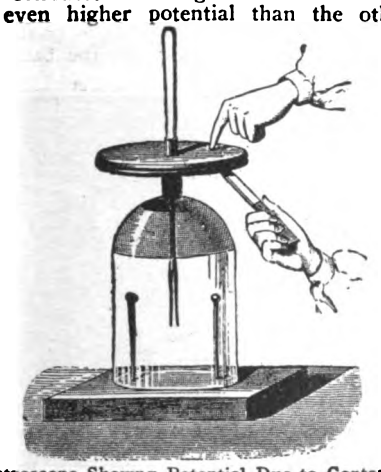
The diagram appended herewith shows how the direct current supplied by the twelve volt potential motor generator set is reversed as well as varied in strength as it is applied to the two insulated rails of the track system. These rails may be made of brass, iron or copper strip about 1/16" thick, ⅜" to ½" in width, fitted into slots cut by means of a hack-saw into fibre or wooden ties. The speed regulator or rheostat can be arranged as shown, so that when the handle is in the center or zero position, no current is supplied to the rails. When the handle is moved to right, or left, current is fed to the rails thru ment mounted on an insulated fibre bar the base of the controller switch a moved by it.

A polarized relay, which may be a hon made one, constructed from a polariz telephone ringer having about 50 to ohms resistance is connected across t wheels of the train and on the locomoti so as to receive current in one direct or the other according to the polarity current supplied thru the speed cont and reversing switch. If the armature the polarized relay is set just past center line, as shown in the detailed d gram, then with the current passing t the coils in one direction, it will prod north and south polarity in the coils, a if the polarities on the lower pole pi agree, then the armature will remain tracted as shown. Now if the curr thru the rails is reversed, a south p will be set up by the coil in the lower p piece, which will neutralize the magnet of this pole, and cause the upper p piece to attract the armature, thus forc its platinum point against the upper c tact screw, permitting current to p thru the opposite solenoid A_1, which throw over the reversing switch c nected to the field windings of the mot thus in turn causing the motors to rev their direction of rotation.

The solenoids actuating the pole-cha ing switch for the field windings of motors, may be small ones about 2" length, and 1" in diameter, with ⅜" iron cores. It will be noted in the sch shown herewith, and as the detailed dr ing further elucidates, that when the solenoid plunger is sucked all the way the coils, it causes the light spring con at the outer end to be opened; thus a the coil has done its work in shifting pole-changing switch over to one sid the other, as the case may be, the cur thru the solenoid is cut off; this elimin any further waste of energy thru t members.

The Contact Theory of Electricity

THE contact theory of electricity is one of the older theories, and states that if two dissimilar conductors, such as plates of copper and zinc are brought in contact with one another, a difference of potential will result, one conductor showing a fraction of a volt or even higher potential than the other.



Electroscope Showng Potential Due to Contact of Dissimilar Metals.

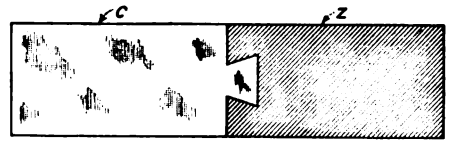
This is the simplest case. To make it more complicated, a chain or succession of various conductors such as plates of different metals, may be placed in series, in contact with each other, so that each of the plates will touch only its neighbor or neighbors. If this is done, the potential difference between the terminal plates will be the same *as if they only* were in the set and were in contact, the others being eliminated.

An electroscope comprising a pair of gold-leaf strips has a circular metallic plate horizontally secured above it, in metallic contact with the gold-leaf strips. A second plate of metal with a glass handle and with its lower surface thickly varnisht, when placed as shown on the lower one, establishes a capacity, and the pair form a condenser. The upper plate is earthed, preferably by a metal conductor. The lower one is toucht with one of the constituent metals of a compound bar of copper and zinc.

By the contact theory, each metal has its own potential, and when one of them touches the lower plate, it charges the condenser. This has practically no effect on the gold-leaf, because of the large capacity of the two discs, but if the upper plate is removed, the capacity of the condenser is reduced to almost zero, the potential rises and the gold-leaf strips diverge.

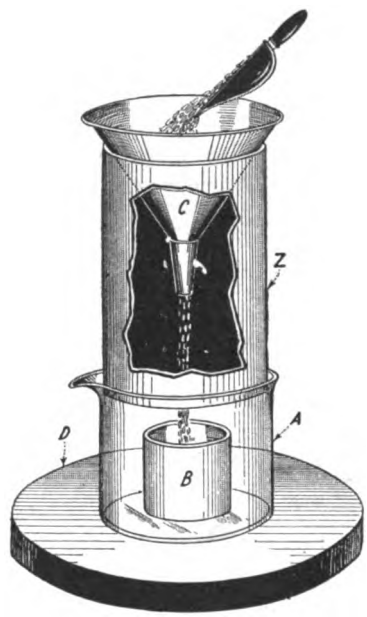
Another demonstration of the principle of the apparatus is based on a variation on the torsion electrometer. Referring to the second illustration, C and Z, are two plates, one (C) of copper, and the other (Z) of zinc. Above them is suspended by an insulating thread an index coated with metal foil shaped as shown, one end flat and expanded, the other end counterpoised. The whole is enclosed in a glass bell-jar. A movable brass rod passes thru a hole in the bell-jar so that it can be brought into contact with the index and removed from contact, as desired. It is caused to touch the index and by touching the protruding portion of the rod with a Leyden jar or other source of excitation, a charge is imparted to the index. The rod is then turned so as to be out of contact with the index. If now, the copper and zinc plates are brought into electrical contact by connecting the ends of the wires shown in the cut, each assumes a polarity and the index is deflected.

As many readers interested in this experiment have failed to obtain results, the matter was referred to Dr. T. O'Conor Sloane, and he explained that usually the instruments employed were not sufficiently



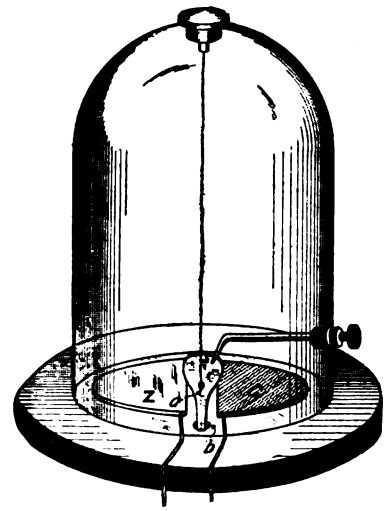
Compound Bar for Showing Contact Action.

sensitive, as the contact electricity produced was mostly potential or voltage and the current or amperage was of infinitesimal value.



Apparatus for Producing Electric Potential Difference by Contact Action.

Carrying this idea still further, Lord Kelvin constructed the apparatus shown in the last illustration. A cylinder (Z), of zinc contains a copper funnel. Below the funnel is a cup of copper. The whole apparatus stands on a glass insulating base, and the copper cup is insulated from the rest of the apparatus. On pouring copper filings into the funnel, they stream down



Torsion Electroscope for Showing Contact Action.

into the cup below, and as zinc is in contact with copper, they carry a charge so that the insulated cup acquires a potential.

What has been described, is designed to show the *contact potential* of solid and dry conductors. The experiments can be developt to include liquid electrolytes—the whole gist of the matter being purely theoretical, to give a basis to establish the rationale of the action of the galvanic cell. There is nothing of practical value in it, and it is not even certain that the potential difference is due to the solid conductors alone.

The following table gives the differences of potential between some of the more common metals and carbon.

Difference of Potential (Volts)	
Zinc	
Lead	0.210
Tin	0.069
Iron	0.313
Copper	0.146
Platinum	0.238
Carbon	0.113

If we add the six potentials together, the result is the potential difference between zinc, the first of the metals, and carbon at the foot of the list. It is 1.089 volts. The difference of potential between any two metals is equal to the sum of the differences of potentials between the intervening metals in the contact series.

Mending Cracks in Glassware

A VERY novel way of mending cracks in glassware has been recently introduced. By means of this plan it is possible to make the articles just as they were when they were new. The work is very interesting and it is not at all difficult to carry out.

For the purpose a small amount of sodium silicate or waterglass is needed. This material can be secured from any chemist and, as is well known, it is largely employed in the preserving of eggs.

Where the cracked object is a decanter, a bottle, or anything that has a stopper, or can be provided with a cork, proceed in this way: Take out the stopper and hold the bottle in front of a stove until it is quite warm. Then replace the stopper and, without delay, get to work with the waterglass. This is painted all along the crack with a brush, care being taken to put it on rather thickly. After a little while the air in the bottle begins to cool down and then a very singular thing happens. The pressure of the atmosphere outside forces the water glass into the crack and the ugly line disappears as if by magic. Leave the bottle for a few hours so that the waterglass may set hard and then wipe away any surplus where the crack has been with a sponge and very hot water. The bottle will then be just as good as ever it was and will hold liquids.

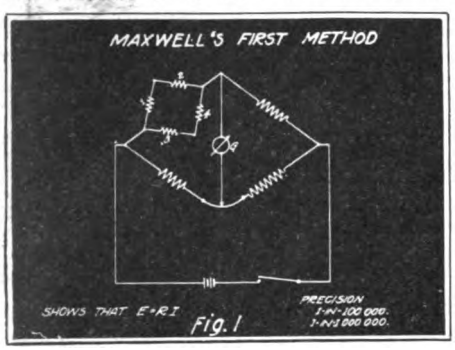
Where the article is a wide-mouthed jar or bowl a somewhat different line of procedure is needful. Take a basin and, in the center of this, put a lighted candle end. Now pour about an inch of water into the basin and place the cracked jar in an inverted position over the light. As soon as the air is exhausted inside the light will naturally go out. Without any delay paint on a thick layer of the waterglass all down the crack. Exactly the same thing happens as was noticed previously. The pressure of the atmosphere outside forces the waterglass into the crack and the line disappears. Thus the jar is perfectly mended and no sign of damage can be discerned. Drinking tumblers which have been cracked can be treated in just the same way only in these cases a short piece of candle should be used such as will conveniently go under the tumbler.

Contributed by S. LEONARD BASTIN.

Is Ohm's Law Valid?

By C. A. B. RIGGS

NINETY-THREE years ago, Professor Ohm, as the result of experimenting with the primitive facilities then available, announced the relations existing in a conductor carrying an electrical current,—between the *current, electro-motive force,* and *resistance;* thereby formulating the law which now bears his name. Ohm's law now comes first in the ritual of things electrical, and to the novice it presents, usually for the first time, a glimpse of the fact that all electrical phenomena obey fixt rules,—laws that are embodied in exact mathematical expressions.



The First Method of Maxwell, Used In Checking Up the Validity of "Ohm's Law." Four Equal Resistances Are Measured Separately In a Wheatstone Bridge, and Are Then Connected In Series-Parallel, as Shown, Giving the Same Resistance as One of the Elements Separately. No Error In the Law Was Found.

Ohm's law states, that in a metallic conductor of a given physical state, i. e., *where the temperature and dimensions remain constant, the electrical current flowing will be directly proportional to the electromotive force imposed.* In terms of the units of electrical measurement which are now in use, it can be stated, that, in a conductor, the current flowing in amperes is equal to the e.m.f. or potential in volts, divided by the resistance in ohms. This is really an experimental law and is not deduced as the inevitable consequence of a theory. It is a simple law. Moreover, it is of fundamental importance to the electrical engineer, the electrical experimenter, and the physicist.

How exactly does this law hold? With the great refinement of the facilities of investigation of the present day, is it not possible that Ohm's law may be found to vary ever so slightly from the exactitude of the mathematical form in which it is presented? In other words, may it not be found possible that the resistance may change just a little in a conductor, in varying the current from a small value to one of greater magnitude?

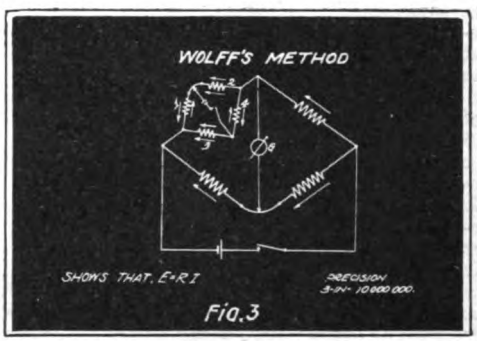
Recent experiments indicate that Ohm's law holds to a high degree of exactitude, no departure being observed in employing the refined methods of testing now available. This subject was discust by Dr. Frank Wenner of the Bureau of Standards, in a paper before the American Physical Society this spring. The statements of Dr. Wenner are of especial interest on the subject, as he is a high-priest in the Temple of Standards, at Washington—the Keeper and Dispenser of the Sacred "Ohm." He has charge of the work of standardizing electrical resistances, and is specially qualified to discuss the subject.

According to the speaker, about fifty years ago a committee of the British Association was appointed to investigate the accuracy of Ohm's law. Maxwell was chairman of this committee, and he devised two methods for making the tests, both of which were capable of giving high precision. No departure from the law was then found.

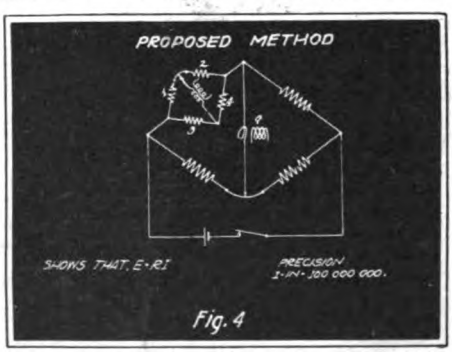
The first method was thought to give a precision of one part in 100,000, and the second was supposed to be good to one part in 1,000,000,000,000 or one part in a million million. On account of the relatively higher accuracy of the second method, little weight was given to the results of the first. However, it now appears, according to Dr. Wenner, that the first method was more fundamental in character than the second, and this was discust in connection with figures which appear with this article.

In Figure 1 is shown the first method of Maxwell. In this method four substantially equal resistances are measured separately in a Wheatstone bridge; and are then connected in series-parallel, as shown, giving the same resistance as one of the elements separately. If a departure from Ohm's law, perceptible by this method, existed, it would become apparent by a discrepancy between the resistance of the four, measured in series-parallel, and as computed from the resistance as determined separately. This was not found.

The second method is shown in Figure 2. Here the bridge is so arranged so that in each branch there is provided one long thick conductor and one short thin conductor, with the result that the current density in each conductor of a branch will be different. In this experiment it is assumed that if the current applied to the bridge is changed then a variation from Ohm's law would cause the balance of the bridge to be upset. The key arrangement and the two battery systems shown, one with a reversing switch, is for changing the current from one value to another very quickly. The key is operated many times a second, for the purpose of switching back and forth, so that temperature conditions will remain constant in comparing the effects of the two currents.

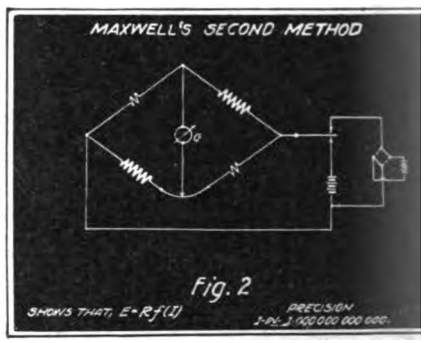


Not Being Satisfied with Maxwell's Method, Dr. Wolff of the Bureau of Standards, Devised a Special Circuit Like That Shown In Figure 3, Giving an Accuracy of One Part In 3,000,000. This Precision Test Once Again Demonstrated the Exactness of Ohm's Law.



Proposed Method for Checking the Validity of Ohm's Law Suggested by Dr. Wenner of the Bureau of Standards. In This Case, Both Direct and Alternating Currents Are Used, In Connection with a Special Wheatstone Bridge. The Precision Attained Would Be One In 100,000,000.

This method in Maxwell's hands showe no departure from Ohm's law. The speake stated, however, that this method was n an absolutely conclusive one, in that the r sistance could vary according to certain sp cial mathematical laws, and the balance



Maxwell's Second Method of Checking Validity of Ohm's Law Is Here Shown wit Wheatstone Bridge Arrangement, Prepa to Show That E Equals R I (I).

the bridge would be maintained with dif ent current densities.

Maxwell's first method was used by Wenner with modern apparatus, giving accuracy of one part in 1,000,000, and departure from Ohm's law was found.

Another method, proposed by Dr. W of the Bureau of Standards, was also t This was capable of giving an accurac one part in 3,000,000. The connections shown in the diagram of Fig. 3. In th Wheatstone bridge equipt with a ba in the position ordinarily used for the g nometer, is placed in one of the arms o other Wheatstone bridge. By a suitable ancing of resistances, the galvanomete the large bridge was so arranged that either of the two battery keys, shown, trolling the battery circuits, were c separately, the galvanometer did not de Both keys were then closed at the time, and the fact that no deflection produced indicated that Ohm's law hel

Dr. Wenner then showed the diagra a new method devised by him which wa more sensitive. This is indicated in F In this case direct and alternating cu are used. As before, one Wheatstone b was arranged to form an arm in an bridge. An alternating current is arr to be supplied to the cross connection little supplementary bridge, and anoth ternating current of just twice this quency is used to excite the field coils alternating current galvanometer, across the arms of the large bridge. rect current battery with a contact arranged at the terminals of the bridge. By a suitable adjustment of t sistances, the bridges are balanced either the alternating current or batter rent is applied separately. The direc rent and the alternating current are t be applied simultaneously, and if th any variation from Ohm's law detect will be shown by a deflection of the nometer. With this arrangement a sen ness of one part in 100,000,000 is prec

Dr. Wenner, with conventional sc caution, stated that from his exp Ohm's law was found to hold for th ductors which were used in the in tion, but he was not making any a tions respecting what might be four other conductors.

In the course of the next year it is to obtain results with the last-me method and with other materials.

HOW-TO-MAKE-IT

This department will award the following monthly prizes: First prize, $5.00; second prize, $3.00; third prize, $2.00.
The purpose of this department is to stimulate experimenters toward accomplishing new things with old apparatus or old material, and for the most useful, practical and original idea submitted to the Editors of this department a monthly series of prizes will be awarded. For the best idea submitted a prize of $5.00 is awarded; for the second best idea a $3.00 prize, and for the third best a prize of $2.00. The article need not be very elaborate, and rough sketches are sufficient. We will make the mechanical drawings. Use only one side of sheet. Make sketches on separate sheets.

FIRST PRIZE, $5.00

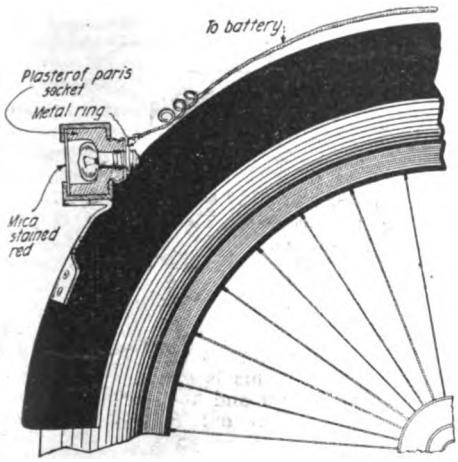
ELECTRIC BICYCLE TAIL LAMP.

Very few people have thought that an old fuse plug would make a very good bicycle tail lamp, but nevertheless, it does. First it will be necessary to remove the mica shield from the fuse plug. In some of the separable plugs this is rather easy; the mica shield is painted red and constitutes the "lens."

The bottom contact of the fuse plug will then have to be removed and scraped larger whereupon a tiny bulb is put into position and locked from the outside by a washer. A wire can be soldered to the washer and led to the battery and the other contact takes place thru the bottom of the bulb where it will touch the mudguard of the bicycle.

The fuse plug is then fastened to a piece of fiber and locked in place on the mudguard as shown in the illustration. A battery is suspended from the frame of the bicycle.

FRANCIS DONNELL.

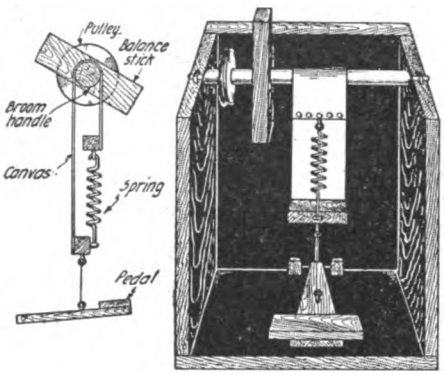


Here Is the Way to Construct a Real Tail Lamp for Your Bicycle or Motorcycle,—the Lamp May be Lighted from a Battery or Dynamo.

SECOND PRIZE, $3.00

A MECHANICAL WHIP MOTOR.

In the diagram shown here, we see the constructional details of a mechanical whip motor. A shaft is made from a broom handle to which the balance stick and pulley are attached. A strip of canvas belting, whose ends are now nailed to two blocks of wood, is passed over the broom handle, and one end is connected to a spring and the other end and the spring are connected to a pedal.



One of the Latest Discoveries in Mechanical Science Is the So-called "Whip" Motor. The Author Shows Above How to Construct a Simple Whip Motor Which May be of Considerable Size, Depending Upon the Strength of the Parts and the Power Available to Operate the Pedal.

When the pedal is moved up and down rapidly, a speedy little motor is the result which does not, however, give much power. This same principle will work on a much smaller scale by using rubber bands and thin tape instead of the canvas, in which event the motor may be actuated by hand.

Contributed by
ARMARD MOTSINGER.

THIRD PRIZE, $2.00

A "TWO CENT" HYDROMETER.

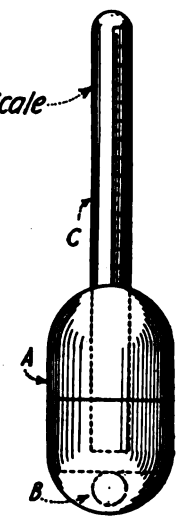
This is a very simple, easily made hydrometer and accurate enough for all ordinary purposes. Two bottle corks, ½ inch in diameter and an inch long, are glued together as shown at A. Then a hole is drilled in the bottom, a lead bullet, B, inserted, about 38 caliber answers the purpose nicely. Now push a piece of steel, C, an old corset steel is suitable enough, about 7 inches long, into the top. Paint the whole thing with a good coat of asphaltum thinned with turpentine.

To make the scale. Take a standard hydrometer and immerse it in a test solution made up so that it sinks until it registers O, then insert the two-cent home-made hydrometer into the same solution and mark it with white enamel just at the line. Then add more salt to the solution and continue graduating it until the scale is complete.

I have a set made for acid, oil, gasoline, alkali, etc., twelve in all, and the actual cost of making the twelve was only ten cents, while if I had purchased them they would have cost $13.00.

You can undoubtedly borrow hydrometers for the purpose of making the scale on these home-made ones from your local pharmacist or garage owner.

Contributed by
EVERHART TURNER

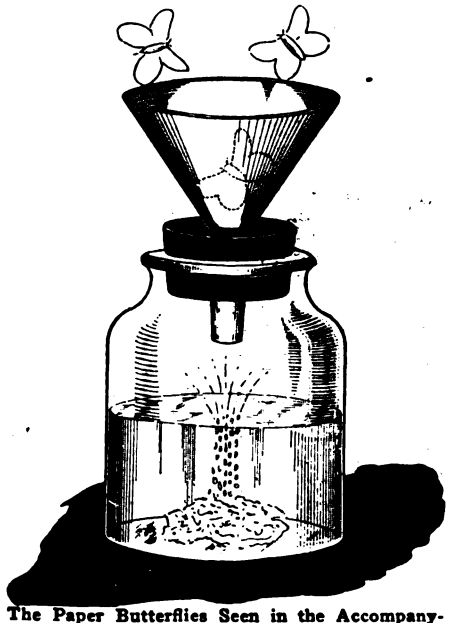


Who Would Not have a Hydrometer When One Can be Constructed as Simply as This One,—Which Consists of Two Corks and a Piece of Corset Steel? Do Not Use It in Your Storage Battery!

PAPER BUTTERFLIES THAT FLY.

Here is a charming little experiment that can be carried out by means of a Seidlitz powder, one of the last things in the world from which one would expect any amusement. Secure an empty jam jar and get a good-sized cork to act as a stopper to this. In the centre of the cork bore a hole thru which opening a funnel is pusht. The way in which this is done can be seen from the sketch. Next, from brightly colored tissue paper, cut the shapes of three or four butterflies. In the middle of each of these, just between the wings, fasten with glue a thin strip of cork. This serves to act as a body for the paper insect and also helps in the balance of the butterflies when they are in the air.

Fill the jar about half full with water. Then, into it, tip the contents of the packets forming the Seidlitz powder. Quickly replace the cork in the jar and put the paper butterflies into the funnel. Soon the gas generated by the effervescence rises and this causes the butterflies to fly up and down in a most life-like manner. The effect continues for quite a good while seeing that the comparative smallness of the opening of the funnel only allows a little of the gas to pass out at a time. This is all sufficient to keep the butterflies flitting up and down in a most fascinating manner.



The Paper Butterflies Seen in the Accompanying Illustration Are Caused to Flit About By the Action of a Seidlitz Powder Dissolving in Water.

Contributed by S. LEONARD BASTIN.

Many amateurs have often desired to join pieces of glass or glass tubing together, but as they are not skillful enough at glass blowing and in handling glass, they have hesitated to try various experiments.

A solder for glass can be made by first melting 95 parts of tin and then adding to it, 5 parts of copper. Zinc in the proportion of ½ to 1 per cent. makes this solder harder, whereas lead in the same proportion, makes it softer.

Glass tubing, united by this means, will separate at any other point sooner than at the point of junction.

Contributed by J. H. K.

Fascinating Experiments in Chemistry

By O. IVAN LEE

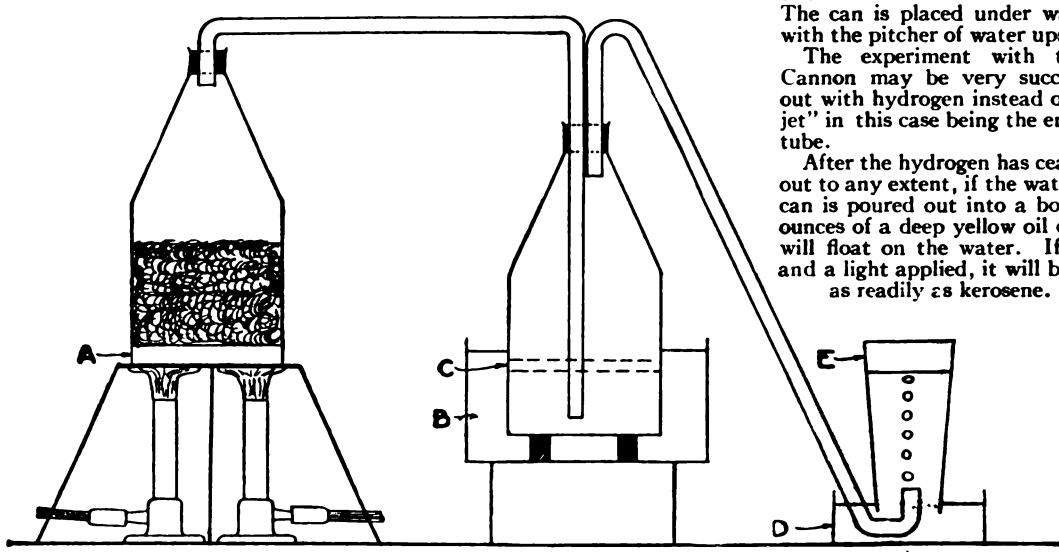
How to Make a Burning Gas (Hydrogen) and a Burning Oil from Castor Oil.

CASTOR oil, of unpleasant memory to many of us, is an extremely complicated substance chemically, and a great variety of interesting and useful things may be made from it, depending upon how it is treated. Among these is the wonderful gas hydrogen with which balloons are inflated.

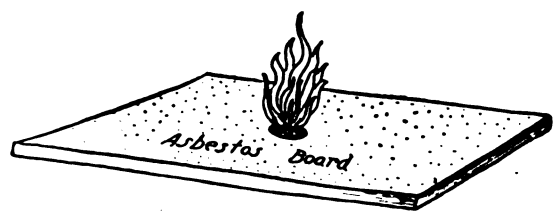
The apparatus required is a couple of quart tin cans, a fire to heat one of them, another larger tin can with the top cut out, a water basin, a glass pitcher (or large olive bottle), and three glass or metal "L" tubes with some rubber tubing for making connections. One of the "L" tubes has one long arm, the other, two. Connect the two tin cans as indicated in the drawing, making one of the long arms of the second "L" tube extend nearly to the bottom of the second can which is half filled with water. An outlet connected to a couple of feet of rubber tubing is made with the third "L" tube and leads from the second can to the water basin. This is partly filled with water. Drill the corks used carefully, and make all the connections air-tight.

Set the second can in the larger can and pour water into the space between. This is for cooling purposes.

Into the first can put one and a quarter ounces of water and two ounces of soda-lye, warming the mixture till the lye is dissolved. Then add half a pound of castor-oil. (The prevailing price for this is 21c a pound, but this will vary with the place of purchase), connect up the apparatus again and light the fire under the first tin can. To avoid direct contact of the flame with the bottom of the can, put a piece of sheet iron or common tin under it. Soon after the fire is lighted, bubbles will be noticed coming from the end of the rubber tubing in the water. These are bubbles of air driven out by expansion, due to the heating. A little later, some white smoke may appear with a peculiar sweetish odor. When the bubbles begin to come at a more rapid rate, fill a long slender vial or bottle with water. Cover the end with your finger and turn it upside down with the mouth under the water in the basin. Now catch some of the bubbles coming from the end of the rubber tube. The water in the bottle will rapidly be driven out. When this has occurred, place your finger over the mouth of the bottle again, strike a match, and holding the vial pointed away from you, apply the flame of the match as soon as you remove your finger. Very likely you will hear a sharp "pop" and you may see a little flame flash down inside the bottle. On the other hand, if nothing happens, only air is coming out and not air and hydrogen, which *together* are explosive. Hydrogen alone burns but will not explode, so when the air has been all pushed out by the hydrogen, a sample of gas caught and burned as described will burn quietly. If you watch closely you may see the hydrogen flame as it sinks down into the bottle forming perhaps a ring.



Apparatus Set Up for Making a Burning Gas (Hydrogen) and a Burning Oil from Castor Oil.



Apparatus Used in Performing "Spontaneous Combustion" Experiment.

No attention need be paid to any white smoke which may accompany the hydrogen gas as it will disappear on letting the gas stand over water. A larger volume of hydrogen may be trapt and stored in the water pitcher, which is to be supported by an inverted tin can with a small hole cut in the bottom, and another near the rim of one side for the insertion of the gas-tube. The can is placed under water, of course, with the pitcher of water upside down on it.

The experiment with the Powderless Cannon may be very successfully carried out with hydrogen instead of gas, the "gas-jet" in this case being the end of the rubber tube.

After the hydrogen has ceased to be given out to any extent, if the water in the second can is poured out into a bottle, about two ounces of a deep yellow oil of peculiar odor will float on the water. If it is removed, and a light applied, it will be found to burn as readily as kerosene.

"Spontaneous" Combustion.

In the first place, there is no such thing as "spontaneous" combustion. If a fire starts, there is always a perfectly good reason for its starting, altho it may be very puzzling if all the facts are not known. What is meant then, is that the mysterious fire starts apparently without any direct human aid, but since nature is always "on the job," there is no magic about the matter. The whole term is based on popular ignorance of natural laws, of the kind which leads some to waste their time and money trying to discover "perpetual motion."

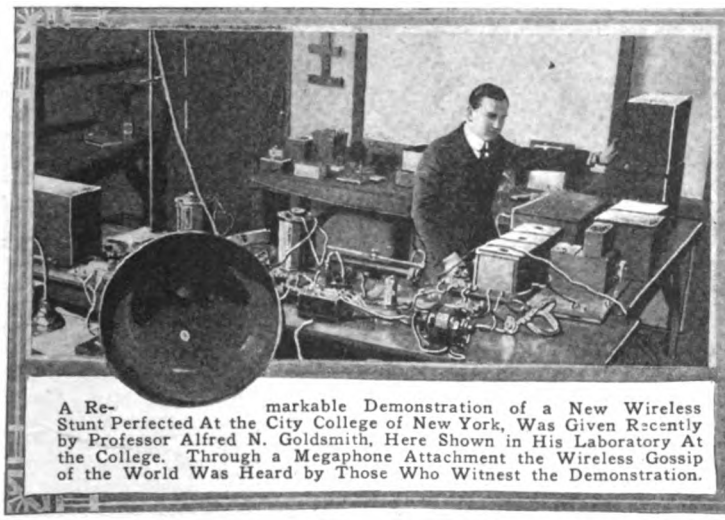
A striking demonstration of the kind of combustion whose origin would be conveniently described by the newspapers as "spontaneous" may be made with ten cents worth of chemicals obtainable at any drug store—five cents worth of glycerine and the same amount of permanganate of potash. This last is a dark violet crystalline substance of which a minute particle will color a glass of water a beautiful purple.

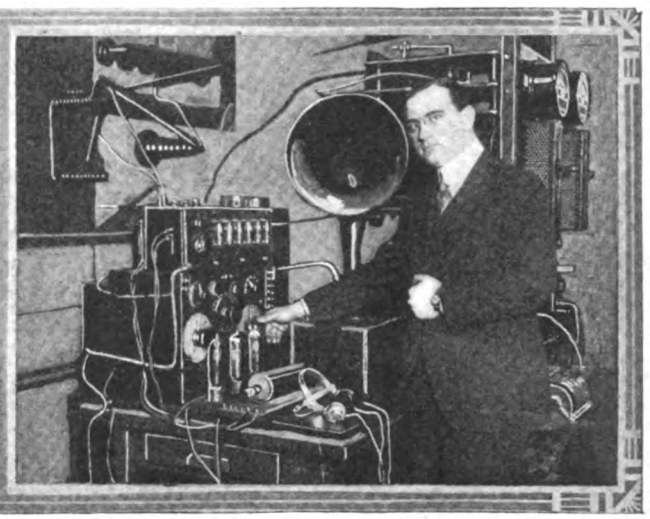
Rub a half teaspoonful at a time between two flatirons until it is a fine powder. Collect a couple of spoonfuls into a little heap on a slab of stone or iron, and make a slight depression in the top of the heap. Now quickly drop about a dozen drops of the thick, sweet and harmless looking glycerine into the little hole in the heap of powdered permanganate. For a moment you'll be disappointed—nothing seems to happen. Then—signs of action!

(*Continued on page* 1328)

RADIO DEPARTMENT

Radio "Talk" Relayed to Land Lines





A Remarkable Demonstration of a New Wireless Stunt Perfected At the City College of New York, Was Given Recently by Professor Alfred N. Goldsmith, Here Shown in His Laboratory At the College. Through a Megaphone Attachment the Wireless Gossip of the World Was Heard by Those Who Witnest the Demonstration.

RECENTLY there was carried out at the radio laboratory of the College of the City of New York some extremely interesting tests in which radio-telephone "talk" was transferred to land lines and vice versa, at will. When interviewed at the Radio Laboratories of the College of the City of New York, concerning these tests, which were under his supervision, Professor Alfred N. Goldsmith, in charge of Electrical Engineering, said:

It is natural that the recent remarkable achievement of the American Telephone and Telegraph Company in enabling persons on board a ship on the Atlantic Ocean to talk by wire and by telephone to persons or individuals on the Catalina Islands in the Pacific Ocean should have aroused such widespread public interest.

This transmission of the human voice over thousands of miles of wire and thru many miles of air has been made possible by the development of a new type of vacuum tube frequently known as the *audion*. It resembles in appearance a large lamp and contains a glowing filament and special forms of metallic grids and plates. This tube can take the extremely feeble speech and raise its loudness by electrical means until tremendously loud speech is produced. When it works in this way, it is known as an *amplifier*, and as such is widely used in wire telephony and in radio communication. It can also be used in a number of other special ways for radio telegraph and telephone transmission and reception, and is largely employed for these purposes today.

Radio-telephony has long been a subject for special investigation in the Radio Laboratories of the College of the City of New York. The first experiments were carried out more than twelve years ago with what is known as the *Poulsen Arc* apparatus and covered only short distances. However, by 1916, a powerful vacuum tube radio-telephone set had been installed in our Laboratories at the College and gave excellent results. It was much the same type of apparatus as is used today for the same purpose.

There was stretched over the buildings of the College a great aerial wire system for transmitting, with more than three-quarters of a mile of heavy bronze wire in it. Thousands of feet of broad copper band were buried in trenches under the College lawns to afford a proper connection to the earth.

The results that were obtained at the College more than five years ago justified the trouble taken. We telephoned from a downtown residence more than seven miles from the Laboratory over the wire lines and then *automatically transferred* or *relayed* the received speech out by radio-telephone. That is, the wire telephone was automatically linked with the wireless telephone and every word spoken downtown went out by radio from our transmitter.

This speech was heard as far away as North Dakota, over 1,300 miles from New York. At shorter distances the loudness of the speech was so considerable that some amusing incidents occurred. For example, a radio amateur some 50 miles from the College happened to "tune in" our speech signals one evening. He afterwards explained that he thought his aerial wires had either fallen across an electric power line or been struck by lightning, judging from the tremendous volume of the speech received.

This pioneer work of five years ago has been carried forward steadily in the Radio Laboratories of the College and about ten different types of radio-telephone transmitters of various sizes have since been produced and successfully tested here.

The American Telephone & Telegraph Company has been interested in radio-telephony as a useful adjunct to its highly successful wire service under special conditions for a number of years.

In 1915 elaborate experiments were carried out by that Company and the Western Electric Company, with the co-operation of the United States Navy, at the Arlington, Virginia, radio station of the Navy. The great aerial wire system at Arlington supported on 600-foot steel towers was placed at the service of the Companies for experimental purposes. A radio transmitter was installed in which as many as 550 of the transmitting tubes were used at a time. Speech from various points was carried by wire to Arlington and then sent out by radio automatically. The voice of the speaker was heard at points as widely separated as Paris, France; Mare Island in the Pacific Coast; and Honolulu.

The promise shown by these experiments encouraged the Telephone Companies to carry the work further and they determined to try out thoroly radiophone communication between ships and shore, and between islands and the main land. Accordingly, the steamship *Gloucester* was equipt with an efficient radiophone set. Furthermore, two land stations were established, one at Green Bay near Boston and one at Foxhurst, N. J., near

Articles to Appear in April Issue of "Radio News"

Aeroplanes and Radiogoniometers by Armstrong Perry.

Simple Measurements and Calculations for the Radio Station Owner by P. F. Geagan.

A Long Range Receiver by Joseph G. Read.

A Honeycomb Coil Tuner by Paul Watson.

Short Wave Radio Vacuum Tube Transmitter and Regenerative Receiver With Two-Step Amplifier by Walter Hyndman.

A Two-step Audiotron Amplifier by Frederick J. Rumford.

Tug or Spirit—a Fascinating Story by Julian K. Henney.

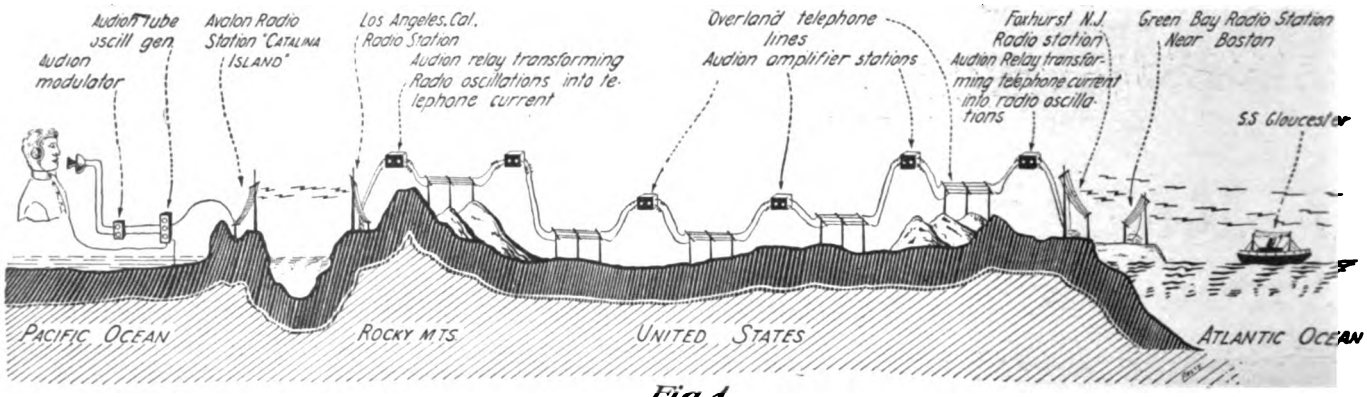


Fig. 1

Fig. 1. Physical Diagram Showing the Combined Wireless and Wire Telephone Conversation Recently Carried Out Between a Radio Station At Avalon, Catalina Islands, Off the California Coast, and the Steamship "Gloucester" Off the Atlantic Coast. This Diagram Shows How a Person At Avalon, Off the Pacific Coast, Talked First by Telephone Then by Radio and Then Again by Telephone, Over the Famous Transcontinental Telephone Circuit Equipt With Audion Amplifiers As Shown At Successive Stages of the Journey and Finally the Telephone Currents Corresponding to the Human Voice Were Converted Into Radio Oscillations and Ether Waves At the Atlantic Coast Stations, Whence the Messages Were Wafted Thru the Ether to the S. S. "Gloucester."

Elberon; these points being near the terminals of the coastwise trips of the *Gloucester*. These sets were all transmitting tube sets and were *duplex* sets. That is, it was possible to send and receive at the same time and the users of these sets could therefore *talk and listen simultaneously*, just as on an ordinary telephone wire line. The Foxhurst and Green Bay radiophone stations were then connected to the wire line systems of the Telephone Company.

About the same time, radio telephone sets were installed at Los Angeles, California and Avalon, Catalina Islands. The stretch of the Pacific Ocean lying between Avalon and Los Angeles was very successfully bridged, and many thousands of calls have been handled without trouble.

Recently, the operator on the *Gloucester* established communication with Foxhurst. There his speech was automatically transferred to the transcontinental line terminating in Los Angeles, where it was again transferred to the radio-telephone and carried to Avalon. So that the operator at Avalon and the operator on the *Gloucester* were in direct personal touch.

While the radio-telephone is not regarded as a competitor of the wire telephone for ordinary overland communication, it is, nevertheless, a useful adjunct in such special cases as those just described and forms an excellent element in the system of any effective public service wire communication company.

The *Gloucester-Avalon* transmission is interesting from another point of view. For the first time in the history the voice of man has been carried across portions of two oceans and an entire continent!

In view of the ease with which the wire service and the radio-telephone can be linked to each other, it is clear that every telephone subscriber in the United States automatically becomes a subscriber to such special radiophone service as may be established by the wire companies and their associated companies.

Clearly, the time is not far distant when, by asking for "radio long distance" or possibly radio marine service any telephone subscriber will be able to reach ships at sea or possibly even telephone subscribers on the other side of the ocean.

The work done in radio research at the College of the City of New York enabled its staff to render valuable service to the Army and Navy during the war. Many hundreds of men were trained for the Navy in a special school established at the College, under the general direction of Professor Frederick B. Robinson, Dean of the School of Business and Civic Administration, and under the engineering charge of myself. The purpose of this School was to teach the Navy's operators how to handle radio direction finders or "radio compasses," as they were called. This interesting device enabled stations equipped with it to find the direction of any station which they heard. Not only

(*Continued on page* 1349)

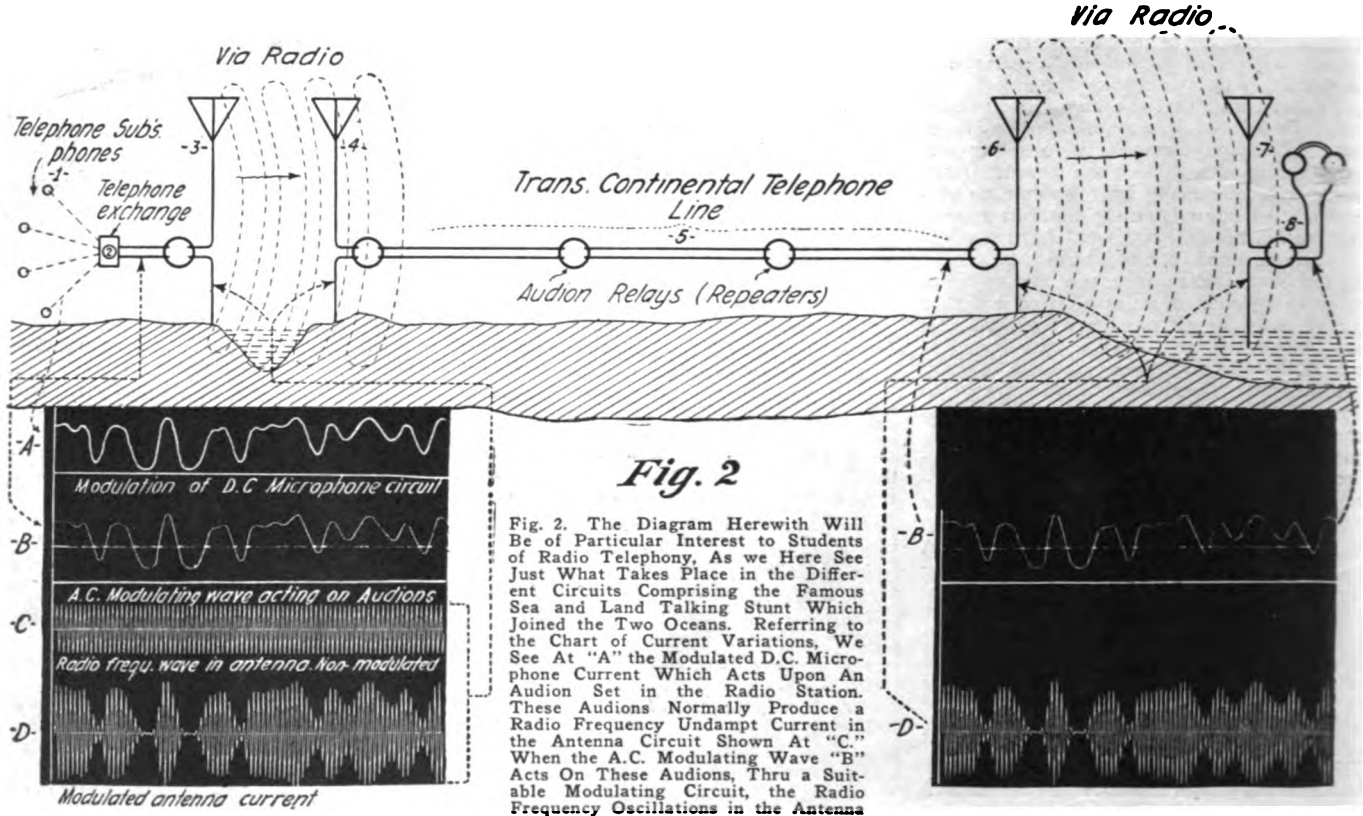


Fig. 2

Fig. 2. The Diagram Herewith Will Be of Particular Interest to Students of Radio Telephony, As we Here See Just What Takes Place in the Different Circuits Comprising the Famous Sea and Land Talking Stunt Which Joined the Two Oceans. Referring to the Chart of Current Variations, We See At "A" the Modulated D.C. Microphone Current Which Acts Upon An Audion Set in the Radio Station. These Audions Normally Produce a Radio Frequency Undampt Current in the Antenna Circuit Shown At "C." When the A.C. Modulating Wave "B" Acts On These Audions, Thru a Suitable Modulating Circuit, the Radio Frequency Oscillations in the Antenna

Are Molded to Resemble Those at "D." The Antenna Current Received At the Antenna 4, for Example, Resembles the Groups of Oscillations "D," Which Are Transformed Thru An Audion Receiving Set, Into Telephone Currents Similar to Those At "B." At the Atlantic Coast Radio Station, 6, for Instance, These Telephone Currents "B," Are Again Changed Into Modulated Radio Frequency Currents "D." The Electro-Magnetic Waves From Antenna 6, Reach the Antenna of the Ship Station At 7, Where Radio Frequency Currents Are Set Up in the Antenna Resembling "D." The Currents in the Antenna 7 Pass Down Thru An Audion Receiving Set and Into the Telephone Receiver Circuit, Where An Audio-Frequency Current As At "B" Is Heard by the Operator. It Was Possible for Conversation to Be Carried on Both Ways Without Switching From Transmitting to Receiving, in the Recent Telephone Tests—the Person Both Talking and Listening in the Same Natural Manner As When Using a Common Bell Telephone.

The Audio-Frequency Amplifier in France

By ROBERT E. LACAULT

Late Lieutenant in the French Army Signal Corps

VERY little has been sai' about the researches made in France on the subject of Radio and especially on the apparatus using V. T.(vacuum tubes), for most of the experiments were carried out during the war

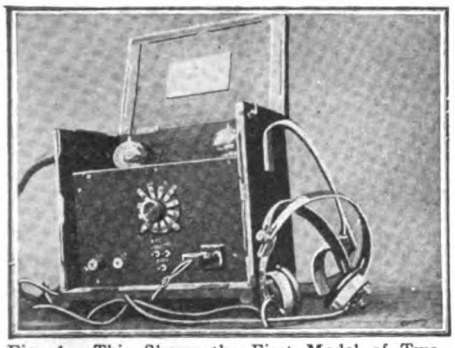


Fig. 1. This Shows the First Model of Two-Stage Audio-Frequency Amplifier Developed for Use by the French Army.

in the laboratory of the Signal Corps, and until peace was signed, nothing could be divulged to the public.

The writer, who has carried out several experiments in this laboratory, is pleased to present to the readers of SCIENCE AND INVENTION some new facts on the birth and growth of the amplifier in France.

It was in 1915 that the need for a sensitive and practical amplifier was felt in the army for until that time spark transmission was used, and the reception was effected on a crystal detector. At this time, some officers who were sent to this country, brought back a few models of V. T.'s, which were practically unknown in France. Immediately experiments were made by the most prominent French radio engineers and a few months later a standard type of V. T. was adapted and manufactured by two firms which produced *5000 tubes a day;* it must be added that a great number were broken at the front every day owing to the bombardments, which explains why this number was only just sufficient.

This standard type of V. T. was so designed that it could give equally good results when used as a detector or an amplifier as well as an oscillator. At the same time research was made to find the best characteristics of an amplifying transformer which was to be used in conjunction with the standard V. T. The result of this work was a two-stage audio-frequency amplifier especially designed for field work. This amplifier is shown in Fig. 1.

Catching the German Conversations

As soon as amplifiers were brought to the front the officers of the Signal Corps tried to use them to catch the conversations carried on over the telephones in

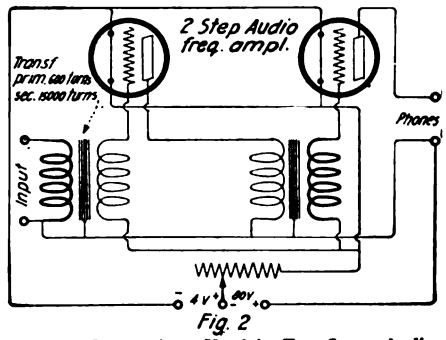


Fig. 2

Fig. 2. Connections Used in Two-Stage Audio-Frequency Amplifier Used Considerably in Trench Radio Sets by the French Army.

the German trenches. These attempts were quite successful and it was found that by running two wires parallel to the German 'phone lines along the ground, it was possible to hear every conversation of the enemy, and thanks to the ultra-sensitive amplifier the inductance was sufficient even at a great distance from the lines to accomplish this successfully. It is needless to add that very important information was obtained by this system.

When no telephone was used by the enemy, a microphone (like that used in a dictagraph) connected to an amplifier was brought near the German trenches during the night and some useful and interesting data for the Allies was gleaned from the overheard conversations.

The amplifiers have also been extensively used in the ground telegraphy system. This ground radio merely effects the transmission of waves in the earth and is very simple. The transmitter is a powerful buzzer operating on 10 volts and the receiver is an audio-frequency amplifier; the radiating system is made of two wires grounded at the ends. This ground telegraphy was especially useful where it was impossible to erect an aerial, and a range of about three miles was obtained with a power of only 20 watts. Fig. 8 illustrates this system.

After this short review of these generally unknown uses of the amplifier we will speak of its use in Radio-telegraphy. With the new warfare it was often impossible to use in the trenches the heavy powerful spark sets which were supplied to the Signal Corps. It was therefore, decided that small portable sending sets should be built which could be carried by one or two men and which could be erected or dismantled in a few minutes. But owing to the small power of these stations it was necessary to use very sensitive receivers.

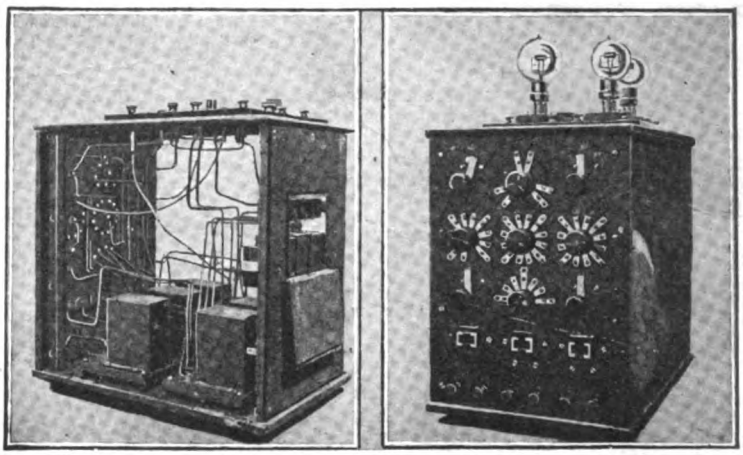


Fig. 3. Regular Model Three-Stage Audio-Frequency Amplifier Which Can Be Used When Desired As a Detector and Two-Stage Amplifier. The Photo Shows the Front View of Switch Panel with Three Jacks for Telephone Receiver Plugs As Well As Interior View of the Cabinet with Wiring, Self-Inductance Coils and Transformers.

The amplifier shown in Fig. 1, was at first used with the receiver of the portable sets and has made long distance communication with low powered transmitters and low aerials possible; the question of Trench sets was therefore solved. As can be seen in the diagram Fig. 2, this apparatus was rather simple. Later a new model fitted with the latest improvements came out of the laboratory. It was a three-step amplifier equipt with a switch, whereby the first tube could be used as a detector for Radio reception. With this apparatus wonderful results were obtained and a great number of these amplifiers have been manufactured for the Signal Corps. This instrument is shown in Fig. 3 and the diagram of the same in Fig. 4.

Altho this model of amplifier was the best ever designed it was found that owing to its size, it was not very practical for trench work, so the former apparatus was modified again and a new model known as the "3-ter" type was produced which was much simpler, but with which the same value of amplification was obtained. Fig. 5 is a photograph of the Standard amplifier now used in France, and as can be seen only one rheostat is used to control the current in the filament

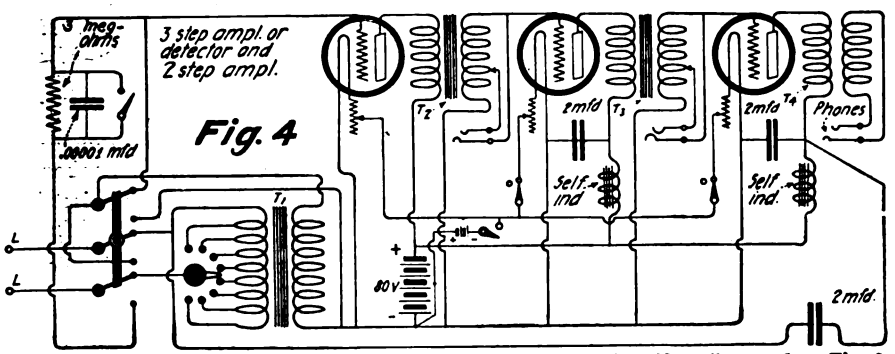


Fig. 4. Wiring Diagram for the Three-Stage Audio-Frequency Amplifier Illustrated at Fig. 3. As Will Be Seen, the Switches Permit the Operator to Employ the First Bulb As a Detector and the Remaining Two Bulbs As Amplifiers in Conjunction with a Crystal or Other Detector.

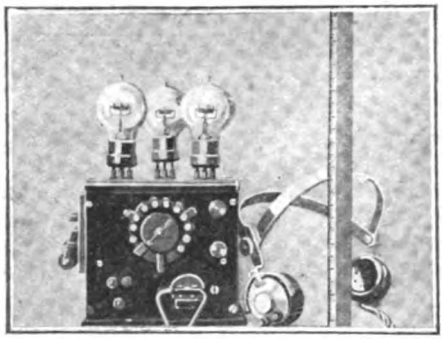


Fig. 7. This Shows One of the Smallest Three-Stage Audio-Frequency Amplifiers Ever Constructed, Possibly. It Was Built by the Writer of This Artilce, and All of the Apparatus Is Combined in a Wonderfully Compact Manner, So As Not to Waste a Bit of Space. The Cabinet Containing This Set Measures But 6"x6"x 6". The Switches Permit the Use of the First Vacuum Tube As a Detector with Two Stages of Amplification, or of Three Bulbs, to Be Used As Amplifiers. The Author States That He Has Accomplisht Just As Good Work with This Set As with the Large One Illustrated at Fig. 3, Which Measures About Four Times Its Size.

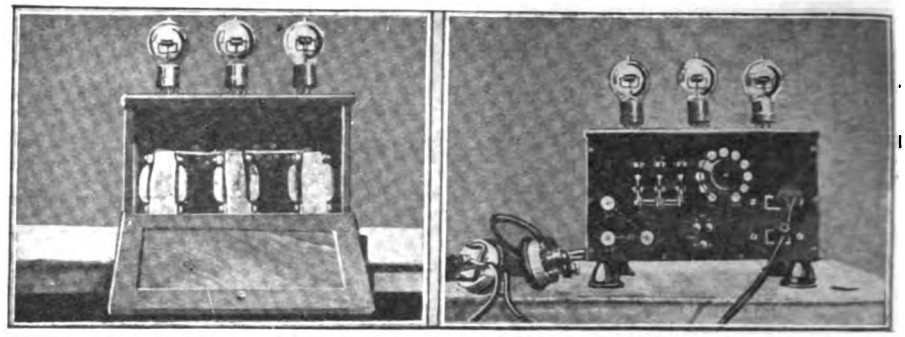


Fig. 5. These Two Photos Show One of the Later Models of Three-Stage Audio-Frequency Vacuum Tube Amplifiers Perfected and Used in the French Army Signal Corps. This Set Has Proven Extremely Efficient and Is Far Smaller in Size and Less in Weight Than the Large Set Shown in Fig. 3, and Is Used Aboard Ships As Well As in Commercial Stations. The Switch at the Left Permits of Using the First Bulb As a Detector When Desired. These Photos Show the Front View As Well As the Interior View of the Set.

of the three tubes. The switch allowing the use of the first tube as a detector is mounted on the front panel, while the cabinet contains only the three audio-frequency transformers and the grid condenser.

The writer has designed and built for a portable set, an amplifier embodying the same characteristics as the model just described but much smaller in size which is represented in Fig. 7. This is to give an idea of what can be done in this line when an apparatus is properly designed to meet a special requirement.

A great number of radio-frequency *amplifiers* have also been built, and at the present time these apparatus make possible the reception of radio signals with very small indoor aerials, including loop or coil aerials no longer than a cigar box. But as this line of apparatus is quite different, it will be described in a future article.

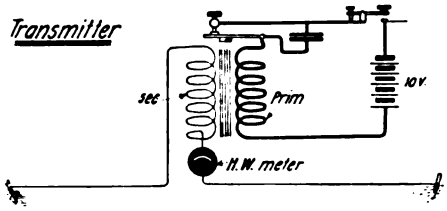


Fig. 8. Hookup and Arrangement of Buzzer Transmitter, Together with Two Step Audio-Frequency V. T. Amplifier Used in Carrying on Telegraphic Communication in the Front Line Trenches of the French Army, During the War. This Set Worked Over Surprisingly Long Distances Considering the Small Wattage Used in the Buzzer Transmitter, and by Changing the Code Used Every Day or So, There Was Little Chance of the Enemy Interpreting the Words Sent by This Method. This System Is Known As the T. P. S. System, Which Is the French Abbreviation for Telegraphie Par Sol, Meaning "Telegraphy Thru the Earth."

Miscellaneous

The American amateur radio man often experiments with other circuits than those here shown, for example: Method of using one or two audion bulbs to amplify the signals rectified by a crystal detector. Where expense is an item or for other reasons, this system can be used, but the most reliable, all - around outfit, of course, is that employing a vacuum bulb as a detector, in addition to the one or more bulbs employed as amplifiers. There are several vacuum tubes on the American market available to amateurs which operate on as low a plate potential as 20 to 22 volts, the voltage rating of the usual "B" block battery now on the market. There are many wrinkles which will help to improve the operation of audion amplifier sets, particularly when two or more steps of amplification are utilized, and which often cause supersensitive electrical conditions about the various instruments, particularly the bulbs themselves. One of the leading American manufacturers has found it advisable to enclose the audion coupling transformers in a metal case and the experimenter can try out different stunts such as this, so as to eliminate the freak conditions which sometimes bother one considerably in endeavoring to amplify thru several stages. One American radio manufacturer encloses the coupling transformer in a brass shell, while in a German set which was examined the audion transformers were enclosed in sheet steel shells. One of the mistakes amateurs make is supposing that the apparatus can be operated at high efficiency by simply mounting the various audion receptacles, switches, etc., on a wooden panel, but this is not so at all, and for best results the switches and other metal current carrying members really must be mounted on either fiber, hard rubber or Bakelite. If wood must be used, it should be thoroly soaked in hot paraffin or beeswax, or a mixture of the two.

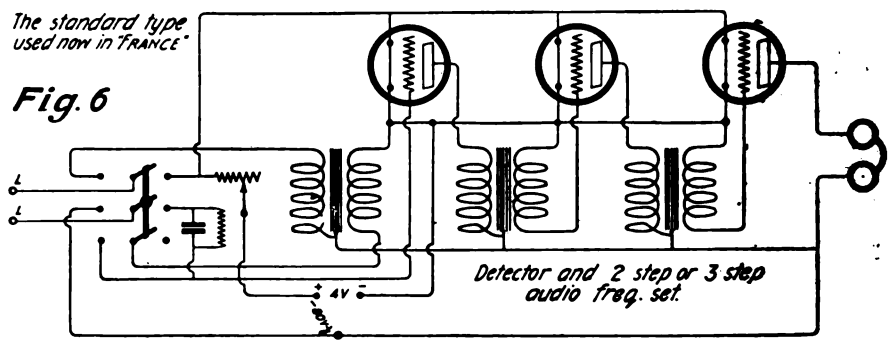


Fig. 6. Connections of Three Bulb Standard Audio-Frequency Amplifier Used Latterly by the French Army Signal Corps and Providing for Quick Change from Detector and Two Step Amplifier to Three-Stage A. F. Amplifier.

U. S. Bureau of Standards News

Observations of Radio Transmission Phenomena by Amateur Radio Operators.

It has been observed by radio amateurs generally that the strength of signals received from a given transmitting station varies rapidly during very short intervals of time, probably depending upon the weather and various meteorological conditions. The Bureau of Standards has desired to collect as much data as possible on the nature and causes of this fading of radio signals. In order to secure simultaneous observations of signals, arrangements have been made for a number of well-equipt amateur radio stations, including 6 transmitting stations and about 40 receiving stations, to begin such a series of tests. The 6 transmitting stations will send out a broadcast message, each of which will last about 3 minutes, on Tuesday, Thursday, and Saturday evenings, beginning just after the time signals from the Arlington Naval Radio Station. The 6 above-mentioned stations will transmit for their different regions 10 minutes apart and 3 or 4 of them will be within the receiving range of each receiving station.

The Bureau of Standards has supplied forms on which the operators will record the strength of the signals they receive and other information, such as weather conditions, presence of strays or atmospheric disturbances, and the general character of radio transmission at the time of each observation. It is hoped that as a result of this program of careful observations some valuable conclusions regarding radio transmission will be reached. If the present plan, which covers only the northeastern part of the United States, is successful, a more extensive program may be undertaken at a later date.

Lecture Explaining the Phenomena of Radio Telegraphy and Telephony

Communication by means of electricity without wires has progressed very rapidly during the last few years, and has probably been given more consideration by the general public than almost any other scientific subject. It is, nevertheless, a fact that due to the somewhat inaccurate and misleading newspaper accounts which have appeared from time to time dealing with

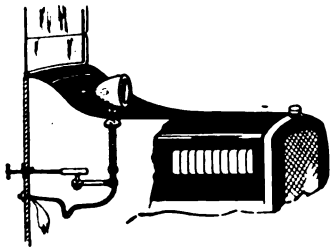
(*Continued on page* 1348.)

LATEST PATENTS

Spot-Light Mounting.

(No. 1,363,426. Issued to Charles Mee.)

This invention relates to a method of mounting spot-lights on the automobile engine hood, so that the spot-light

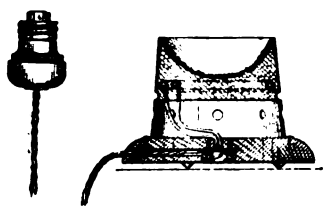


may be operated by the driver of the car thru the agency of rods. When it is desired to tilt the lamp down, the operator draws the rod and handle toward him. When he wishes to tilt the lamp up he pushes the handle away from him. When he wishes to turn the lamp from side to side he moves the handle to the right or left, swinging the rod on the dash board as a center and this in turn swings the arm and turns the stem of the lamp and the lamp as well.

Evaporizer.

(No. 1,359,000. Issued to Carl. L. Stottmeister.)

This invention has for its main object to provide an evaporizer, in which various substances in liquid, powder or solid form are subjected directly to the effects of heat within an integral of the heating apparatus. It is portable and has a relatively cool base when in

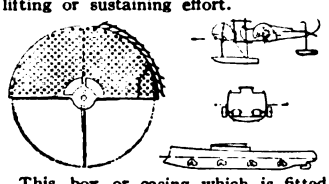


operation and there is a cup-like metallic receptacle in its upper part, so that when current is turned on, certain resistance wires are heated and evaporize the medicant. This is particularly adaptable for treating such diseases of the respiratory organs and such affections as sore throat, hay-fever, catarrh and asthma.

Propulsion Means.

(No. 1,360,182. Issued to Salustio Valdés Cortés.)

This is indeed a very clever method of arrangement for a paddle wheel or rotating propulsion mechanism, mounted on a vertical, horizontal or inclined shaft, whereby the inventor realizes some possibilities, which were heretofore overlooked. He adapts the invention for airplane, submarine or seagoing vessels with but slight modification. Essentially it consists of a new casing made to fit over one-half or more of the paddle wheel, which casing is constructed with permeable or perforated lateral sides, and with holes or openings and deflecting vanes in its perifery whereby greater efficiency of propulsion is attained together with a lifting or sustaining effort.

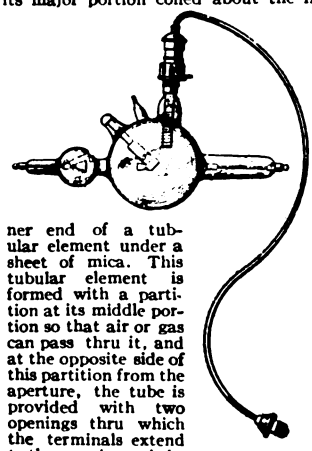


This box or casing which is fitted around the propeller utilizes the centrifugal force of the revolving medium, air or water, confined in the casing by converting it into propulsive or lifting effort.

X-Ray Tube

(No. 1,359,300. Issued to Edmund Wandner.)

This invention aims to provide for an improved X-ray device including a manually controlled regulator by means of which a very steady or uniform vacuum can be maintained in the X-ray tube, and by means of which the vacuum can be lowered so as to prevent the tube from being punctured. It also affords an easy method of controlling the current. It will be seen by referring to the diagram that a screw-plug is formed so as to be adapted to fit an ordinary electric lamp socket, which likewise fits a regulator or rheostat-socket, whereby the resistance and current strength may be regulated. A wire of relatively high resistance has its major portion coiled about the in-

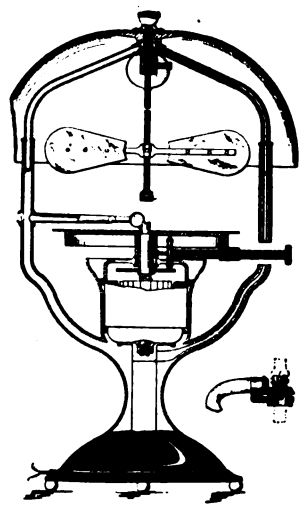


ner end of a tubular element under a sheet of mica. This tubular element is formed with a partition at its middle portion so that air or gas can pass thru it, and at the opposite side of this partition from the aperture, the tube is provided with two openings thru which the terminals extend to the exterior and thence connect to the current line.

Combined Light, Fan and Phonograph.

(No. 1,359,053. Issued to Peter R. Gonsky.)

This rather simple, yet clever device, comprises a phonograph, fan and a table lamp, all within the same con-

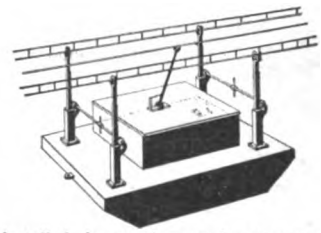


struction. An important feature is that the shaft for the rotating table of the phonograph also rotates or drives the fan and there is an additional interposed flexible shaft connection employed so that a record can be changed without interfering with the driving of the fan. The lamp-motor base is further used as a sound amplifier. The entire device is made in compact form and has a very pretty effect when placed upon the table. A bevel gear is provided so that the device can be used to drive small household appliances such as massage vibrators, which gears may be thrown into or out of operating position.

Electrically-Propelled Boat.

(No. 1,355,156. Issued to Maria Rodrigues Loija.)

Altho this invention will require considerable expenditure in order to make it operate properly, when once

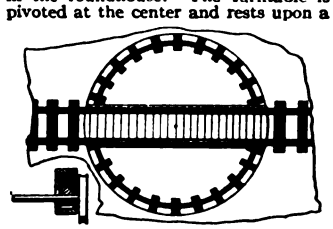


installed, it promises to be very successful, in that not alone is a ship propelled by electric current operating a motor, but it requires no steering control. There are two horizontal members which engage four wheels serving to guide the vessel over the waterway. These wheels are on standards automatically or manually adjustable for changes in tide and current, which also serve to act as one conductor, whereby the power will be conducted from any suitable source to the motor on the boat.

Turntable.

(No. 1,355,722. Issued to Byron E. Viele.)

The invention relates to an improved method of operating a turntable in roundhouses, etcetera, so as to dispatch locomotives to different points in the roundhouse. The turntable is pivoted at the center and rests upon a

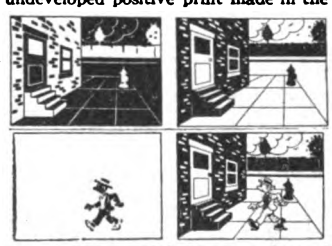


circular track. An electric motor or steam engine is housed at the center point, and thru the agency of bevel gears, power is transmitted to friction wheels which serve to drive the table around on the circular track.

Animated Cartoons.

(No. 1,355,648. Issued to Leslie Elton Brownley.)

This invention provides for an improvement in making animated comic characters or cartoons and photographic backgrounds, or so-called "real life action" upon motion picture films, or also in making real life action in combination with animated silhouette figures. The inventor first takes a photograph of real life action and produces a positive print therefrom, but does not develop this positive print. Then he makes a cartoon character in detail upon a black background by projecting the negative of the real life image on to a ground glass and sketching the character therefrom. Now a black silhouette of the cartoon is made, omitting all detail; a print of this silhouette is also made, when this latter negative print is placed upon the undeveloped positive print made in the

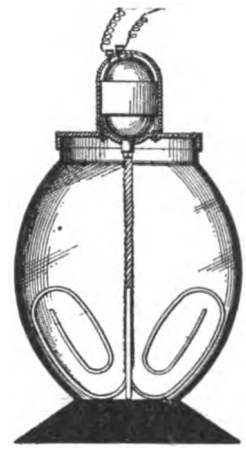


second stage, and both are subjected to light. Upon viewing the same in its developed state we will find a real life background with a black silhouette figure. The cartoon that has been drawn is then photographed and superimposed in the position occupied by the black silhouette figure, giving us a cartoon figure acting with real life objects on real life backgrounds.

Electrically-Operated Egg-Beater.

(No. 1,359,208. Issued to Burr D. Vicrs.)

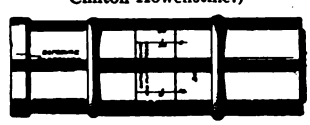
This little device is so arranged that it is readily adapted for disposition on the top of an ordinary glass or tumbler and is constructed on novel lines. It can be taken apart for cleaning and re-



pairing. There is a dome-shaped casing covering the motor and openings are formed in the sides of the casing to facilitate the introduction of oil. It will thus be seen that when the cover is removed from the receptacle, the motor will also be removed, while the dasher shaft will remain in the receptacle. Thus the dasher can be changed or cleaned without taking the motor apart or removing the motor from the cover.

Photographers' Light-Meter.

(No. 1,361,999. Issued to Charles Clinton Howenstine.)



This meter is intended for determining the strength of light, particularly in taking photographs so as to give the correct exposure for any diafram opening and any speed of exposure of plate or film. Enclosed within the meter is a self-luminous body or compound which constitutes the standard. A light coming from the subject is compared with this self-luminous body and by adjusting the shutter so as to cut out or allow for a greater proportion of incident light, a point is reached where both lights will match exactly, by means of a suitable scale, the correct exposure for any stop or speed of film or plate, etc., is easily determined without calculation. Before the light enters from the subject it passes thru the uncovered portion of the shutter opening, then thru a diffusing body and a color screen. This color screen may be a gelatin film, stained a bluish-green color and therefore only transmits light of the same color.

What To Invent

By JAY G. HOBSON

PRACTICALLY all modern player pianos have automatic tracking devices for the purpose of keeping the music rolls in proper alignment with the holes in the tracker-bar, which represents the eighty-

For Years Railroad Travelers, Especially Those Having to Make Journeys Between Cities Early in the Morning, Have Had to Go Without Anything to Eat Until the Dining Car Was Ready to Serve Breakfast. What a Boon It Would Be to Travelers If Some Progressive Railroad Manager Would See Fit to Have Developed and Installed, a Suitable Coin-in-the-Slot Sandwich Machine As Well As a Coffee Dispensing Device.

eight keys, the number on all standard pianos.

If the perforation in the paper music roll does not pass over the hole in the tracker-bar there can be no playing of music. The reason for this fact is, that player pianos are in reality another form of the vacuum cleaner, adopted to make the piano play. Therefore if the note hole in the music roll fails to effect a proper conjunction with the hole in the tracker-bar, the piano keys cannot operate because of insufficient vacuum and air pressure—hence no music.

There are several semi-successful tracking devices for player pianos on the market, but all have their faults, causing no little dissatisfaction and trouble in operation, by tearing the paper music rolls or causing discords in playing when the rolls are not tracking properly as required for good music.

In view of the present unsatisfactory tracking devices installed on player pianos, and because of the great need for a practical and simple improvement upon same, there now exists a splendid opportunity for the inventive public to exercise their ability of creation by perfecting a new design for this important purpose.

I would suggest that the reader procure catalogues of the different player mechanisms, which will explain the player action and automatic tracking device in detail. The present tracker construction is made to operate from the vacuum or suction that also produces the music in the player piano. But, the pneumatic tracker soon becomes clogged with dust and lint from the paper roll, thereby making it ineffective in keeping the roll properly aligned.

In my opinion, what is needed is a mechanical tracking device of simple construction, so arranged that it can be quickly attached by the average piano tuner, and made to operate from the mechanism that runs the music roll. If the problem is worked out along this line and solved, I am confident the invention will sell promptly to some large piano company who will gladly pay a good sum or royalty for the improvement.

SANITARY FOOT WARMERS.

The other day I had an occasion to get myself shod in one of these up-to-date, "While-U-Wait" electric shoe repair joints, (And truly—many are only joints, being so small, and built in to make a patron feel out of joint to find a place to wait) where the head man grunts out his gruff interrogation of what is wanted; and when you tell him you are all run down at the heel—needing a new pair, he pushes you, (figuratively speaking) into one of his lame chairs with a remark:—"Put on theese hare slippers," or: "Jus use theese hare paper t'put yourn feet on!"

Dejectedly you slip on an old, dirty pair of carpet slippers about ten sizes too large for you; or else choose the other alternative of assuming an unconcerned air about sitting in your sock feet, secretly thinking everyone around you is looking at your big feet. But the horror of it all is the inner fear you contain, lest in your walking one of your suffocating toes has bitten a hole in your sock which now shows up like an automobile headlight during an eclipse.

Its pesky hard to maintain one's equipoise of appearance when finally you gather enough nerve to let your eyes fall floorward, and to your painful surprise find your fears exactly realized, making you wish your father had been of a darker hue.

But granting that all the above did not happen to you, the need still remains for improved and sanitary foot warmers. While I was waiting for my "heels" the idea came to me picturing individual paper slippers of average size, printed on either side with the advertisement of the repair shop, etc., paper

An Idea Which Has Often Appealed to the Author, Takes the Form of a Paper Slipper Carrying the Advertisement of a Shoe Repair Shop Like That Shown Above. This Paper Slipper Could Be Given to Each Customer After His Shoes Had Been Repaired, and He Can Use Them at Home for Some Time;—Thus Providing Excellent and Cheap Advertising.

A Simple Water-Purifying Filter, Modeled Somewhat After the Arrangement Here Illustrated, Should Prove Valuable As a Part of Equipment for Life-Boats and in Fact All Vessels Which Make Trips Out to Sea—the Filter After Proper Chemical Treatment of the Salt Water Giving Pure Drinking Water.

slippers that would certainly be comfortable and warm, as well as, splendid advertising for each shop, because their customers could take them home; they would serve in the place of the frequently misplaced, regular slippers.

SANDWICH SLOT MACHINE.

As I write these jiggles while slowly creeping on the S. & U. R. R. thru the "Tar Heel" state, my liver is having a heated argument with my stomach about the fuel supply. You see these family arguments happen with the best regulated livers and stomachs, when the question of "eats" is a point to be considered.

Whoever figures up the train schedules certainly has some enemy traveling, and takes this early means of revenge by setting the time of departure in the wee-sma-hours, when the first cock crows—or to be more exact somewhere around five A. M. Now, I am sure you will agree that no decent person likes to catch a train before the Sun gets out of bed; for when he does, it surely means an empty stomach and angry liver until the destination is reached.

Of course, if the "Slow & Uncomfortable R. R." provided us early birds with some movable means of obtaining coffee and rolls, even tho it be of the tin can variety, we could hold out and appear a little more peaceful when reaching our destination. However, and sad as it may be, such is not the case. NO, in this case the early bird doesn't get the worm. He gets the grouch instead. So as I sit here on the S. & U. R. R. this hungry morning, weaving our empty way among the fat and juicy morsels that we know these country folks are now enjoying, my mouth begins to water for some good old fashioned ham and—with flapjacks for the finish.

(Continued on page 1342)

Scientific Humor

Like an Echo!—"Pa, why do they have repeating rifles?"

"I guess, son, to make every shot tell."

—*William Tuman.*

Couldn't "Bear" It.—Pulley: "Why did you get so hot-headed yesterday?"

Motor: "The oil ran out of my bearing."—*E. W. Vahle.*

The Origin of Brainstorms.—COLLEGE PROF: "What is mind?"

STUDENT: "No matter, sir."

COLLEGE PROF.: "What is matter?"

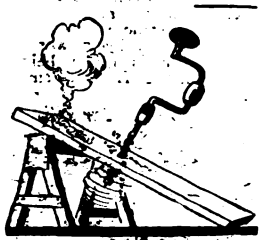
STUDENT: "Never mind, sir."

H. C. Bearden.

Heard in the Criminal Court.—HOUSE: "I've been framed by a bunch of low wood-butchers."

STREET: "That's nothing; these crooked car tracks have double-crossed me."

—*F. J. Schwab.*



A Hint for Bores.—"Am I boring you?" said the auger to the plank.

"You are boring me to death," groaned the plank.

"I'm sorry," said the auger. "I'll soon be thru."—*F. J. Schwab.*

Depends What He Hits.—"Just think of it, Pat," said the auto salesman to his prospective purchaser, "this car will go sixty miles an hour."

"Fore!" said the Irishman. "And, now, how fast will it stop?"

—*Dick Dickinson.*

Eggsactly.—TOMPKINS: "Bently has received a million dollars for his patent egg-dating machine. It's absolutely interference proof, and dates correctly and indelibly as the egg is being laid."

DEWLEY: "Is the machine on the market yet?"

TOMPKINS: "Oh, my no! and it won't be either. The patent was bought by the Cold Storage Trust!"—*H. S. Johnson.*

+ And − Is O.—STUDENT OF ELECTRICITY: "Can anything be both positive and negative at the same time?"

ELECTRICIAN: "Sure. When I proposed to my girl last night she gave me a negative answer which was very positive."

—*Walter Luire McDonald.*

A Black and White Artist.—"Well Rastus, I hear you are working again. What business are you engaged in now?"

"I'se done be in de mining business, sah."

"What kind of mining are you doing: gold, silver or diamond?"

"I'se doing calsomining, sah."

—*Henry Sorenson.*

But the Juice Ain't "Lower" There.—FIRST STUDENT OF ELECTRICITY: "Why are the lights in lower New York brighter than those in the upper section?"

SECOND STUDENT: "Because they are nearer the Battery, I guess."

—*No Name.*

FIRST PRIZE $3.00

Or Feeding "Hootch" to the Radiator!—TEACHER: (in physiology class) "Who can tell me what is auto-intoxication?"

A pause—then little Johnny volunteers.

TEACHER: "Yes, what is it, Johnny?"

JOHNNY: "Riding around in an auto till you're dizzy."—*Paul Abramson.*

Little Songs of Safety First.—

Lies slumbering here
One William Lake;
He heard the bell
But had no brake.
—*Detroit News.*

At fifty miles
Drove Ollie Pidd,
He thought he wouldn't
Skid, but did.
—*Rome, (N. Y.) Times.*

At ninety miles
Drove Edward Shawn;
The motor stopt.
But Ed kept on.
Little Falls, (N. Y.) Times.

WE receive daily from one to two hundred contributions to this department. Of these only one or two are available. We desire to publish only scientific humor and all contributions should be original if possible. Do not copy jokes from old books or other publications as they have little or no chance here. By scientific humor we mean only such jokes as contain something of a scientific nature. Note our prize winners. Write each joke on a separate sheet and sign your name and address to it. Write only on one side of sheet. No letters acknowledged unless postage is included.

All jokes publisht here are paid for at the rate of one dollar each, besides the first prize of three dollars for the best joke submitted each month. In the event that two people send in the same joke so as to "tie" for the prize, then the sum of three dollars in cash will be paid to each one.

This monument's
For Jackson Druck;
His Lizzie was lighter
Than the truck.
—*Scrantonian.*

Down in the creek
Sleeps Jerry Bass;
The bridge was narrow,
He tried to pass.
—*Wilkes-Barre Times-Leader.*

In peace here rests,
Poor Jerry Fitch
He put his hand
Upon the switch.

In state here lies
Old Archy Hale,
He put one foot,
On the third rail.

The Stomach Contains Indigestion.—The physiology instructor had asked Johnny to name the parts of the body and the organs contained therein.

Johnny answered, "The body consists of the head which contains the brains, if any, the chest, which contains the heart and lungs and the abdomen which contains the bowels which are A, E, I, O, U, and sometimes Y and W."

—*Carl Wm. Timm.*

No Wonder the Joke Editor Is Blue.—HE: "Why does a black cow give white milk that makes yellow butter?"

SHE: "For the same reason that a blackberry is red when it is "green."

—*Dwight L. Parham.*

(We heard always that the white cow gave milk and the brown cow gave coffee.—*Printer's Devil.*)

Wasted Science.—JIM: "I see a certain doctor has cured insanity by pulling out infected teeth."

JAM: "It won't do any good; they'll go crazy again when they see the bill."

—*Victor C. Heubner.*

Heard in Biology. — TEACHER: "Johnny, can you tell me what a tissue is?"

JOHNNY: "Sure, a tissue is a collection of cells, all of which are similar."

TEACHER: "Correct. Now give me an example."

JOHNNY: "The Penitentiary."

—*Chas. E. Harrison.*

Scientific Facts.—Sound travels 400 yards per second, but there are some exceptions to the rule.

Scandal—2,000 yards per second.
Flattery—1,500 yards per second.
Truth—2½ yards per second.

—*Melvin Greene.*

He Was "Charged" Too.—HE: (screwing electric fixture to the ceiling) "Better not stand so close Mary, you might be shocked if this thing slips."

HER: "Why would I? I am used to your language."—*Henry S. Johnson.*

Squaring the "Circle."—SHE: "What shape is a kiss?"

HE: "Give me one and we will call it square."—*Albert E. Snyder.*

A Good "Find."—HE: "They are a wise couple."

SHE: "Why?"

HE: "They feed their baby garlic so they can find it in the dark."

—*Evarest Ryan.*

We'll Be Switched.—Trans: "Nellie's hair used to be light, but now it's dark."

Former: "Perhaps she turned off the switch."—*Earl A. Keiser.*

THE ORACLE

The "Oracle" is for the sole benefit of all scientific experimenters. Questions will be answere here for the benefit of all, but only matter of sufficient interest will be publisht. Rules under whic questions will be answered:

1. Only three questions can be submitted to be answered.
2. Only one side of sheet to be written on; matter must be typewritten or else written in ink, n penciled matter considered.
3. Sketches, diagrams, etc., must be on separate sheets. Questions addrest to this department can not be answered by mail free of charge.

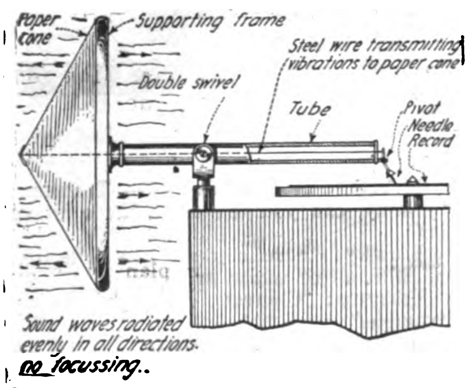
4. If a quick answer is desired by mail, a nominal charge of 25 cents is made for each question. If the questions entail considerable researc work or intricate calculations a special rate will be charged. Correspondents will be informed as to the fee before such questions are answered.

Hornless Phonograph

(1086) Oscar W. Hartung, Detroit, Mich., asks:

Q. 1. How does the Pathé *Actuelle* phonograph operate?

A. 1. Relative to the two articles "Building Your Own Phonograph" which appeared in the September and October issues of this journal, it would probably be a welcome idea, as you suggest, to publish the details of the Pathé *Actuelle* hornless phonograph, but we have to state that it would hardly be compatible with ethical principles to publish details of a specific machine of this new type.



The Diagram Above Shows the Principal Features of the Hornless Phonograph In Which a Paper Diafram, Taking the Shape of a Cone, Vibrates So As to Radiate Sound Waves In All Directions with Equal Intensity. This Eliminates the Undesirable Focusing Effect of the Usual Phonograph Horn or Sound Chamber.

The details which we did publish were practically all based on common knowledge of phonographs, and we did not feel that we were giving away any great trade secrets in explaining the details there given. The *Actuelle* or hornless phonograph, like all simple things, must be built carefully and very exactly to obtain anything like satisfactory results. The diagram herewith shows its general make-up. The paper cone is a good piece of parchment paper stretched or supported in such a manner as to form a rigid cone, and the center of this cone is attached by a stiff metal wire to the stylus at the inner end of the moving arm supporting the cone.

The secret of the *Actuelle* lies in the fact that the paper cone or diafram vibrates in a particularly free manner, and this causes sound waves to be set up practically all around and thus eliminates the disagreeable focusing effect due to the usual horn—which produces sounds only in one direction, *i. e.*, from inside the horn and outward. Thus it is that with the *Actuelle* a person hears the sound equally well in any part of the room and not in a certain corner of the room as is the case with practically all other machines having a horn-shaped amplifying chamber.

Motor-Bus Versus the Trolley

(1087) H. P. P., L——, Canada, writes the Oracle:

Q. 1. I am writing you to learn if you can put me in touch with places where I can get information in regard to the comparative cost of operating electric railway and motor-buses.

Some business men are of the opinion that the motor-bus cannot compete in a city which has only a population of about 70,000.

A. 1. We would refer you to an article by Mr. L. H. Rosenberg, an engineer of the General Electric Co., which appeared in our May, 1920, issue. In this article are discust some of the merits and demerits of the one-man trolley and their relation to the motor-bus.

To our mind, and providing your city board were faced with the consideration of building a new electric railway, then by all means it would seem the most economical to purchase the necessary number of motor-buses and establish a regular and specific operating schedule, etc. Of course, it is a question not so easily answered, when it comes to the consideration of substituting motor-buses for an already established electric railway.

It would seem to the editor of this column that one of the important factors bearing on this particular matter would be whether or not the electrical energy for operating the present railway is derived from coal or from a hydro-electric system. As you undoubtedly know, the gross efficiency obtainable from small or medium size steam-driven electric power plants is very low, and does not usually rise above 7 to 8 per cent.; while if the electrical enegy required is secured from a hydro-electric system, particularly if it is owned by the operating company, this may show a gross efficiency as high as 40 to 50 per cent.

Finally, we would suggest that you write to the American Institute of Electrical Engineers, 29 W. 39th St., New York City, N. Y., and to the American Railway Engineering Institute, 431 Dearborn St., Chicago, Ill., who may have in their files copies of papers presented before these respective bodies that you can procure.

The railless trolley, an omnibus taking power from an overhead wire, has been used more in Europe than in America, and is worthy of careful consideration. There is a very great saving in capitalization, but the passenger-carrying capacity is more limited than in the case of a regular electric railway.

We described and illustrated the railless trolley in our issue of July, 1916, to which we refer you.

Electric Motorcycles

(1088) Fred Post, Auburn, Ill., asks the Oracle:

Q. 1. In the article by Mr. Secor in the January issue, on building a small automobile, it is stated that the electric type requires 300 to 600 amperes. At this rate and figuring on 15 amperes per battery, 25 starting type batteries would be required weighing 1,500 pounds, and costing about $750. Is this right?

A. 1. Concerning the number of storage batteries required for operating the small automobile as outlined in the article in the January number of SCIENCE AND INVENTION, would say that the figures you give are right, but in actual practice those who have built electric motorcycles have done either of two things, it seems:

1. They operate the batteries at a higher discharge rate and use a smaller number of them than that theoretically required, or:
2. They do not operate the motor with the full load current required, or in other words, the motor is operated at a lower horse-power output.

There is a photograph and description of an electric storage battery motorcycle in the February number.

Water Motor Query

(1089) Roy E. Dukette, Hoboken, N. J., asks:

Q. 1. Several queries about water motors.

A. 1. Small water motors can be procured from several manufacturers of these devices.

With a ¼-inch pipe and 25 pounds pressure, we do not believe that you can develop much over 1/6 to 1/5 horse-power, altho if you can procure a very efficient turbine, you might develop as much as ¼ horse-power.

Operating 32 Volt Lamps on 110 Volt A. C.

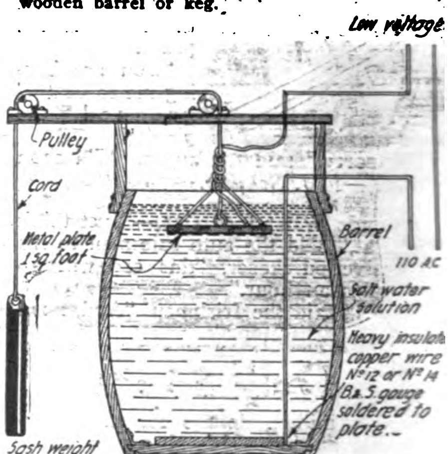
(1090) R. M. Ayers, Detroit, Mich., writes:

Q. 1. What is the simplest way to operate 32 volt lamps from 110 volt A. C. mains?

A. 1. In reply to your query asking for the easiest way to reduce 110 volts A. C. to 32 volts, for operating lamps rated at this potential, we would advise as follows:

The usual method of doing this and the one in commercial use for operating the lamps a 32 volts from a 110 volt circuit is by means of a step-down transformer. Four lamps might also be burned in series on 110 volts.

You did not state in your letter how many watts you will need. But as you mentioned therein that your particular requirements are of an experimental nature, we would suggest tha you reduce the voltage in the same way as tha followed in shop and field work, by means o a water rheostat. A diagram is given belo showing a water rheostat made from a smal wooden barrel or keg.



The Water Rheostat Is One of the Handi and Most Useful of Mechanisms for the P pose of Controlling the Amount of Current Su plied to Any Certain Piece of Electrical A paratus. A Very Serviceable One May Made from a Barrel, the Larger the Barrel Greater the Current Capacity, and Vice Ver

Of course the rheostat will have to be p portional in size to the amount of energy watts you require. With a saturated salt wa solution in a beer keg and using iron or ot plates in the solution having about one squ foot area each, you can take care of 500 600 watts, and somewhat more than this shorter periods.

How Many Miles of Wollaston Wi per Cu. In. Platinum

(1091) William A. Romans, Baltimore, M asks:

Q. 1. Several questions as to the ducti of platinum wire.

A. 1. Regarding the ductility of platin we have calculated the length to which this v can be drawn.

The very common form of Wollaston wir that used in ordinary delicate electrical ins ments which has a thickness of .0004 inch. cross-sectional area of this wire is .000,000,1 664 sq. in. by the formula, area is equal $\frac{\pi d^2}{4}$ dividing this into 1 square inch we ob the figure 7,957,730. In other words, there be exactly 7,957,730 inches of wire in 1 c inch of platinum.

This will give us 663,144 feet or 125.6 m of wire obtainable from 1 cubic inch of platir Inasmuch as 1 cubic inch of platinum we .7758 pounds, we obtain a figure of 162 r for one pound of wire. This wire is howe not the finest platinum wire obtainable. have on record, wire w diameter is .0 inch. This will mea a wire of above thickness could wn out just times as long as the mentioned wir 16,200 miles.

This light wire i means the sma wire obtainable; it nmercial product can be obtained market.

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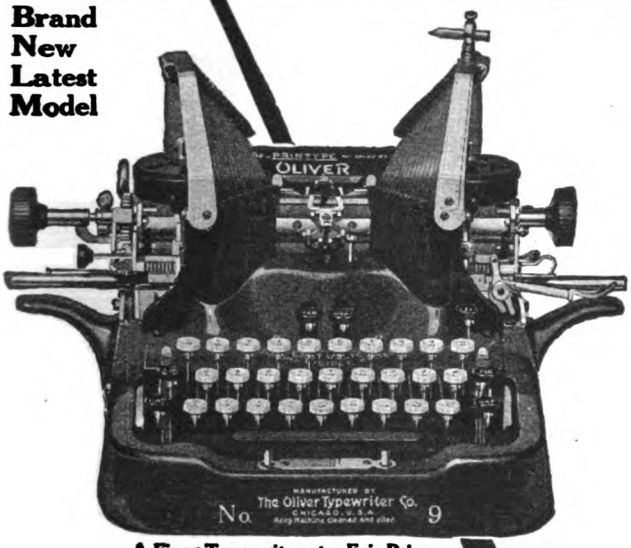

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How Big Are Molecules?

By ROGERS D. RUSK, M.A.

(*Continued from page 1286*)

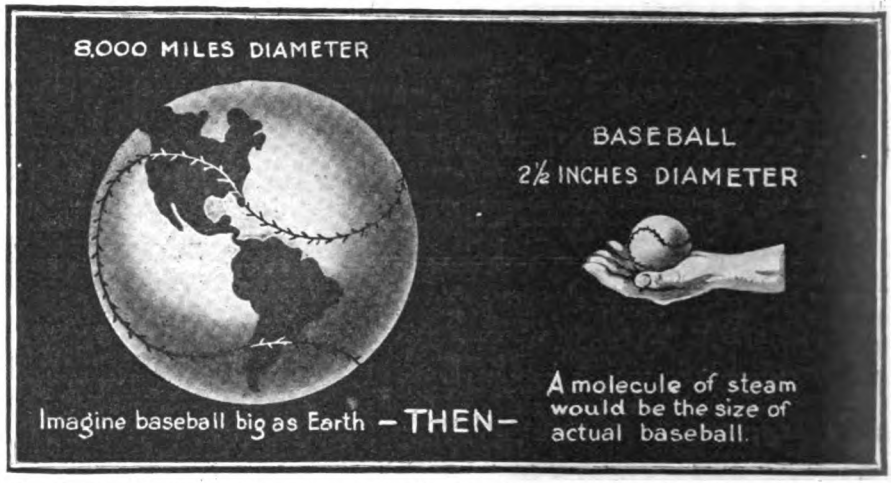
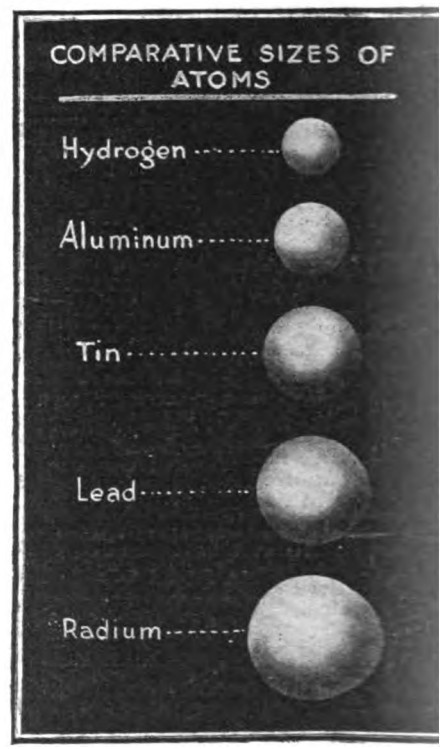


Fig. 4. The Illustration Above Shows That if a Baseball and a Molecule of Steam Were Magnified Until the Baseball Was as Large as the Earth, Then the Molecule of Steam Would Be About as Large as the Baseball Was. Fig. 1 Below Shows Comparative Size of Atoms.

Prof. Millikan, the American investigator, in his wonderful laboratory at the University of Chicago, has carefully measured and determined the electrical charge of the electron under very elaborate laboratory conditions.

An article describing how the electron was measured and even weighed, appeared some time ago in this journal, and those interested in the electron theory and the precise mathematical measurements of this basic quantity of matter, according to the present-day hypothesis, will find Prof. Millikan's book entitled "The Electron" extremely interesting and valuable.

The illustration at Fig. 5, brings out in a clear manner, the extremely small mass of the electron of which the human body and all other matter is now supposedly constructed. Imagine a powerful ray of light focust on to a spot on the man's chest down to a point no larger than the head of a pin, and that in turn, the reflected light ray is magnified or enlarged to the size of the earth, or a circle 8,000 miles in diameter. The whirling electrons would only then be visible as shown to the left of the illustration, Fig. 5. The continents of North and South America are superimposed on the illustration at the left of Fig. 5, to emphasize the idea that this enlarged view of the area the size of a pin-head, on the man's body, is of the same size as the earth or 8,000 miles in diameter.



Blasting Pole Holes

By E. H. Dana, Missouri.

I had an opportunity, late last fall, to try a new method of digging pole holes for the Cairo Light & Power Co., of Cairo, Mo.

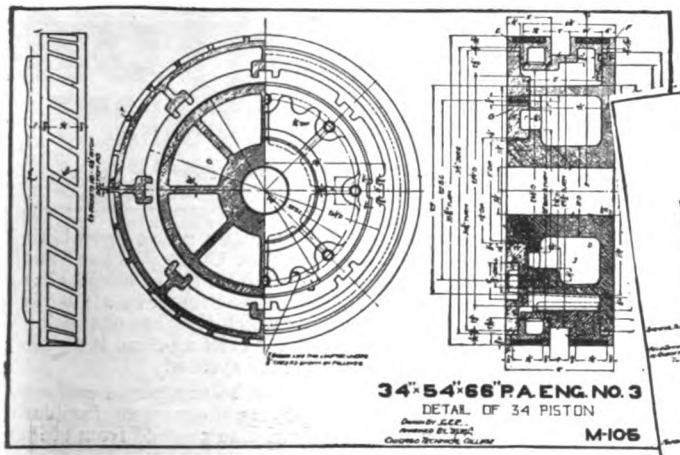
There were 155 holes needed, 20 in hard rock, the balance in clay soil. The holes were wanted in a hurry and labor was scarce. I have seen the use of dynamite advocated for this purpose and had read a description of the proper way to do it.

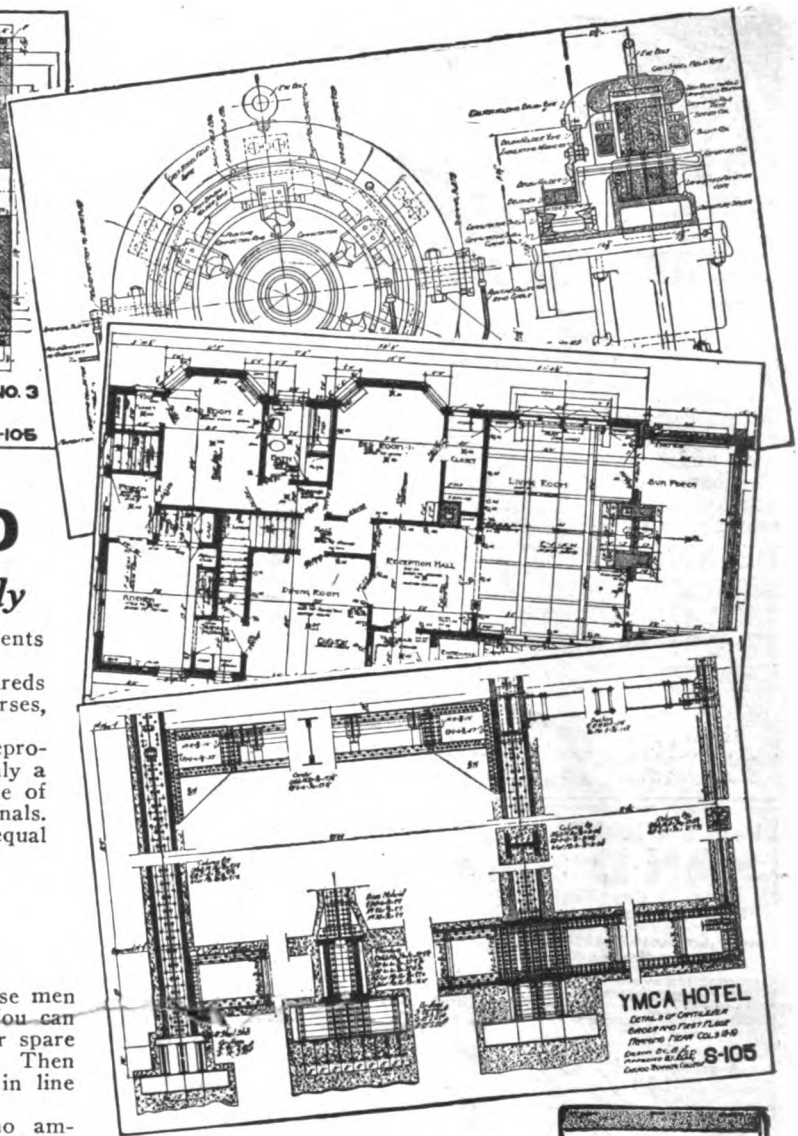
Bore holes were put down to a depth of five feet. Two cartridges of 40% dynamite were cut in halves. The four half sticks were tied to a thin strip of wood spaced about six inches apart. A cap and fuse were inserted in the top piece of dynamite. The holes were not tampt, as we desired a hole of only large enough diameter to take the pole. The less the surroun soil was disturbed and broken up, the be

The shots made a clean, well shaped just right for planting a pole.

The work consumed thirty hours' The total cost for labor and explo was $80, or a trifle over 50 cents per The engineer in charge was entirely s fied with this cost.

Of course, the method described ap only to the holes in clay. The holes i rock were blasted in a way well under by engineers, so will not be described However, the rock work added mate to the labor cost of the job. Had al holes been in earth the expense would been somewhat less.





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Naturally the large reduction made necessary to reproduce the drawings in the space of this page gives only a partial idea of the high excellence of the work—some of the lines losing the strength they show in the originals. But even so, it will be seen that these drawings are equal in merit to the work of men of long experience.

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Recent Work of the Bureau of Standards

(*Continued from page* 1305)

avoid absorption of gases and in special refractories. The latter treatment guards against solution by the molten iron of small amounts of impurities which occur when the former comes in contact with any ordinary refractory materials. With vacuum fused electrolytic iron as a starting point alloys have been prepared containing the elements commonly present in steel. Mechanical, thermal, microscopic and magnetic tests on these alloys reflect the relation between these properties of steels and its chemical composition.

NEW TEMPERATURE CHANGE THEORY OF CRYSTALLINE QUARTZ.

Strange enough, it would seem, that the Sugar Section of the United States Bureau of Standards, engaged as it is in the study of sugars, both common and rare, should stumble upon a new theory relating to the properties of quartz. The latter, however, is employed extensively in the construction of polarimeters, a device common to the sugar industry, and while analyzing the natural rotation of light by crystalline quartz the research led to other fields of science.

At a temperature of 573 degrees Centigrade crystalline quartz changes into another crystal, with a transformation of energy during the process. Here a scientist of the government, by employing special equipment consisting of a large electromagnet for studying the effect of magnetism upon light evolved the theory that the temperature at which the transformation starts when the crystal is being heated is sharply defined; namely, that of 573°.3 C. The change of energy at this temperature seems to be more clearly marked and more easily determined than that utilized in revealing the ordinary points on the high-temperature scale. A thermocouple close to but not in actual contact with the specimen of quartz will register this point with fine precision. Preferably, the thermocouple should be inserted in a small opening in the crystal, which method standardizes it at a fixed and accurately known temperature.

A study of quartz assembled from widely distributed areas of the United States reveals cumulative evidence that this phenomenon is characteristic of all crystalline quartz. According to the Bureau of Standards, the temperature of 573°.3 C. is a fortunate one inasmuch as there has been heretofore no known method of conveniently calibrating temperature-measuring devices in this region. As the temperature of a crystal of quartz approaches 573° Centigrade a change is exerted in all the physical properties of the substance. The change is particularly abrupt in the optical properties. When light, vibrating in a single plane, penetrates the specimen, the rotation of the plane of vibration which usually occurs in quartz is found to suffer a jarring change as the temperature of 573° is neared. The magnitude of the transformation is, of course, influenced by the wave length or color of light employed. The measurements of polarimeters, as negotiated by the Bureau of Standards, is said to be the first precision determinations ever made at high temperatures.

(*Continued on page* 1328)

Popular Astronomy

By ISABEL M. LEWIS, M. A.

(*Continued from page* 1295)

of photography as many novas have been discovered in the past thirty years as have been recorded through all the centuries that elapsed up to that time. A nova a year is about the rate at which they are now being discovered, and how brief a period is a year in the life of a stellar system!

Instead of suns and solar systems evolved from nebulae we are now more familiar with the idea of nebulae evolved from stars through some terrific cataclysm.

It is now known that there exists in certain parts of space a number of sharply-defined stars surrounded by extensive nebulous envelopes. Are these suns that are going thru the process of forming their planetary systems?

The fact is now recognized that pressure of light and electrical repulsion are forces to be reckoned with in the evolution of stars and nebulae as well as gravitational contraction. It has long been felt that the peculiar formations existing among the extended gaseous nebulae could not be explained as gravitational effects alone.

Light-pressure and *electrical repulsion*, as well as *gravitation* are at work within the solar system and the sun is the seat of powerful disturbances which produce periodic outbursts of exceptional activity and which may have produced in the distant past more startling effects than any with which we are familiar at present.

The earth and moon form a system that is in a way unique. No satellite in the solar system is so large in proportion to its primary as is our own moon. Seen from the distance of Venus or Mars, the two bodies would apparently form a *double star*. The diameter of the moon is one-fourth that of the earth. Satellite III of Jupiter far exceeds our own moon in actual size but its diameter is only about four-hundredths of the diameter of the planet its orbit encircles. The diameter of Titan the largest satellite of the Saturnian system, bears the same ratio to the diameter of Saturn. Moreover, all the nearer satellites of Jupiter and Saturn lie nearly in the equatorial planes of these planets, but the orbit of the moon is inclined at a high angle to the plane of the earth's equator.

It is not difficult to believe that the satellites of Jupiter or Saturn were at some time thrown off from the equatorial belts of their primaries, just as the planets themselves may have been ejected from the equatorial belt of the sun, but we cannot so readily believe that our own satellite was formed from the earth in a similar manner.

The moon's orbit lies nearly in the plane of the *sun's* equator however, and it is conceivable that both earth and moon were *simultaneously ejected* from the equatorial zone of the sun, the two nuclei being so close together that the smaller one remained under the gravitational control of the larger.

The difficulties in the way of believing that the moon once formed a part of the earth are very great. It has been shown mathematically that if the two bodies at one time formed a single mass it would have been impossible for the moon to break away from the earth, unless the force that caused the separation were sufficient to hurl the moon to a greater distance than two and a half times the earth's radius. Roche found out by computation that a satellite could not remain intact within this distance (2.44 radii, to be exact) of its primary, but could be broken up into small fragments

(*Continued on page* 1356)

Recent Work of the Bureau of Standards

(*Continued from page* 1326)

LARGE ELECTROMAGNET FOR MAGNETO-OPTICS.

This electromagnet is used for studying the effect of magnetism upon light. It takes 100 amperes at 240 volts and is water cooled. It is perforated along the axis to allow a beam of light to pass thru. A polariscope is shown set up on the end pillars—the polarizer at the far end and the analyzer at the other. The strength of the magnetic field is measured by means of a Bismuth Spiral or a test coil (both shown on the small table) in conjunction with the accessory apparatus (shown on the left), mutual inductance galvanometer, milliammeters, sliding resistance, etc. The apparatus as shown is arranged for studying the effect of temperature on the rotation of crystal quartz, a crystal of quartz being placed in the small cylindrical furnace between the poles of the magnet.

Fascinating Experiments in Chemistry

By O. IVAN LEE

(*Continued from page* 1314)

The glycerine is uneasy and begins to bubble—then smokes and fumes. In a flash, the whole mass bursts into a hot and dazzling violet flame resembling a miniature volcano, for sparks and clouds of smoke are not lacking to complete the illusion. It will need little imagination to conjure the possibilities of such chemicals starting trouble if broken cases should get them to rubbing elbows in transit. Fortunately, there are not a great many combinations which are so energetic, but the moral is: No matter how mysterious the fire—there's always a reason!

HOW "RED CROSS" KEPT LIGHTS GOING.

Along with keeping "the home fires burning," the Transportation Department of the "American Red Cross" considers it also essential to keep its office lights shining. To this end, by providing its own electric light by means of a rather novel agency, it has given Paris its latest American sensation, the one preceding it, being the afternoon when Major George H. Robertson, head of the department, stood at the junction of two of the city's most congested thorofares giving Paris policemen his ideas on how to regulate traffic.

Recently the city authorities notified the headquarters of the Department at No. 4, Avenue Gabriel, that there would be no "juice" for the electric lights between the hours of 9 a.m. and 3 p.m. Fuel is scarce in Paris and must be used sparingly. Now this particular day happened to be dark and foggy with much work to be done in the department. Some had visions of a holiday, for without light it was practically impossible to figure up long columns of gas consumption, finance, or play on a typewriter. That idea, however, was rudely dispelled, for a telephone message to the Red Cross garage brought out a big Crochat repair car, equipt with powerful generators and heavy cables.

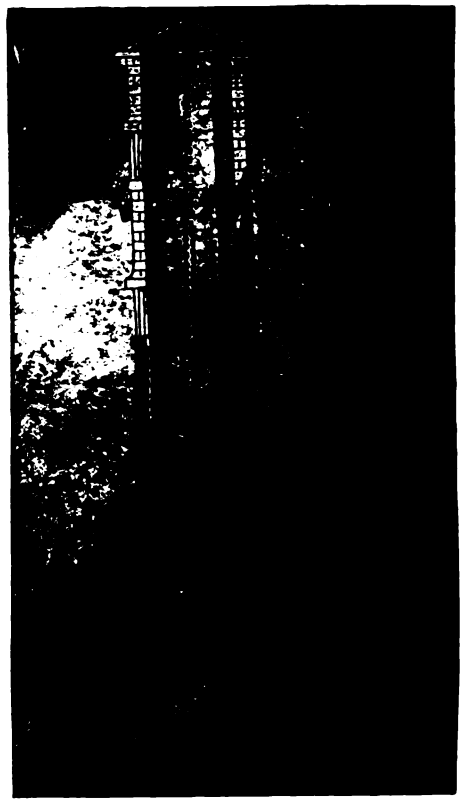
Within a few minutes after its arrival, the motor was snorting away in the street, and the generators were sparkling and sending out over the cables into the building sufficient current to furnish the light for every lamp there. Standing as it did on a much frequented thorofare, the big car attracted considerable attention.

Oddities of Physics

By H. WINFIELD SECOR

(*Continued from page* 1285)

building a wall one mile long, the difference between the actual wall as constructed by leveling with spirit levels, and a dead straight line (sighted across the top of the wall by using a leveling telescope or surveyors instrument) is one-half foot. In other words, if the wall was constructed two miles long by leveling, the top of it would curve upward in the center, so that if a perfectly straight line or chord were drawn across the top of the wall, there would be one-half foot difference between the line and the top of the wall at either end. For longer walls this difference increases of course, and decreases as the wall becomes shorter.



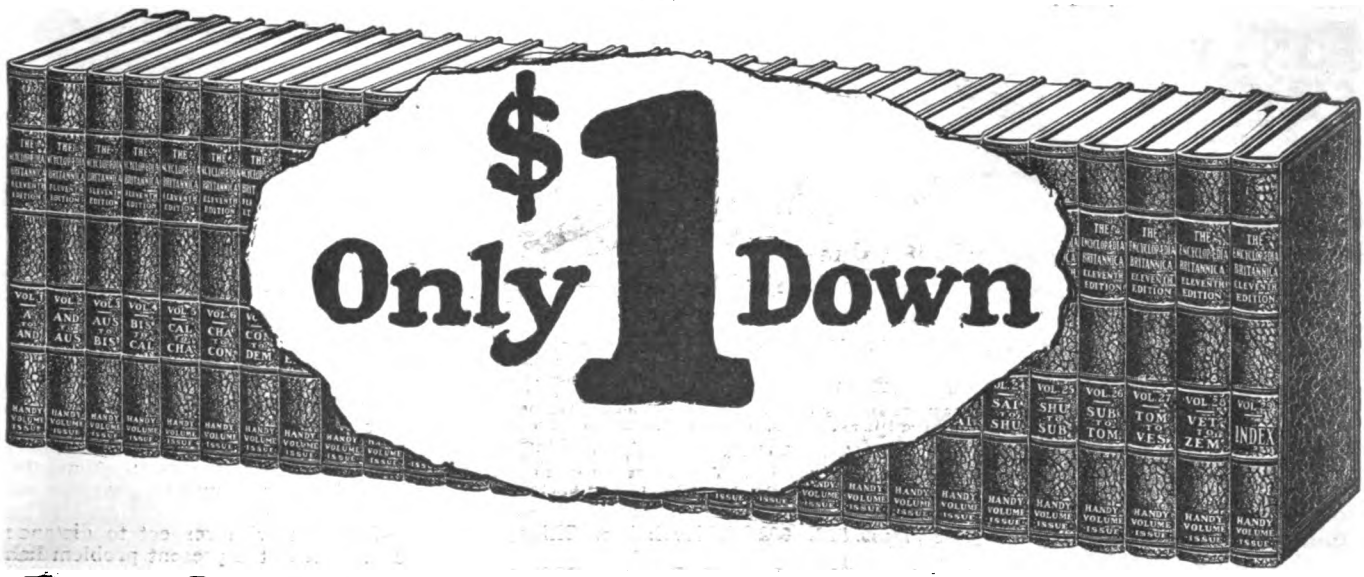
The Illustration Above Shows, Greatly Exaggerated of Course, How a Mountain or Hill Exerts a Sidewise Gravitational Pull on a Suspended Plum Bob, for Example. That Is, If a Tower Were Built by Means of a Plumb Bob on the Side of the Mountain in the Position Here Shown, the Tower Would Not Be Straight But Would Lean Away from the Mountain, (Unless Precautions Were Taken to Allow for the Sidewise Pull of the Mass of the Mountain, of Course). This Difference Would Not Be Very Much,—But the Higher the Tower, the Greater Its Magnitude.

HOW MOUNTAINS ATTRACT MASSES.

It is a well known fact in physics that if we suspend a mass, such as a leaden sphere, whether small or large with a cord by the side of a mountain or hill, this promontory will exert an attraction for the suspended mass, and which varies with the respective sizes of the mass and of the mountain.

The particular consideration we are interested in here is that if we were to construct a tall chimney or tower on the side of a mountain and line this up presumably vertically with a plumb line and bob, then as the diagram, Fig. 4 shows, the tower would not be exactly vertical, but would lean outward from its base, owing to the attraction between the plumb bob and the mass of the mountain which, altho

(*Continued on page* 1332)



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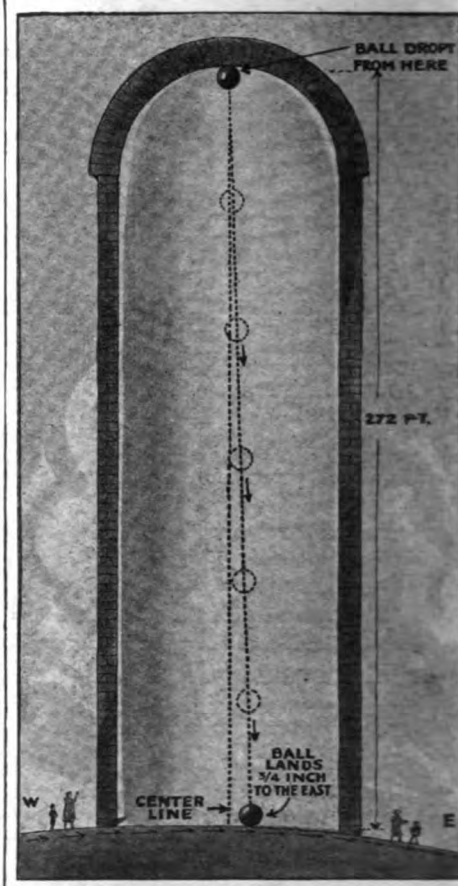
Oddities of Physics

(*Continued from page* 1330)

extremely slight, might become quite an appreciable factor to reckon with in a tall structure. About the simplest way to check up the perpendicularity of the tower or other structure would be by means of a surveyor's theodolite.

DOES AN OBJECT WEIGH THE MOST ON THE EARTH'S SURFACE?

If you want to start a good "rainy day" argument at the club or in the smoking car, just ask the question, "Where does a cannon ball weigh the most,—at the surface of the earth, below the surface, or above the surface?" Due to two well defined laws of Nature. we come to the conclusion, that the object, whatever it may be, weighs its greatest at the earth's surface. The law of weight with respect to distance which concerns the present problem has



An Iron Ball or Other Weight Dropt from an Elevation Such As the Top of a 272-Foot Tower Here Shown, Will Land to the East of the Point Directly Under the Central Point from Which It Was Dropt, the Ball Landing on the Average ¾" to the East. Fig. 6.

been formulated as follows: "The weight of a body varies directly as the mass, and inversely as the square of the distance between its center of gravity and that of the earth."

This is shown in the accompanying illustration, Fig. 5. A 100 pound ball, that is, one weighing 100 pounds at the surface of the earth, will weigh but 25 pounds when four thousand miles above the earth's surface. Since the weights of objects above the earth are inversely proportional to the squares of their distances from the center of the earth, we find that w, the weight at any elevation is to W, the weight at the surface, as D^2—the distance in miles from the surface to the center of

(*Continued on page* 1334)

Oddities of Physics

(*Continued from page* 1332)

the earth squared, $4{,}000^2$ is to d^2—the distance from the center of the earth to the level at which the object is placed. Algebraically we have:

$$w : W = D^2 : d^2$$

$$\text{or } w : 100 = 4{,}000^2 : (4{,}000 + 4{,}000)^2$$

$$\text{and } w = \frac{100 \times 16{,}000{,}000}{64{,}000{,}000} = \frac{100 \times 16}{64} = 25$$

When we go *below* the surface of the earth we find that objects *weigh less as we progress towards the center.* In this case the decrease of weights follows a different law than that for bodies placed above the earth's surface. This last law states that *the weight of a body placed below the surface decreases as the distance to the center decreases.* That is, if the body is only one-half as far from the center as the surface is, it will weigh but one-half as much as on the surface. This is due to the fact that the mass between us and the center of the earth becomes less and secondly, the force of direction is less. Thus the weight of a 180 pound ball or mass, 2,000 miles below the surface is but 90 pounds, or our 100 pound ball in the illustration, Fig. 5, would weigh but 50 pounds at a depth of 2,000 miles below the surface.

"FALLING EAST."

One of the most interesting and not so well known of physical phenomena is that known as "falling east." Dr. Daniel W. Hering in his work, "Essentials of Physics" states that inertia has been employed to demonstrate the rotation of the earth upon its axis; and furthermore, if the earth rotates, the top of a tower or mast moves faster than the bottom, which we perceive as being true upon consideration of the facts in the case.

The apex of Dome of the Pantheon in Paris is 272 feet above the floor, and the latitude of this structure is 48+ degrees; and for the earth to rotate once in 24 hours, the top of the dome or structure moves to the east faster than does the bottom of the tower, by .18 inch per second. A body requires 4.1 seconds to fall from the top of the dome to the floor; theoretically, therefore, the body should strike .75 inch to the east of a point directly under the plummet when dropt. This was born out by actual experiments, repeated many times, when an iron ball thus dropt, always fell to the east one-half inch to one inch away.

As Dr. Hering states, "This experiment may be interpreted either way, for if we regard the rotation of the earth sufficiently well proved, we may regard this experiment as confirming the principle of inertia."

WHICH IS THE MOST EFFECTIVE—A SHORT OR LONG HITCH?

When it comes to a good argument in "applied physics,' one that will shake up the whole bunch and rattle the kitchen stove as well as the oil paintings in the parlor, and when you really feel like starting something, just spring this one: "Which is the most effective,—a short or long hitch when pulling a load?"

Fig. 7 illustrates what is meant more clearly. Usually of course it is the farmers' argument, or one frequently heard among those having to do with horses, that it is a well-known fact that

(*Continued on page* 1336)

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Oddities of Physics

(*Continued from page* 1334.)

when a truck is caught in the mud or ditch, a short angular hitch permitting the horse or horses to pull up and out on the load, will invariably give success; whereas a straight pull, if the traces are horizontal, would not pull the truck out of the mire or ditch.

This question, let it be said, is not as easily solved or answered as might at first seem, for there are several factors which bear on the matter, and these are considered briefly below:

In the first place, we had probably best consider what happens in the case of a short or long hitch when the pairs, traces, ropes or chain used are of different lengths for each pull, but perfectly horizontal during the act of pulling. As the scale in the two figures shown, the pull exerted in this case, 200 pounds, is the same whether the trace is long or short. This may not seem so at first, but it is a proven fact and anyone who has studied engineering calculations, especially those concerning the movement of railroad trains and the power required to move a given load (whether in a car, wagon, automobile or sled) with a certain co-efficient of friction, and knowing the speed at which the mass is to be moved, will see this point immediately.

Regarding the short and long hitch with the horizontal or usual style of traces, it might be interesting to note that the writer before being able to convince a friend of his that the pu is practically the same in either cas (disregarding any small infinitesima loss due to any extra long traces, chain or ropes used and their consequen weight, or any swinging) had to get the opinions of five professors of mechanical engineering in leading American universities (and these letters are still on file for the benefit of any other "Doubting Thomases"), to the effect that this law is correct.

To sum up the situation in a few words then, and providing the traces are straight or horizontal, and not placed on an angle, which changes the effect of the problem at once:—it does not make any difference whether we use a short or long hitch. The same would apply to a man pulling with a rope attached to a piano or other heavy mass, and he would not pull any more—or less, whether he were five feet or twenty-five feet from the load!

Where this problem changes entirely, due to placing the traces at an angle, is shown in the two lower illustrations at Fig. 7. The illustration showing the front wheels of a wagon in a gully, and resting against a large amount of dirt, talks for itself and shows that the only successful or logical way in which to get this wagon out of the rut, is to apply two forces, one *upward* and one *forward*. Calculating the resulting forces accruing from the slanting traces and solving the parallelogram of forces as shown in the drawing, taking the pull exerted in the traces as 200 pounds, we find that the horizontal component or forward pulling force would be 199 pounds, while at the same time an upward or vertical lifting force of 20 pounds would be exerted to help raise the wagon out of the rut or gully.

(*Continued on page* 1338)

Oddities of Physics

(*Continued from page* 1336)

The solution of the parallelogram of forces is solved by the laws of geometry, viz: the force exerted by the traces, or 200 pounds, is equal to the square root of the sum of the squares of the vertical and horizontal components. Likewise, the value of the horizontal component is equal to the square root of the trace pull, squared, minus the value of the vertical component, also squared; and the value of the vertical component is equivalent to the square root of the trace pull, squared, minus the value of the horizontal component, squared.

It might seem at first glance, after looking over this solution of the short hitch, angular trace problem—that we really obtain more power than was exerted on the traces by the horse, but this is not so, for otherwise we would have *perpetual motion*. What really happens is this:

When the trace is placed at any angle other than horizontal, the horse begins to exert on the load a lifting effect—as well as a forward pulling one, but as the vertical pressure increases, the forward pull decreases in value, until when we have the trace directly vertical, the horse would theoretically be exerting a purely vertical lifting effort, and would exert no forward pulling effect whatever.

Typewriting and Stenographic Machines for the Blind

(*Continued from page* 1282)

produced a typewriter remarkably similar to the original Remington, for making books for the blind.

Some years later, typewriters for everyday use made their appearance, and the names of the American inventors Pratt, Shoales, Soulé, Glidden and Densmore covering the periods from 1864 to 1872 appear on the roll of honor. It is curious to note that the origin was identified with machine-writing for the blind.

Today there are two types of typewriters for the blind, some writing the regular everyday letter and others the Braille alphabet.

The Hall-Braille machine which we illustrate in one of our cuts has had extensive employment in America. It has only six keys, symmetrically placed to right and left, and is arranged with a spacer to separate the words. It will be remembered that we said the Braille letter never needed more than six points, so in the Hall machine with its six keys, all the points required for a letter by one impulse of the operator's hands can be struck at once. With the Hall machine a blind person can write 20 to 30 words a minute, three times the speed of the original typewriting for the blind.

The Frenchman Lotz, the Italian Dr. ...ota, the German Pichl and the Eng...n, Stainsby, all produce machines ...ix keys, so that a complete Braille ...an be made with one blow.

...e of our cuts we show the Stainsby ...e, which has been much used in ...d, like the Hall machine in ...a.

...rds 1910, M. Maurice, Constançon, ...f the Asylum for the Blind in ...ne, Switzerland, produced a dis... machine illustrated herewith. **so ingeniously constructed that**

both sides of the paper can be used. It must be remembered that the letters are read by the points in relief,—the arrangement of this machine is such, that the relief points on one side of the paper occupy the blank spaces of paper between the relief points on the other side. Of course with this machine exact registration is absolutely essential. Again we have the six keys arranged radially for making the Braille embossments. Like all the machines hitherto mentioned, this Constançon machine is deficient in speed.

We now come to a stenographic machine. M. Pierre Villey, the eminent professor of the University of Caen, France, blind from infancy, invented a stenographic machine for the blind, and in spite of the war, managed to complete its construction by October, 1916. It uses syllabic signs and adhering to the Braille embost points, the inventor developt a most ingenious phonography of his own. It is fair to say that the development of his stenographic system to be written in points, was as much an invention as the machine which executes it. Twelve points in his system can be combined in over 4,000 ways, giving an immense number of syllables; three lines are used for the development of each normal line of writing. What is called the tactile field of the finger is not called upon to go outside of the area of the six Braille points. He has even developed the embossing to such an extent that the blind person can read simultaneously with both hands.

A blind stenographer has reached the remarkable speed of 140 words a minute with this machine. It is to be noted that he was an exceptionally expert operator. Our illustration shows the general arrangement of the parts and it will be seen that it prints upon a wide band of paper.

Finally Lieut. Muller, an officer of distinction who was wounded in the war, and blinded there, has produced what he calls his stenoglyphe, also in the year 1916. He uses a phonetic stenograph alphabet in which each sign represents a syllable. He adheres to the Braille embossments. He uses ten points. One feature of his system which is favorably commented on, is that while its rapidity of execution is quite sufficient, it gives a text very easy to read. It was thought at one time that the ten points covered too much of an area, but it is found that it can be read with as great a rapidity as any other system.

FIREFLIES' LIGHT IS MOST EFFICIENT.

Fireflies which will soon be flashing in parks and gardens are called by Dr. E. Newton Harvey, professor of physiology, Princeton University, "a most extraordinary kind of lamp which is able to make its oil from the products of its own combustion." Speaking before the American Philosophical Society, he described the chemistry of the production of light by the firefly. Without going into technical details, it may be said that this light is due to the burning or oxidation of a substance called luciferin in the presence of an enzyme or catalyst called luciferase. As in other methods of burning, oxygen is necessary; unlike other methods, water is essential, and no carbon dioxid or heat is produced.

When the luciferin is oxidized, producing light, it turns to oxyluciferin and water. The strangest part of this reaction is that it reverses itself immediately, the oxyluciferin and water forming luciferin. 'Thus, while a firefly is flashing, oxyluciferin is produced, and between the flashes oxyluciferin is reduced and is now ready to be again oxidized with light production."

This reversible reaction can be produced in a test tube by any one who can collect the luciferin and luciferase.

200 Miles per hr. Air Propelled Railway

(*Continued from page* 1279)

major part of the load or weight, the car units resting on ball-bearing wheels so as to minimize all friction.

The car units as devised by the inventor, are intended to be made up in short, inter-locking sections, the coupling between each unit being flexible to a certain degree so as to facilitate the train of several sections moving thru curved tubes at high velocity.

Mr. Barlow has called the front section, the "engine unit," and this contains the electric motors and the propellers which create the rearward thrust on the air and on the side walls of the tube, which walls are formed into annular pockets with curved tails, the air taking the course indicated by the arrows. The tube is designed to be about 9 feet in diameter, while the body of the train and the engine units are much smaller so as to provide plenty of space for the air currents and propeller action.

Mr. Barlow has had considerable experience in flying large airplanes and it was due to this experience, that he was imprest with the idea of designing a new transportation carrier embodying the principles here elucidated. The reason for using three propellers is based on the fact that a smoother action is obtained in creating such a high velocity thrust on the air. Each of the three propellers rotates at the same speed, but they are arranged with successively increasing pitch so that the air current from front to rear is smoothly but rapidly accelerated to a very high velocity.

One of the principal points covered in his patent on this railway, and as explained to the editors, is the arrangement of the inner wall of the tube or duct so as to quickly bring to rest the rapidly moving air currents set up by the propellers mounted at the forward end of the car or train. If this were not done, a powerful current of air would be created which would continue rearwardly from the train for a great distance, and would eventually interfere with the progress of any train or car units which might be following close upon the leading train.

The inventor explained that by this method of curving the rear edge of each wall pocket around toward the front, any current of air thrown into it by the propellers, would swirl around and be shot out in a forward direction eventually, so as to react against the sides of the train,—as well as forming a reaction jet or wall for a part of the rearwardly current of air from the propellers, and thus give greater speed to the onward rushing train.

By this arrangement of the operating factors, it will be seen that all which will result in the rear of the train, would be a series of air eddies or practically local swirls of air.

Another one of the important merits of this system, as compared to an airplane flying in free air, is that none of the power used in propelling the train *is required for sustaining the load*, as is the case with the former machine.

The inventor also points out that the provision of the enclosing tube insures a continuous solid and stable condition of the air on which the propeller operates, and it is interesting to note that contrary to most systems proposed along these lines, the tube does not have to be air-tight. In fact when there are conditions where ex-

tremely high speed is not desired, it need not be covered at all.

It would seem that the high speed claimed by the inventor, as attained by this novel form of railway, propelled by air screws in contra-distinction to the usual form of railway car propelled by an engine or electric motor geared direct to the wheels,—is due to the fact that with the standard form of railway, the total tractive effort—which directly concerns the speed and power with which the car is moving,—is dependent upon the great weight of the car upon the wheels.

In other words, the steam locomotive which has the largest weight directly over the driving wheels,—other things being equal, such as good design, etc.,—will exert the maximum tractive effort. Further it seems that Mr. Barlow gets around this defect by decreasing the weight on the bearing wheels in order to realize high speed and propelling power by utilizing the air screw as employed in the airplane.

The traction of a locomotive engine depends on its weight, giving adherence to the wheels, but of course an airplane has no such requirements, the lighter it is the better, and in the Barlow air-screw engine, the weight has nothing to do with its tractive power.

At this point it might be well to mention, as a matter of actual fact, that no railway carrier in which motors or other prime movers are geared directly to the wheels, have ever attained a speed in excess of 130 miles per hour (Berlin-Zossen tests)—but, as we know, airplanes have reached a speed closely approaching 200 miles per hour in the past year, in several instances,—and a speed of 150 to 160 miles an hour has been attained several times by the standard type, medium powered, U. S. Government mail planes.

Mr. Barlow prefers to drive his propellers with a series of eight small electric motors, geared in any suitable manner, in preference to one large electric motor, for the simple reason that the small motors can operate at high speed much more efficiently and safely than a large one. All the construction and operating features of such an air-propelled railway are we believe, quite clear now, and these features present mostly details to be worked out by construction engineers.

COMMERCIAL ASPECTS OF THE AERIAL PROPELLED RAILWAY.

The commercial features of this air-propelled railway devised by Mr. Barlow, are surprising and revolutionary in the extreme. As pointed out by Mr. Barlow in an interview, the inventor's great dream is to see railways of this type built over great stretches of country so as to serve not only sections of great cities or suburban sections thereof, but to act as automatic high speed carriers of everyday mail, grain, oil, etc., between various parts of the country,—such as between the lake-ports of the North and the gulf-ports of the South.

One of the detailed drawings in the illustration herewith shows one of the unique features of the Barlow aerial railway, namely, the automatic switching arrangement and the device whereby the cars can be routed at their originating stations so as to distribute themselves to the proper destination, without the aid of any human agency. A code box with a series of levers projecting for each of the different stations along the route, which route may be several hundred miles in length or more, is fastened to the forward end of each train.

As will be evident, if the index trip is pulled out corresponding to St. Louis, for example,—and a car is started at Chicago

with this trip properly arranged, the car will hit the St. Louis "trip" when it reaches that city, causing the track to be switched over a considerable distance ahead of the swiftly moving car, and it will be shunted into the St. Louis tube. As seen, when the car passes into the St. Louis tube, it hits a second trip which causes the main line switch section to be quickly moved back into junction with the main line tube. A flexible section of tube can be used for this switching purpose, as one of the diagrams clearly shows. This is a detail which can be solved, of course, in several different ways.

The beauty of Mr. Barlow's idea which appeals to our minds in both a commercial and utilitarian sense, is the automatic distribution of great quantities of grain, oil, and other miscellaneous products, to shipping ports and municipal distribution centers at a heretofore undreamt of speed. The cars in this system can be operated all day and all night, and follow one another at intervals of one-half to one mile, the distance between them being regulated, if necessary, by automatic electrical block systems.

The cars need never stop,—even to discharge their cargoes, an automatic trip system being arranged at the receiving warehouse, whereby the grain for example can be dumped from the compartments as the car moves at a reduced rate thru the graineries, the grain being readily discharged thru pipes directly into the holds of steamships, which would thus distribute the grain to all parts of the world almost automatically from the time the wheat was growing until it was received by the consumer.

Undoubtedly it will be found advisable to adapt a system of signals to be placed in the master dispatcher's office of his high speed railway, which would indicate instantly at a moment's notice, just what carriers were in the tubes and their exact location, similar to the visual signal boards used at the Panama Canal, and also in the Hudson Tube Railway system which passes under the Hudson River from New York to New Jersey.

What to Invent

By JAY G. HOBSON

(*Continued from page* 1320)

Still, right now I would be mighty thankful if the S. & U. R. R. had a SANDWICH SLOT MACHINE somewhere in its anatomy, and from the look upon the faces of the other early birds stretched around me, who didn't get their worm either, I'll wager ten to one, there wouldn't be many sandwiches left, at any price, if there was only a sandwich slot machine where we unfortunates could push our coins into it. So if this condition is true with us today, why isn't the idea for a sandwich slot machine for trains, and public places as practical as chewing gum slot machines? I am sure it is, and also believe slot machines for dispensing food in such places would make lots of money for the inventor and those placing them there.

WATER PURIFIER FOR LIFE BOATS.

I have in mind a possible filter of improved design, made so sea water could be poured into it and purified for drinking purposes. A filter construction with the purifying element of silver citrate or some other substance that would decompose the saline contents of sea water, and make it suitable for drinking when wrecked at sea. One of these filters would be included as standard equipment on each life-boat.

Electric Power from the Air

(*Continued from page* 1280)

urements obtained, in a number of works which may be consulted at the local library.

The atmospheric charge is usually gathered on a metal ball fastened to a rod, to the other end of which rod is connected an electro-static voltmeter in a suitable casing. Measurements have been made with this apparatus during the changing seasons of the year; the apparatus has been established in a laboratory on the ground as well as in a balloon which was sent aloft.

Dr. Plauson therefore proposes in his latest scheme for utilizing the electrical energy collected in the atmosphere, that we send aloft a series of inflated balloons having metal coatings, all of these balloons being connected by means of flexible copper conductors so as to discharge all of the energy they may gather thru a single large conductor to the central power station, as shown in the accompanying illustration.

Several important and extremely interesting points now come up for consideration. One of these is that it would probably be advisable in the first plants that are erected for this purpose, to place them on high elevations such as mountains or hills, as in this way it may prove possible to gather the same quantity of electrical energy with a shorter balloon cable than would be the case with plants situated in valleys. If the balloon cables were guyed, the guy wires would have to be suitably insulated the same as radio antenna masts, so as to prevent the dissipation of energy down thru the guy wires to earth.

Dr. Plauson points out that the balloons should be fitted with a multitude of sharp points in order to enhance their collecting powers for the static electricity of the atmosphere, which, as is well known, always discharges toward or from a point more rapidly than with other form of discharger. He even goes so far as to propose that we shall attempt the ionization of the air in the neighborhood of each balloon by suitably coating or painting the surfaces of the balloons with some radio-active salts,—of radium, of polonium, or of other metals.

Some interesting ideas in this direction were publisht several years ago in this journal,—where the process of producing rain by discharging huge quantities of electrical energy from metal surfaced balloons placed in a highly ionized atmosphere, was described. There the ionization was created by powerful X-rays or by ultra-violet rays.

Another very interesting question, but which does not condemn the scheme necessarily, is as to whether or not the electrical energy would be drawn off continuously (under normal weather conditions) or whether it would be discharged to the central collecting station periodically,—similar to the discharge of static electricity which most of us have probably heard in the receivers of radio telegraph stations; but in any event the main problem which all atmospheric electricity investigators have been confronted with, is the danger of being annihilated or else of having their plants destroyed when electric storms are frequent as in the summer months; when a lightning discharge is of unusual severity, it may pass down the balloon feed wire or cable and destroy the machinery of the plant.

The diagram shown in the accompanying illustration is given merely as a suggestion of what we may expect in the direction of atmospheric power plants. Needless to say, the first and foremost mechanism we will have to design will be a suitable and absolutely certain lightning protector, and which is indicated in the present diagram by the ball spark gap. Practically all radio apparatus, at least the commercial types, are fitted with suitable micrometer spark gaps, so that if lightning or extra heavy static charges may pass down the antenna to earth, this energy will be able to leap the gap and thus prevent burning out of the apparatus.

Ordinarily, the atmospheric electric currents will pass down the balloon feed cable and thence thru the transformer primary winding down to earth, at the same time energizing or inducing electric currents in the secondary of the transformer, and from which the successive quotas of electrical energy may be stored in suitable accumulators (of the condenser or other type). The energy stored in the accumulators can then be drawn off as desired and distributed thru a transformer and transmission line. At the receiving end of the line possibly 100 to 200 miles away or more, the line current can be reduced by a transformer to a suitable potential for operating motors, lights, etc.

It is well to mention a word of caution on this point with regard to experimenting with atmospheric static electricity, and it may be said at the outset that this is not a branch of science to be investigated by those untrained in such matters, as they may be electrocuted,—particularly if an electric storm happens to be in the vicinity. The writer has seen electric sparks jump a gap of several inches across the blades of an aerial switch in a radio-telegraph station, even when an electric storm was only approaching and not yet directly overhead.

To those uninitiated in handling elevated aerial conductors such as radio antennae and balloon cables, etc., it should be noted that the only safe method and the one followed in practically all cases, is to ground such free elevated conductors during electric storms.

If it comes to pass that such plants prove practical and the hopes of Dr. Plauson and other investigators who are working on this problem, are actually realized, the electric current thus obtained from the atmosphere can be utilized directly in the preparation of nitric acid and ozone from the air, thus giving us a sure means of refertilizing the soil.

By suitably transforming the current, it can be further employed on a large scale in the realms of electro-chemistry and electro-metallurgy. A French writer, M. Matignon, has stated that by means of the electrical energy collected upon the surface of six square kilometers (about 2.16 square miles) will result in producing five tons of carbid within 24 hours. This expert further points out that if we assume that we obtain 100 horse-power per square kilometer, it will be possible to develop 100,000,000 horse-power from the total surface of France.

The German writer, who describes the invention of Dr. Plauson, and whose article appeared in *Ueber Land Und Meer*, states that one of the engineer's estimates shows that 720,000,000 horse-power per day can be procured from the atmosphere with an area equivalent to that covered by the German nation.

It is claimed by Dr. Plauson that even with the considerable initial cost of erecting these atmospheric electric collecting stations over the country, the operating factor of the total production cost would be considerably less than that resulting from electric plants operating with coal.

In this Department we publish such matter as is of interest to inventors and particularly to those who are in doubt as to certain Patent Phases. Regular inquiries addrest to "Patent Advice" cannot be answered by mail free of charge. Such inquiries are publisht here for the benefit of all readers. If the idea is thought to be of importance, we make it a rule not to divulge all details, in order to protect the inventor as far as it is possible to do so.

Should advice be desired by mail a nominal charge of $1.00 is made for each question. Sketches and descriptions must be clear and explicit. Only one side of sheet should be written on.

Making Money from an Invention*

By JAY G. HOBSON

(Conclusion.)

WITHIN a short time everything was arranged to spread the news far and wide about the meritorious sharpener. The following month several prominent magazines carried attractive advertisements of their products. Orders began to come in almost instantly. Dealers commenced to inquire about representation, salesmen were taken on to cover more territory, jobbers were becoming interested in large orders and business began to boom.

The little factory was soon swamped, another building was added, then another, until three times the former manufacturing space was being used. Figures began to reveal the fact that the cost of production was being decreased per article. The turnover was increasing by leaps and bounds. The profits, while smaller on each article amounted to many times the former total.

Over night, it seemed, these boys were actually getting rich. They became quite a factor in the business circles of the city and were soon rated among the very prosperous.

Advertising—telling the world about their product—made the universe their market and every nationality their customer. But had their product been of little value all the money and advertising at their command would not have made success permanent. After the public starts buying a new article or invention it behooves the manufacturer to maintain efficient service in his products so that the satisfaction will continue. Profitable repeat orders result from satisfied customers.

There are several ways to make money from an invention. One is to sell it outright for a certain cash sum, another to sell it to a manufacturer on a royalty basis, and another to form a company and market it. The first plan is the one most tried, but the difficulty encountered in finding a cash buyer discourages the majority of inventors. The second way is easier and often more profitable in the long run. The third I believe is the quickest of all, and undoubtedly the best, if the inventor has some executive ability, plenty of confidence in himself and in his invention and can influence sufficient capital, with the necessary cooperation from the investors to wait until the patent has had time to prove a commercial success.

It takes hard work and considerable time to place an invention on the market. It takes some money too, but money is generally forthcoming if the improvement has merit and possibilities of success. There are people who are always interested in a money-making proposition. They can be found through advertising, through friends and acquaintances, and by giving public demonstrations of the invention.

The American spirit is one of adventure; to take a chance for making big profits. A large number of people have the courage of the western pioneers handed down to them. They enjoy the thrill possible from investing in a prospect and cashing in when it becomes a large success. They understand that to make the big money from a new thing, a person must get in at the start, and sell out after the company has reached the peak of its career.

To wait until a business has become one of the seasoned investments paying the usual rate of interest, is to buy the securities at the top figure, which means paying someone else the big profit which could have been made by getting in on the ground floor in the beginning.

Everybody will lend an ear to the inventor selling an interest in a meritorious proposition where the commercial gain is in evidence. If the inventor first sells himself on the article, he will have little trouble to sell others, this day and time. The day of Bell, Fulton and Howe has gone and with it the many vexing tribulations of scorn, ridicule and abuse they

*No queries are publisht this month owing to the article by Mr. Hobson.

had to endure, in order to succeed with their inventions.

Today the inventor is encouraged, assisted and boosted along by the people if they are assured that he has ability and is sincere. Often men with money appropriate finances to further the success of some idea they learn to be of value.

So in this wonderful country of one hundred million busy people there is great opportunity for people with new ideas of improvements, to become successful inventors.

He need not be of a mechanical turn of mind. It may be an invention in fruit, clothes, shoes, painting, sculpture, chemistry and beverages. Or it can be an improvement in machinery, houses, wagons, bridges, tents, kitchen utensils, fixtures, glass and hundred of various things always needing improvements.

Home Electrics

By G. L. HOADLEY, M. E.

(Continued from page 1305)

of the man of the house to have the cutouts for your flat located and marked in such a way that you will know them for certain, as you do not want to be meddling with some other family's fuses. Then open up the switch and replace the fuses as previously outlined. Opening the switch shuts off lights for the other families whose circuits lead to that cabinet-box of course, but it only takes a half minute at most to replace your fuses and the power-house quite often shuts off power for considerably longer periods. It is a perfectly safe way to replace blown fuses, however.

In some large flat buildings the switch is replaced by a fuse block with large fuses. It then becomes necessary to replace your blown fuses with others while the circuit is alive. To do this, open the self-closing hinged lid or door of the cabinet-box and insert a thin wedge-shaped piece of wood in the hinged side of the box to hold the door open. Then stand with both feet on a dry board and use one hand only for replacing one fuse at a time. Be careful not to touch any part of the metal cabinet-box with your hand or your body and replace one fuse at a time, then no shock can possibly be received.

There are several ways of locating your cutout blocks which lead to your flat. Your meter is tagged with your name and it is frequently possible to trace back from this point to the cutout blocks. Another way is to first make sure all switches in your flat are off except one. Then, let some one—your wife for instance, stand before your meter and have her tell you when the meter stops, as you replace one fuse in the various circuits. This will locate only one branch cutout. To locate the others repeat this procedure for each one of the switches in your flat.

The second way previously mentioned: namely, testing out each circuit in the cabinet-box to determine the blown fuse is nearly always preferred by the electrician or others familiar with electricity. Referring to Fig. 7, a test lamp is made by connecting two wires to an ordinary lamp socket. Use a heavy enough wire so that it will retain its shape well and bend it as shown in figure 7. Then, with one hand you can rapidly place the test lamp across the terminals of each cutout in turn. As long as the test lamp lights up the fuses are good, but when a cutout is reached where the lamp fails to light it shows that one or possibly both fuses are blown for that cutout.

U. S. Bureau of Standards News

(*Continued from page* 1318)

the principles of radio communication and which have been apt to surround the whole matter with an air of mystery, most people believe that the principles underlying wireless transmission are not very well known. On the contrary, radio communication is a natural effect following well-known causes.

The Transmission of Music by Radio

Music can be transmitted by wireless in the same manner as speech or code signals. As an incidental result of research work on radio telephony at the Bureau of Standards, it has been shown that music can be transmitted by radio without loss of quality. The possibilities in this direction are great and very interesting. By this means a concert given in one place may be available to those living at a distance. One way of transmitting music has been to place a phonograph so that the sound from it will pass into the radio transmitter. The Bureau of Standards has made an interesting improvement upon this method, which consists of substituting the carbon microphone, which is the mouthpiece of an ordinary telephone, for the vibrating diaphragm ordinarily used on the phonograph. As a result, the phonograph sound record produces direct variations of electric current in the telephone apparatus instead of producing sound; thus while no sound is heard where the phonograph record is being played, the music is easily heard by those at the distant receiving stations.

Radio "Talk" Relayed to Land Lines

(*Continued from page* 1316)

was this device useful as an aid to navigation, for example during fog, but it automatically served its main purpose of assisting in running down the submarines which then infested the main lines of marine traffic. As soon as a submarine sent a radio message, its direction from one or more destroyers was obtained and the necessary measures taken.

Extreme secrecy was preserved during this training work, even the class rooms being provided with double doors, lest unauthorized persons should catch a glimpse of the special apparatus then employed. In this case, as in others, the unusual equipment, facilities, and willing personnel of the City College enabled it to be of real service to the country.

Radio signals from the great transmitting stations in France, Germany and England were received on the special long distance receivers in one of the Laboratories and the latest methods of recording these in permanent form when necessary, were also made clear.

Another unusual demonstration consisted in showing the way in which the new tubes can be used to *amplify* signals. On another receiving set equipt with such amplifiers of special construction, wireless signals of deafening loudness were obtained. Messages from ships many hundreds of miles at sea rang out with surprising clearness.

Practical Chemical Experiments

BY PROF. FLOYD L. DARROW

(*Continued from page* 1308)

Flame Test for Potassium: If possible obtain a few grams of chemically pure potassium chlorid or some other potassium salt and dissolve in 50 c.c. of distilled water. Preserve this free from contamination in a glass stoppered bottle. Into this solution dip a cleaned platinum wire and as before place in the flame of the Bunsen burner. If the salt is pure a lavender to violet color will appear for a few moments and then disappear. Now observe this flame thru the cobalt-blue glass and note that the color is not cut off.

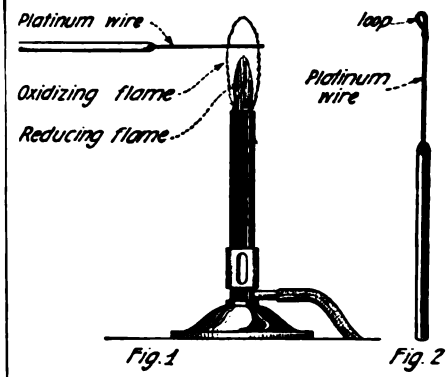
Testing for Potassium in the Presence of Sodium: Prepare a mixture of solutions of sodium and potassium salts and make the flame test. You will observe that the yellow sodium color completely masks the delicate violet of the potassium and did you not know that the latter element were present you would be totally unable to detect it by direct vision.

Now observe the color of the flame colored by the mixture thru the cobalt-blue glass. The yellow sodium color is thus cut off and the violet of the potassium permitted to pass. In this way we may test for potassium in the presence of sodium.

Other Flame Tests: Prepare solutions of lithium, strontium, calcium and barium salts and make separate flame tests for each one, being careful to clean the wire after making each test. You will find that *lithium gives a beautiful carmine red, strontium a bright red, calcium orange to brick red and barium green.*

Such tests as the foregoing are made in the preliminary examination of unknown substances and as confirmatory tests for substances found in the regular course of qualitative analysis.

Spectroscopic Analysis: The spectroscope is one of the most wonderful instruments at the disposal of the trained



Apparatus Used in Making a Flame Test.

chemist. It places between the eye of the observer and the flame being examined an optical device that increases to a marvelous degree his ability to detect the presence of minute quantities of unknown substances. By its aid he is able to determine the chemical composition and physical state of the infinitely distant stars and nebulae. Every element in the state of incandescent vapor will give by means of the spectroscope a characteristic bright-line spectrum, i.e., a dark background crost at right angles by a series of bright lines separated by intervening dark spaces. By the color of these lines and their position in the spectrum the presence of an element is known with absolute certainty.

An accompanying photograph shows the spectroscope in use. For home laboratory work a small direct vision spectroscope may be had at a very moderate outlay.

Borax Bead Tests: Another series of tests of great value to the chemist are the so-called *borax bead tests.* Borax is a flux, i.e., it is able to dissolve metallic oxides and many of these oxides give to the bead characteristic colors.

Make a small loop on the end of your platinum wire as shown in Figure 2. Heat the wire in the oxidizing flame of the Bunsen burner and quickly thrust it into some borax powder. The powder will cling to the hot wire. Then place the wire again in the flame and the borax will melt into a clear glassy bead which by a repetition of the process may be made to fill the entire loop.

While the bead is still hot touch it very lightly to a small crystal of some cobalt salt such as cobalt nitrat. Upon reheating in the flames the borax will completely dissolve the cobalt compound and become

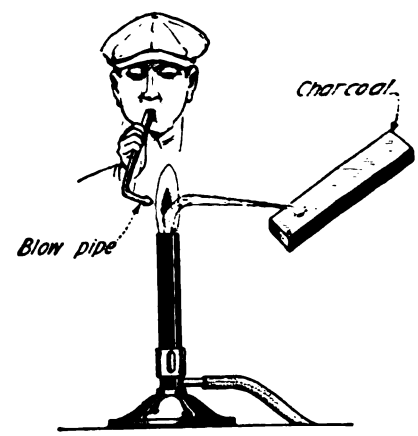


Fig. 3. Heating a Compound on a Stick of Charcoal by Means of the Blowpipe.

a deep blue in color. Therefore should this test be made on an unknown substance and a blue color result, *the presence of COBALT would be proved.*

Because cobalt gives a blue color when fused with vitreous substances, it is used to color glass.

To remove the bead thrust it into cold water while still hot and it may easily be removed with the fingers. Then prepare a fresh bead and if it is still colored remove it and repeat until one that is colorless is obtained. In the same manner as cobalt was tested make tests for compounds of manganese, chromium and iron. After each test make a fresh bead. Each metal will give a characteristic color but in the case of manganese only a very minute particle should be used, or the resulting color will appear to be black. Iron will give a light yellow in the oxidizing flame and a green in the reducing flame when allowed to cool, but the color will be brownish red while hot. Chromium gives green both hot and cold and manganese a wine red if heated in the oxidizing flame. Copper compounds give a green color while hot and a blue when cold. Nickel and bismuth compounds may also be tested with the borax bead. When heated in the oxidizing flame, nickel gives a violet color if hot and a reddish brown if cold. Bismuth is yellowish brown when hot and light yellow when cold.

Cobalt Nitrat Tests: Obtain a small rectangular piece of willow charcoal and a brass blowpipe. Also prepare a solution of cobalt nitrat carrying a stopper fitted with a medicine dropper.

At one end of the charcoal stick hollow out a small cavity and place in it a little of some zinc compound. Moisten it with a drop of water. Then, having adjusted the Bunsen burner flame to rather small dimensions, hold the stick of charcoal in the left hand and direct the flame of the blowpipe upon the zinc compound. You will observe that the zinc residue becomes yellow when hot and white when cold. Now moisten the residue with a drop of cobalt nitrat solution and reheat with the blowpipe. This time you will obtain a green color. See Figure 3.

Clean out the cavity in the charcoal stick and repeat the test using some aluminum compound as alum. After adding the cobalt nitrat and reheating you will obtain a blue color.

With magnesium compounds, as Epsom salts, a delicate rose color appears.

Heating on Charcoal with Sodium Carbonat: Using the charcoal stick and blowpipe as before, heat a mixture of dry sodium carbonat and some copper compound. A metallic globule without any incrustration about the edges of the cavity will result.

A silver compound similarly heated will also give a metallic globule without incrustration.

Compounds of lead and tin heated with sodium carbonate yield incrustrations accompanied by malleable beads of shining metal, while antimony and bismuth give brittle beads.

Iron, cobalt and nickel will give magnetic particles that will be attracted by a magnet.

If you obtain from some unknown compound after heating with sodium carbonat a mass which, when moistened on a silver coin, stains it brown or black, sulfur compounds are present.

Marsh's Test for Arsenic: A somewhat famous test for arsenic, and one which has been used in many cases of arsenic poisoning, is carried out as follows:

First let me say that the gas, *arsine,* which is generated in this test is *exceed-*

(*Continued on page* 1354)

Scientific Lifting Stunts for Your Parlor

(*Continued from page* 1281)

Fig. 4 shows how the lift is made. One of the committee stands behind the subject and places the index finger of each hand under her arms. One man is placed on either side of her in a stooping position and each places one finger under either foot, while the fourth man stands directly in front of the subject and places one finger sidewise under her chin.

MISS ANNIE ABBOTT, THE "GEORGIA MAGNET," DEFIES FIVE MEN TO LIFT HER.

A surprising fact is that by careful observation and experiments, first instituted by Dr. Leon Lansberg, and publisht in a recent article by Miss Grace Nicholas of the New York *Evening World*—Miss Nicholas was able to duplicate the lifting stunts performed by Miss Abbott—such as defying five men to lift her.

At Figure 5 is shown the best and in fact the only way in which a woman, or man, can be lifted; that is, they must—as Dr. Lansberg pointed out—lock their arms or rather their elbows tight to the body. Try this on your wife, sister, sweetheart or mother, and even if she weighs 140 pounds or more you will be surprised how easily two men, with one hand under either of her elbows and the other hand grasping her hand on either side, can lift her 10 to 12 inches above the floor.

At the offices of the New York *Evening World* where the writer was present and assisted in the demonstrations given by Miss Annie Abbot, Miss Grace Nicholas, an athletic young lady, weight about 130 pounds, successfully resisted the efforts of five muscular men to lift her from the floor.

Now for the secret, as it was pointed out by Dr. Lansberg: The subject who is to be lifted, first permits her arms to be held in (or holds them in tightly against the body) and the lift is at first "allowed" with two or perhaps five men, to show that she *can be lifted* up while the "magnetic power" is switched off.

After a little coaching of your lady subject, and after a few experiments, you will find that the secret of *resisting the efforts* of five husky men to lift her from the floor is accomplisht by allowing her arms to remain flexible and loose from the shoulders, so to speak, and not to tense the muscles.

Another one of Miss Abbott's tricks is to have a number of men stand in a row back of her, while she places her hands against a wall and braces her body and arms.

HOW JOHNNY COULON WORKS HIS MARVELS.

Much mystery and secretiveness has surrounded the performances of Johnny Coulon, who has successfully demonstrated to the French public that he cannot be lifted when he "so wills it," by even the most powerful man, including the champion weight lifters of France: Johnny Coulon weighs 110 pounds.

When ready for the lift, Johnny Coulon allows the lifter to raise him by the waist. Of course the hands must come in contact with the bare body. This, according to the investigators, is quite a hindrance, the hands slipping away rapidly due to the velvety skin effect. Coulon now places his right hand upon the wrist of the lifter and the index finger of his left hand upon the jugular vein region in the neck and by pressing upon both points defies the strongest man to lift him.

Practical Chemical Experiments

(*Continued from page* 1351)

ingly poisonous, and, therefore, the utmost caution must be observed at every point to see that all joints are perfectly tight and that no gas escapes into the room.

The apparatus consists of a hydrogen generator, a calcium chlorid drying tube and a hard-glass delivery tube drawn out somewhat at the end and bent upward. At the middle of the tube is placed a Bunsen burner carrying a fish-tail tip. See Figure 4.

In the generator place zinc and dilute sulfuric acid to generate hydrogen. Collect some of the hydrogen by placing an inverted test tube over the end of the delivery tube and after a few moments present the inverted tube to the flame of a Bunsen burner kept at some distance from the apparatus. If a sharp explosion occurs the hydrogen is still mixt with air. Repeat the test until the gas burns quietly. Then light the escaping gas at the end of the delivery tube.

At the same time have ready a solution of arsenious oxid, ordinary white arsenic,

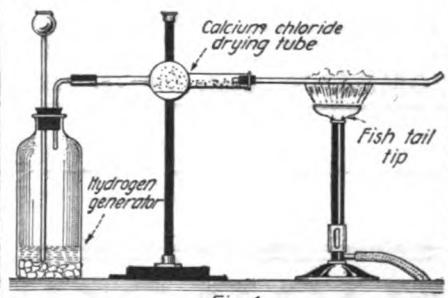


Fig. 4

Fig. 4. Making Marsh's Test for Arsenic.

in concentrated hydrochloric acid. Pour down the thistle tube into the generator a *few drops* of this solution. Immediately the colorless hydrogen flame changes to a lavender color and a garlic-like odor is evident.

Light the burner with the fish-tail tip and heat the tube strongly. Just beyond the heated portion you will observe a deposit of arsenic which appears as a shining, brownish-black mirror.

Then hold in the flame by means of tongs the lid of a porcelain crucible. A shining deposit of metallic arsenic will at once appear. The nascent hydrogen evolved in the generator unites with the arsenic compound to form the poisonous *arsine.* Arsine is a very unstable compound and both the heating of the tube and the cooling of the gas by thrusting it the porcelain crucible lid decomposes it with the deposition of arsenic.

At this point the generator will be full of the *poisonous arsine!* To be safely rid of it carefully pour water down the thistle tube, being careful to keep the tube full so as not to admit any air and thus make an explosive mixture in the generator. As the contents of the generator are forced out the arsine will burn at the end of the delivery tube which must not be allowed to go out.

To determine whether a person has met death from arsenic poisoning the contents of the stomach are pumped out, thoroly extracted, filtered and reduced to small volume. A little of the solution thus obtained is introduced into the hydrogen generator and the test carried out as above.

Flying In Space

By H. GERNSBACK

(*Continued from page 1292*)

explosive charges at the right time and in the right order would be an undertaking that might tax the ingenuity of the best navigator but of course it is not impossible.

Our front cover illustration shows another space flyer imagined by the writer, and this machine contains several new ideas not proposed heretofore. In general principle it is along the lines of the space flyer proposed by the writer in 1915. Generally speaking, the present machine is a sphere about 50 feet or more in diameter and it may be made to rotate at will in a system of rings as shown. These rings crossing at an angle of 60 degrees serve a triple purpose. Firstly, they are used for landing purposes; on them the machine may roll when it reaches its destination, for example, on the moon. Secondly, the rings give the sphere free movement so that it can be turned upon its axis in a manner best suited for landing purposes. Thirdly, these rings contain a wire system which is used to annul gravitation by means of certain currents, not as yet known. By energizing these wires, a counter reaction is set up against the earth's gravitational influences, and the machine will rise to the sky. Upon approaching the moon or other body, the current is again brought into play, and the counter reaction is set up, which gradually decreasing should permit the machine to descend without harmful consequences to the travelers.

It goes without saying that such a machine must be airproof and that the inmates must take cylinders of additional air and oxygen along with them, and purify and renew the air by chemical means by the well-known means carried out today in submarines.

While the idea of the space flyer today may seem extravagant, it is not more impossible than the airplane was thirty years ago, and there is no telling that we all may live to see the day when our present "pipe dreams" become a thing of reality.

MAGNESIUM FROM SEA WATER

According to dispatches from Christiania, Norway, the prominent scientist, Professor Helland Hansen, at a meeting of the Central Committee for Scientific Co-operation in Furtherance of Industry, lecturing on the use of salt water as raw material for Norwegian industry, declared that the new salt works at Bergen, which are now nearly ready, will produce 100 tons of metallic magnesium yearly, the raw materials being only salt water and electric power.

Trip to the Moon

(*Continued from page 1303*)

meteors come unheralded without hiss or noise and bury themselves on the surface of the moon or smash against the rocks, pulverizing the latter as well as themselves instantly. Nothing announces their approach and the traveler only knows of them by the terrific shaking of the rocks or ground on which he stands. In consequence of these meteors, the whole surface of the moon is covered with an impalpable powder made up of iron dust of the meteor and sand caused by rocks being ground to powder thruout the ages.

Illustrations courtesy Bray Studios.

Popular Astronomy

(Continued from page 1326)

under the tidal changes produced by the larger body. It follows that within that limit the smaller body would have been disintegrated into small particles, or moonlets, under the tidal strains exerted upon it by the earth and would have been gradually distributed about the earth in the form of a meteoric ring which in the course of ages would be absorbed by the earth, *just as Saturn is right now gradually absorbing its rings.*

The planets differ greatly in density. The more distant and larger planets—Jupiter, Saturn, Uranus and Neptune—have densities equal to or less than that of the sun. The densities of the inner planets—Mercury, Venus, Earth and Mars—are relatively extremely high, the density of the Earth's core being about that of meteoric iron. The densities of Mercury and Venus are slightly less than that of the earth and the densities of Mars and the moon about equal to the density of the earth's crust.

It is conceivable that, if a stream of matter were ejected from the sun under the influence of some external force, such as that exerted by a passing star, the outlying parts of the stream would consist of the lighter elements and the lower parts of the heavier elements, since the lighter solar elements lie at or near the surface of the sun and the heavier elements at greater depths. At the time of ejection the lighter elements would be thrown to great distances and would go to form the less dense outer planets; the heavier elements would go to form the inner planets of high density. It is conceivable that ejection of solar material might have taken place under the influence of certain forces at work within the sun itself, such as *electrical repulsion* or *pressure of light* which under certain conditions more than offset the effect of *gravitation.*

It is known that certain chemical compounds form at the surface of the sun in sun-spot regions which are regions of comparatively low temperature and great magnetic intensity. We know next to nothing about the physical state of matter at great solar depths, where abnormal conditions of temperature and pressure must exist, and where great physical changes and disturbances may have taken place in the past. Even today solar activity goes through a cycle of change coincident with the sun-spot period, and many millions of years ago the sun-spot cycle of solar activity may have been far different from what it is today and a far more potent factor in producing changes in the solar system.

Outbursts of novas indicate that agencies making for peace and order are not the only ones at work among the stars any more than they are upon our own planet. The cause of these outbursts has not yet been satisfactorily explained. The theory that they are caused by the close approach of a passing sun or by the encounter of a star with a dark nebula does not account for all of the circumstances of such outbursts and is by no means beyond criticism. The nebulous matter, seen about a nova after the outburst, is now believed to have been expelled from the star itself at the time of the catastrophe and *may conceivably be the stuff of which planetary systems are made.*

At some epoch in the past our own sun may have undergone some such cataclysmic change and this may, conceivably, have been brought about by disturbances within the sun itself. Elements may have been so formed and distributed within the interior of the sun that friction and internal instability resulted and in time produced an upheaval of solar elements with initial velocities so great that, thru electrical repulsion and light pressure, portions of the ejected streams were permanently detached from the sun *and became the nuclei of future planets.*

The Love Machine

By CHARLES S. WOLFE

(*Continued from page* 1300)

"Easily said," jeered the wrathful millionaire.

"Easier done," retorted Parsons, promptly.

"May I ask how you propose to accomplish this miracle?" queried Fennimore, sarcastically.

"I am not telling you what I expect to do, young man," rejoined Parsons, "I am telling you what I am going to do. There is no question whether I am able to get the results I advertise. I know I can. I have the necessary apparatus and the knowledge required to use it."

"Apparatus?" gasped the startled lover, "Do you use machinery?"

"Most certainly," snapt the professor, somewhat nettled, "Did you have an idea that I charmed them with a flute?"

Fennimore ignored the thrust. "When can we begin on this system of yours?" he queried, uncertainly, for the whole thing seemed quite unreal to this lad who had never been accustomed to think of love in terms of ergs or calories.

"We can begin and end just as soon as you can get the object of your affections into my laboratory for a period of two hours."

"Great Scott," gasped Fennimore, "Does one treatment suffice?"

"It does," Parsons replied grimly "Quite."

"Do you guarantee a permanent——er——cure?" Fennimore demanded, determined to go thru with the business, bizarre as it looked.

"I do not," chuckled Parsons, "But I do guarantee it to last long enough to get you past the minister and back from Europe. Say two years. Then if you have any trouble, bring her around for another treatment."

"How am I to get her into your laboratory?" asked Fennimore, satisfied.

"Great Heavens, man," Parsons was exasperated, "If you haven't enough native wit for that task I don't wonder that you have been tagging around without getting anywhere.'

"I can't drag her in by the hair of the head, you know," Fennimore interpolated hastily, "It isn't being done at all."

"No, I suppose not," the professor sighed, sarcastically, "And what a pity the fine pointed needle is taboo, too. Well, I suppose I must plan a course of action for you. Convince our young friend that she isn't looking as well as she has been. Tell her that you have heard of some wonderful electric treatments that are getting remarkable results. Tell her that all your wealthy friends are having them. That's the bait she'll raise to. And then offer to pay for a course for her. I think that'll bring her here. Once inside my laboratory, I'll answer for all the rest."

Fennimore arose. "All right, Parsons," he said, "We'll try it. I'll telephone you as soon as I get a definite decision from Violetta."

Parsons smiled quaintly after the departing car. "Before that two year period expires, son," he soliloquised, "You'll be around begging me for the antidote."

It took Fennimore a week to convince Violetta that she needed toning up. Finally, attracted by the price that the young millionaire would have to

pay for her treatments, the fickle young beauty consented, agreeing to place herself in Parson's hands.

When the last curtain fell one evening she hastened to her dressing room and made ready for her first visit to the professor's laboratory. The impatient Fennimore was waiting for her with his big limousine, into which he piloted her as soon as she emerged from the stage door alley. Half an hour later she was shaking hands with Parsons.

"Rotten of us," she drawled, languidly, as the scientist dropt her limp hand, "Rotten of us to keep you working at this hour. But I just can't get up in the mornings. Habit I formed out in the sticks making night jumps. Nothing really the matter with me, is there, Doc?"

"Haven't had a chance to examine you yet, young lady, but off hand I should say there were several things the matter with you," said Parsons, dryly, as he led the way into his laboratory.

Fennimore shot him a sharp look, started to speak, then changed his mind. The girl, who had not caught the hidden meaning of the scientist's remark, rattled on, waxing doubly garrulous as she caught sight of the formidable array of electrical apparatus and switchboards in the sanctum. Had either she or Fennimore been versed in such matters they would have been able to identify several familiar pieces of high frequency apparatus, the brass stripped oscillation transformers and burnished Leyden jars being quite conspicuous in the array.

Parsons wasted no time in useless preliminaries. "You first, Fennimore." he said, curtly.

"I," objected the amazed millionaire, "I'm not here for treatment."

"Heavens, man," interposed the professor, testily, "Don't question my methods. I must have your rate."

Fennimore's teeth snapt shut on his unspoken retort, and submissively he took in each hand the peculiar metal electrodes the scientist proferred. He was finding Parsons a different man in the laboratory from what he had been in his consulting room.

The professor, his eyes watching intently the quivering pointer on a meter face, paid scant attention to his two companions. Finally he made some notes on a pad and relieved Fennimore of the electrodes.

"That will do, thank you," he said, "Now I must figure out your rate."

"My rate of what?" demanded the mystified youth.

"The rate at which you are vibrating per second," replied Parsons, none too graciously, "Let's see. The square root of ——. Ah! There we have it. You vibrate, Fennimore, between the twenty-fifth and twenty-seventh octaves. Thirty-seven million, five hundred and fifty thousand and some odd cycles a second, if figures interest you."

"They don't," replied Fennimore, promptly, his eyes feasting on Violetta, "Not that kind, anyway."

Parsons handed the girl the electrodes, and again studied the quivering needle. Again his pencil was busy. Then he faced the pair, a satisfied look on his face which told plainly that he had found what he sought.

"And you, my friend," he said to Violetta, "Vibrate at the rate of thirty-seven million, five hundred and forty-nine thousand and a few odd hundred. There's only about seven hundred cycles difference between you. You're a fine pair of zincs."

"Fine pair of zincs," echoed Fennimore, "What the devil, Parsons,——"

"Ever see a dry cell, Fennimore?" Parsons asked, calmly, "Carbon and zinc poles, you know? Well, you're a pair of negatives. You couldn't have succeeded in this case in a thousand years."

"See here," broke in the imperious Violetta, "What's all this about a pair of negatives? When do I get those treatments?"

"Don't worry," Parsons assured her, "You'll get them."

Fennimore faced her doggedly. "Look here, Violetta," he said, determinedly, arms folded, jaw squared, "You may as well know the truth. I've told you a thousand times how desperately I love you. Every time you've laughed in my face. I've grown desperate. I had to do something. The professor here thinks he can arouse in you some love for me by means of these treatments. That's why we're here, and that's why he has to take observations of the both of us."

After one startled moment, the girl gave way to uncontrolled laughter. "Make me love you with a bunch of juice," she gasped, "Oh, Lord. This is rich."

Parsons regarded Fennimore with deep disgust. "Fennimore," he said, icily, "You have, in the language of the street, spilled the beans. Now will you kindly keep your mouth shut before you scatter them so hopelessly that I can't pick them up."

"She had to know sometime," retorted Fennimore, stubbornly, "And it might as well be now."

"She didn't have to know before I got these electrodes on her arm," Parsons shot at him, deftly clamping an arm electrode on each wrist of the unresisting girl, who was paying no attention at all to the busy professor. She was regarding Fennimore with contempt.

"Why, you poor simp," she sneered, "I've told you a dozen times, and I tell you again, that if you had a hundred times the money you have, and if you were a hundred times better looking than you are, I wouldn't marry you if you were the last man on earth. Or any other boob in trousers, either. I've got my work to think of. Do you think I'm going to quit being a chorus girl? Not on your life."

Parsons snapt on a switch and grinned at the disheartened millionaire. "How's that for a mouthful, son? he asked, "Think that will hold you for awhile?"

Then the girl turned on him. "And you, Mr. Smart Guy," she demanded, "How do you expect to change my mind with your foolish old treatments?"

Parsons looked at his trembling meters and smiled. "Easily, my dear," he replied, "Oh, quite so. You see, life itself being of an electrical nature, it obeys the laws which govern electrical phenomena in general. To what extent and by just what means we are hardly in position to say as yet. My own researches have carried me beyond the frontiers in certain directions, and the treatment you are undergoing tonight is just one application of the facts that I have unearthed.

"You young people think that love is a question of good looks, circumstances, and mutual attraction. You have fallen into the common error of mistaking the effect for the cause. No two people will be attracted to each other to any degree—far from sufficiently to love—if their natures aren't tuned properly for the occurrence of the phenomenon. Take your own case, for

example. You told the truth when you said that you would not love Fennimore in a million years. Your rates of vibration were so nearly alike that you were, as I said, like poles of a battery."

She regarded him thoughtfully. "Then how, Mr. Man," she asked, "Do you account for the fact that this poor fish is gone on me? Seems to me the rule ought to work both ways to be any good."

"Bravo, little reasoner," exclaimed Parsons, admiringly, "You will be the brains of your household. Well, I account for that quite easily. The simple fact is that HE'S NOT IN LOVE WITH YOU AT ALL."

Fennimore jumped about two feet. The girl looked at the calm scientist in open mouthed amazement. "Say, Parsons, what the ——" burst out the wrathy Fennimore.

"Calm yourself," came the unperturbed reply, "I know what I'm talking about. Bluntly, you've mistaken lust for love. You think you're in love.

"What I'm doing is just this. By a process which I do not choose to reveal, I am changing the rate, or call it natural period, if you like, at which this girl vibrates. When I have changed it sufficiently you will be as far apart as you were together before. In other words, you will be splendidly positive and negative. Then you will love. You won't be able to help yourselves."

Vaguely alarmed at the cool assurance of this man, the girl stirred uneasily in her chair and regarded the quivering meter needles with some apprehension.

Parsons leaned back comfortably against his instrument board and resumed.

"I find that the exact adjustment of these oppositions is quite critical. For maximum manifestation I should have to readjust you to the very cycle. Were I to do that, the attraction would be so violent that you would literally hurl yourselves into each other's arms. That critical state quite frequently occurs naturally, and when it does you see the conventions hurled ruthlessly aside, and every man-made barrier scaled, be it as high as the mountains or as broad as the sea. Let me get the coldest, most haughty beauty of the upper class into this chair, and I can force her to lavish every attention on the dirtiest ash man you can find in the city.

"It is sufficient that we attain a degree of attraction necessary to arouse domestic instincts and impulses." He broke off to study gravely the indication of a large meter. "That state we have about reached now," he said, quietly.

Fennimore started, and regarded the girl intently. For a second she met his gaze. Then her eyes dropt, and she blushed.

Parsons smiled faintly. "I'm a few years ahead of my time, of course," he said, "Within the next few years every couple that applies for a license to wed will have their vibratory rates taken and the corrections necessary to accomplish true affection made. The divorce evil will be wiped out as mis-mating is prevented."

He snapt off the switch and deftly removed the electrodes from the girl's arms. She arose, a trifle unsteadily. Fennimore regarded her anxiously. "How do you feel?" he asked, in some concern.

"A little queer," she replied, dazed, "You'd better take me home, Roderick."

Roderick! The young man's heart pounded within him and a look of exultation came over his features. He faced her squarely. "For the thousand and first time, 'Letta," he said, "Will you marry me?"

"In 1999"

By B. FRANKLIN RUTH

(*Continued from page* 1302)

peculiar nature of the disturbances could only be explained as the result of some human agency capable of exercising extraordinary powers over the physical universe. After the occurrence of several successive manifestations, the latter were immediately identified as radio-active in origin. It was admitted that atomic disintegration had at last been accomplisht, and that the fate of the world was in the hands of its unknown discoverer, who might destroy the planet at his whim. With deep secrecy science kept its knowledge, and waited for the discoverer to make himself known either as the benefactor or destroyer of mankind.

Early in 1925, the great Indian physicist, Signa Beth, announced his discovery of a method of releasing the immense energy stored in the atom, and his intentions of benefiting mankind. Thus the most momentous discovery ever made by science was disclosed.

From that date, science bounded forward. The commercialization of Signa Beth's discovery and its direct application to the immense stores of energy contained in the atoms of the common heavy elements brought unprecedented benefits to mankind. With almost unlimited power waiting to be unleashed by the pressure of a finger, men laid aside their work and took a holiday. It was like the discovery that water could be turned into steam and made to work for us,—multiplied a million times.

Close upon the discovery of atomic disintegration came that of the transmutability of matter. This was the natural sequence of the analysis of the properties of by-products formed during the successive steps of disintegration. The result of this discovery, as we all know today, was the immediate demonetization of gold and all precious metals. In a day the world was threatened with its greatest financial panic.

Fortunately, there was at the head of our government a man of great foresight and ability who saw the threatened disaster and took immediate steps to avert it. At a joint meeting of the representatives of the various governments, measures were taken to meet the crises, and thru pressure brought to bear from certain sources a coalition of nations was formed under a single government. This we know today as the United States of the World. It was in effect a League of Nations similar to the plan advanced by the great Wilson in 1919. It arranged for a semi-annual world congress at Washington, and enforced its decrees by means of an International Police. Paper notes on the World Government were issued as legal currency, and substituted for all outstanding metal currency. Threatened Bolshevik outbreaks in Russia, and labor crises in Europe and America were immediately quelled by the efficient iron hand of the international government. Thus was civilization again saved from destruction.

One of the most apparent effects of the world coalition was the abolishment of war. The United States, as principal creditor of the bankrupt nations, held a unique position in the league, both as its sponsor and guardian. The

former president of the United States was elected president of the World Congress. But he also represented the United States.

The reason for the disappearance of war, we are led to believe, was the potential power held by the United States. When the Great War came to an end in 1918, many new and terrible inventions were just nearing completion, and were perfected too late to be used in actual warfare. The possession of these secrets by the United States constituted an effectual curb to the aggressive instincts of any nation inclined to war.

One of the most spectacular inventions resulting from Signa Beth's discovery was that of Thomas Soddy's space navigating apparatus in 1938. By utilization of the terrific recoil developed in a certain method of disintegration, this instrument was able to leave the earth's surface like a sky rocket and travel beyond its gravitational orbit in any direction, at a tremendous rate of speed.

The effect of this invention upon the lay mind at that time can hardly be imagined. Nineteen years before, powerful waves of mysterious but undoubtedly ethereal origin had been received by some of the larger radio stations. The scientific explanations and press exploitations of these unidentified waves created such widespread excitement at the time that when Soddy returned from his epoch-making explorations of Mars and Venus in 1938, and confirmed these attempted Martian communications of 1919, and testified as to the residence on Mars and Venus of highly civilized beings, the people of the earth became wildly excited.

Results followed speedily. Intercourse between the inhabited planets of our solar system was quickly established. Interplanetary laws governing spacial navigation were quickly formulated and ratified, so that today we witness our great interplanetary merchant marine, touching all planets in the solar system, and many of the nearer stars. Trips of exploration are bringing in reports of new discoveries every day. Excursion ships dash thru space at regular hours, bound for other planets.

Soddy's invention truly marks the beginning of this Utopian era of Science. Mankind began to live a life of ease and indulgence, yet governed by sobriety and health.

Due to the congestion of our cities, some of which had a population of fifty-five millions, and to existing agricultural conditions, it was increasingly difficult, during the early sixties, to furnish enough food. The great Browning's discovery of a method permitting the direct conversion of heat into electricity enabled engineers of the period to solve this problem adequately. Thirty-foot tubes were excavated thru the earth's diameter, reaching from a large industrial center on one side to some extensive agricultural area upon the other. Africa, China, Australia, and parts of South America were touched. As these tubes were sunk, they were lined with Browning's electro-heat converting apparatus, which turned the intense heat of the bowels of the earth into an immense voltage, giving an electric current, but left the interiors of the tubes relatively cool and insulated from the fiery medium thru which they passed.

Food, produced easily and in large quantities in the farming countries, was quickly hauled over extensive railroad systems to the mouths of the tubes, and regular consignments dropped thru in specially designed cars. The momentum gained in the four thousand mile drop

easily carried the cars past the center of the earth, where gravity began to exert its counterpull, up to within several feet of the opposite surface. The moment they started to fall back, they were caught and held by automatic catches. Giant electric hoists completed their journey to the surface.

It is to these great engineering feats that credit must be given for the comfort of our modern city life. They may easily be regarded as among the most beneficial gifts to mankind that science has produced in the last four decades, for they make possible our present-day existence. Today we are so dependent for food upon these earth-piercing tubes, that if they all should be damaged simultaneously, there would be much suffering and hardship before repairs could be effected. Possibly many deaths might result from starvation. These tubes are indeed the arteries of our daily existence.

Some of the most widely known of Science's improvements have been those of transportation and travel. Speed, as demanded by the ease and luxury-loving internationalite of today, has been furnished by the prolific genius of science. Huge liners of the air, several thousands of feet in length, inflated with helium gas (which is a plentiful end-product of the disintegration processes), driven by powerful atomic engines at several hundred miles per hour, and luxuriously fitted with accommodations for at least a thousand passengers, ply the great Atlantic and Pacific between breakfast time and dinner. Our skies today are filled with wings swiftly propelled by noiseless thorio-actinic motors. Since the helium-filled ship came into general use, more than forty-five years ago, not a life has been lost in aerial transportation. Certainly this is a magnificent record, and a worthy tribute to the science that made it possible.

Progress in Education has been no less rapid. Today we have our great university cities, endowed by a benevolent government, for the free use of all mankind. Free higher-education to any who desire is as much a right of the world citizen of today as liberty was of the American of a century ago. Thousands of investigators in pure science now finish their education in the immense national universities of Mars and Venus, as all learning went to Europe to receive its degree in 1900.

In biology, geology, bacteriology, zöology, engineering, chemistry, and all branches of science there has been rapid advancement. In biology, I understand, the synthetic production of living organisms has been lately accomplished, and promises wonderful achievements. It is no great flight of fancy to say that if we were able one billion years from now to look upon those warm, steamy, cooling, and still lifeless planets, where our interpid space-fliers have recently placed cultures of synthetic Amoeba, we might hope to see a creature occupying a place in that planetary existence comparable to that now filled by the earth's human race.

In medical science there has been such progress that death by sickness and disease is rare, whereas continued pain is hardly known, and certainly avoidable. By observing scientific methods of right living and obeying natural laws, one may expect to live for more than one hundred years. That is a period of existence nearly twice that of the average man fifty years ago.

Gentlemen, I ask you, can the coming century be filled with such an array of achievements? Possibly. Who can tell? Biology holds hopes which some of us may live to see realized.

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Be a Mirror Expert. $3 to $10 a day; spare time home at first; no capital; we train, start you making and silvering mirrors French method. Free Prospectus. W. R. Derr, Pres., 579 Decatur Street, Brooklyn, N. Y.

Detectives earn big money. Excellent opportunity. Travel. Great demand everywhere. Experience unnecessary. Particulars free. Write American Detective System, 1968 Broadway, N. Y.

Men Wanted at $35 to $100 a week to make mechanical drawings. Work is easy, pleasant, and leads to higher positions in Industrial Field at excellent salaries. We furnish set of instruments, train you at home, in spare time, by practical method and help you qualify for position. Write today for particulars. Roy C. Claffin, Pres., Dept. 1368, 14th & T Sts., Washington, D. C.

Be a Detective. Travel and earn big money. Learn this fascinating profession by home study. Particulars free. Write American School of Criminology, Dept. B, Detroit, Mich.

Business Opportunities

Texas Land $6.00 Per Acre. We offer for immediate sale, in tracts of ten, twenty, forty and eighty acres each, patented land, full mineral rights and oil royalty included, located near a railroad in Brewster County, Texas. Warranty deed and opinion by reputable attorney approving the title, furnished with every tract. References: Dunn or Bradstreet, also State National Bank, San Antonio, Texas. H. J. McMullen, Bedell Building, San Antonio, Texas.

If you want to sell or exchange your farm, unimproved land, city property or patent, write me. John J. Black, 194th St., Chippewa Falls, Wis.

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(*Continued on page* 1365)

El Paso, Texas, Oct. 1, 1917.

MR. CHARLES F. HAANEL, St. Louis, Mo.

In Re "The Master Key."

My dear Mr. Haanel: The value of an idea is determined by its application. Pragmatism has long since spread beyond the confines of Missouri. The world to-day insists on being shown.

The lash of circumstances and the logic of events are, more than ever, impelling men to think. Whether an idea be a new process for picking cabbages or an old process (Kaiserism, for instance) for preserving kings, we are from Missouri.

A philosophy of life having as its base blind optimism; a religion that won't work seven days a week, or a proposition that isn't practical, appeals to the intelligent not at all. It is results that we want and the acid test is, will it work?

The Master Key qualifies. It is the most lucidly scientific statement of "Truth" that I have seen. It reconciles rationalism and religion; illumines economic determinism and the materialistic conception of history, and is an infallible guide to understanding. It contains in condensed form the substance of an entire library on science. Its teaching, if consistently applied, will make a man healthy, wealthy and wise. Its distribution is supermissionary work in excelsis. Those who wish to think intelligently will find it invaluable.

Intelligence rules. Desire intelligently directed is a creative force which automatically causes its object to manifest on a material plane. It is the law. Let him that hath an ear to hear, hear.

Yours truly,
CHAS. A. HEARD.

May 15, 1918.

Dear Mr. Haanel: Ever since I have been old enough to read, I have been reading metaphysical literature. I have waded ears deep through the books from all ages, all lands, all schools.

I have rejected tons of lies, oceans of misconceptions, an entire universe of false deductions.

I have found grains of truth in mines of folly, and words of truth in a single grain. The pursuit was interesting in itself, and I do not regret the time spent upon it. But it was a genuine surprise to read your Master Key System and find within, the essence of all that I had read, with much more added thereto.

In this extraordinary system you have sifted the true from the false; you have given in concrete form all that is worth while in many schools of philosophy.

You have placed arcane truths into the hands of the uninitiated as weapons they can learn to use without danger to themselves. I congratulate you. You are doing mankind a service.

Yours very sincerely,
CHARLES F. OURSLER.
501 Fifth Avenue, New York City, N. Y.

Detroit, Mich., May 28, 1917.

Dear Sir: The words, "Your world will change as if by magic, the moment you realize the marvelous power within your control," page 6, I have underlined. They state a fact, a real live fact; and to me this is the most wonderful, the most important fact of all—that one may put this knowledge to an immediate test, that one may, after learning of this power, proceed to apply it with a definite knowledge as to results.

W. M. HOWE.

THE LOWE OBSERVATORY
Edgar Lucien Larkin, Director
Los Angeles, Cal., Dec. 6, 1916.

MR. CHAS. F. HAANEL, St. Louis, Mo.

Dear Sir: Your booklet, Master Key, ought to be expanded into a book. Its teachings that Mind is the all-dominating creative force is precisely in line with the wonders of the most recent psychology. All persons having desks should have this pamphlet thereon. And it would be a fitting pocket companion.

EDGAR LUCIEN LARKIN.

WHICH can unlock the secret chambers of success; can throw wide the doors which seem to bar men from the treasure house of nature, and bids those enter and partake who are wise enough to understand and broad enough to weigh the evidence; firm enough to follow their own judgment and strong enough to make the sacrifice exacted.

Chattanooga, Tenn., Feb. 22, 1918.

The Master Key is wonderful, it has brought about a most remarkable change in my environment, attitude toward life, mental and physical condition. I am an entirely new person and improving daily, discouragement, lack of ambition, physical ills, mental distress, and fear are things of the past

I cannot find words that express my gratitude for all that the Master Key has done for me. With heartfelt thanks to you, I am

Yours sincerely,
R. J. ARNOLD.

Washington, D. C., Dec. 29, 1916.

Dear Sir: Your little booklet entitled, "The Master Key," has been received and I had great pleasure in studying it carefully. It is a very clear and concise, yet forceful presentation of the big subject handled and shows a very wide study of the absolute teachings and deep understanding of the same.

Very truly yours,
JAMES LEE BOST.

"I am able to extract from this system all that can be made known by the finite mind relative to origin, evolution, destiny and the much-mooted riddle of the Universe."

"I can hardly grasp the full significance of the facts. The vastness of this subject is so overwhelming it seems a life-time of effort could never fathom all its possibilities.

"The Master Key is too modest a title for such a stupendous revelation."

"I have found the Key and with it each day am opening the store-house of wisdom and success, of which for many years I was utterly ignorant."

New York City, May 20, 1918.

Dear Mr. Haanel:

The Master Key system deals with the energy which creates things, rather than with the manipulation of things after they are created, because of this fact it is absolutely limitless.

Very sincerely,
E. FLOOD.

Charles F. Haanel, 203 Howard Bldg., St. Louis, Mo.

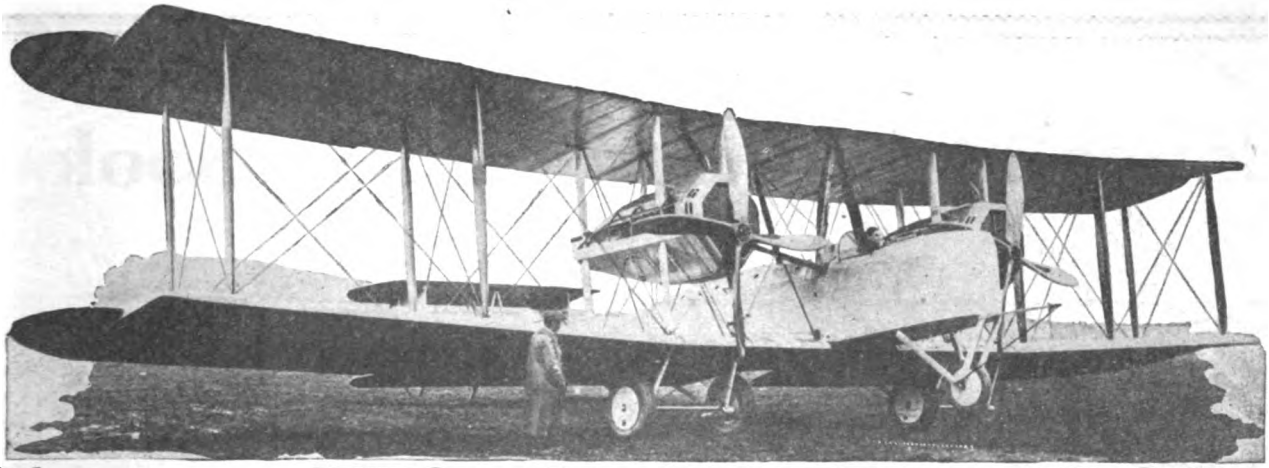
Send me the Master Key without cost or obligation of any kind.

Name .....

Address .....

Post Office..... State .....

NOTE—*Tomorrow, today will be yesterday.* Get your Master Key TODAY! NOW!



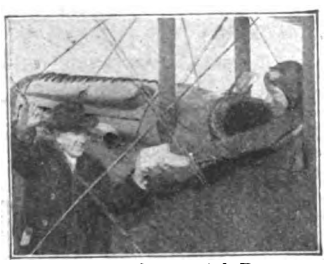
Go as High as You Like

No Limit to Salaries in Aviation

No other industry offers the wonderful chances for big money-making that the Airplane Industry offers to ambitious men. Many more trained men will be needed to fill big paying jobs. The airplane has come to stay—it will soon be a part of our everyday life. The men who get in now are the ones that will cash in big. Look at the "big fellows" in the automobile game today. They represent power and wealth because they got in early—you can do the same in Aviation and you have an advantage because you can be trained before you start.

Delivering Newspaper "Extras" by Airplane

A New Seven-Passenger Airplane



A New Job—The Aerial Postman

View in an Airplane Factory

Thousands of Airplane Mechanics Will Be Needed

The airplane industry is going forward by leaps and bounds. Transportation—passenger carrying and mail carrying lines are being opened up everywhere. This means men—men—men! Trained men only are wanted—men who know what's what. Get ready now to make big money. The industry is calling for real red-blooded fellows—heed the call—*now* is the time to get started—while the industry is still in its infancy.

Here Are a Few Jobs That Will Pay $50 to $250 a Week:

Aeronautical Instructor Aeronautical Engineer Aeronautical Contractor Airplane Repairman Airplane Mechanician Airplane Inspector Airplane Salesman Airplane Assembler Airplane Builder

Learn at Home IN YOUR SPARE TIME

Keep right on with the work you are doing now. A little of your spare time is all you need. Our Special Course is simplified for home instruction and is endorsed by airplane manufacturers, aeronautical experts, aviators and the leading aero clubs. Any man that can read English can understand it. The Lessons are self-explanatory and are made plain as day with Blueprints, Diagrams, etc.

Our Advisory Council and Instructors are behind you all the time giving you everything you must know. The entire field of Practical Aeronautics and Science of Aviation is laid right before your eyes. You are bound to succeed with this training. This means for you a man's size job with a man's size pay.

Big Book of Opportunities FREE!

Send for our big free book showing just what is going on in the Airplane Industry. It also shows what other men have done in this fascinating field and what you can do, too. It gives a list of some large manufacturers and dealers in airplanes and some of the jobs that are open to trained men. With the book we will send you a special offer that you will be glad to know about. This special offer may be withdrawn at any time without notice. *Send the coupon now and take advantage of this offer.*

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Chicago, Ill.

Without obligation on my part you may send me your book entitled "Opportunities in the Airplane Industry" and your SPECIAL Limited offer.

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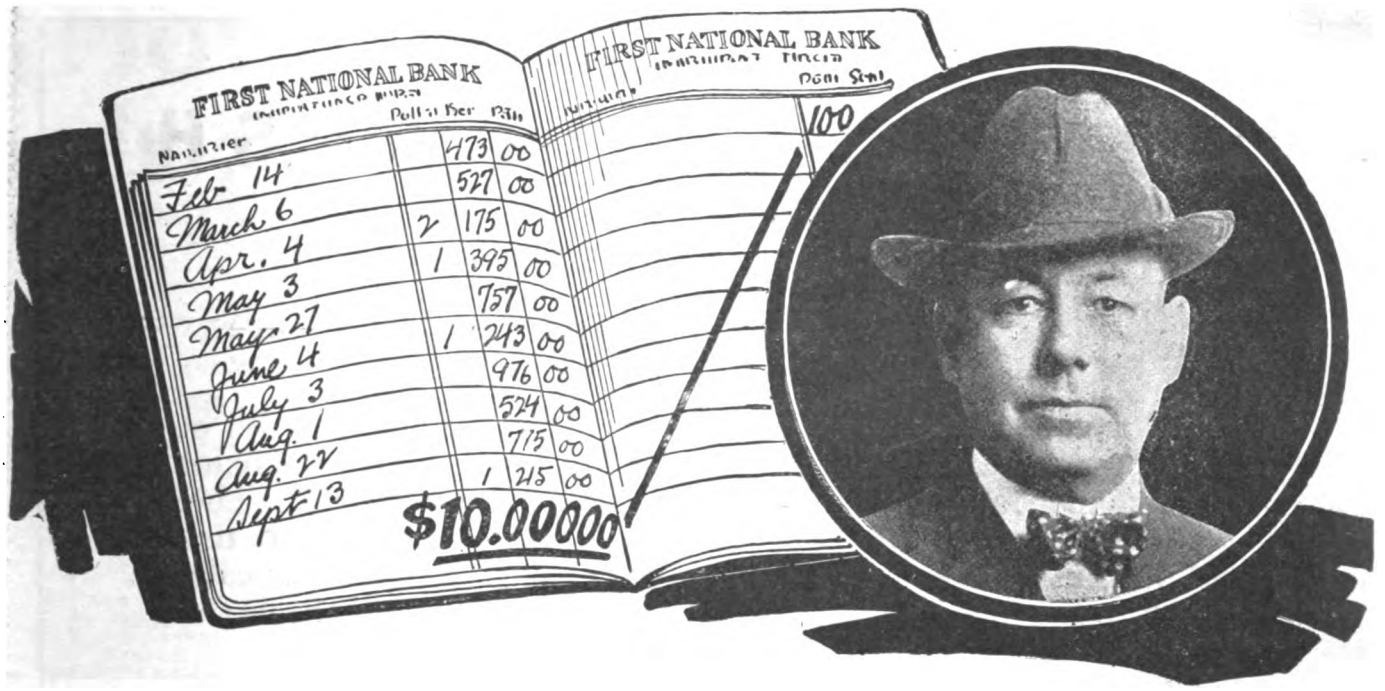

Worth $10,000 a Year and Didn't Know It

For Years Warren Hartle Worked for $18 a Week, Never Thinking He Could Make Much More. Today He is Earning $10,000 a Year! Read the Amazing Story of His Easy and Sudden Rise to Success

FOR ten years he worked in the Railway Mail Service at pay ranging from $900 to $1,600 a year—just bare existence wages, with no opportunity to make more or save. *And now he is earning $10,000 a year!* Yes, Warren Hartle makes as much some months now as he formerly did in a year's hard work on the railroad.

Hartle's sudden rise to real success may sound amazing, almost unbelievable, yet there is not the slightest doubt that you can do exactly what he did. What was the secret of his sudden rise from small pay to magnificent earnings? *It was the same secret that has brought prosperity to thousands of others.*

Another man I happen to know is J. P. Overstreet of Denison, Texas. A short time ago he was a police officer earning less than $1,000 a year. Now he writes: "My earnings for March were over $1,000, and over $1,800 for the last six weeks while last week my earnings were $356.00." G. W. Campbell, Greensburgh, Pa., was formerly a railroad employee on a small salary. In one month his earnings were $1,562. Then there is Charles L. Berry of Winterset, Iowa, who quit his job as a farm hand and earned $2,140 in one month.

Why Don't YOU Get Into The Big Money Field?

MR. HARTLE, Mr. Overstreet, Mr. Campbell and Mr. Berry are all successful Salesmen. They realized their ambition by landing $10,000 jobs in an amazingly simple way with the help and guidance of the National Salesmen's Training Association. Some time—somewhere back in the past each one of them read of this remarkable course of Salesmanship Training and Employment Service, just as you are reading of it today. Each one of them was dissatisfied with his earning capacity as perhaps you are—and each one cast his lot with the N. S. T. A. Today they are important factors in the business world—enjoying all the comforts and luxuries money can buy. And yet they are not exceptions, for there are thousands of N. S. T. A. Trained Salesmen who are making big money, as we will be only too glad to show you if you will mail the coupon below.

Why Salesmen Earn Such Big Pay

THE man who starts working as a bookkeeper or clerk for $25.00 a week, never increases his value to the firm. At the end of ten years he is no more essential to the life of the organization than he was at the end of ten weeks. He is only a necessary liability—drawing his pay because somebody must be found to work at the unimportant, routine jobs.

If you will study any business organization you will see that the big jobs go to the men who are in the Selling end, for upon their efforts depend the profits a company makes. Without trained men to place a product on the market, the finest goods are worth no more than so much clay. Salesmen are the very nerve centers of a business. Is it any wonder that they earn such big pay?

Secrets That Only Master Salesmen Know

FROM "greenhorn" to Master Salesman in next to no time sounds almost too good to be true. Yet we accomplish this wonderful transformation year after year because we teach the REAL SECRETS OF SALESMANSHIP. We take you through this fascinating subject step by step—teach you how to get an audience—how to open a sales talk in order to get the prospect's attention—how to make the prospect eager to get all the facts about your proposition—how to get him to act at once instead of putting you off—when to stop talking—and definite principles of overcoming every possible objection that may arise in the process of making a sale.

There are certain ways of doing and saying things in selling—the secrets that only Master Salesmen know—and once you have acquired the fundamental principles—once you are master of these Selling Secrets—your power of accumulating money is almost unlimited. The man who understands the underlying principles of Salesmanship has a two-fisted grip on prosperity. He can sell his services a hundred times over, for there is an enormous demand for his highly specialized knowledge.

We Train You and Help You Land a Job

THE National Salesmen's Training Association is an organization of top-notch Salesmen and Sales Managers formed for the express purpose of training men in the science of successful Selling. You do not need to know the first thing about Selling—you need not give up your present position until you are ready to begin actual Selling.

In addition, the N. S. T. A. maintains a Free Employment Service to help its members to positions in the lines for which they are best suited just as soon as they are qualified and ready.

Salesmen Are Needed—Now!

GET out of that rut. Work for yourself! Salesmanship is the biggest paid of all professions. We have made Master Salesmen of men from all walks of life, with no previous Selling experience. These men have jumped from small pay jobs to positions that pay real money. You can follow in their footsteps. Never before have the opportunities been greater. Investigate the great field of Selling and see what it offers you. The facts and proof you will receive will surprise you.

Send for Free Book on Salesmanship Now

JUST mail the coupon or write for our free illustrated Book, "A Knight of the Grip," which we will be glad to send without any obligation on your part. Let us prove to you that regardless of what you are doing now, you can quickly become a Master Salesman. Let us show you how you, too, can step into the ranks of these big money makers of business. See how easily you can learn this fascinating, big pay profession at home in your spare time. Learn what we have done for others and what we stand ready to do for you. Don't put it off a minute—write us now. Every day lost keeps you that much further from success. Mail the coupon at once.

National Salesmen's Training Association
Dept. 42-D, Chicago, Ill.

National Salesmen's Training Association
Dept. 42-D, Chicago, Ill.

Please send me without any obligation on my part, your free Book on Salesmanship and full information about the N. S. T. A. system of Salesmanship Training and Free Employment Service. Also a list showing lines of business with openings for salesmen.

Name .....

Street .....

City ..... State .....

How One Evening's Study Led to a $30,000 Job

A Simple Method of Mind Training That Any One Can Follow With Results from the First Day

By a Man Who Made Formerly No More Than a Decent Living

I HOPE you don't think I'm conceited or egotistical in trying to tell others how I suddenly changed from a comparative failure to what my friends term a phenomenal success.

In reality I do not take the credit to myself at all. It was all so simple that I believe any man can accomplish practically the same thing if he learns the secret, which he can do in a single evening. In fact, I know others who have done much better than I by following the same method.

It all came about in a rather odd manner. I had been worrying along in about the same way as the average man, thinking that I was doing my bit for the family by providing them with three square meals a day, when an old chum of mine, Frank Powers, whom I had always thought was about the same kind of a chap as I, suddenly blossomed out with every evidence of great prosperity.

He moved into a fine new house, bought a good car and began living in the style of a man of ample means. Naturally the first thing I did when I noticed these things—for he had said nothing to me about his sudden good fortune—was to congratulate him and ask him what had brought the evident change in his finances.

"Bill," he said, "it's all come so quickly I can hardly account for it myself. But the thing that has made such difference in my life lately began with an article I read a short time ago about training the mind.

"It compared the average person's mind to a leaky pail, losing its contents, as it went along, which if carried any distance would arrive at its destination practically empty.

"And it showed that instead of making the pail leak-proof most of us kept filling it up and then losing all we put into it before we ever reached the place where the contents would be of real use.

"The leak in the pail, the writer demonstrated, was forgetfulness. He showed that when memory fails, experience, the thing we all value most highly, is worthless. He proved to me that a man is only as good as his memory, and whatever progress a man accomplishes can be laid directly to his powers of retaining in his mind the right things—the things that are going to be useful to him as he goes along.

"Farther on in the article I read that the power of the mind is only the sum total of what we remember—that is, if we read a book and remember nothing that was in it, we have not added one particle to our experience; if we make a mistake and forget about it, we are apt to make the same mistake again, so our experience did not help us. And so on, in everything we do. Our judgment is absolutely dependent on our experience, and our experience is only as great as our power to remember.

"Well, I was convinced. My mind was a 'leaky pail.' I had never been able to remember a man's name thirty seconds after I'd been introduced to him, and as you know, I was always forgetting things that ought to be done. I had recognized it as a fault, but never thought of it as a definite barrier to business success. I started in at once to make my memory efficient, taking up a memory training course which claimed to improve a man's memory in one evening. What you call my good fortune to-day I attribute solely to my exchanging a 'leaky pail' for a mind that retains the things I want to remember."

* * * * *

Powers' story set me thinking. What kind of a memory did I have? It was much the same as that of other people I supposed. I had never worried about my memory one way or another, but it had always seemed to me that I remembered important things pretty well. Certainly it never occurred to me that it was possible or even desirable to improve it, as I assumed that a good memory was a sort of natural gift. Like most of us, when I wanted to remember something particularly I wrote it down on a memorandum pad or in a pocket notebook. Even then I would sometimes forget to look at my reminder. I had been embarrassed—as who has not been?—by being obliged to ask some man whom I had previously met what his name was, after vainly groping through my mind for it, so as to be able to introduce him to others. And I had had my name requested apologetically for the same purpose, so that I knew I was no different than most men in that way.

I began to observe myself more closely in my daily work. The frequency with which I had to refer to records or business papers concerning things that at some previous time had come under my particular notice amazed me. The men around me who were doing about the same work as myself were no different than I in this regard. And this thought gave new significance to the fact that I had been performing practically the same subordinate duties at exactly the same salary for some three years. I couldn't dodge the fact that my mind, as well as most other people's literally limped along on crutches, because it could not retain names, faces, facts, and figures. Could I expect to progress if even a small proportion of the important things I learned from day to day slipped away from me? The only value of most of my hard-won experience was being canceled—obliterated—by my constantly forgetting things that my experience had taught me.

The whole thing hit me pretty hard. I began to think about the subject from all angles as it affected our business. I realized that probably hundreds of sales have been lost because the salesman forgot some selling point that would have closed the order. Many of our men whom I had heard try to present a new idea or plan had failed to put over their message or to make a good impression because they had been unable to remember just what they wanted to say. Many decisions involving thousands of dollars had been made unwisely because the man responsible didn't remember all the facts bearing on the situation and thus used poor judgment. I know now that there isn't a day but what the average business man forgets to do from one to a dozen things that would have increased his profits. There are no greater words in the English language descriptive of business inefficiency than the two little words "I forgot."

I had reached my decision. On the recommendation of Powers, I got in touch at once with the Independent Corporation, which shortly before had published the David M. Roth Method of Memory Training. And then came the surprise of my life. In the very first lesson of the course I found the key to a good memory. Within thirty minutes after I had opened the book the secret that I had been in need of all my life was mine. Mr. Roth has boiled down the principles perfecting the memory so that the method can almost be grasped at a glance. And the farther you follow the method the more accurate and reliable your memory becomes. Within an hour I found that I could easily memorize a list of 100 words and call them off backward and forward without a mistake. I was thunderstruck with the ease of it all. Instead of study the whole thing seemed like a fascinating game. I discovered that the art of remembering had been reduced by Mr. Roth to the simplest method imaginable—it required almost nothing but to read the lessons! Every one of those seven simple lessons gave me new powers of memory, and I enjoyed the course so much that I look back on it now as a distinct pleasure.

The rest of my story is not an unusual one among American business men who have realized the value of a reliable trained memory. My income to-day is close to $30,000. It will reach that figure at the beginning of our next fiscal year. And two years ago I scarcely made what I now think of as a decent living.

In my progress I have found my improved memory to be priceless. Every experience, every business decision, every important name and face is easily and definitely recorded in my mind, and each remembered experience was of immense value in my rapid strides from one post to another. Of course I can never be thankful enough that I mended that "leaky pail" and discovered the enormous possibilities of a really good memory.

David M. Roth

When Mr. Roth first determined to exchange his leaky mind for one that would retain anything he wanted it to, it was because he found his memory to be probably poorer than that of any man he knew. He could not remember a man's name 20 seconds. He forgot so many things that he was convinced he could never succeed, until he learned to remember. To-day there are over ten thousand people in the United States whom Mr. Roth has met at different times—most of them only once—whom he can instantly name on sight.

Mr. Roth can and has hundreds of times at dinners and lectures asked fifty or sixty men he has never met to tell him their names, businesses and telephone numbers and then after turning his back while they changed seats, has picked each one out by name, told him his telephone number and business connection. These are only a few of the scores of equally "impossible" things that Mr. Roth can do, and yet a few years ago he couldn't remember a man's name twenty seconds. Why go around with a mind like a leaky pail when, as Mr. Roth says, "what I have done any one can do."

SEND NO MONEY

Mr. Roth's fee for personal instruction to classes limited to fifty members is $1,000. But in order to secure nation-wide distribution for the Roth Memory Course in a single season the publishers have put the price at only five dollars, a lower figure than any course of its kind has ever been sold before, and it contains the very same material in permanent form as is given in the personal $1,000 course.

So confident is the Independent Corporation, the publishers of the Roth Memory Course, that once you have an opportunity to see in your own home how easy it is to double, yes triple the powers of your memory, and how easily you can acquire the secret of a good memory in one evening, that they are willing to send the Course on free examination.

Don't send any money. Merely mail the coupon or write a letter and the complete course will be sent, all charges prepaid, at once. If you are not entirely satisfied send it back any time within five days after you receive it and you will owe nothing.

On the other hand, if you are as pleased as are the thousands of other men and women who have used the course, send only $5 in full payment. You take no risk and you have everything to gain, so mail the coupon now before this remarkable offer is withdrawn.

Independent Corporation

Dept. R-1104, 319 Sixth Avenue New York

FREE EXAMINATION COUPON

Independent Corporation

Dept. R-1104, 319 Sixth Avenue New York

You may send me the Course or Courses checked below. Within five days after receipt I will either remail them or send you $5 for each in full payment.

- ☐ Roth Memory Course ($5) By David M. Roth
- ☐ Mastery of Speech ($5) By Frederick Houk Law
- ☐ Drawing, Art, Cartooning Course ($5) By Charles Lederer
- ☐ Super-Salesmanship ($5) By Arthur Newcomb
- ☐ How to Read Character at Sight ($5) By Dr. K. M. H. Blackford
- ☐ How to Write Stories By Prof. W. B. Pitkin

Name.....

Address.....

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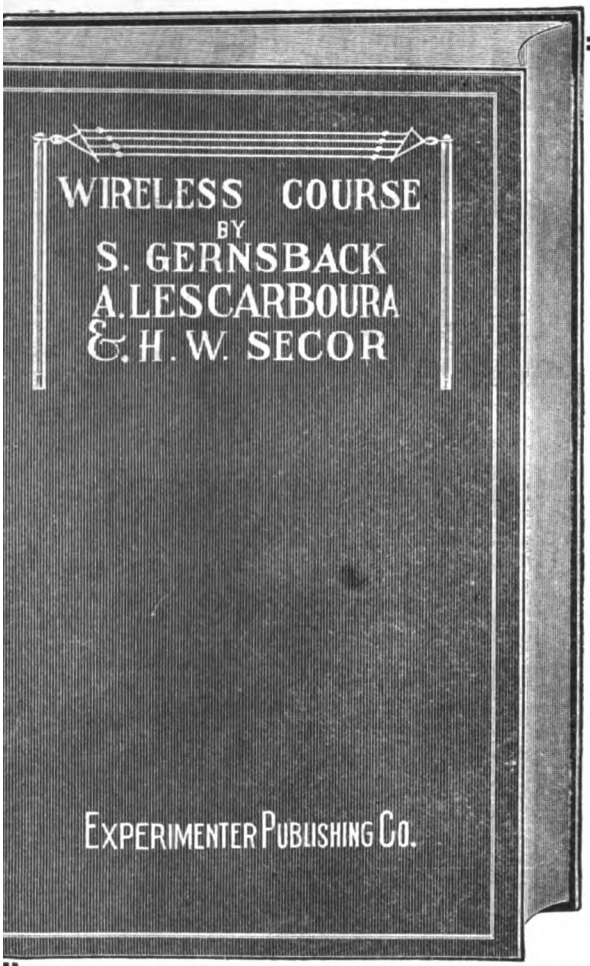

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THIS Course has been considerably revised in order that it meet some of the many important changes which have occurred in Radio Telegraphy and Telephony within recent years. Much valuable data and illustrations concerning the Vacuum Tube has been added. This comprises the theory of the Tube as a detector and as an amplifier, and in addition has been included modern amplification circuits of practical worth. Incidentally, space has also been devoted to the development of the Radio Compass as operated and controlled by the United States Navy with its consequent great aid to present-day navigation.

The beginner and general student of radio will find this Course of great value in securing the necessary fundamentals of a most fascinating and instructive vocation, or avocation—as the case may be. Radio holds out considerable inducements as a career.

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Enclosed find $1.75 in ..... CHECK M. O. for which send me one copy of 10th EDITION WIRELESS COURSE POSTPAID.

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Has This Ever Happened to You?

IF you were a guest at dinner and you overturned a cup of coffee, what would you do? What would you say? Would you turn to the hostess and say "I beg your pardon"? Would you offer your apologies to the entire company? Would you ignore the incident completely? Which is the correct thing to do?

To be able to do and say the right thing at the right time is the badge of culture, and the man or woman who has that power is indeed an individual of polish and poise.

What blunders do you make in the ball-room? These questions may help you discover them.

Does etiquette allow a woman to ask for a dance? May she refuse to dance without a reason? What is the proper thing for a young girl to do if she is not asked to dance? What is a polite and courteous way of refusing a dance? How many times may a girl dance with the same partner without breaking the rules of etiquette? Is it correct to wander away from the ball-room with a fiance?

According to etiquette's laws is it necessary for a gentleman to dispose of his partner to someone else before he asks another lady for a dance? How shall he ask a lady to dance? Which are the correct forms and which the incorrect? How shall he dispose of the lady after the dance if he must return to the lady he has escorted? What is the right dancing position for the gentleman? For the lady? What style of dress is correct to wear at a dance?

There is perhaps no better place to display the culture and finesse of your breeding than the ball-room, resplendent with the gay gowns of women and enchanting with the ease and gracefulness of dancing couples. Here the gallantry of true gentlemen and the grace and delicacy of cultured women asserts itself. Here you can distinguish yourself either as a person of culture or a person of boorishness.

What Do You Know About Introductions?

To establish an immediate and friendly understanding between two people who have never met before, to make the conversation flow more smoothly and pleasantly, to create an agreeable, harmonious atmosphere —that is the purpose of the ***introduction***. A correct, courteous conversation-making introduction is an art itself, and reflects refinement and culture on the person who is the medium.

How do YOU introduce two people? Do your introductions create a pleasant, easy atmosphere, or one that is uncomfortably strained?

Try this simple test and see what you really know about the art of introduction:

Mrs. Brown and Miss Smith have met at your home for the first time. Would you say, *Mrs. Brown, meet Miss Smith*, or *Miss Smith, meet Mrs. Brown?* Would you say, *Miss Smith, let me make you acquainted with Mrs. Brown?*

If Mr. Blank happened to drop in for a little chat, how would you present him to the ladies: to both at once, or to each one individually? And how would you present Bobby, who comes running in from school; *Bobby, this is Mr. Blank*, or *Mr. Blank, this is Bobby*, or would you use the *I want you to meet* method? Do you ever say, *I take pleasure in introducing?* Is it right or wrong?

How do you introduce a sweetheart to your relatives for the first time? How do you introduce her or him to your friends?

On the other hand, if you are being introduced, how do you acknowledge it? Do you use any of these expressions: "*Pleased to know you*," "*Delighted*," "*How do you do?*" Does a gentleman rise upon being introduced to a lady? Does the lady rise? Is it correct for the lady and gentleman to shake hands?

The difference between the right and wrong thing in introducing is the difference between culture and coarseness.

The man who would be polished, impressive, and the woman who covets the wonderful gift of charm must cultivate the art of introduction.

Etiquette at the Dance

The ball-room should always be a center of culture and grace. To commit a breach of etiquette at the dance is to condemn yourself as a hopeless vulgarian. But alas! how many blunders are made by people who really believe that they are following the conventions of society to the highest letter of its law!

When Wedding Bells Ring Out

etiquette again comes to the fore. What is the right dress for the bride to wear? How shall the invitations be worded? When shall the groom give his farewell bachelor dinner? How shall congratulations be extended? And after the wedding there are cards of thanks and cards of invitation to be sent. The wedding breakfast must be arranged and perhaps a honeymoon trip must be planned. Suffice to say, that the bride and bridegroom will find invaluable aid in the "Encyclopedia of Etiquette."

Encyclopedia of Etiquette

In Two Comprehensive Volumes

In the most minute details of daily life, in the hours of prosperity and adversity alike, at all times, there is the omnipresent need of holding one's self in hand, of impressing by one's culture and breeding, of *doing the right thing*. Culture is, after all, one of the fine arts. To excel in music or painting, the price is vigilance, study and incessant effort; to be cultured, polished, the price is conscientious effort and study.

"Clothes may make the man," but whether you are clothed in rags or silks your culture cannot be hidden. For he who is polite, refined and well bred wears a gorgeous robe endowed with the fine embroidery of honor and respect. Not even rags can cover it.

The world is a harsh judge, but it is just. It will not tolerate the man who makes blunders at the dinner table. It will not tolerate the woman who breaks the conventions of society at the dance. It will not tolerate the illiterate in the Art of Etiquette.

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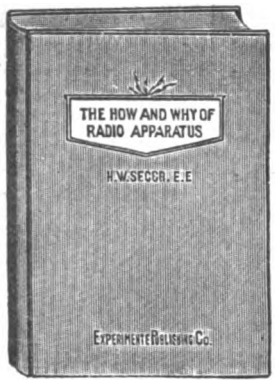

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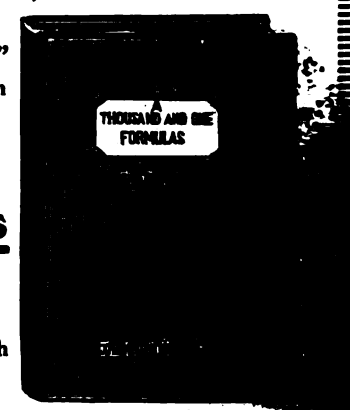

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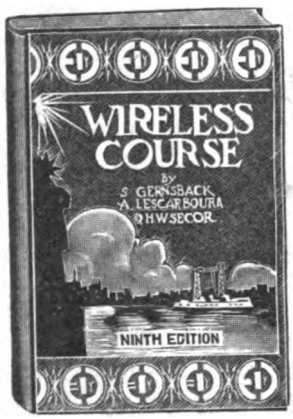

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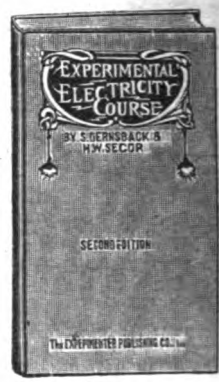

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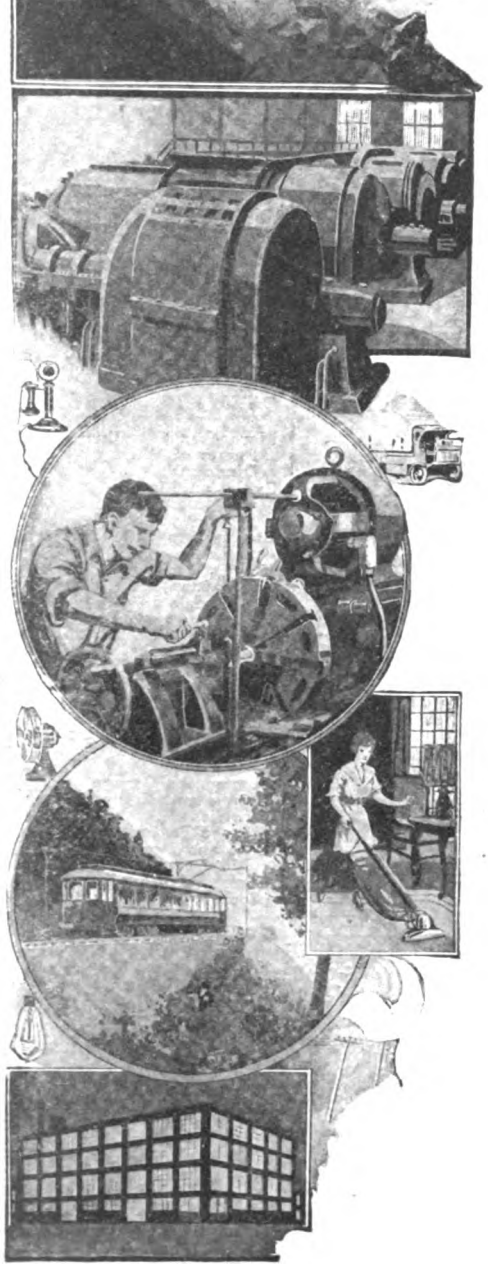

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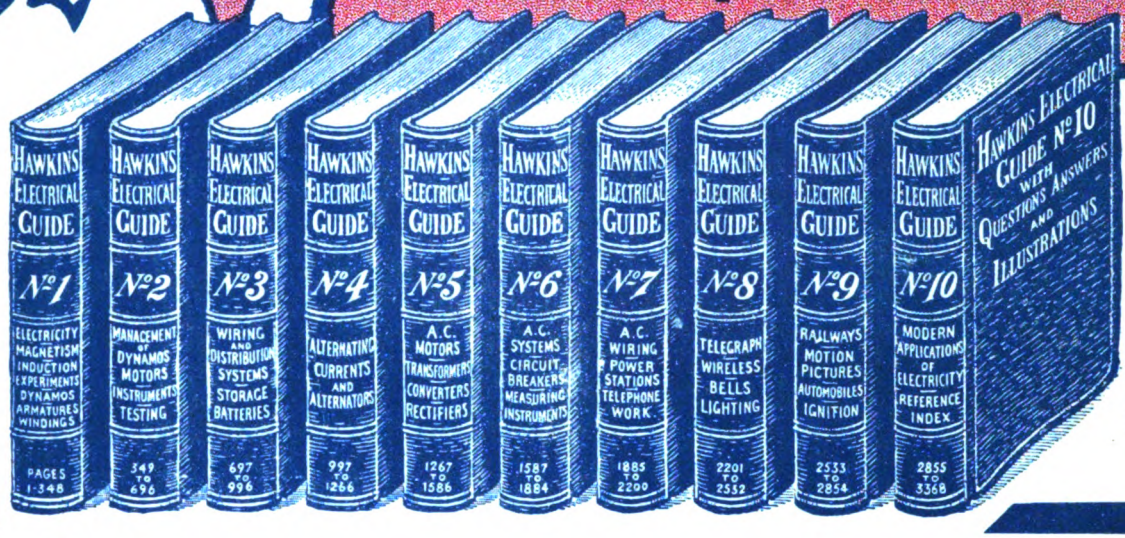

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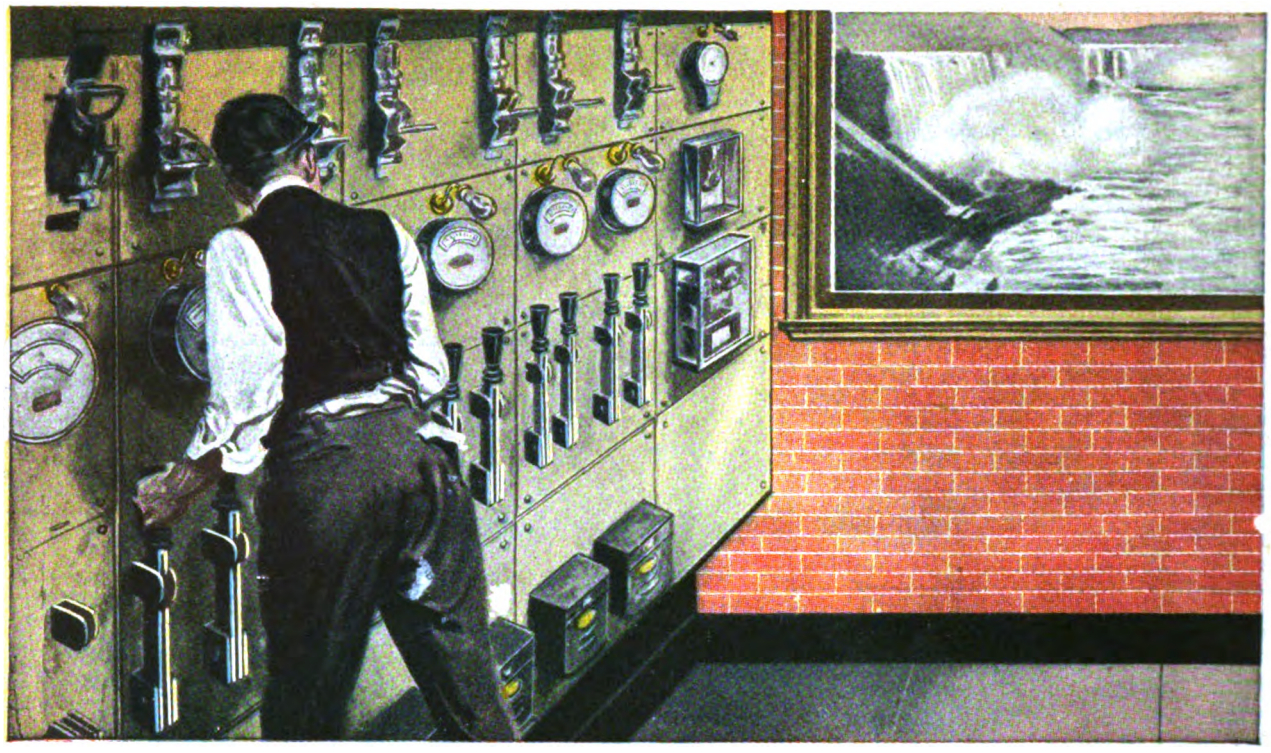

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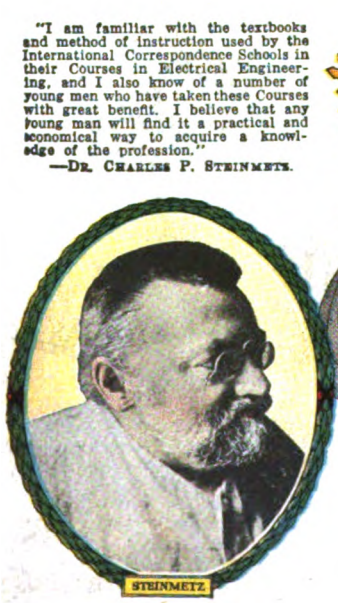

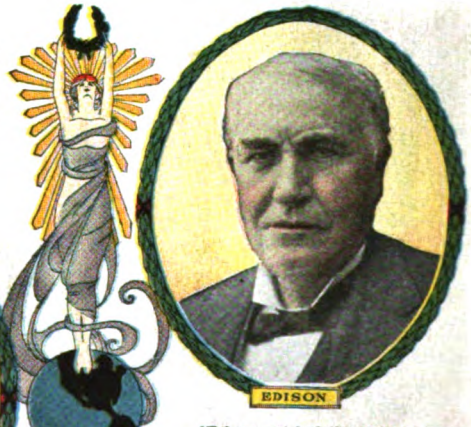

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